CREATE HEALTH WAYS OF WORKING

INSIGHTS FROM TEN EHEALTH INNOVATION RESEARCH PROJECTS

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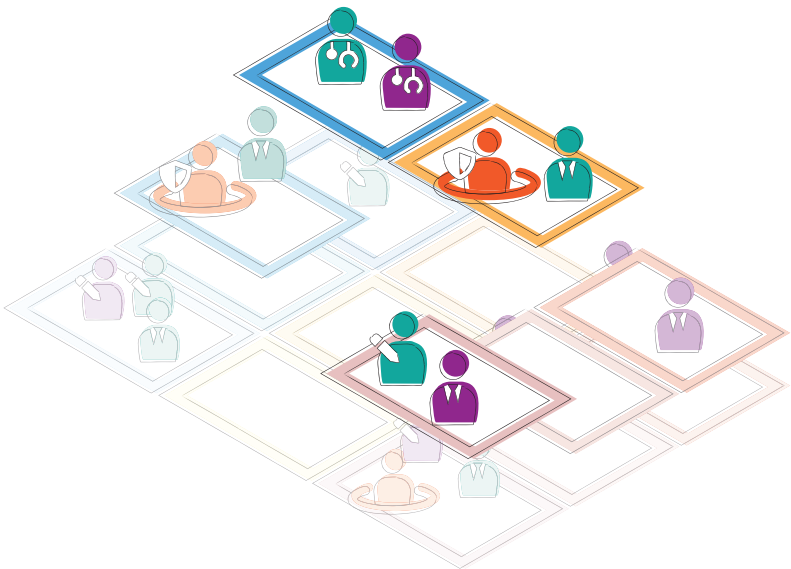


PREFACE

"DESIGN TECHNIQUES OFFER A RICHNESS FOR WORKING TOGETHER ACROSS DISCIPLINARY BOUNDARIES."

-PIETER JAN STAPPERS

This book shows how ten projects connect design and health, across the boundaries of research and practice. People from design and health worked together on challenges around dementia, obesity and loneliness. This book is a collection of insights gained through the project Create- Health Innovation Ways of Working Analysis (CHIWaWA) and describes a multiple case study that looked at the richness of ways of working in research projects in which design and health researchers and professionals investigated eHealth solutions together.

The research was done by researchers from the Research Groups Research Competences and Co-Design of HU University of Applied Sciences. The advisory board consisted of Pieter Jan Stappers (Professor of Design Techniques at the Faculty of Industrial Design Engineering, TU Delft), Ellen Moors (Professor of Innovation and Sustainability at the Faculty of Geosciences, University of Utrecht), Jan-Willem van Dijk (Partner & Founder of Greenberry), Alain Dujardin (Creative Director & Partner of Greenberry) and Karin Alfenaar (Program Manager Regional Innovations Health Hub Utrecht). We would like to thank the members of the advisory board for sharing their insights during the start and the end of the project. We asked them to respond to the insights of the book from their own background and expertise. We are pleased to share some of these responses here:

In his reaction to the book, Pieter Jan Stappers mentions the importance of research into the application of creative ways of working: "*With design thinking, part of the tools of design has become more widely applicable, but it is important that the tools are always part of deeper design techniques. That is easily lost when tools are simplified to a persona or journey template. That is precisely why it is great that research has been done into the application of creative ways of working in health research.*"

Alain Dujardin indicates after reading the conclusions that he wants to emphasize that experience shows that it is important to trust designers to apply creative ways of working in projects in the healthcare context: *"It requires flexibility from healthcare professionals and researchers to be open to design methods."* Karin Alfenaar, in her response to the book, emphasizes the importance of having a conversation with all stakeholders: *"From the Health Hub Utrecht, we want participation of all stakeholders to be a part of all plans."*

To be able to introduce creativity and creative methods into eHealth innovation processes, one needs so-called boundary spanners or boundary brokers between disciplines. Ellen Moors mentions as important - and recognizable - insight from the book: *"The deployment of boundary brokers is crucial for pushing boundaries. Creativity brings in an element that allows you to go outside the standard routines of health care. Creativity can be a preparation for a yet unknown pathway, a challenge or way of working that we do not yet know, but may need in the future."*

With this book, we aim to provide insight into how Create Health ways of working can contribute to the innovation and research process and the people involved in it. We were able to gain these insights because we were allowed to engage with multiple projects and draw overarching conclusions. We therefore thank ZonMw for the opportunity to conduct meta-research into the use of creative ways of working and the added value of using these methods to achieve new innovations in healthcare. We hope that this meta-research will be helpful to researchers who are looking for solutions with and for healthcare from the design and health domain. In addition, we also hope that the insights will help grant makers to set up new research programs.

We would like to thank all project leaders, PhD students and post docs who wanted to talk to us about their project: Pieter van Gorp, Raoul Nuijten, Annemarie Braakman-Jansen, Christian Wrede, Thomas van Rompay, Josca van Houwelinge-Snippe, Emely de Vet, Lean Kramer, Rens Brankaert, Maarten Houben, Sebastiaan Peek, MyrteThoolen, Amy van Grieken, Sophie Korenhof, Job van 't Veer, Bard Wartena, Valentijn Visch, Niko Vegt and Natalia Romero Herrera, as well as many other people who were involved with the projects, one way or the other. Thank you all for sharing the lessons learned from your projects during our conversations and interviews, and during the final stage of the research project. We hope that we have done justice to your insights and hope that they empower people who read this book to strengthen their create-health collaboration in both research and practice.

June 2022

Wilke van Beest, Berit Godfroij, Marieke Zielhuis,
Daan Andriessen, Remko van der Lugt

INTRODUCTION

DAAN ANDRIESSEN EN REMKO VAN DER LUGT

Monday morning at our ConceptSpace: After the first round of studying the project proposals and auxiliary information from 10 different projects, we have come together as a research team to spend a full day analyzing data. The co-design researchers prefer an open approach, utilizing the room as a "shared external memory," using scissors and tape to organize fragments on the wall, then looking for connections and generating mini-theories. The team members from the research methodology group are familiar with different approaches to analyzing data and developing coding schemes and are more familiar with identifying and coding fragments on the computer, using Atlas TI as a software program. We end up alternating between different tasks in the room, recording insights using Atlas TI, then printing these out for another round of interpretation. Even though this is a hassle, it helps us take time to engage with each other's approaches to research, which, in turn, helps develop shared understanding throughout the project. Moreover, the Create-Health research team needed some boundary-crossing events to start functioning as an interdisciplinary research team.

In recent years, the application of creative ways of working in the domains of healthcare and well-being has become increasingly popular, both in research and in practice. For instance, the personas, fictive personalities that represent needs or motives of people involved are constructed from actual user research. Another example is a patient journey, which is a variation of the user journey as a central tool in service design (Simonse, Albayrak & Starre, 2019). The patient journey is the pathway that a patient takes through the healthcare process, from (before) the beginning to (after) the end of the given care or treatment.

These approaches have become common practice to such an extent that when I talked to a healthcare administrator, she mentioned that "*The way WE do it in our field is to create a patient journey*" (personal conversation with the director of a paramedic school). However, many of the creative tools and methods are used in instrumental ways without connecting to more structural applications or integrating the ways of working involved. This is amplified in research projects, where creative and healthcare research traditions are quite different in their respective epistemological stances and research approaches.

Even when tools and methods have been incorporated, it remains unclear whether these approaches improve health innovation and research processes. Moreover, what are the obstacles, and how can we learn from research groups that successfully marry the different approaches? With the Create-Health program, the Dutch research funding agency ZonMw created a unique opportunity to study the application of creative ways of working in health research. The program aimed to bring parties from the creative and the health sectors together to develop knowledge building blocks on eHealth applications in elderly care. We followed 10 projects over the course of three years and studied the way they combined research and innovation methods from the creative and health sectors. This allowed us to answer the following main research question that we address in this book:

"WHAT WAYS OF WORKING ARE EMPLOYED IN RESEARCH PROJECTS ON EHEALTH INNOVATIONS IN WHICH RESEARCH AND PRACTICE PARTNERS FROM BOTH THE CREATIVE AND THE HEALTH SECTOR COLLABORATE, AND HOW DO STAKEHOLDERS BENEFIT FROM THESE WAYS OF WORKING?"

This chapter introduces and explains these creative ways of working in healthcare, describing what we set out to investigate and how we approached this meta-research.

PREJUDICE AT WORK

Making design work in the field of healthcare requires interdisciplinary research with close collaboration between researchers from the creative and the healthcare sector. However, the intensive collaboration between different disciplines is often not without its challenges, and healthcare and creative professionals come from different worlds that do not automatically align. This was illustrated in a small experiment we conducted at a Design for Health conference in October 2018. We challenged a group of 70 researchers and professionals working in the healthcare and creative industry to name as many prejudices and assumptions about the other sector as they could.

A total of 290 comments, evenly divided between both fields, were written down, folded into paper airplanes, and thrown on stage. The creatives considered their healthcare counterparts bureaucratic, conservative, and rule-oriented but also caring and people-oriented.
When it came to healthcare research, they believed it was evidence-based and scientific but also too focused on randomized controlled trials. The healthcare professionals viewed it as creative but also impractical and chaotic. When it came to creative research, they thought it lacked rigor, even to the extent that some used the word "dangerous."

WHAT ARE CREATIVE WAYS OF WORKING?

What constitutes creative ways of working? Is it a mindset? A skillset? Methods and tools? Or all of the above? We found that they are difficult to define. The ways of working are visible in the applied tools and methods, but they can also be seen as the skills and motivations that manifest in the ways people engage in innovation and research projects.

In this book, we will not try to demarcate or define creative ways of working but instead provide examples of working methods employed by the 10 projects. These examples show the diversity of ways of working that are possible when parties from the creative and health sector unite in research, as shown in Figure 1.1.

The ways of working observed did not come strictly from the creative sector. In fact, in many cases, it was difficult to identify their origins. Based on the analysis of the 10 project proposals, we developed a card sorting exercise with the 10 project leaders and the steering committee of the Create-Health program. A textual analysis of the 10 project proposals revealed about 100 activities that could be considered *ways of working*. During the exercise, we tried to identify the origins of these ways of working by asking the participants whether they thought one was from the creative or the health sector. The general conclusion was that, in many cases, it was not possible to say. Therefore, we refer to the ways of working described in this book as "create healthier ways of working."

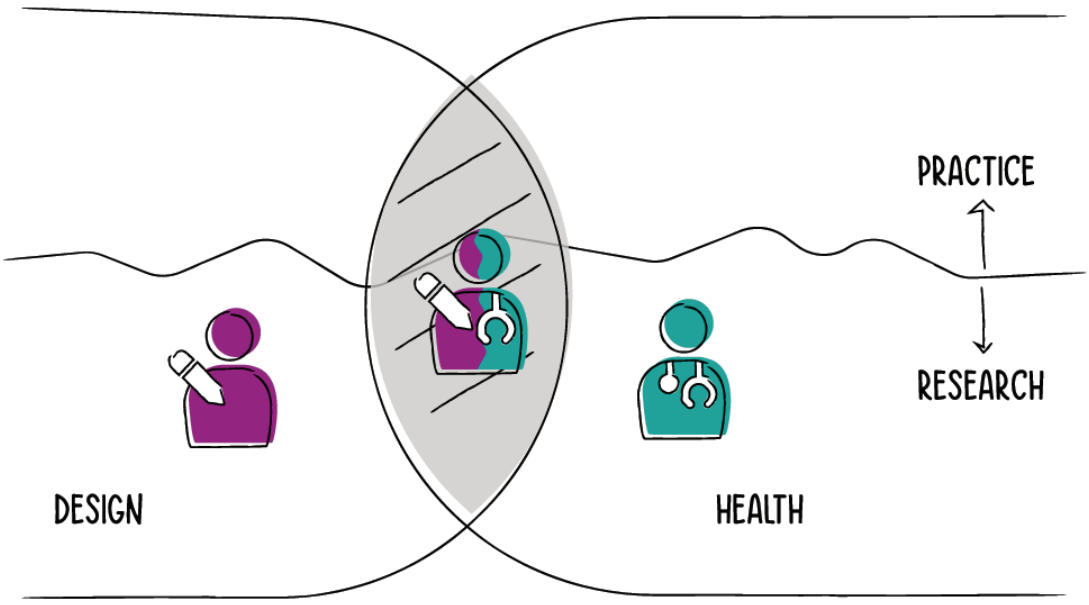


Figure 1.1: When creative and health sectors unite

The funding agency ZonMw did not define creative ways of working in their Create-Health call either, which gave the 10 participating projects room to choose their own research design and approach. However, the funding agency highlighted three aspects that all projects needed to comply with. These aspects defined the boundaries of the phenomena under investigation in our research. We will be looking at the following:

- The use of specific methods for research and innovation: The ZonMw call stated that "*through an iterative and, at the same time, designerly research method (for example, research-through-design), projects can produce knowledge building blocks during the research period" (p. 5).* Although not strictly a prerequisite, this sentence indicates that the funding agency was thinking of iterative research methods that apply design activities as part of the design. We will be looking at methods and approaches that apply these principles.
- The inclusion of the target group: Clients, patients, and healthcare professionals all needed to be involved in the research process. We will be looking at how beneficiaries and other actors involved are included in research activities.
- Collaboration: The call demanded that parties from both the creative and health sectors as well as parties from research and practice work together. The expectation is that this collaboration will create an interdisciplinary approach that will lead to better innovation. We will be looking at how this collaboration takes shape and whether the collaboration can be characterized as interdisciplinary, multidisciplinary, or transdisciplinary.

Thus, in this book, we look at the application of methods and approaches to research and innovation in Create-Health projects (Chapter 3), ways to involve target groups in research and innovation (Chapter 4), and ways to collaborate between creative and health sectors (Chapter 5).

OUR METHOD

In the project, which we named "Creative and Health Innovation: Ways of Working Analysis" (CHIWaWA), we conducted cross-cutting research on the use of Create-Health ways of working in health innovation research by studying 10 research projects on eHealth innovation in the Netherlands. Researchers from the research group "Research Competence" and the research group "Co-design" – both based at the Utrecht University of Applied Sciences in the Netherlands – conducted this meta-research between 2018 and 2022. CHIWaWA and the 10 research projects involved are part of the ZonMw program "Create-Health – eHealth Knowledge Base for a Healthy and Active Old Age." ZonMw is a Dutch funding organization for health research and care innovation.

RESEARCH DESIGN

Our study was set up as a multiple case study design (Yin, 2009). The selection of cases was convenience sampling, as the funding agency had already made the selection. However, we found out early on in the process that each case was unique in terms of the consortium members, the topic of the research, the research approach, and the collaboration method. Therefore, each case was studied independently, and a cross-case analysis was applied to the 10 projects. A consortium of various actors from academic and applied research institutes in the Netherlands was involved in each project, as well as partners from the creative industry and health sector. For each of the 10 projects, actors from the creative sector and health sector collaborated to create new eHealth products and services and to generate knowledge, bringing ways of working to the table from their own sectors. The general presupposition of the Create-Health program was that these creative ways of working in innovation and research might lead to a better quality of the innovations as well as further development of interdisciplinary practices between creative practices and research and health practices and research (research impact). The cases are presented in Chapter 2.

In our approach to this multiple case study, we were guided by two important principles:

1. We involved the researchers from the 10 projects in our own project whenever possible. For example, project members from the 10 projects were invited to become co-authors of our publications
2. We tried to ensure that our research activities would benefit both the participating projects and our cross-cutting research. Therefore, we minimized the use of questionnaires and limited the number of interviews. We also used the joined meetings that ZonMw scheduled to gather additional data when possible.

Within the multiple case study we applied the following data gathering methods:

Exploratory literature review: We performed an initial literature search on collaborations between creative and healthcare professionals that involved related methods, boundary-crossing, and impact. This search guided the preparation of a checklist and protocol for both the analysis of documents and the first series of interviews.

Taking stock: We analyzed the 10 project proposals and held preliminary interviews with the project leaders, often accompanied by the main researcher. The interviews were done by two of the CHIWaWa team members during site visits. In addition to the general checklist questions, specific issues encountered in the project proposal were discussed. We also assigned one of our researchers as the main case-holder to maintain regular contact with the project leader.

Monitoring the projects: While monitoring the projects, we collected two kinds of configurational process data: research elicited data and naturally occurring data. Research elicited data was collected by questioning linked and unlinked actors from each of the 10 projects. The data was gathered both in formal and informal settings, in semi-structured interviews, but also by asking topic-specific questions in more informal settings (e.g., face-to-face during coffee breaks of knowledge sharing sessions and monitoring meetings). The informal questioning focused on inductively developed themes and events that emerged during the process. For instance, when project actors described specific events as very creative, we would ask questions about the ways of working, such as why they thought the ways of working were creative or how different actors collaborated. The naturally occurring data consisted of information that was observed or overheard through participative observation in knowledge sharing sessions and monitoring meetings, as well as report analyses from the 10 projects, including project proposals, presentation slides, progress, and other kinds of reports, publications, posters, and the websites from the 10 projects. We documented this data through field notes, audio and video recordings, and a digital project dossier.

Assessing impact: Once the 10 projects reached their knowledge extension phase, interviews were held with the project leaders, as well as one or more key users from each project, about their interaction with the project, their awareness, and interpretation of the results and the role of creative ways of working. In addition, the practical results and knowledge products developed by the 10 teams were analyzed.

Overall, 35 interviews were conducted. The project leader from each project was interviewed three times, as well as four practice partners and the ZonMw program leader. The interviews were conducted by following a topic list. In many cases, supporting material was used, including an actor map and a project timeline.

OUR THEORETICAL LENS

This book examines what happens when researchers and practitioners from the creative and healthcare sectors join forces in research and what this means for the ways of working. In a three-year period, the 10 projects took on many activities that we had to structure accordingly to study them. As a basis for this structure, we went back to one of the key characteristics of creative ways of working described above: the iterative way of working. In the iterative way of working, the researcher moves between theory and practice several times during the research. We found Nelson and Stolterman's (2003) distinction helpful here, as used by Jonas (2006), between *what should be* (theory), *what could be* (concepts), and *what is* (practice). We were able to plot the sequences of activities from the 10 projects in these three categories. We used the Research Pathway Model (RPM) in order to do so (Van Beest et al., 2021). The RPM is a process model that makes explicit the research steps taken toward impact. The model proposes that research takes place in three contexts: the theoretical context, the conceptual context, and the real-life practice context:

"In the theoretical context, the research is focused on creating, exploring, and delivering a better understanding of problems and related propositions for solutions, which are advanced and not verified in practice yet. The conceptual context translates presupposes solutions to a more specific prototype that is created, explored, and made.
In this context, researchers, project partners, and other stakeholders bring in experiential knowledge to translate theory to prototype, by themselves, together with the consortium, and with or without the end-users, but always in a protected niche as a brainstorming room, a pilot environment, or in the context of a pilot organization. The real-life practice context concerns the context in which the prototype is tested in the world of professional practice and/or the living environment of end-users" (Van Beest, 2021, p. 7).

The model also distinguishes three clusters of activities: "understand and create," "explore and test," and "deliver and implement." The "understand and create" activities refer to getting a grasp on the issue at hand, understanding the problem, and creating ideas. Some examples include a literature review (theoretical context), co-creation workshops (conceptual context), and contextual interviews with people in their own context (real-life practice context). The "explore and test" activities relate to exploring or validating an idea, concept, construct, or solution through research activities. Examples include double-blind lab experiments (theoretical context), a pilot in a living lab (conceptual context), and a prototype test in the environment of the end-user (real-life practice context). The "deliver and implement" activities entail the transfer of the insights gained. Examples from this category include writing academic journal articles (theoretical context), handing over a prototype to the market (conceptual context), and implementing a new protocol (real-life practice context).
Examples are: academic journal articles (theoretical context), handing over a prototype to the market (conceptual context), implementing a new protocol (real-life practice context).

This results in a 3x3 matrix of activities for the different realms and activities (Figure 1.2). In working with the RPM together with researchers from the 10 projects, we found we needed to slightly adjust the names of the three types of activities. Van Beest et al. (2021) referred to these activities as create, explore, and deliver. Researchers with a design background were confused by these terms since many were used to the Double Diamond terminology from the British Design Counsel: discover, define, develop, and deliver. The first three Ds of the Double Diamond describe the process of understanding the issue, defining it, and co-designing. This is covered by the first row of activities. For the sake of clarity, we designated this row as "understand and create." The last D describes the process of testing solutions on a small scale, which is equivalent to our second row of activities. Therefore, we designated this row as "explore and test." The Double Diamond model does not include activities that produce and implement results from research. Because the RPM is about research and innovation, the RPM does include these types of activities due to its focus on research and innovation; therefore, we categorized these activities as "deliver and implement." These changes to the model were made to accommodate it to the specific context of the Create-Health projects and were approved by the authors of the RPM.
Van Beest et al. (2021) have demonstrated that different paths can be chosen and that there is no order of activities that is better than the other. In this book, we will use the RPM as a descriptive model to help provide structure across the different cases and sub-research questions.

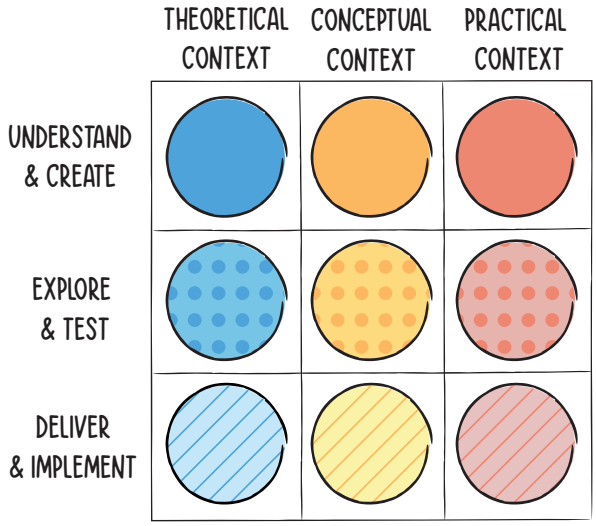


Figure 1.2: Research Pathway Model (RPM)

Chapter 4 examines how the Create-Health projects involved end-users and other actors in their research. To better understand this process, we used the Service Dominant logic theory (Vargo & Lusch, 2004). This theory describes innovation projects as an exchange of services rather than the creation of goods. By looking at services delivered by all project participants, including representatives from the target group, we addressed an important question raised by these types of projects: "what's in it for me?"
To further describe how partners collaborate within these research pathways, we relied on the Boundary Crossing Theory, which is part of the Cultural-Historical Activity Theory (e.g., Akkerman & Bakker, 2011). This theory provides the concepts that we used to describe the characteristics of the collaboration between the partners (see Chapter 5).

OUR OWN COLLABORATION CHALLENGES

Our multidisciplinary team consisted of three main researchers, supervised by two professors and supported by auxiliary staff (graphic designers, research assistants, and project managers). Our research groups are strongly rooted in the Research-through-Design tradition from the design sciences (i.e., co-design) and the Design Science Research tradition of the organizational sciences. We had our own challenges to tackle by overcoming differences and finding synergy. For instance, in the early data interpretation meetings, the co-design team preferred to conduct data analysis through in-the-room, on-the-wall, open-ended coding with taping, cutting, and annotating involved. In contrast, the research methodology researchers were more inclined to develop a coding scheme in Atlas TI. By alternating between different methods, we developed collective ways of dealing with and interpreting data.

AND THEN COVID 19 HIT

We originally intended a highly participatory research process, with numerous workshops for data interpretation and triangulation with the projects' participating researchers. We organized a card sorting exercise for the first-year review meetings to discuss terms found in the project proposals. For the second-year session, we had prepared posters with the thematic ordering of issues found to be discussed with the project teams. However, that is when the first lockdown started, which dramatically changed the program dynamics. The projects struggled to find new ways to engage with their target groups and collaborate between health and creative settings. Person-to-person meetings became rare. Thus, the lockdown significantly impacted the Create-Health ways of working employed. We organized a knowledge exchange workshop to support the research groups and gain insight, which ultimately led to a white paper.

STRUCTURE OF THE BOOK

The book's structure is as follows: Chapter two provides an overview of the 10 projects and their key characteristics. Chapter three addresses the Create-Health ways of working and the insights gained during the research process. Chapter four looks at the collaborations with the target group(s) and consortium members. Chapter five focuses on the boundary-crossing issues between creative and healthcare academics and practitioners. Chapter six provides some overarching insights and conclusions. Finally, Chapter seven offers a practical guide for using the Research Pathway Model in other projects.

The reference list and the list of tables and figures for all chapters can be found in the appendixes.

EHEALTH INNOVATIONS TO DEAL WITH ISSUES AROUND LIVING WITH DEMENTIA, LONELINESS, AND OBESITY

CREATE HEALTH WAYS OF WORKING

In the meta-study, we followed and studied 10 projects that are all part of the Create-Health program of ZonMw. The Create-Health program aims to contribute to the social challenge surrounding healthy and active aging. Create-Health brings parties together from the creative industry and the health care and welfare "industry," supporting knowledge development, knowledge sharing, gaining access to money, and supporting scaling up.

The research within Create-Health is focused on three themes, in which the elderly or aging people are the main target group:

- Living with dementia;
- Preventing loneliness in the frail elderly;
- Prevention of overweight and obesity.

The call suggests a broad choice of research topics within the themes, such as focusing on a user interface that works for people living with dementia or developing new validation methods to determine the effectiveness of applications. As a result, there are various ambitions and goals within the various projects, with different perspectives on innovation and on the timeframe of the innovation path.

Each of the 10 studied projects focused on one or two of the three themes. In a number of projects, we saw a combination of the themes "living with dementia" and "preventing loneliness."
Therefore, we have chosen to combine these two themes in the general description in this paragraph, with one side note: the project "Growing Roots" did not focus specifically on people living with dementia but rather on frail elderly more in general.

THEME:
LIVING WITH DEMENTIA AND PREVENTING LONELINESS IN THE FRAIL ELDERLY

Within the last decade, it has become more common for elderly people to live at home rather than being admitted to a care home or a nursing home. The frail elderly are encouraged to live at home as long as possible, including those living with dementia. This is not only to reduce the increasing costs of health care but also to improve quality of life by continuing to live in familiar surroundings. Medical care and self-management are key to making it possible to live at home, in which eHealth could play a role. The projects within these two themes each address different aspects of the opportunities provided by eHealth. Most projects focus on the initial stage of application development. However, Everyday Sounds of Dementia also conducts research in a nursing home, where patients are often in more advanced stages of dementia. Several projects studied eHealth in relation to the possibilities and desirability of monitoring people. Because all kinds of ethical issues are involved, this is still in its early stages, and such projects take a more fundamental approach with a focus on knowledge development.

The following projects mainly focus on living with dementia and preventing loneliness in the frail elderly:

- *Everyday Sounds of Dementia* focuses on the use of sounds to calm, reduce agitation, stimulate, excite, and engage people living with dementia;
- *Dementia Dynamics in Design (DDD)* focuses on promoting the independence and quality of life of people with dementia by developing eHealth solutions that can prevent loneliness in people living with dementia (see below);
- *Need Articulation Through Autonomy Loss in the Elderly (NATALIE)* aims to develop a theoretical framework that describes design principles and methodological procedures that guide the design of applications to minimize difficulties in the dialogue between patients and (in)formal caregivers;
- *Growing Roots*: *Connecting Elderly through Virtual Nature Spaces* aims to develop a framework for creating a virtual natural environment that inspires feelings of connectedness and stimulates social contact among the frail elderly;

- *Support Quality Care for Elderly Using Ambient Living Environment Data (SQUEALED)* focuses on monitoring independent-living elderly persons via smart energy meters, which are already installed in >30% of all Dutch households;
- *Track, Trace, and Trigger!* (*Unobtrusive Sensing Technologies to Monitor and Coach Elderly People with Dementia*) aims to develop sensory technology to identify an individual's daily dynamic activities (track, trace) and trigger (social) behavior and communication with music cues;

THEME: PREVENTING OVERWEIGHT

Obesity is a complex problem. People who are overweight have a higher risk of developing health issues. The projects within this theme focus on knowledge development about the prevention of obesity and the development and maintenance of a healthy lifestyle. The four projects in this theme show a diversity of target groups and eHealth interventions that could support users in developing a healthy lifestyle.

The projects with a focus on this theme include the following:

- *Designing Persuasive eHealth Agents for Coaching Older Adults Toward Dietary Behavior Change (PACO)* studies the use and usefulness of virtual eHealth agents to prevent obesity in the elderly;
- *Healthy Storytelling for eHealth* proposes storytelling as a persuasive eHealth element to motivate people with low literacy skills for obesity prevention;
- *FoodSampler* aims to determine the best practices of dietary reporting in daily life and the contextual factors that influence dietary practices;
- *Gamification for Obesity Prevention and Active Lifestyle (GOAL)* focuses on gamification as a technique in eHealth solutions to tackle patient engagement and motivational issues.

In each case portrait, the project is described in general terms, including the *topic* of the project, the project's target group, the theoretical *background* of the project, the project actors, what happens over the course of the project, and the *results*. An illustrative quote is added to vivify the factual project descriptions.

The Venn diagram (Figure 2.1) of the *Actor map* represents three contexts: the theoretical context (blue), the conceptual context (yellow), and the real-life practice context (orange-red). The contexts and colors match the RPM (see p. for a general introduction to the model). The project actors are plotted according to their main role in one or more of these contexts.

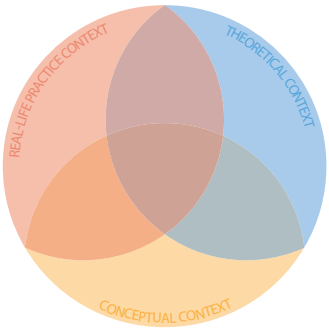


Figure 2.1: Actor Map Venn diagram

The project actors (Figure 2.2) are visualized not as individual participants but as representatives of a type of organization or a role in the project.

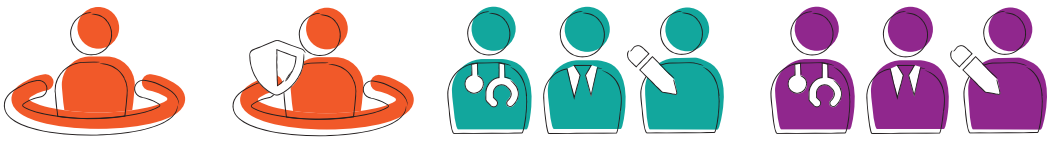


Figure 2.2: Project Actors

The project actors are divided into target group individuals and target group representatives (orange), practitioners such as health care organizations and creative agencies (green), and knowledge partners such as universities and universities of applied sciences (purple).

The attributes of the actors visualize the focus of their role in the project. The shield is used to visualize the representation of a certain target group. The pencil represents a design perspective, and the stethoscope represents a healthcare perspective. The tie stands for a partner in the project. Combined with the main roles, one figure could represent a university (purple), for instance, with a design research focus (pencil) or a healthcare focus (stethoscope).

The course of the project is described and visualized in a project timeline. As most projects have a duration of four years, the timeline highlights only the main events or turning points in the project (numbered). As a result, the reality is overly simplified. Based on the Research Pathway Model (RPM) (see Figure 2.3) and its corresponding colors, the timeline colors read as follows:

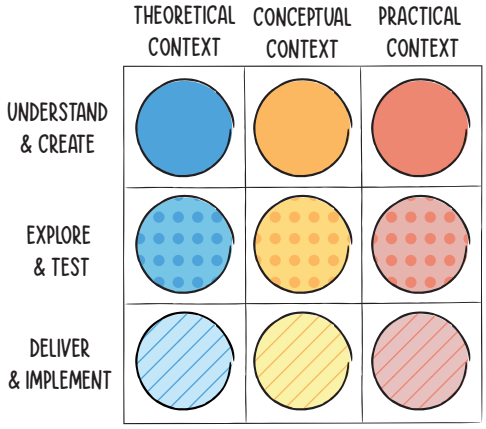


Figure 2.3: Research Pathway Model

The circles correspond to the theoretical context; solid blue stands for the "understand and create" phase, dotted blue for the "explore and test" phase, and striped blue for the "deliver and implement" phase. The same goes for the yellow circles in the conceptual context and the red for the practical context: solid for the "understand and create" phase, dotted for the "explore and test" phase, and striped for the "deliver and implement" phase.

The *results* are clustered according to the RPM into *knowledge building blocks* (results in the theoretical context), *prototypes* (tangible results in the conceptual context), and *practice (results)*. In line with the aim of each project, not every case resulted in an evenly divided number of results for all three contexts.

EVERYDAY SOUNDS OF DEMENTIA

TOPIC & FOCUS

The project Everyday Sounds of Dementia focused on the use of everyday sounds – such as waves crashing or bird songs – to calm, reduce agitation, stimulate, excite and engage people living with dementia. The project investigated the added value of such sounds for people with dementia, and developed and evaluated audio-based technology to explore the opportunities for immediate meaningful impact in care practices. Additionally, the project developed insights into collaborative methods that enable people living with dementia and their caregivers to engage in co-design and participatory approaches.

"WHEN LISTENING TO THE SOUND OF THE WIND AT THE BEACH, A PARTICIPANT DESCRIBED A JOYFUL MOMENT SHE ONCE EXPERIENCED ON THE SEASIDE BOULEVARD."

The project drew on the large body of evidence about how music provides emotional and behavioral benefits for people living with dementia. The project built on the concept of soundscapes: (everyday) sounds that help people build unifying relationships with their environment (Schafer & Murray, 1977). The impact of sound, and how meaning can be created through soundscapes for people living with dementia, is under-researched. The need to involve people living with dementia, and their caregivers in the collaborative design of technology is increasingly being recognized (Treadaway et al., 2015; Kenning, 2017) but remains an under-addressed issue.

The project also drew on the view that well-designed technology can play a crucial role in supporting people to live independently at home (e.g., Brankaert, 2016). For an intervention to be successful, the design approach needs to take into account individual wants, needs, likes and dislikes, circumstances, personal context and environment, and existing relationships with family members and caregivers (Brankaert, 2016).

PROJECT ACTORS

The project management and core researchers of this project were part of a design research group at a university with expertise on design for dementia. Researchers from other universities were closely involved in the knowledge development, bringing expertise on design and dementia and the social and technical aspects of care innovation. The healthcare organizations were involved in gaining access to the target group, contributing to co-design activities and in employing prototypes. The target group of people with dementia was involved in co-creation activities in all studies. A network organization was tasked with dissemination to care and welfare organizations, knowledge institutes, companies (incl. SMEs) and government organizations. During the third study, a design practice partner was involved in the technical development of the final prototype.

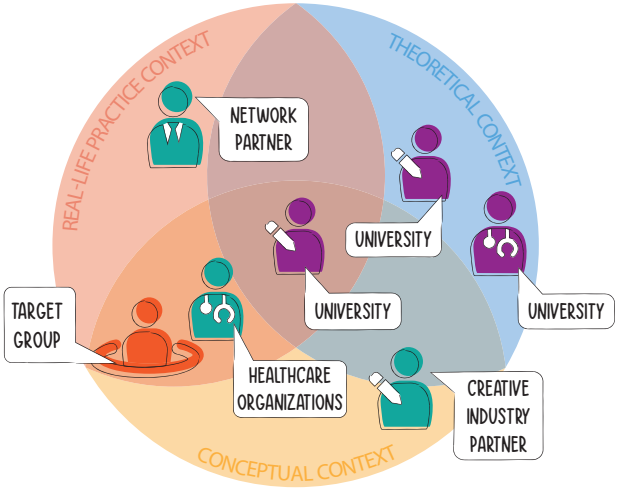


Figure 2.4: Actor Map

TIMELINE

A Research-through-Design approach was adopted through which research artifacts (i.e., interactive, digital, or physical objects) were developed and used (Hummels et al., 2011). A participatory, person-centered, and reciprocal approach was used to involve people with dementia in the process (Kenning 2017), providing activities with interactive audio-based technology that stimulate agency, playfulness, and social engagement. The project developed further insights into this participatory and reciprocal approach: how to involve people with dementia not only by watching and observing them but by actively involving them in all phases. This was most prevalent in the final study, in which the researcher worked closely with three couples in user research, design, and evaluation.

The project consisted of three sequential studies. In all three studies, research artifacts were used. The first studied the phenomenon of sound & dementia and took place in a daycare context (sessions with the researcher present). In the second study in two different care homes, a research artifact was deployed in actual practice with a big role for caregivers in this use. The last study involved three couples (a person with dementia and a caregiver) who co-developed and used a research artifact in their home.

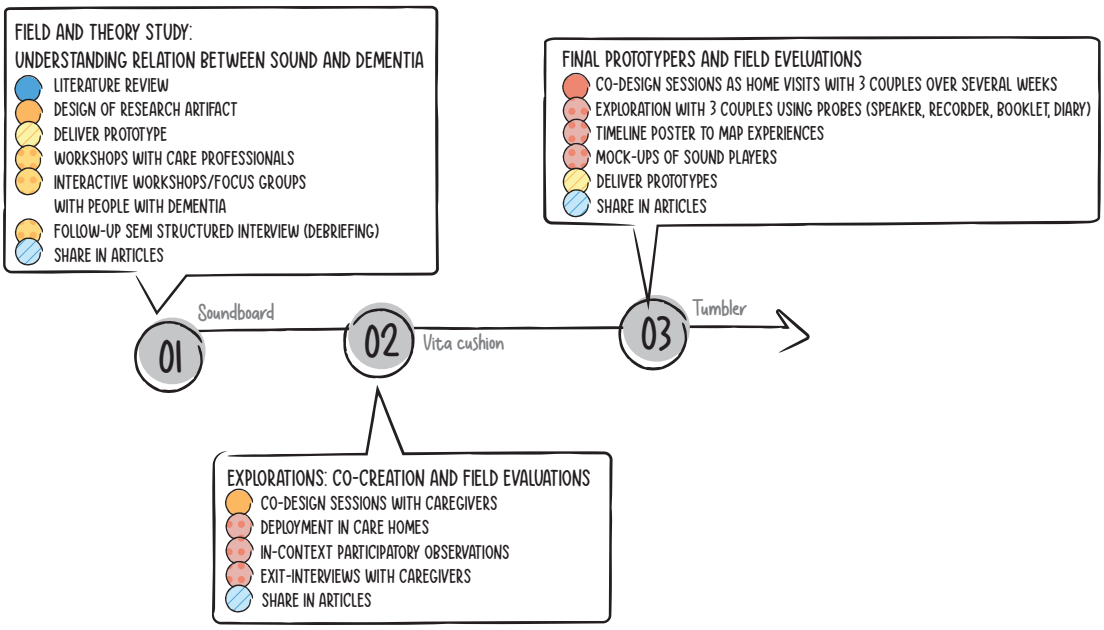


Figure 2.5: Timeline

Figure 2.6 (Left): The "Soundboard" plays everyday sounds when objects are on top of it, such as the sound of the sea when a shell is placed. This prototype was used in a workshop setting at a daycare facility to study sound in relation to dementia.

Figure 2.7 (Right): A research participant with dementia interacts with the "Tumbler", a prototype that fosters initiative and agency through the rediscovery of familiar everyday sounds. The research participants were closely involved in the development of this prototype.

RESULTS

KNOWLEDGE BUILDING BLOCKS

- Insights into how everyday sounds evoke memories, emotional experiences, and a sense of social belonging during activities at a daycare center (Houben et al., 2019).
- Insights into how everyday sounds stimulate meaningful conversations, playfulness, curiosity, and verbal and nonverbal contact with people in advanced stages of dementia (Houben et al., 2020).
- Demonstration of opportunities for everyday sounds and design in the home environment to provide social activities through storytelling and exploring selfhood and identity (Houben et al., 2022a, Houben et al., 2022b).
- Participatory co-design guidelines on how to engage participants in workshops and in their natural context to identify and collect personal and generic sounds, categorizing them according to source and potential emotional or behavioral impact (Houben et al., 2019).

PROTOTYPES

- Soundboard: a design artifact that enables people in the early to mid-stages of dementia to listen to and interact with various soundscapes (Figure 2.6).
- Tumbler: a prototype that enables people with dementia to initiate and participate in meaningful activities with their partner in everyday home settings (Figure 2.7).

DDD: DEMENTIA DYNAMICS IN DESIGN

TOPIC & FOCUS

The DDD project aimed to understand the use of technology regarding social health and social participation of independent-living people with dementia. The researchers explored how people with dementia accept and use technology to maintain social contacts and how the use of technology changes over time
as people go through various cognitive, physical, and social changes as they age. The DDD project designed a high-fidelity prototype of a supportive and sustainable eHealth solution "LivingMoments" to reduce the risk of loneliness by improving or maintaining social participation.

DDD combined expertise in technology acceptance and product design research by applying a Research-through-Design approach to adapt and evaluate a theoretical framework. DDD had three objectives: 1) Improve knowledge about technology acceptance in people with dementia, 2) design eHealth solutions for social needs in people with dementia, and 3) allow third parties to apply this body of knowledge to product offerings and the implementation of technologies.

"QUICK AND DIRTY PROTOTYPING IS OFTEN USED IN CO-DESIGN, WHILE A WORKING PROTOTYPE PROVIDES MORE IN-DEPTH INSIGHTS INTO THE EXPERIENCES AT THE TIME OF USE."

The project partially drew on a theoretical framework regarding technology acceptance by older adults who are aging in place (Peek, 2017). The framework addresses the changes that elderly people experience and how these changes affect technology use (Peek et al., 2014; Peek et al., 2016; Peek et al., 2017a; Peek et al., 2017b). In DDD, researchers adapted the theoretical framework to the specific circumstances and characteristics of independent-living people with dementia. They also evaluated how the adapted framework can contribute and be enhanced by the design of supportive and sustainable eHealth solutions for preventing loneliness of independent-living people with dementia and their caregivers (formal caregivers and family members): How they experience technology use in relation to social participation.

PROJECT ACTORS

The core researchers of this project were a post-doc researcher at a university faculty in social behavioral sciences and a PhD student at a university faculty in industrial design. The PhD design researcher held weekly meetings with a supervisor (assistant professor) in the industrial design department, who was also involved in writing the project proposal with the behavioral sciences post-doc. The latter was project lead in DDD and supervised by a full professor in social behavioral sciences, who was the main applicant. Moreover, two other university partners were involved in a mental health organization and were part of the advisory board. A local innovation network for active and healthy aging was also part of the consortium. This practice partner was particularly involved in recruiting participants, disseminating results, and making connections with healthcare institutions, technology companies, and municipalities. Figure 2.8 shows the project actors mapped according to the theoretical, conceptual, and real-life practice contexts.

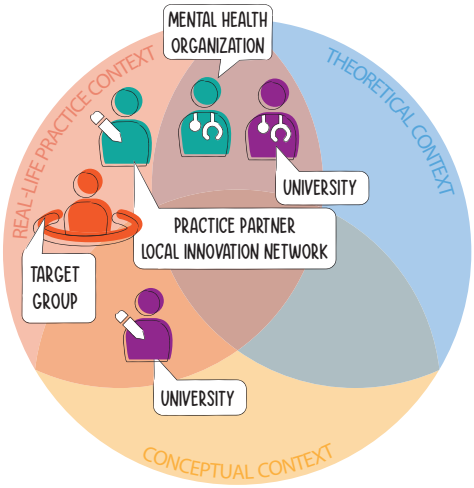


Figure 2.8: Actor Map

The research design was an applied Research-through-Design and consisted of a process in which participatory design techniques were applied to design and evaluate supportive and sustainable eHealth solutions. Central to the project's way of working was the combination of longitudinal field research with design research. Longitudinal interviews and contextual interviews with design tools took place in parallel and informed each other.

Three rounds of interviews were conducted, during which the social behavioral research focused on the current situation and the same questions in each follow-up interview to observe change over time (which can be expected regarding the technology use by people living with dementia). The contextual interviews focused on creating a visual understanding with the participants through three tools: A social mapping tool, a diary probe, and a hobby-and-activity tool (Den Haan-Wintermans et al., 2019). Based on the findings of the combined study, the researchers developed a prototype (Living-Moments), which was due to COVID-19 an accelerated development, not leading to a quick-and-dirty prototype which is common in design research, but a high-fidelity prototype that participants could use in their homes without a researcher being there. Health experts and consortium members provided feedback on the first ideas of the prototype in an online co-design session. The prototype was tested for at least six weeks at the homes of people living with dementia and their care providers. Researchers from both disciplines published their findings (knowledge generated) in interdisciplinary outlets.

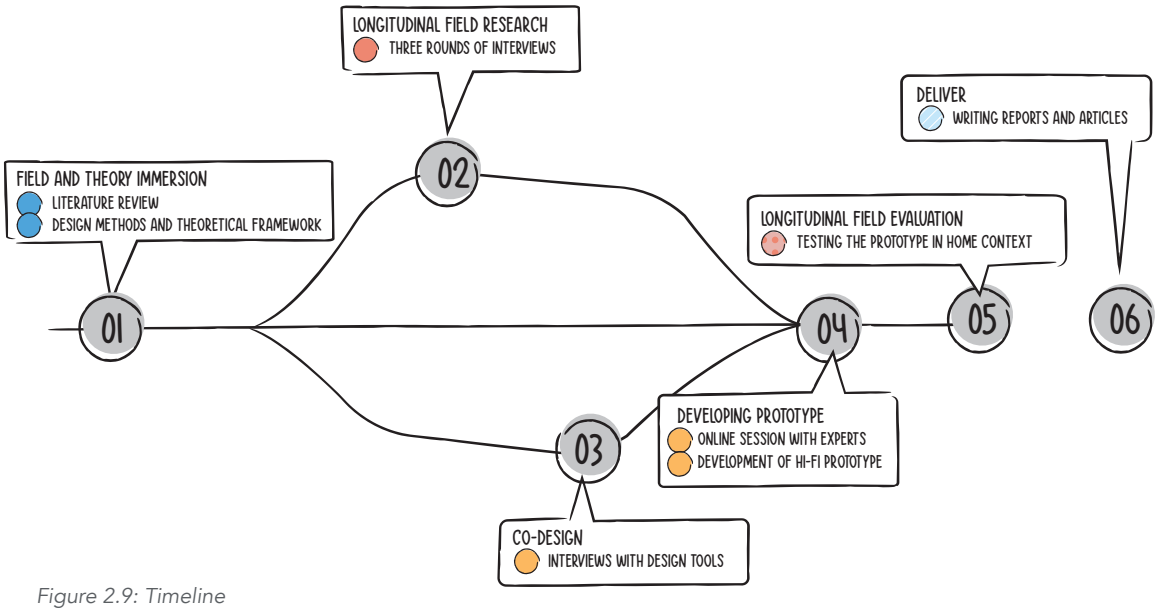


Figure 2.9: Timeline

Figure 2.10 (Left): LivingMoments prototype

Figure 2.11 (Right): Participants receive a postcard from family members via the LivingMoments prototype

RESULTS

KNOWLEDGE BUILDING BLOCKS

- DDD provided knowledge regarding the experiences, problems and needs of community-dwelling older adults with dementia that are related to their social participation and the use of communication technologies.

PROTOTYPES

- DDD delivered a stand-alone prototype of a social health research product, a device that enhances social participation by allowing the creation and receiving of instantly printable postcards: LivingMoments (see www.livingmoments.nl). LivingMoments supports people with dementia to establish and maintain social contact by bridging the gap between modern technology and historical but more familiar means of communication, such as sending postcards. LivingMoments won the accelerator award from IllionX during the TU/e contest 2021.
- Furthermore, DDD created a social mapping tool as a research artifact specifically designed to conduct qualitative research among community-dwelling older adults with dementia.

PRACTICE

- DDD delivered guidelines for designing the participation of community-dwelling older adults with dementia and experiences and tips for interdisciplinary research projects in particular projects that involve behavioral and design researchers.

NATALIE (NEEDS ARTICULATION THROUGH AUTONOMY LOSS IN ELDERLY)

TOPIC & FOCUS

The project NATALIE focused on the difficulties in the dialogue between patients and (in)formal caregivers. The project aimed to generate knowledge that helps to design adaptive, user-friendly applications for people with dementia that persuade them to overcome impediments to talking about their illness, support them to enter the dialogue with their (in)formal caregivers, and assist in creating better insight into what support they need to uphold independent living.

The project provided a framework based on the Research-through-Design approach that should make the design of suitable (digital) applications for this target group more appropriate and effective.

"ULTIMATELY IT WAS A THEORETICAL FRAMEWORK THAT WE TESTED, REFINED AND VALIDATED DURING THE RESEARCH-THROUGH-DESIGN PROCESSES. BUT THEN WE ALSO LOOKED AT HOW WE COULD BRIDGE THE GAP BETWEEN THE CREATIVE INDUSTRY AND HEALTHCARE. THAT IS WHY WE STARTED TO FOCUS ON DESIGNING DESIGN GAMES."

The theoretical background of the project was based on persuasive technology to develop user-friendly, motivating, and adaptive eHealth applications. The participation of people with dementia in decision-making about their own situation was not self-evident; overall, (in)formal caregivers tend to make decisions for them rather than with them (Dupuis et al., 2011). Many scholars argue that it is important to involve people with dementia during the eHealth innovation process (Malinowsky et al., 2013; Lindqvist et al., 2013; Span, 2016). The consortium's practice partner gathered valuable knowledge about specific applications that assist in the dialogue between elderly care consumers and caregivers and developed an application to establish suitable care planning (Van den Berg, 2013). Based on the Care-Dependency Scale (Henderson's framework of human needs, Dijkstra et al., 1996; Dijkstra, 1998; Henderson, 1966), this application supports care professionals and patients in the shared decision-making process, focusing on activities the person can perform as independently as possible. Although Span and colleagues (2015, 2016) identified a set of user requirements for digital shared decision-making tools for people with dementia, knowledge about the use of persuasive technology as a conceptual perspective to identify the design principles needed to develop eHealth interventions that aid this patient-centered approach was still missing and therefore formed the starting point for this project.

PROJECT ACTORS

The project management and core researchers of this project were a PhD student and a researcher from a university of applied sciences. The researchers at the universities were part of the advisory board. One of the health organizations and the target group were involved in data collection during the project. A consortium was formed with related projects in the region to share knowledge and experiences from practice.

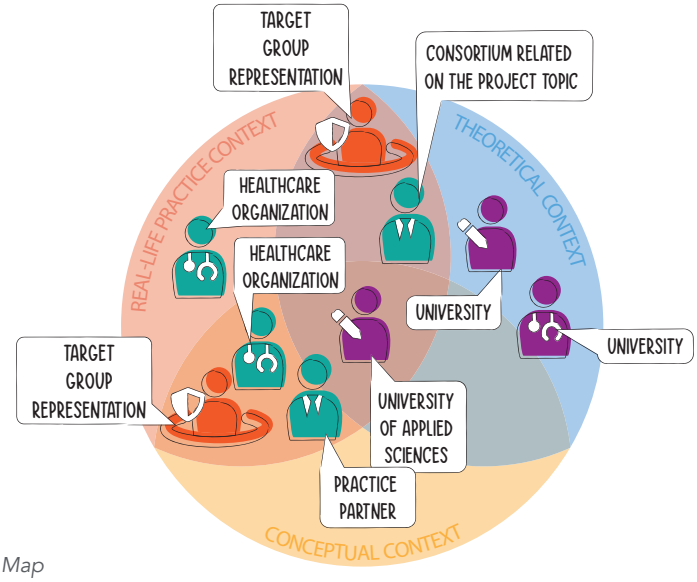


Figure 2.12: Actor Map

TIMELINE

The project started with a literature review to establish a framework and an explorative field study with healthcare professionals using personas, a day-in-the-life approach, contextual interviewing, cultural probes, and context mapping. This was followed by an exploratory phase: five studies in which design, development, and evaluation took place. These studies partly informed each other and partly ran parallel. The five studies were set up based on the Research-through-Design approach. Artifacts were designed together with the target group. Gaining knowledge from making these artifacts has been carried out to reduce the dependency of people with dementia and offers insight into a form of discussion in which people with dementia and their informal caregivers can make joint decisions. In this co-creation process, the researchers used, among other things, objects that were created through the process of abstraction, which made them useful during the conversation.

The main purpose of the prototype was to develop principles from which the framework could be further developed and then expanded and refined. Based on this, a framework and a whitepaper were developed.

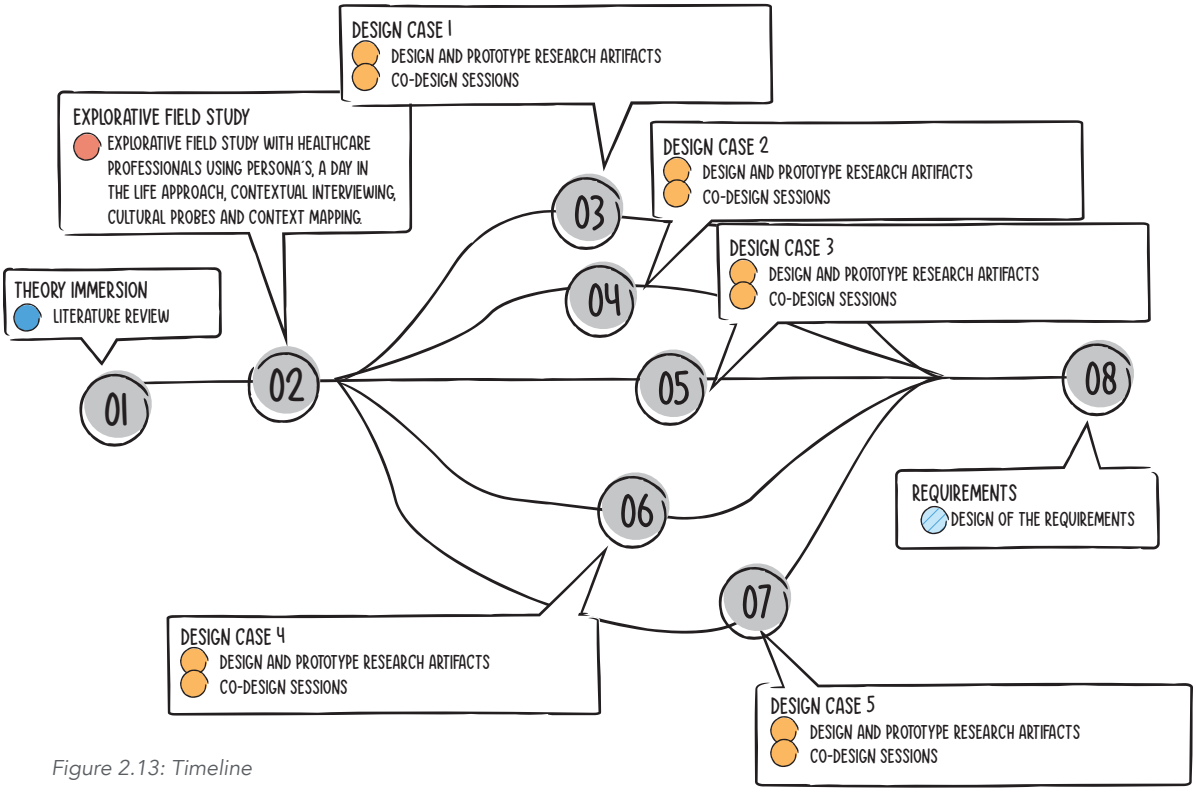


Figure 2.13: Timeline

Based on the framework, the experience of autonomy that is created through communication and decision-making was examined. Balancing the experience of autonomy in communication and decision-making was an important starting point of the design process. The design principles and triggers to maintain a balance in autonomy were converted into a toolkit for the design sessions. During co-creation, we looked at how this toolkit was used and its concrete impact on the design choices for the prototypes from the design sessions (e.g., wicked circles and hackathons). Through these activities, the researchers gained insight into how wishes and needs can be supported and how triggers can be applied to promote decision-making.

KNOWLEDGE BUILDING BLOCKS

Knowledge that helps to design adaptive, user-friendly applications for people with dementia that accomplish the following:

- persuade them to overcome impediments to talking about their illness;
- support them to enter the dialogue with their (in)formal caregivers;
- and assist in creating better insights into what support they need to uphold independent living.

PROTOTYPES

Five demonstrators:

- The design game Remembrance focused on jointly designing tools that can assist with retrieving memories, understanding each other, and supporting the formulation of help and care questions on the basis of these memories.
- The design game "Vertel eens," a quartet game, was developed to strengthen the relationship between the caregiver and the person with early dementia and to get conversations going.
- My Lable Care is an extension of the Lable client system for residential care centers. With this digital client system, it was already possible for the resident's family to read along in the client file, but during the project, an extension was made in co-creation. This extension makes the system more interactive, whereby the end-user can fill in their own file and share it with their (in)formal caregivers.
- The Digi-Hug is a game that was designed in collaboration with the healthcare organization to find ways in which the nursing home residents could get in touch with their loved ones and relive meaningful activities together. In this way, a number of concepts emerged in which message streams, photos, videos, and music became the carriers of connection in the form of digital hugs.
- Timesteps is a smartphone with a specially designed Android operating system in which widgets can be placed. The smartphone is part of an ecosystem in the house that supports prospective and retrospective memory.

GROWING ROOTS: CONNECTING ELDERLY THROUGH VIRTUAL NATURE SPACES

TOPIC & FOCUS

The project Growing Roots: Connecting Elderly Through Virtual Nature Spaces focused on the potential of using encounters with nature to address loneliness in elderly people.

The research aim of this project was the development of an evidence-based framework for the creation of a virtual nature environment that inspires feelings of connectedness and stimulates social contact among the frail elderly.

"SEVERAL TIMES, I HAVE OBSERVED THAT SOMEONE ACTUALLY DID NOT REALLY WANT TO PARTICIPATE IN THE RESEARCH PROJECT. HOWEVER, IF SOMEONE STILL PARTICIPATED AND WATCHED THE VIDEO, THEY HAD THE FEELING THAT THEY HAD BEEN OUTSIDE (THROUGH THE VIRTUAL NATURE IMAGES). SO JUST WATCHING THE VIDEO FOR FOUR MINUTES HAS IN MANY CASES REALLY MADE A DIFFERENCE IN THE STATE OF MIND AT THAT MOMENT. WE CAN´T SAY ANYTHING ABOUT THE LONG TERM, BUT ACTUALLY ALL INDIVIDUALS WE VE SEEN HAVE BEEN POSITIVE ABOUT THE EXPERIENCE."

The theoretical background of the project was shaped by Kaplan and Kaplan's (1989, 2011) Attention Restoration Theory (ART), emotion research (Frederickson, 2001; Piff et al., 2015), work on nature experience (e.g., Van Rompay & Jol, 2016), and insights into how the elderly adopt and use new technologies (Jaschinski & Ben Allouch, 2015a; Graaf et al., 2017; Lange et al., 2010). The frail elderly who live at home are in need of nature's benefits but are often the least likely to receive them. Nature heals and combats feelings of loneliness and disconnectedness (Kaplan & Kaplan, 2011; Ulrich, 1984). Earlier research has indicated that when people feel related to nature, they also experience a greater sense of connectedness to other people and the world at large (Aron et al., 1992; Zelenski & Nisbet, 2014). New, innovative technologies provide opportunities for accessing nature in a social and engaging manner. Several studies have suggested that Virtual Reality (VR) technology is highly suitable for addressing the social challenges faced by the elderly (Baños et al., 2012; Farris et al., 1994; Goldstein et al.,1997; Jung et al., 2009). However, fundamental research indicating which specific natural features are essential for delivering nature's benefits is scarce. This realization inspired previous research (Van Rompay & Jol, 2016), the subsequent development and research of a virtual nature environment (Tech4People, 2016), and this project.

PROJECT ACTORS

The project management and core researchers of this project were a PhD and a researcher at a university and a researcher at a university of applied sciences. The design partner was involved in building and giving advice about the prototype. The health organizations and the target group were involved in data collection during the project.

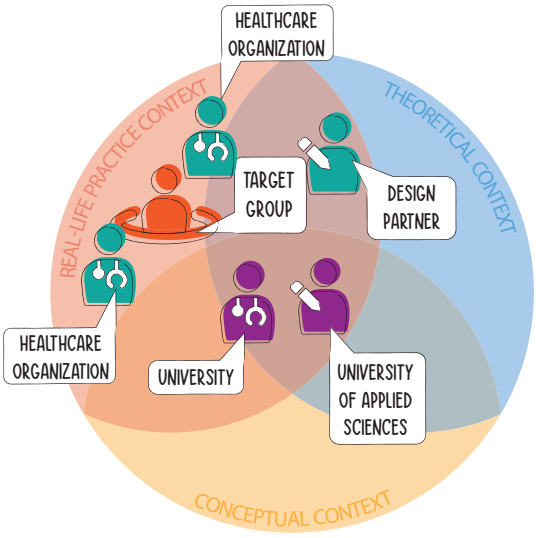


Figure 2.14: Actor Map

TIMELINE

The project started with developing a theoretical framework in which relevant research findings were documented. In parallel, the project extended on existing knowledge through analyses of existing design and VR interventions, and exploratory techniques to uncover which nature elements provide people with a sense of connectedness. The project addressed expectations and needs of elderly people towards VR and ambient technology during surveys, focus groups and interviews at the care center and at home.

Based on the qualitative findings, the outcomes were reflected on potential VR design approaches with the creative industry partner after the project assessed suitability of the approaches in co-design sessions with elderly people supervised by the healthcare partners. The VR environment was tested in an experimental setting, in a living lab situation and during interviews at home.

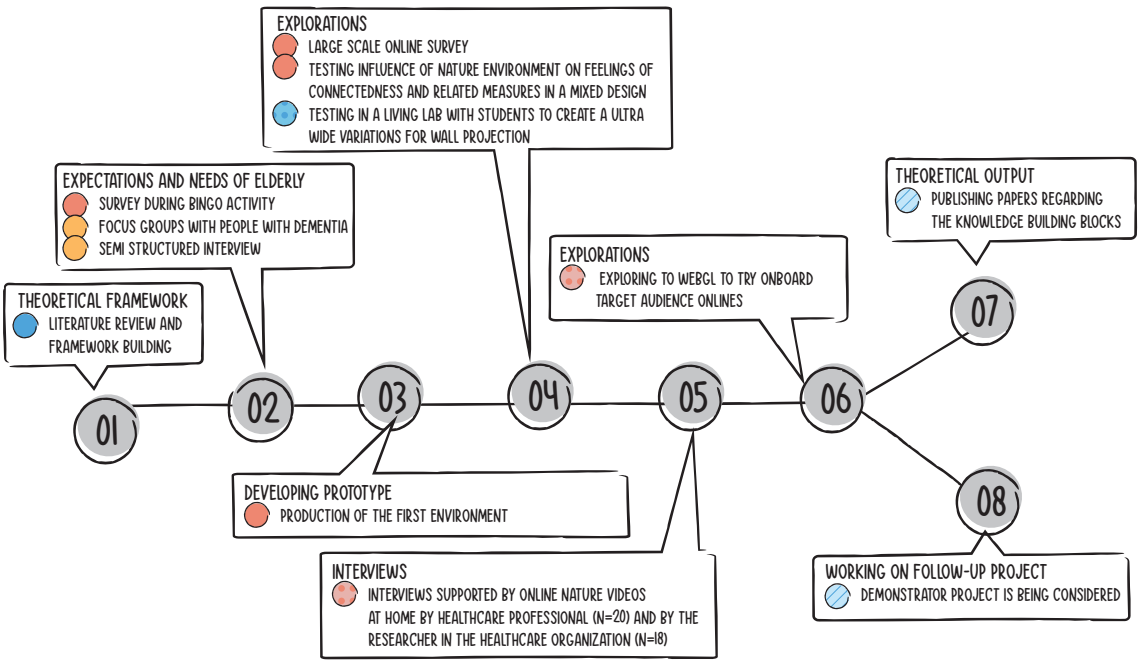


Figure 2.15: Timeline

Figure 2.16 (Left): Virtual nature space in a room setting

Figure 2.17 (Right): Virtual nature space in VR

RESULTS

KNOWLEDGE BUILDING BLOCKS

An evidence-based framework for the creation of a virtual natural environment that inspires feelings of connectedness and stimulates social contact among frail elderly, which consists of knowledge building blocks about the following:

- Experimental condition: different nature conditions related to feelings of social connectedness were identified. Both types of nature and spaciousness would be relevant factors in relation to social aspirations.
- Spaciousness: the spaciousness of nature scenes was manipulated; both dense and spacious scenes were developed. The results show that spacious rather than dense scenes elicited significantly higher social aspirations.
- Type of nature: the type of nature was manipulated; tended and wild nature scenes were developed. The findings show that tended nature scenes elicited more social aspirations than wild nature scenes.

PROTOTYPES

- The application is available via the website www.growingroots.nl. The digital nature experience made with the game engine Unity was exported as a desktop PC build (.exe).
- A demonstrator project is being considered, through which the consortium can further develop another prototype.

SQUEALED: SUPPORT QUALITY-CARE FOR ELDERLY USING AMBIENT LIVING ENVIRONMENT DATA

TOPIC & FOCUS

The SQUEALED project aimed to develop an eHealth tool to support safe, independent living of older people using energy consumption data. The eHealth application uses energy consumption data to determine the older person's daily routine. When something seems off in the daily routine, a message can be sent to either the older person or the primary care provider (e.g., family members or formal care providers). The project aimed to study whether the eHealth tool could support independent living at home and enhance older people's safety and quality of life.
Research findings indicated that identifying disruptions in the daily routine in a reliable manner was challenging.

This was mostly due to the low overall energy consumption and irregular daily routines which appeared from the data collection performed among independent-living older people. The project provided insight into energy consumption among independent-living older persons and the challenges of detecting disruptions in daily routines.
As a stand-alone system, an eHealth tool based on energy consumption needs to be further developed before it is suitable as a product. However, it might be suitable for specific subgroups of older people and/or combined with other sensors like water and gas to monitor daily activity.

"WE DECIDED TO REPLACE THE PRODUCT WITH A QUALITATIVE STUDY, A VIGNETTE STUDY IN WHICH WE PRESENTED FICTITIOUS PEOPLE USING THE SYSTEM."

Most older citizens prefer to live independently for as long as possible. However, direct care providers often have safety concerns, especially when signs of dementia appear. After time, these include risks of falls, self-neglect, and social isolation (Kelsey et al., 2010). The signs of early dementia appear in daily activities, such as turning on the television at night, leaving the tap water running, and getting up earlier every day.

The SQUEALED project investigated the possibility of monitoring older people using energy consumption patterns (e.g., using the television, light, and coffee machine), as registered by the smart energy meter. The project aimed to develop, design, and evaluate an eHealth solution monitoring older people's energy consumption patterns.

PROJECT ACTORS

The project management and core researchers of this project were a PhD student and a health sciences researcher (assistant professor) at the public health department of a university. The researchers worked together with researchers from another university who brought in expertise in design, autonomous aging, electrical engineering, mathematics, and computer science. Moreover, two additional university/care partners were part of the advisory board (i.e., departments of geriatrics and neuropsychology). Various practice partners, such as health care professionals working with older people, informal care organizations, a housing and a care organization, technical and creative partners, and the local government were involved in SQUEALED to develop the product's back-end, recruit participants, provide a context for evaluation studies, and disseminate results. Figure 2.18 shows the actors mapped on the theoretical, conceptual, and real-life practice context.

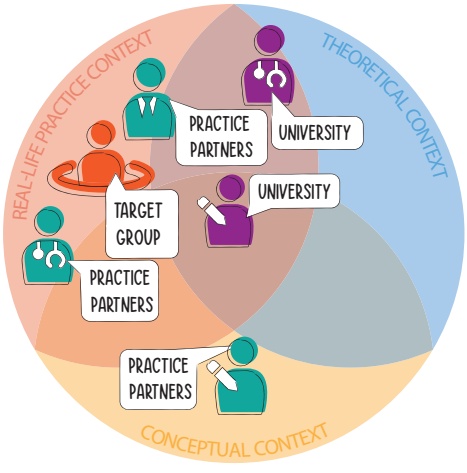


Figure 2.18: Actor Map

By means of a participatory approach, SQUEALED gathered data on how the proposed intervention could contribute to the safety and quality of life of independent-living older persons. The research method combined a literature study with a longitudinal field study that consisted of interviews at people's homes and field tests with a prototype.

Although the research initially consisted of sequentially scheduled activities, the research took place more in parallel. In addition, during the development phase, the focus was on technical development rather than the creation of design solutions. The recruitment of participants also took some time. Collaboration with the partners in care and community was needed to reach the right people and inform them about the project. Using the collected data from the field research (i.e., collection of energy consumption from independent-living older people), the analyses revealed that many false notifications would be sent to family and formal caregivers when the system was implemented. Therefore, researchers decided it would not be useful to further develop the eHealth system into a product. Instead, they focused on the technical development and analysis of the energy consumption data using qualitative research methods. Technical partners developed research reports with graphics and visuals that provided insight into daily energy consumption and energy consumption routines. The core researchers created vignettes that presented fictitious people using the system, based on the reports. Participants were asked to respond to these vignettes. This research step was instead of the controlled trial with a prototype of the eHealth tool.

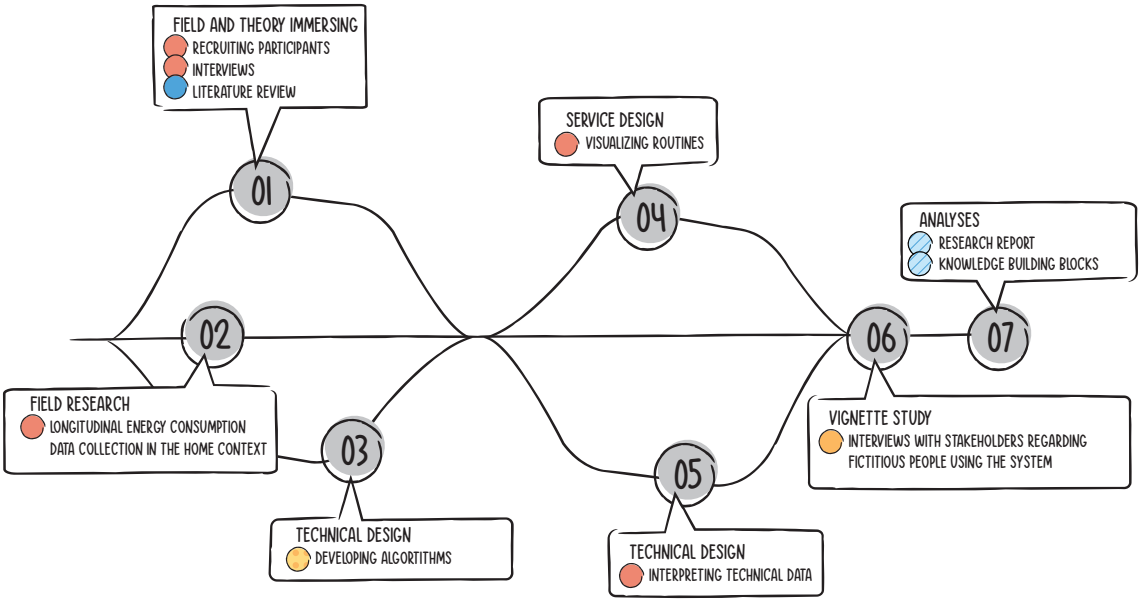


Figure 2.19: Timeline

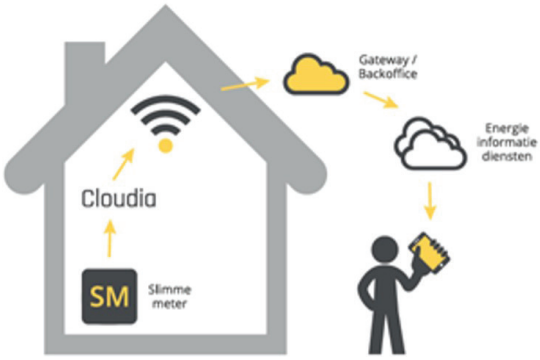


Figure 2.20: Ambient Living Environment Data (Technolution bv).

RESULTS

KNOWLEDGE BUILDING BLOCKS

- Understanding that monitoring energy consumption is not enough to fully support older people in safe, independent living. The concept might be useful in combination with other sensors, or, when further developed, only for a part of the population. Further research will have to be performed to study how more accurate monitoring can take place (e.g. using additional data) and for which groups of older people the monitoring system is the most valuable.

PROTOTYPE

- Report with historical data of total energy consumption (technical data report)
- Report with visualizations of energy consumption patterns (service designs)

PRACTICE

- There is a need among older people, informal caregivers, and care providers for a monitoring system that can increase the (perceived) safety of independent-living older people without interfering in their daily life. Detecting activity based on energy consumption is challenging when there is a lower activity level or when people have an irregular day-night rhythms.

UNOBTRUSIVE SENSING TECHNOLOGIES TO MONITOR AND COACH OLDER ADULTS WITH DEMENTIA: TRACK, TRACE & TRIGGER

TOPIC & FOCUS

The project Track, Trace, and Trigger (TTT) aimed to develop an unobtrusive Wi-Fi channel state information (CSI) system designed to accurately track and trace deviations in the relevant behavior of persons with dementia. The researchers explored the possibilities of a platform for caregivers to provide information regarding their daily functioning and behavioral and emotional state (Braakman-Jansen et al., 2017). The project explored how sensor technology can assess and monitor behavior and inform caregivers of people with dementia while preventing potential obtrusions or privacy breaches.

The CeHRes Roadmap for eHealth, a holistic, participatory development approach combining value-based design with persuasive technology, led to this project to realize a suitable fit between technology, context, and stakeholders (Van Gemert-Pijnen et al., 2011). The first three phases of the CeHRes Roadmap were included in this project: contextual inquiry, value specification, and design (Kip & Van Gemert-Pijnen, 2018). The project's ultimate goal was to optimize the independent living of people with dementia by providing meaningful support to (in)formal caregivers.

"WE HAD A FANTASTIC START TO THE LOCKDOWN WITH THE TECHNICIANS OF A HEALTHCARE ORGANIZATION. THEY WERE RIGHT IN THE MIDDLE OF IT. THEY UNDERSTOOD OUR NEW MONITORING TECHNOLOGY. THEY UNDERSTOOD WHAT WE WANTED TO DO WITH IT AND IT SUITED THEIR OWN NEEDS. IT WORKED WELL BECAUSE THEY HAD THE BUDGET TO BE ABLE TO TALK TO US FREELY AND THINK ALONG WITH US. WE THEN INVITED THEM TO COME AND VISIT US IN OUR TECH MED CENTER. THEY HELPED US SET UP THE MEASUREMENTS IN THAT LAB. IF IT WEREN T FOR THE LOCKDOWN, THEY WOULD HAVE HELPED WITH ON-SITE MEASUREMENTS AS WELL."

Current monitoring technology studies focus on positioning technologies (domotica) that are static and not context-aware. They can only track how often a certain facility is used but not by whom or when. Therefore, these systems provide data that is difficult to interpret in view of supporting people's health and well-being. As such, these technologies generate many false alarms, which results in overcharging the professional and informal caregivers. Therefore, the focus of the TTT project is to develop novel unobtrusive sensory technology to identify an individual's daily dynamic activities (Kamminga et al., 2016a; Kamminga et al., 2016b; Le et al., 2013; Le et al., 2014; Le et al., 2016; Nguyen et al., 2017; Salomons et al., 2016; Van Kleunen et al., 2016). This way, the user does not have to wear anything, and their privacy is potentially better protected since it is not easy to retrieve user identification from the obtained data, such as the reflected radio waves.

PROJECT ACTORS

The project management and core researchers of this project were a PhD student and a researcher in the Section Psychology, Health & Technology of the Faculty of Behavioral, Management and Social Sciences at a university. The research was executed in collaboration with another research group of the same university (Engineering: Pervasive Systems) and researchers from other universities abroad. Three university partners were part of the advisory board. The practice partner was involved by giving advice and facilitating the data collection and development of the prototype. One of the healthcare organizations was involved by giving advice about the organizational and technical processes. The health organizations and the target group were involved for data collection during the project.

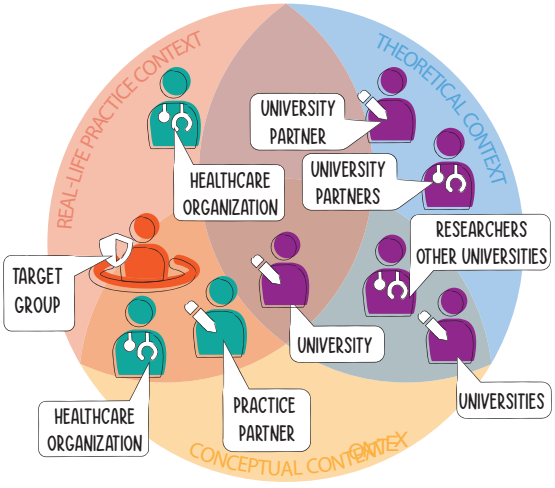


Figure 2.21: Actor Map

TIMELINE

The research approach is described as mixed-methods research and participatory development design approach, and, therefore, they used the CeHREs roadmap, combining qualitative methods (e.g., contextual inquiry and value-based requirements for design) and quantitative methods (e.g., deep learning using Wi-Fi and sensor data). Due to the user-oriented and iterative approach, stakeholders and a representation of future users were involved throughout the research. Interviews and focus groups were started with informal caregivers and care providers to map out needs and barriers with regard to monitoring. Focus groups with experts and stakeholders were organized to arrive at the values and attributes of TeleResearch at home. In addition, a survey with informal caregivers was conducted via the platform of the practice partner. The results of the qualitative and quantitative methods were translated into system and service requirements for the sensing system, as well as preconditions for its successful implementation from a multi-stakeholder perspective. In a parallel process, the system that analyzed motion data was assessed in experimental set-ups involving test subjects (lab setting). Machine-learning techniques were applied to improve the system's accuracy.

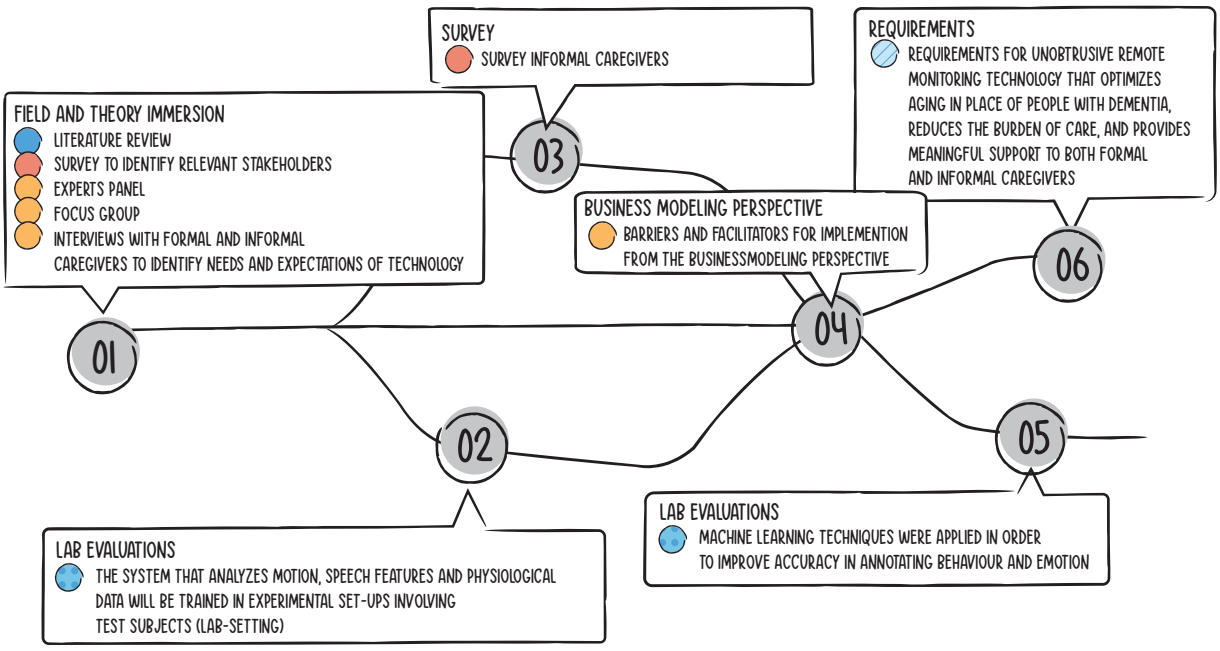


Figure 2.22: Timeline

Despite the presence of barriers, formal and informal caregivers of people with dementia generally saw value in unobtrusive in-home monitoring, and felt that these systems could contribute to a shift from reactive to more proactive and less obtrusive care. The requirements that emerged from the project can inform the development of more acceptable and goal-directed in-home monitoring technologies to support home-based dementia care.

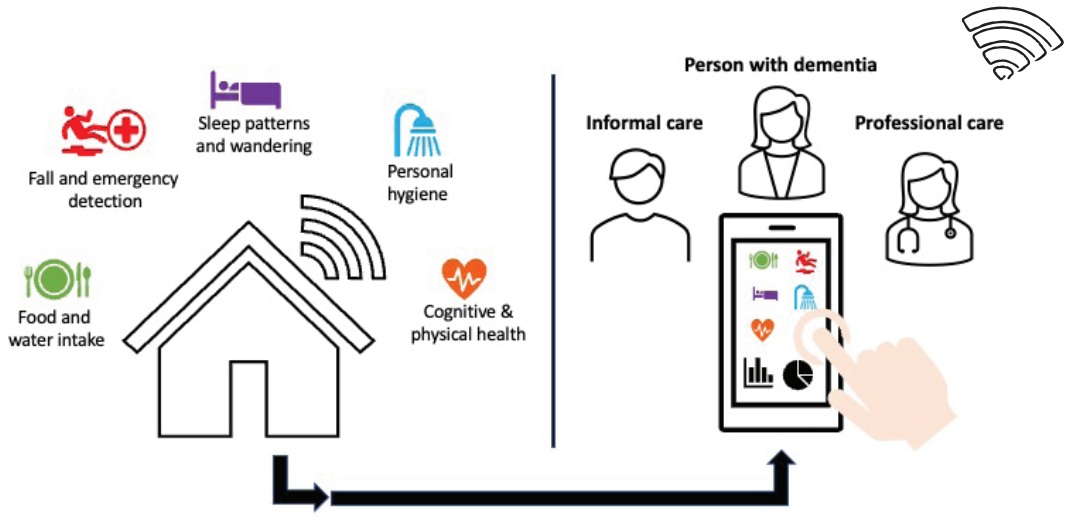


Figure 2.23: Unobtrusive Monitoring to Support Home-Based Dementia Care

KNOWLEDGE BUILDING BLOCKS

- Requirements for unobtrusive remote monitoring technology which optimizes aging in place of people with dementia, reduces the burden of care, and provides meaningful support to both formal and informal caregivers.

PROTOTYPE

- Algorithm Wi-Fi technology

PACO: PERSUASIVE DIGITAL AGENTS TO COACH OLDER ADULTS TOWARDS DIETARY BEHAVIOR CHANGE

TOPIC & FOCUS

The PACO project studied the use and usefulness of virtual eHealth agents to support healthy diets for older adults and decrease their loneliness. Such agents are computer-generated and animated conversation partners for technology users. The project identified the different factors that explain virtual agents' potential success for dietary change in older adults and developed and evaluated a web-based prototype based on these factors. In this prototype, two virtual agents engage in dialogue with older adults in order to motivate them to change their dietary behavior and decrease their loneliness.

"BASED ON THE LITERATURE, WE MADE A LIST OF THE THINGS WE AIMED TO LEARN IN THE CO-CREATION SESSIONS, SUCH AS PEOPLE'S VALUES, THE FOOD CHOICES THEY MAKE, AND WHY THEY SOMETIMES MAKE UNHEALTHY CHOICES. THE CREATIVE INDUSTRY PARTNER TRANSLATED THIS TO METHODS: HOW CAN WE GET ANSWERS ON THAT, AND HOW CAN WE BEST ADDRESS THIS IN A SESSION? ONE OF THE THEMES WAS THE PHYSICAL LIMITATIONS THAT ELDERLY PEOPLE EXPERIENCE AS THEY PREPARE FOOD. THIS IS VERY PRACTICAL, SUCH AS LIFTING HEAVY PANS OF WATER FOR COOKING."

As theoretical background, the project drew on concepts from persuasive health communication. As compliance with health advice is important for positive health outcomes, the successful design of persuasive virtual agents can have significant health benefits. However, insights into how to design such agents for the eHealth context are non-existent. Coaching and mentoring older adults via virtual agents is a radically new approach that may be far more motivating and persuasive than utilizing text-based information (as is currently the main approach). These agents allow for rich and persuasive automated communication. In theory, virtual agents should be able to deliver behavior change techniques such as self-monitoring, goal setting, action planning, and feedback, but research is lacking. Therefore, the PACO project built upon the fundamental research into virtual agents as done by Battagolino and Bickmore (2015) and Vardoulakis et al. (2012) and drew on the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1986) to explore how individuals with lower motivation or ability to process arguments can be effectively reached.

PROJECT ACTORS

The project management and the lead researcher were based in a research group at a university. This group has expertise in intervention strategies to promote healthy behavior. A company and knowledge institute with expertise in design for the care sector was closely involved in user research activities. A research and development company in rehabilitation technology and telemedicine was closely involved in the knowledge development and the development and testing of the prototype of the virtual agent. The target group representation organization was involved to gain access to the target group and was also closely involved in the theory building. The target group of elderly people was involved in co-creation and prototype evaluation activities.

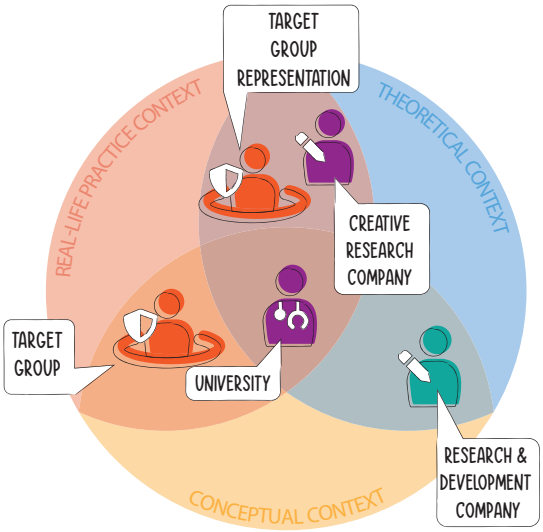


Figure 2.24: Actor Map

TIMELINE

The research design consisted of a series of studies: a study to build the general model of persuasion, a study with online experiments with different prototypes, and a real-life randomized control trial. To develop a general model of persuasion for virtual eHealth agents, the project combined the results of a scoping review with a co-design approach with older adults and their caretakers. The online experiments contained both qualitative experiments in group interviews and a quantitative survey. The persuasiveness of the (online) prototype of a virtual agent was studied in a randomized control trial.

The project started with an immersion in both theory (scoping review) and field (interviews, co-design sessions, and focus groups). The results were translated into the design of a set of three initial prototypes. Digital mock-ups were proposed to the target group in qualitative experiments through group interviews, and a large survey (N = 732), which was quantitatively analyzed. The results were used to develop design guidelines.

Based on these guidelines, a final integrated prototype was developed, which was run in a two-month field evaluation of elderly people using the virtual agent at their homes. This evaluation was an unblinded randomized control trial in two cohorts, with 30 participants per cohort.

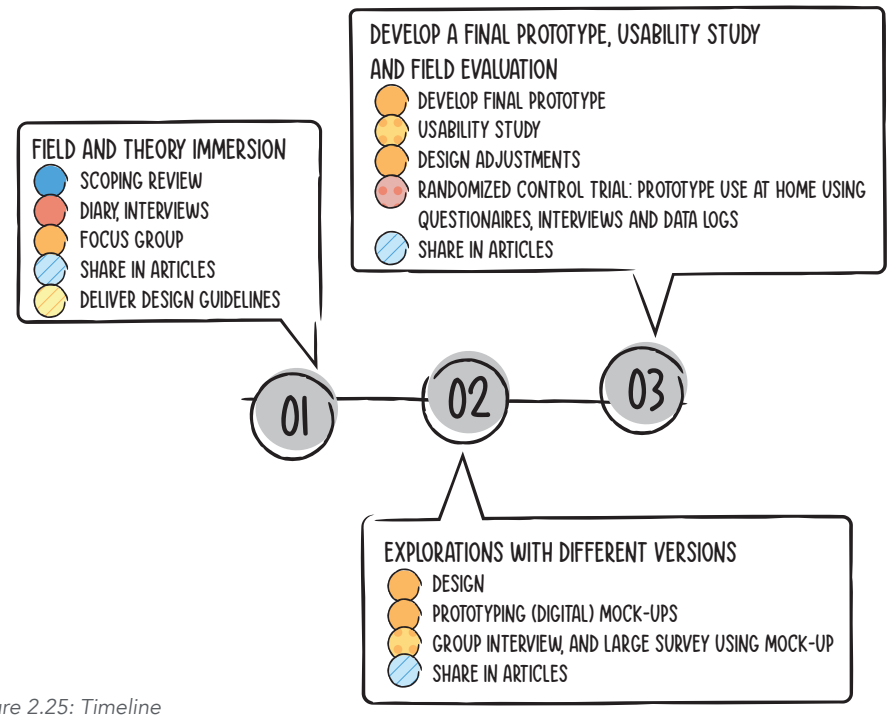
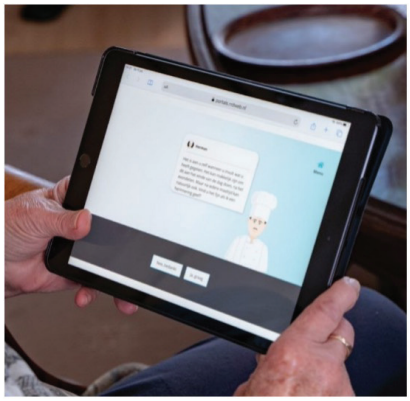


Figure 2.25: Timeline

Figure 2.26: One of the virtual agents in the PACO web application: Herman, the cook, who gives nutritional advice.



RESULTS

KNOWLEDGE BUILDING BLOCKS

- A general model of persuasion for virtual eHealth agents (Kramer et al., 2020)
- Guidelines to design a virtual agent for coaching older adults on dietary behavior change (Ter Stal et al., 2020).

PROTOTYPES

- A web application of a virtual agent (figure 2.26, Kramer et al., 2021) will be further developed in a follow-up research project.
- The co-design development of this agent is described in Kramer et al. (2021b), and the randomized control trial is described in Kramer (2021a).

HEALTHY STORYTELLING FOR EHEALTH

TOPIC & FOCUS

The Healthy Storytelling project studied the potential of interactive storytelling to include people with low literacy skills in eHealth and to increase their health literacy regarding obesity prevention.

The project investigated how communicating medical information through stories can improve the health literacy that is required to prevent obesity.

"WHEN STORYTELLING IS USED AS A DESIGN ELEMENT, STORIES HAVE A DOUBLE FUNCTION. THEY CAN BE COLLECTED TO GAIN INSIGHT INTO THE MOTIVATION OF USERS. BUT THEY CAN ALSO BE USED AS A MOTIVATIONAL ELEMENT, TO GET PEOPLE TALKING.

FOR INSTANCE, STIGMAS ARE A VERY SENSITIVE ISSUE REGARDING OVERWEIGHT. YOU CAN ASK SOMEONE: TELL ME WHEN YOU FIRST FELT STIGMATIZED? NOT EVERYONE WILL WANT THAT, BECAUSE IT MAKES YOU FEEL BAD. A STIGMA IS SOMETHING THAT MAKES YOU FEEL LESS. YOU CAN ALSO CHOOSE TO TELL A STORY: SOMEBODY ELSE TOLD US, THAT THEY FEEL VERY MUCH OBSERVED AND JUDGED WHEN THEY EAT A PIECE OF PIE AT A PARTY."

The project drew on the literature about health literacy and storytelling. Obesity is not only related to an unhealthy lifestyle but to many other factors, such as genetic disposition, hormonal disturbances, and medication. These factors are not always known by people with obesity or by the general public. It is important to be able to talk about obesity, which is often not easy. Many people feel shame and do not want to talk about their overweight. Middle-aged people with low literacy skills, in particular, have a severe risk for obesity development at a later stage in life. They face difficulties in understanding and acting upon medical information and eHealth communication. However, when medical information is communicated by stories, their health literacy improves (Haigh & Hardy, 2011). Communicating health information by means of stories is well-suited to the interest and capabilities of people with low literacy skills (Horvath, 1987; Macaulay, 2002) and increases its memorability (Gray, 2009) and believability (Slater et al., 2003), both of which positively influence healthy behavior. However, design principles for effectively integrating storytelling interactively in eHealth are yet unknown.

PROJECT ACTORS

The project management and core researchers of this project were all part of a design research group at a university. Several other research groups were involved as knowledge partners and advisers to this core research team, advising from the perspectives of persuasive communication and storytelling, psychology and eHealth, and obesity. The creative industry partner was involved in the theory development throughout the project and in the final study developing the prototype. The health organizations and the target group representation organizations were involved in gaining access to the target group and giving expert advice, for instance, on obesity or low literacy. A municipality was involved in the second study ("Torries") to link to a regional health initiative (school project) and to give advice based on earlier health intervention projects. The target group was involved in co-creation activities in the three studies, which involved obesity patients and people with low literacy skills

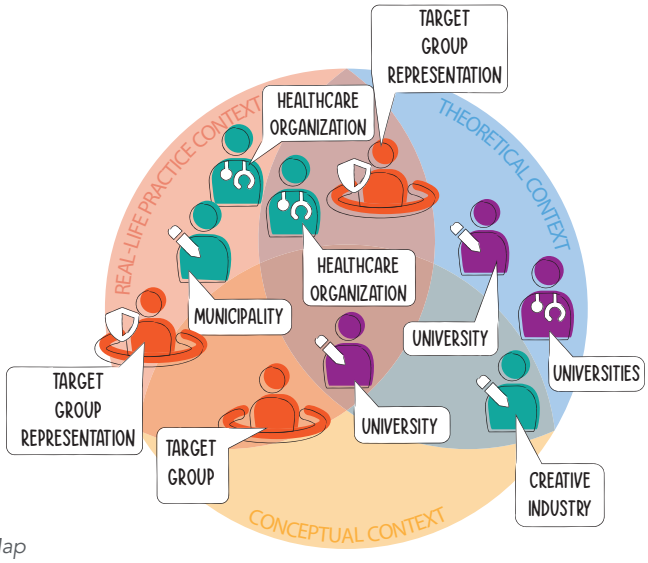
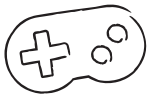


Figure 2.27: Actor Map

TIMELINE

This project took a Research-through-Design approach and consisted of several studies in which prototypes were developed and evaluated to explore the solution space for Healthy Storytelling. Two activities were intertwined in these studies: 1) gathering story content about the personal experiences of people with low literacy skills and (ex-)obesity patients, as well as related medical information on obesity, and 2) developing interactive formats to represent this content as persuasive stories in a digital Healthy Storytelling space. Each iteration addressed a specific theme: taboos, stigmas and myths, and stimulating the conversation about obesity. The project started with an immersion in both theory (literature) and field (experts review). Based on this, both an initial theoretical model and an initial storytelling design method were developed. Two main studies followed in which design, prototyping, and evaluation took place. During these studies, the storytelling design method and model were further developed. The first study, "Bal & Spriet" ("Ball & Stalk"), was about stigmas and the ability to talk about overweight. A board game was developed during this study which involved people from a low-socioeconomic status (low-SES) group. This study led to a spin-off, a student project that created a website with conversation starters about overweight: "Dikke Onzin" ("Fat Nonsense"). The largest and final study, "Torries", ran at primary schools. The intervention involved a game in which both children and parents (via these children) are reached to increase their health literacy.



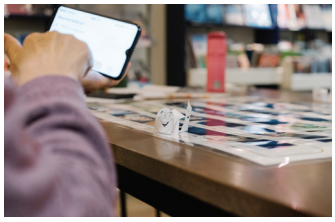


Figure 2.29 (Left): The conversation game Bal & Spriet (Ball & Stalk) during development with the target group.

Figure 2.30 (Right): Children engaged in a co-design session to develop the "Torries" intervention.

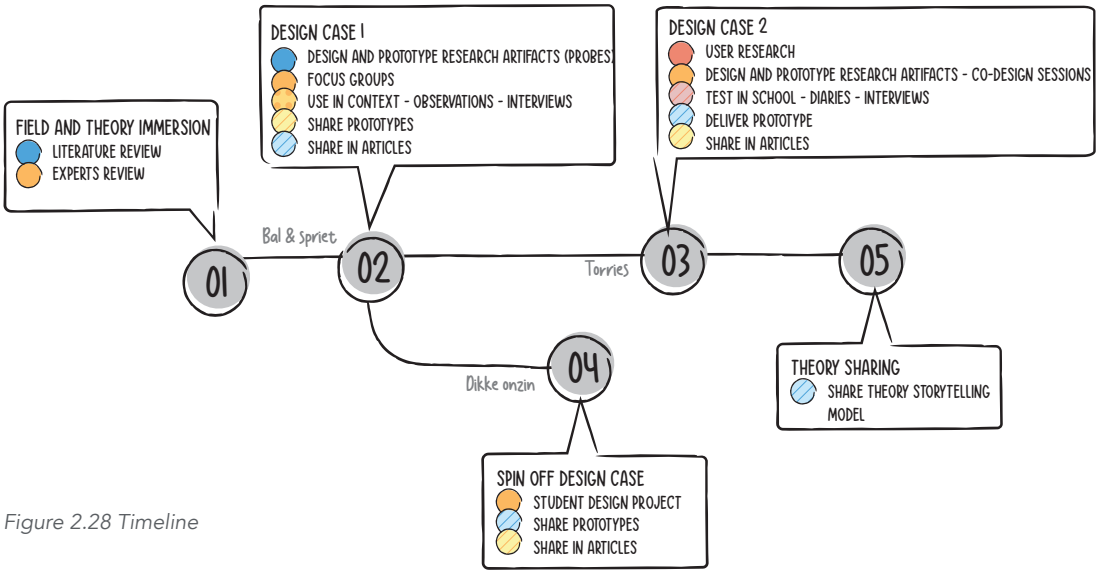


Figure 2.28 Timeline

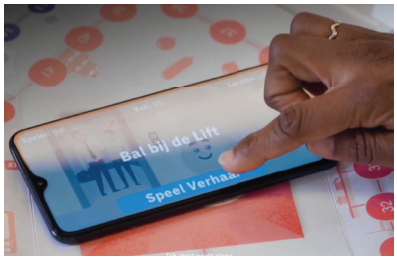


Figure 2.31 (Left): The game Bal & Spriet (Ball & Stalk), which works as a conversation starter about weight and its associated stigmas. The game consists of a foldable gameboard and an app. Players engage with two main characters, Ball and Stalk, who run into stigmatizing weight-related situations.

Figure 2.32 (Right): The Torries plushies, which are part of an intervention in the form of a teaching package on healthy eating for primary schools. The Torries are introduced to the children as imaginary creatures arriving from a fictional island. The children need to take their Torries home. This way, the intervention involves both children and their parents

RESULTS

KNOWLEDGE BUILDING BLOCKS

- A theoretical model which describes why and how interactive storytelling can contribute to obesity-related preventive eHealth interventions. It describes which storytelling elements, such as fictive personas, discussions, and diaries, can be used and why (Vegt et al., expected).
- A design method is used that applies interactive storytelling while considering the various desires, motivations, capacities, and cultural backgrounds of people (Van Boeijen et al., expected).

PROTOTYPES

- Three demonstrators: design proposals that show how preventive eHealth based on storytelling can be included in a design (Van Eijk, 2019; Vegt et al., 2021. Vegt et al., expected; Visch et al., expected).
- Interest from the municipality to further develop the demonstrator in the third study ("Torries") and embed it into education programs.

PRACTICE

- The game that was developed in the second study ("Bal & Spriet") is produced in low quantities and is being used at community centers.

FOODSAMPLER: DIETARY REPORTING IN DAILY LIFE

TOPIC & FOCUS

The FoodSampler project aimed to understand the practices of dietary reporting in daily life, that is, how people report their eating during the day. Dietary reporting is often used when dieticians work with people who want to address their weight. They use various eHealth tools such as apps. These apps give insight into and subsequently change food consumption habits. To better design such eHealth reporting tools and make sure that they are used by people in their daily activities, it is crucial to understand these reporting practices.

The FoodSampler project aimed to incorporate not only what is normally recorded – what is relevant for a dietician – but also what is relevant for a patient or participant to report on, as well as the reporting qualities regarding patient privacy or data ownership. Relevant insights were captured through the knowledge building blocks that can be used to develop eHealth monitoring tools.

"WE DO NOT LOOK AT HOW A MONITORING TOOL IS GOING TO MAKE PEOPLE LOSE OR GAIN WEIGHT. WE JUST WANT TO MAKE THEM USE IT, AS WE UNDERSTAND THAT THIS DATA NEEDS TO BE GATHERED FROM THEM. WE WANT THEM TO REPORT NOT ONLY WHAT NORMALLY HAS BEEN RECORDED, BUT ALSO THE REASONS WHY. HEALTHCARE PROFESSIONALS OR DIETICIANS ALWAYS NOD AND SAY: "YEAH, THAT IS IT. IT IS ABOUT GETTING TO THE WHY." AND THEY SAY THEY DO TRY BUT THEY DON'T GET THE DOOR OPEN TO GET THERE.
WE LOOK AT PARTICULAR QUALITIES OF REPORTING. SUCH AS: WHERE WOULD YOU LIKE TO REPORT IN YOUR HOME CONTEXT? WHEN YOU'RE OPENING YOUR FRIDGE, WHEN YOU'RE SITTING AT THE DINNER TABLE, WHEN YOU'RE LYING ON YOUR COUCH?"

To study and understand monitoring food intake practices, the project drew on concepts from several areas. First, this project took the angle of "positive health" (Huber et al., 2016), addressing the shift to support the active involvement of people in their own health conditions. This is opposed to the majority of existing scientific and commercial food measurement systems, which focus on treatment rather than prevention and describe rather than explain overweight. Second, it drew on persuasive and user engagement theories (e.g., O'Brien & Toms, 2008). Third, it used in-situ reporting methods to investigate the ease-of-use and direct benefit of in-situ tools that integrate different techniques for collecting (Hektner et al., 2007) and reconstructing (Kahneman et al., 2004). Finally, it drew on concepts from mixed-method research (Creswell & Piano, 2011; Romero Herrera, 2017) about using a mixed set of data sources and collection techniques.

PROJECT ACTORS

The project management was part of a design research group at a university. This group has expertise in self-management, user engagement, self-reporting, and monitoring. Researchers from this group worked closely together with a research group at a university of applied sciences that has expertise in food measurements for overweight interventions. The creative industry partner was involved with the theory development throughout the project and in the conceptualization and development of the prototypes. Target group representation organizations and several expert organizations were involved in gaining access to the target group and giving expert advice, for instance, on obesity or dietary practice. The target group was involved in co-creation or activity evaluation in all studies. This involved obesity patients and people with low literacy skills. Sometimes in the practice context (at home), sometimes in the conceptual context (in focus groups), and sometimes in the theoretical context (in the lab at the university).

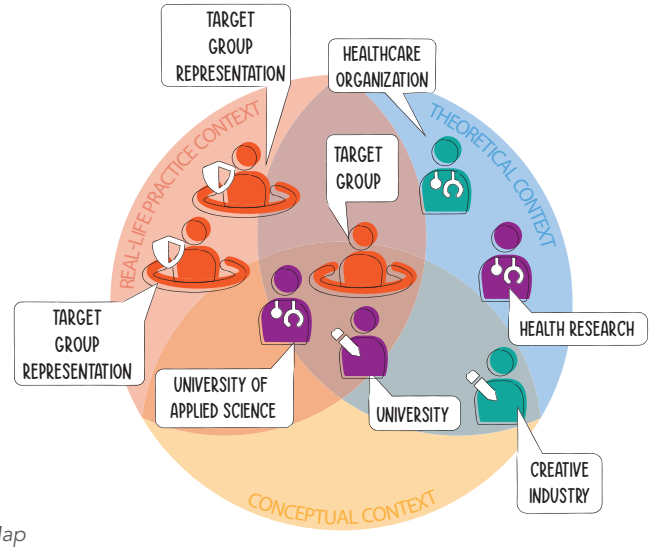


Figure 2.33: Actor Map

TIMELINE

Central to the project's way of working was the evaluation of interventions or prototypes in context through the so-called Living Lab design research approach (Krogstie, 2012, Romero Herrera, 2017). The project employed various methods to capture knowledge from, with, and by users regarding the day-to-day practices and experiences of a phenomena (in this case: the self-reporting dietary behavior).
End-users and professionals were explicitly involved as providers and users of information through the user-centric design approach.

The project takes a research-through-design approach through which design artifacts (existing products as well as newly developed low and hi-fidelity prototypes) were iteratively developed and deployed in context. The project started with an immersion in both theory (literature) and field (interviews). This was followed by an exploratory phase: three studies in which design, prototyping, and evaluation took place. These studies partly informed each other and partly ran parallel. Based on the results, a final prototype is currently under development. This will run in a short evaluation in the home context (still in progress at the time of writing this publication). All data was collected in the end-users' context, interpreted, and evaluated with and by end-users (parents of overweight children and older adults at different stages of overweight) and food experts (dietitians and scientists).

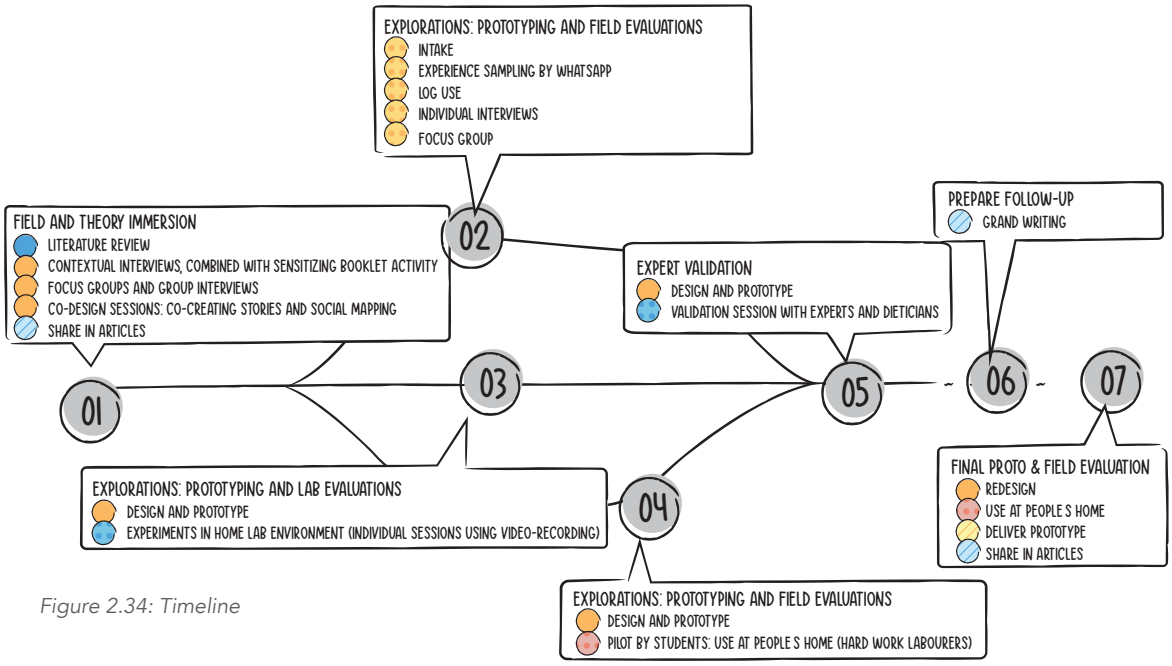


Figure 2.34: Timeline

Figure 2.35 (Left): A research participant engaged in a contextual interview.

Figure 2.36 (Right): A research participant engaged in the home lab setting at TU Delft to explore the qualities of interaction.

RESULTS

KNOWLEDGE BUILDING BLOCKS

- A conceptual model is developed which identifies the contextual aspects that influence dietary behavior and the specific needs of people with overweight and obesity regarding personal data dietary behavior (van Oers et al., 2019, Romero Herrera et al., 2018). Best practices are developed of contextual reporting (what to report when, where and how).

PROTOTYPES

- A demonstrator of novel engaging interactions is under development. The theoretical insights from FoodSampler will be applied in real-life tools for dieticians in follow-up projects to develop an enhanced proof-of-concept digital food coach.

PRACTICE

- The project reframed how the involved dieticians and eHealth developers see the future of dietary tools: minimizing people's reporting effort by adding advanced sensing technologies and increasing engagement through gaming and social techniques.

GOAL: GAMIFICATION FOR OVERWEIGHT PREVENTION AND ACTIVE LIFESTYLE

TOPIC & FOCUS

The GOAL-project aimed to gain un understanding of intervention strategies for overweight prevention in the aging population. Therefore, GOAL conducted two case studies and a series of gamification experiments with end-users of a mobile health (mHealth) app to measure engagement (e.g., the number of days end-users visited a mobile health (mHealth) app or the number of health behaviors that end-users registered in the app). With the experiments, the research team investigated the impact of four intervention strategies: How 1) reward mechanisms, 2) social comparison, 3) adaptive goal setting, and 4) personality tailoring can be employed to foster engagement with an mHealth app. Seven experiments took place with (pre)adolescents with low socioeconomic status (SES) in educational contexts and one experiment with sedentary office workers in occupational contexts. The experiments lasted between four weeks and twenty weeks each between 2018–2021. Relevant insights were captured through knowledge building blocks that were used to propose a toolbox, "SciModeler," that estimates the potential impact of intervention strategies in a given context (i.e., based on existing empirical data). GOAL demonstrated that SciModeler could be used effectively (i.e., by querying its central database) to explore promising intervention strategies for a specific context.

"WE HAVE COLLECTED A LOT OF EMPIRICAL DATA AND INFORMATION ABOUT HEALTHY BEHAVIOR CHANGE IN PRACTICE, IN THE WILD, WITH REAL PEOPLE AND WITH APPS."

Many eHealth tools have been developed to support and promote an active, healthy lifestyle. Popular health apps can, for example, count steps and track workouts. Engagement levels with mHealth apps typically collapse after short periods of time, and the effectiveness of an mHealth app largely depends on the specific combination of intervention strategies the app employs (Nuijten, 2022). The GOAL project investigated levels of engagement of various intervention strategies regarding overweight prevention through the use of gamification techniques, which refers to game strategies outside of a game context (Deterding et al., 2011). Important factors for effective gamification that lead to healthier lifestyles are the theoretical underpinning and personalization (Cugelman et al., 2013; DeSmet et al., 2014). However, many existing gamified and eHealth approaches have limited theoretical foundations (Tabak et al., 2015). GOAL addressed the theoretical gap between health behavior changes, smart, healthy living environments, and health game design.

PROJECT ACTORS

The project management and core researchers of this project were a PhD student and an information systems researcher (associate professor) in Industrial Engineering and Innovation Sciences at a university. The researchers worked together with design honors students from the Industrial Design department at the same university and a researcher in digital (game) technology for healthy urban living from another university. Additionally, there were four other university partners (two full professors and two associate professors) who were on the advisory board.

Many practice partners were involved in GOAL as sparring partners, including well-being organizations and end-user organizations like many municipalities and various secondary schools. The end-user organizations provided the context for the experimental studies and participant recruitment. Figure 2.37 shows the actors involved in GOAL, mapped according to the theoretical, conceptual, and real-life practice contexts.

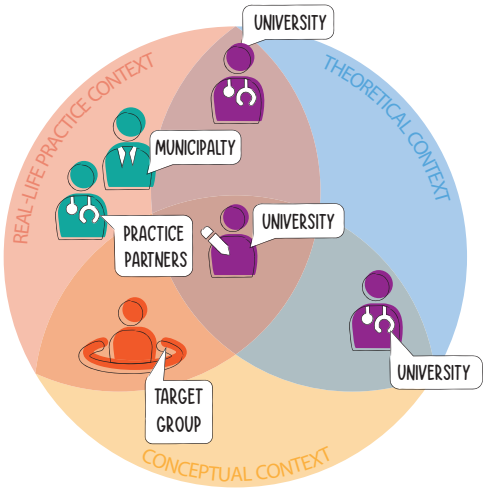


Figure 2.37: Actor Map

GOAL researchers experimented with an existing mHealth platform called GameBus, which they incrementally improved by adding creative ideas and evaluating the ideas in practice. Central to the project's way of working was experimenting in practice with different health game configurations in the health app. The configurations were creative ideas as possible solutions for the four intervention strategies that were added to the health platform. For example, they experimented with the intervention strategy "reward mechanisms" by which badges could be earned and points collected that are then converted into gift cards to investigate the impact of the various ideas. Through the app, they monitored the progress of end-users regarding specific tasks, such as "go for a walk" or "eat an apple." They visualized the performance and engagement of the end-users when using different health game configurations; for example, are they more engaged when collecting badges or saving money for a gift card?

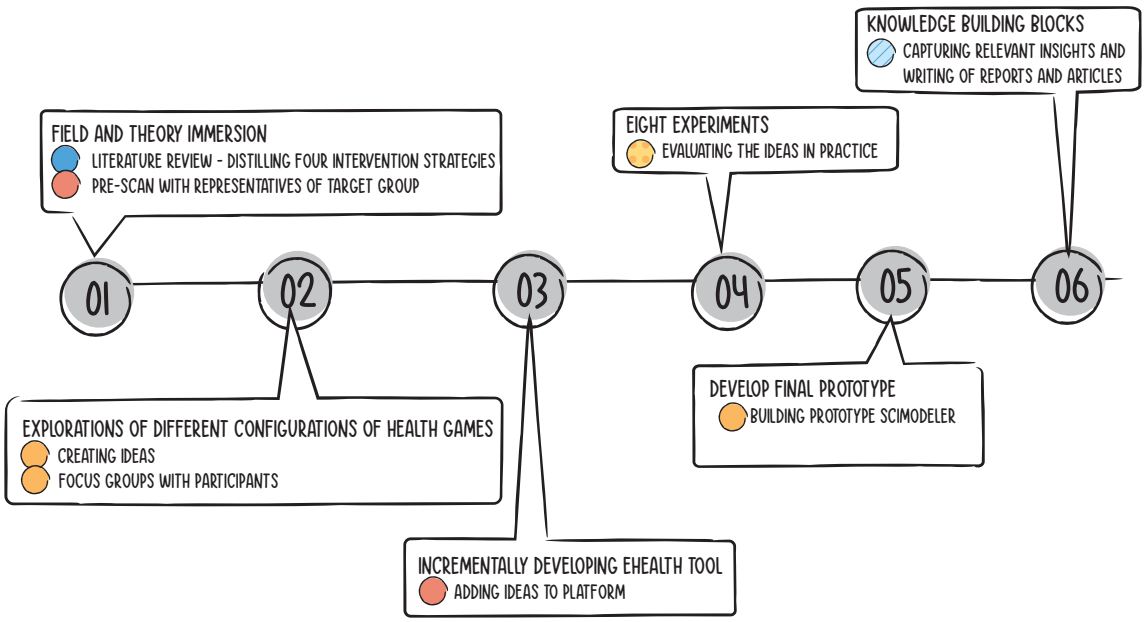


Figure 2.38: Timeline

Figure 2.39 (Left): Research participants engaged with the mHealth app.

Figure 2.40 (Right): Research participants engaged in healthy tasks.

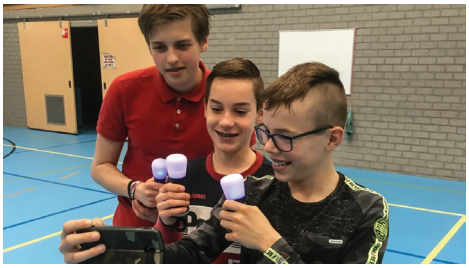


Figure 2.41: Research participants engaged in an experiment using the mHealth app.

RESULTS

KNOWLEDGE BUILDING BLOCKS

Empirical data on behavior change intervention strategies in health games were gathered during experiments in occupational and educational contexts. This resulted, among others, in the following knowledge building blocks:

- Insights into how gamification prevents overweight and supports an active lifestyle (Nuijten et al., 2018).
- A theoretical meta-model for consolidating scientific knowledge by linking empirical data with theoretical constructs (Nuijten & Van Gorp, 2021).
- Assessment of the influence of physical activity on the experiences with sampling response devices (Khanshan et al., 2021).
- Various evaluation studies.

PROTOTYPES

- A database toolbox for consolidating scientific knowledge on intervention strategies for obesity prevention in specific contexts has been created. The theoretical insights from GOAL have been applied to this real-life toolbox, "SciModeler," for researchers in follow-up projects to estimate the potential impact of intervention strategies in a given context (i.e., based on existing empirical data).

WAYS TO INNOVATE AND DO RESEARCH

MARIEKE ZIELHUIS

"I WAS HAPPY TO SEE 'RESEARCH THROUGH DESIGN' AS SUGGESTED APPROACH WITHIN THIS PROGRAM. TO SEE WHAT IT BRINGS WHEN YOU USE THIS APPROACH, BUT ALSO TO DEVELOP MORE GUIDANCE ON HOW TO DO THIS EFFECTIVELY."

-DESIGN RESEARCHER

3.1 INTRODUCTION

In research projects on eHealth, such as those in this book, several practices and worlds come together. All have their own beliefs and ways to go about their work. In this chapter, we will see how this works out in their joint methods.
The two worlds that meet are those of research and innovation. They find each other in the shared goal to eventually improve peoples' lives. Innovation is the successful implementation of creative ideas within an organization (Amabile et al., 2016). The journey to this goal is a long-term effort, and research can contribute to a part of this journey (Moors, 2013). Combining these worlds can pose some problems as they essentially differ in the nature of their processes. Even though many companies try to organize innovation in clear-cut stage-gate models, it is hard to control and predict in practice (e.g. Van de Ven et al., 1999). Most research, conversely, aims for structure and control.

A strand of research that combines these two worlds is the research that originates in the field of design. Stappers and Van der Lugt (2006) illustrate how design became recognized as a driving factor in innovation and as a knowledge-growing activity. This resulted in design research as a branch of academic research. The role of design is central to this research. Such research comes in many flavors and goes by different names.

For some researchers, design and research are separate. In *design science research*, they are organized as separate activities which take turns over time. In this type of research, the focus of the research activities lies on validating solutions (Hevner, 2007; Peffers et al., 2008; Van Aken, 2005). The design process itself is a black box that is not part of the

research process. In other types of research, the two are intertwined. This is particularly the case in *Research through Design* (RtD) (Zimmerman et al., 2010; Stappers & Giaccardi, 2017). In this type of research, design and prototyping are seen as crucial to knowledge production (Durrant et al., 2017). In other words, the design process is a knowledge-generating activity in itself (Stappers & Van der Lugt, 2006; Stappers & Giaccardi, 2017; Zimmerman et al., 2007). This intertwinement of design and research is operationalized in many different ways.

As we see in these 10 eHealth projects, the world of research also meets the world of practice in various ways. Issues from real life often stand at the base of the research, and practical impact is part of the goals. In many cases, design research projects are aimed at societal issues (e.g. Roggema, 2017; Zimmerman et al., 2010). We also see practice partners join into the project. Even ways of working that are derived from practice find their way into the projects, for instance when methods from design practice are adopted (Wensveen & Matthews, 2015).

In addition, various challenges can arise when one attempts to integrate ways of working from the disciplines of healthcare and design. In particular, Blandford and colleagues (2018) pointed out several differences and related challenges in human-computer interaction. Healthcare research is typified by a focus on evaluation through randomized controlled trials and effect studies. However, this is not the only way of working in healthcare research. The paramedical professions, such as nursing, have a tradition of grounded research and other qualitative research approaches, which are also often pursued in design research. The difference is that in qualitative research in nursing science is conducted in a more structured and protocolized manner than is common in the field of design (e.g. McCann & Clark, 2003). In the design field, evaluation has a formative function. This provides insights on usability, usefulness and user experience. Differences can also be found in the approaches towards identifying user needs and developing interventions. Groeneveld and colleagues (2019) and Van der Lugt and Van der Laan (2017) describe how these differences also create challenges in collaborations with health practitioners. Collaboration between these domains can also be problematic because the design field lacks a clearly described and agreed upon set of methods. This makes it difficult to explain approaches to design research and the corresponding methods to non-design partners. For instance, the term 'co-design' is interpreted in many ways within the field of design (Koskela-Huotari, 2013; Mattelamki & Sleeswijk Visser, 2011; Sanders, 2008). If there is no consensus within the design field, it is even harder for partners outside of that field to understand what a certain method entails. The health research tradition, conversely, has clear ideas and method descriptions. As a result, the authors of design research papers typically need to dedicate many words to descriptions of method, whereas naming the specific methods that are used tends to suffice in healthcare papers (Blandford et al., 2018).

In short, in eHealth research collaborations, several practices, with their own beliefs, values and ways of working, come together. *Innovation* meets *research* in various design research approaches. The explorative world of *design research* meets the world of *health research*, with its randomized control trials and effect studies. And finally, ways of working from *research* are combined with ways of working from *practice*. This chapter investigates what happens when these worlds meet and the ways of working that are employed as a result. It answers the following question: *how do the ways of working in eHealth research projects add value to the quality of the process?*

We observed a variety of characteristic ways of working, which we organized in the following themes (Figure 3.1):

1) the goals of a project (Section 3.3) and, in light of those goals
2) the mix of methods (Section 3.4)
3) the role of prototypes (Section 3.5)
4) iterations and the research path over time (Section 3.6)

The four sections (Sections 3.3-3.6) present the emergent ways of working that we found within each theme. They add value to the projects, and they highlight points at which the different worlds, namely those of design and health and of research and practice, reinforce each other.

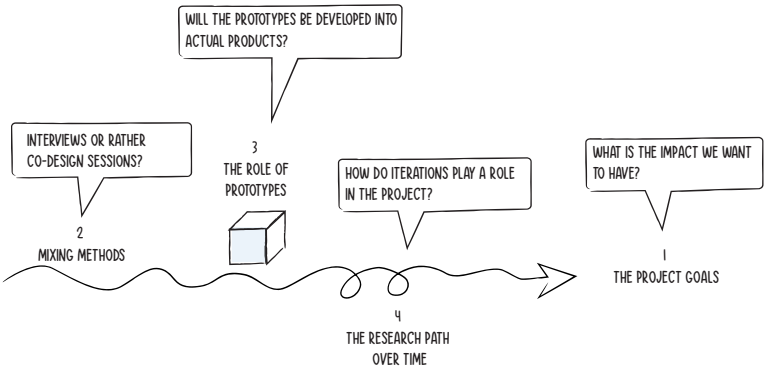


Figure 3.1: Four themes on ways of working in research-practice projects in which the design domain and the health domain meet.

In the following paragraphs, we will discuss each theme. First, we will explore the four themes from a theoretical perspective (Section 3.2). That exploration is followed by a discussion of observations from practice in relation to each of the four themes. In that section, we start with the end of the process, that is, with project goals, in mind. The main tips that we provide, which are based on the insights in this chapter, are summarized in Figure 3.16 in Section 3.7.

3.2 THEORETICAL PERSPECTIVE ON THE FOUR THEMES

PROJECT GOALS

The goals of a Create-Health research-practice collaboration that is directed towards an (eventually) meaningful eHealth innovation can be manifold. The Research Pathway Model (RPM) that we introduced in Chapter 1 highlights that projects can deliver outputs in three contexts: the theoretical context (papers, models and theory), the conceptual context (ideas, prototypes and such like), and in real-life practice (changes to practices). This entire range of outcomes could be beneficial for the practice situation in the long run: others may build on theoretical contributions to devise new solutions, and prototypes can be developed into actual products or services.

When researchers and practice partners collaborate, they can be expected to have different priorities. As Stokes (2017) argued, there need not be a trade-off between an 'eye for generalization' and an 'eye for application' in research. In fact, many design research projects aim for both. Beck and Stolterman (2016) argue that design publications often contain multiple knowledge claims of different kinds. Publications in the natural and social sciences, conversely, tend to contain singular knowledge claims of similar kinds. RtD projects, in particular, are often intended to instigate societal change (Brankaert & den Ouden, 2017). In doing this, they typically produce a wide range of outcomes. This range of outcomes also encompasses so-called 'intermediate knowledge,' such as guidelines and demonstrators (Gaver & Bowers, 2012; Hoök & Löwgren, 2012; Löwgren, 2013). Sleeswijk Visser (2018) shows how a single project can produce outcomes on all these levels.

The health and design domains also differ in the nature of the knowledge that they aim to generate. Healthcare researchers try to find evidence of effects, such as changes in behavior. The dominant approach in health is evidence-based practice or evidence-based medicine (e.g. Burns et al.,2015; Portney & Watkins 2000), in which different types of evidence are ranked. This approach has become prevalent in evaluations of non-pharmacological interventions, but it has also been criticized (e.g. Howick et al., 2009). Design research, conversely, concerns, among others, the quality of interactions (Blandford et al., 2018). Essentially, health research is oriented towards what we know now, and design research is oriented towards exploring possible futures. In the words of Koskinen and colleagues (Koskinen et al., 2011), '*designers focus on the creation of artifacts through a process of disciplined imagination*.' By doing so, they open the solution space.

This also implies a difference in research objects. Design research typically produces knowledge not only about phenomena or solutions but also about approaches to design. The various audiences of these projects have different interests in them. All three types of knowledge, about phenomena, solutions, and approaches, are of interest to design professionals (Zielhuis et al., in press).

THE MIX OF METHODS

For design-health collaborations, there is not much guidance on how to deal with these differences in orientation, and to operationalize this in method use. Current guidance focuses on highlighting the differences between disciplines and the challenges of working with those differences. Little guidance is provided, especially for user research and intervention development. One of the main challenges that result from the different orientations is that disciplines have different views on what an adequate basis for moving forward is and on the manner in which research findings should be grounded.

Blandford and colleagues (2018) provide some helpful directions. As far as the overall approach is concerned, they suggest that creatives and health researchers find each other through a person-centered approach. In the healthcare domain, the importance of considering individual situations and needs has been emphasized (e.g. Council for Public Health and Society, 2017). Personal approaches also have advocates in the field of design (e.g. Smeenk et al., 2022). Blandford and colleagues (2018) suggest that those who evaluate interventions should make a distinction between immediately measurable effects, such as user actions and perceptions, and more distal outcomes, such as longer-term effects on health.

Methods from different disciplines can be mixed in many ways. In some cases, one of the disciplines essentially takes the lead. At the other extreme, disciplines really integrate their ways of working. Choi and Pak (2006) distinguish between three main ways of working with multiple disciplines. They describe multidisciplinarity as a salad bowl in which the different ingredients are clearly distinguishable. Activities stay within the boundaries of the field. Interdisciplinarity is described as a melting pot or a stew in which the ingredients are only partly distinguishable. Links are formed between the disciplines to form a coordinated and coherent whole. Finally, transdisciplinarity is presented as a cake in which the ingredients form a final product of a different kind. This approach integrates various disciplines and transcends traditional boundaries. McComb and Jablokow (2022) argue that all degrees of disciplinarity can be valuable.

THE ROLE OF PROTOTYPES

The prototypes that play parts in these projects should be assessed in the light of the goals

of the projects. This can be difficult when objectives are manifold and viewed differently by partners (as discussed previously). By 'prototypes,' we mean the created objects (often tangible) that are used in research and can realize the (inter)action that is studied (Stappers & Giaccardi, 2017). Prototypes (both physical and digital) play an important role in many design research projects, and they can have different functions (Stappers & Giaccardi, 2017; Wensveen & Matthews, 2015). These are sometimes considered to be important end goals of a project—a prototype that can be developed further into a product. This said, in many cases, these prototypes are a means of inquiry or exploration (e.g. Keller, 2005). The artifacts that are created function as embodiments of possible futures (Koskinen et al., 2011). For practice partners, the role of prototypes in a particular project may not always be clear. In some cases, the *process* of prototyping is a vehicle for inquiry (Wensveen & Matthews, 2015). For instance, it can provide insights about the design approach. Horst (2011) describes the process of crafting prototypes as 'platforms for participation' in iterative design. Reay and colleagues (2017) illustrate how prototyping can facilitate collaboration between designers and clinicians (and support the boundary-crossing process—see Chapter 5).

ITERATIONS AND THE RESEARCH PATH OVER TIME

Bringing ways of working from different disciplines together involves activities that extend beyond the level of method mixing. There is also the matter of deciding how to move forward and how to ground research findings. This problem is about building a research path over time.

Iterating is a characteristic way of moving forward in much of design research. Researchers who work in a design research context are accustomed to design and research being interwoven, which makes for an agile and dynamic process. However, this process can take many different forms, especially when design is closely tied to the research process. This is particularly the case in RtD. Stappers and Giaccardi (2017) distinguish various approaches to RtD projects that all exhibit different ways of iterating. These differences are related to their different goal orientation. Some projects iterate on successive prototypes, which can be left behind when moving towards a final product. Other projects take a programmatic approach in which a conceptual frame is filled with explorations in design. These design explorations are also seen as iterations. The research process in design science, conversely, is characterized by cycles of observation and analysis that revolve around a specific design proposal—developing and building, using, testing and evaluating, and receiving and integrating feedback. Since all of these iterations have different goals, the criteria for moving forward are also different.

In the health disciplines, experiences of and views on working with iterations differ (Mann et al., 2018). Blandford and colleagues (2018) describe how many health researchers see

the development of complex (non-pharmacological) interventions as a sequential process that culminates in a randomized controlled trial that determines effectiveness. This view has gradually been broadened as more researchers have seen the necessity of iterative development.

Unfortunately, there is not much guidance on adopting an iterative approach when working across boundaries and towards health interventions. Hermsen and colleagues (2020) show how an agile approach leads to rapid progress and successful stakeholder inclusion when a multidisciplinary team is developing health interventions. However, they note that the integration of user research and scientific evidence in the development process is still a challenge as speed seems to be favored over rigor.

3.3 PROJECT GOALS

"WE TRY TO FIND A BALANCE BETWEEN PRACTICAL APPLICATION AND FUNDAMENTAL RESEARCH. THIS COMBINATION IS WHAT STANDS OUT IN THIS PROGRAM AND WHAT REALLY ADDS VALUE."

-RESEARCHER, GROWING ROOTS

"WE REFINED AND VALIDATED A THEORETICAL FRAMEWORK AND ADDRESSED THE PRACTICAL APPLICATION. HOW TO CONNECT THE CREATIVE INDUSTRY AND HEALTHCARE? THAT IS WHY WE FOCUSED ON DEVELOPING DESIGN GAMES."

-DESIGN RESEARCHER, NATALIE

Although project partners are united by an interest in new knowledge, we found that they actually have different interests, which can be hard to combine. We found several ways in which projects manage to overcome this difficulty.

FOCUS ON THEORY AND RELEVANCE TO PRACTICE

The call of ZonMw provides an opportunity to focus on theory development. Since previous programs apparently focused too much on delivering solutions for practice and, in

the words of the program manager, 'skipped over the knowledge production,' projects are sought that can produce knowledge building blocks in order to contribute to solutions to problems in healthcare practice. All design and development activities should be aimed towards knowledge production.

Many of the researchers who were involved welcomed this focus on theory development. They explained that this is not always the case in health-design eHealth collaborations. Instead, the focus is often on the development of a specific product, such as an app. They sometimes feel the need to take a step back and to develop the knowledge that is needed before going into product development. For instance, the project *Track, Trace, Trigger* deals with technological explorations and ethical issues—which aspects of the lifestyle, health and safety of individuals with dementia can be measured through the use of innovative and unobtrusive technology, and how does the target group perceive and accept them? The researchers see developing a product proposal as premature in this early stage of the innovation path. One of the researchers explained that they were glad that the call did not require 'jumping to solutions.'

Although the Create-Health program was not intended to result in actual product development or implementation, most researchers aim to achieve a combination of generic ('fundamental') knowledge and relevance to practice. All projects were conducted in close cooperation with practice partners, who brought their perspectives from practice into the project. In addition, most researchers felt driven to be relevant to practice and to contribute to it. In these projects, which interact with practice, they were often able to achieve these results. An example from the *GOAL* project follows (see Box 3.1).

This example shows how a researcher can combine a focus on theory development with a direct impact on practice. A focus on theory is also not problematic for most of the practice partners who are involved. Design practitioners and health practitioners recognize the need for an evidence base in healthcare innovations. For instance, the design practice partner in the project *Growing Roots* observed, '*This was a chance to develop an evidence-based mechanic that we can seamlessly implement in other games and VR environments that we make […] That is the first thing healthcare clients ask for: evidence based.'* The design practice partner in *FoodSampler* accepted this focus on theory development and expected practical value in the long run: '*I see this more as building up knowledge for follow-up projects than that it helps us now.'* They were explicitly involved in this knowledge-development process within the project. Care organizations and care professionals also understand the need for an evidence base in healthcare innovation. Moreover, most of them had worked with the researchers in the past and understood the theoretical focus of the collaboration.

BOX 3.1

DIRECT IMPACT IN A THEORETICAL PROJECT

Project: *GOAL*

Although the project aims at the development of a theoretical model and tools for researchers, it is very important for the main researcher that the project and the research impact the lives of individuals positively. This means that they also value a direct impact on practice. While they were working on the two main outcomes of the project, this impact took shape in various ways.

One of the two main outcomes is empirical knowledge about behavior-change intervention strategies in health games. This knowledge was gathered from experiments in occupational and educational contexts. Several experiments with health games were ran in a practice context. They had different configurations. For instance, subjects could earn badges as rewards or collect points that could be converted into gift cards. The researcher made the following observation:

Figure 3.2: one of the experiments with health games ran at schools

For the past four years, my personal goal has been to restore the connection between living healthy and feeling energetic. I have tried to inspire people to live healthier lives and feel energized through a mobile health app. I feel that I have made some valuable contributions to this challenge. I am very proud to have reached over 800 individuals with my digital lifestyle programs throughout this period. My programs have encouraged some of these individuals to engage in a healthier lifestyle.

The other main outcome of this project is a toolbox, SciModeler. This toolbox is a metamodel and database that helps researchers or health innovators to estimate the potential impact of intervention strategies in a given context (i.e., based on existing empirical data). This can be used to develop and evaluate personalized eHealth interventions to prevent obesity. By providing this toolbox, the researchers hope to affect the lives of even more individuals.

A VARIETY OF GOALS AND OUTCOMES

The new knowledge that was developed is not presented solely in the form of models or theory. The projects aimed for a broad range of outputs, which varies, first of all, in terms of

content. We see that many projects produce knowledge about three topics: about phenomena, about design approaches or about solutions. Knowledge about a phenomenon yields insights on issues such as loneliness or persuasion. Knowledge about design approaches, for instance, may result in the development of guidelines on design for individuals with dementia or the use of storytelling as a design element (*Healthy Storytelling*). Finally, knowledge about a solution refers to descriptions of a particular solution but also to the requirements or components of new solutions or even a broader solution space for future projects.

These various types of knowledge are disseminated in a variety of formats. Apart from theoretical contributions (such as models that are described in papers) and prototypes for eHealth solutions, the projects yielded various types of in-between outputs, such as design guidelines. A researcher from the *PACO* project explained that the project was geared not only towards developing a virtual agent but also towards creating and sharing the design guidelines on which that agent is based: '*It is most important to share the knowledge and experience that we developed during the project. In our case, about designing eHealth applications, and virtual agents in particular. We view the design guidelines more as the main outcome than the virtual agent as such.*' Such guidelines are often shared through academic papers as well as at events and workshops that are aimed at an audience of design practitioners. The *Growing Roots* project developed content for a VR environment that can be reused in other VR solutions for older adults. This is an example of an 'intermediate' result. The researchers on the *NATALIE* project developed their knowledge of design approaches into design games that other designers can use (see Box 3.2).

BOX 3.2

A DESIGN GAME THAT MAKES THEORY ACTIONABLE

Project: *NATALIE*

The project entails the development of knowledge about the experience of autonomy in communication and decision-making. The researchers have developed a set of design games to use these insights in practice, for audiences of both creatives and health practitioners. How to maintain balance in autonomy?

With the design games, we aim to make this larger framework actionable: how can you use this in practice? There are a lot of aspects that you need to keep in mind when working with products or client systems that aim to facilitate the communication. How can you provide an overview of all the aspects for someone from the creative industry or the caregiver or the people whom it concerns? The design game guides you along all these conceptual aspects and makes clear how to recognize the principles in products. So, the game helps you apply the theoretical framework in an analytic and a designerly manner.

The various project partners sometimes exhibited different interests in these various knowledge outcomes. This can complicate matters. These different interests sometimes lead to partners having different goals in certain steps of the research. This tendency is particularly pronounced in the steps of analysis. For instance, in the *PACO* project, the design practice partner was interested in the values of older adults that are relevant to food. This would be helpful in similar design projects. The university partner was more focused on the theoretical model of a phenomenon (in this case, changing behavior). As a result, the design practice partner focused on the analysis of the optimal translation of these values, whereas the university partner focused on identifying the consequences for the theoretical model of the phenomenon of eating behavior.

OUTCOMES FOR DIFFERENT AUDIENCES

These various types of knowledge outcomes are also informative for different audiences in different ways. Since most projects aim to impact multiple audiences, it is hard to combine their different interests. In these projects, the researchers aim to inform the fields of design and healthcare research as well as the practice of design and healthcare. In particular, the design-practice audience seems to occupy a secondary position, behind the other audiences. We identified several challenges that stand in the way of informing the practice of design effectively. These are described in more detail in Zielhuis et al. (2022). For instance, differences between design research and design practice are sometimes not recognized, which makes it difficult to address the needs of the latter. This problem will be discussed in greater detail in Chapter 5. In additions, researchers on some projects refrain from reaching out to a design-practice audience until after the end of a project, whereas practitioners prefer to be involved at a much earlier stage. We also found that the involvement of a design practice partner in a project does not necessarily mean that the partner in question will assume the role in order to represent the interests of design practice as a whole.

CONCLUSIONS: PROJECT GOALS

We found that a focus on theory can be combined with relevance for practice in projects that are conducted in close cooperation with practice partners. Partners join these projects because they have some interest in knowledge development. However, the domains of research and practice and of design and health aim at different types of knowledge. These differences are on two dimensions: the *topic* and the *orientation* of the desired knowledge. If project partners are clear about those dimensions from the outset, they have the opportunity to discuss them early.

The first dimension is *topic*—what is it about? Projects can produce knowledge about three general topics: a phenomenon, design approaches or solutions. For health researchers, the approach of design-science research, in particular, is close to home, in that it focuses on developing knowledge about specific solutions. When a specific solution is part of the work of the design-practice partners (when it is their design), this can also be of interest to them.

Knowledge with a different *orientation* can be produced on each of these topics, which results in the second dimension on which the domains differ. Some researchers are more intent on developing knowledge about what we know now, and others are oriented towards the future. Design researchers in the tradition of RtD, in particular, develop knowledge on all three topics but mostly strive to explore possible futures. While they develop insights about phenomena and design approaches, they also produce information about a range of interventions, which create a broader solution space for future projects. They often develop knowledge about several solutions in this process.

Finally, we found how the different interests of audiences can lead to similar difficulties. In order to inform a broad audience, researchers need to consider the needs and interests of different groups. Combining these interests can be challenging. Researchers can draw on the examples of projects, such as that of Sleeswijk Visser (2017), that distinguish project outcomes on various levels. They can also use many examples of intermediate knowledge, such as design games or guidelines, to create knowledge with generative qualities.

Table 3.1 summarizes the main insights, the ways of working that we found in the projects, and the relevant literature. In the next section, we will explore the manner in which researchers employ mixed methods to work towards these goals.

TOPIC	INSIGHT	LITERATURE	EMERGENT PRACTICE FROM THE PROJECTS OR LITERATURE
THE GOALS			
Focus on theory	Focus on theory is relevant to practice. However, the domains of research and practice and of design and health differ in the type of knowledge that they aim for.	Evidence-based practice (Burns et al., 2015; Portney & Watkins 2000); differences between healthcare and HCI (Blandford et al., 2018); future orientation of design (Koskinen et al., 2011)	• Be clear about the type of topic of the intended output: knowledge about phenomena (e.g. dementia), about design approaches (e.g. using storytelling), about solutions (e.g. a specific eHealth application). Often, projects aim for a combination of the above but have different emphases. • Be clear about orientation: now oriented (what do we know about this intervention now) or future oriented (how does this open the solution space).
Various audiences	In much of design research, particularly RtD, knowledge is typically captured by a range of outcomes, from theory through guidelines to technology demonstrators and prototypes. It is difficult to ensure that these outcomes serve the different interests of the various audiences.	Range of outcomes in RtD projects (Sleeswijk Visser, 2018); intermediate knowledge (Gaver & Bowers, 2012; Hoök & Löwgren, 2012; Löwgren, 2013); serving design practice (Zielhuis et al., 2022)	• Targeting different audiences through specific outcomes. Consider the range of available options: models, design guidelines, design requirements, design games, demonstrators, etc. *"We view the design guidelines as the main outcome."* *"With design games, we aim to make this larger framework actionable."*

Table 3.1: Insights on the ways of working that deal with goals in eHealth projects. Emergent practices from the projects and references to the relevant literature are added.

3.4 MIXING METHODS THROUGHOUT THE PROJECT

"THIS SUBSIDY SAW THE VALUE OF GENERATIVE AND EXPLORATIVE METHODS."

-END REPORT, FOODSAMPLER

"HOW DO YOU PUT EVERYDAY PEOPLE ACTUALLY IN THE LEAD OF A DESIGN PROCESS? YOU HARDLY SEE THAT IN RESEARCH PROJECTS THAT WORK WITH CONCRETE SOLUTIONS. OUR PROCESS PROVIDES AN ANSWER FOR THIS."

-DESIGN RESEARCHER, EVERYDAY SOUNDS OF DEMENTIA

In order to work towards the goals described in the previous section, the projects combined methods from different disciplines in various ways. The researchers used four main approaches to address the differences between now-oriented and future-oriented perspectives. To map these approaches, we use the RPM, which distinguishes between various research activities and contexts.

In all projects, activities take place in all three contexts that the RPM distinguishes (see Figure 3.3): the theoretical, the conceptual and the real-life-practice context. The colored dots in the timelines in Chapter 2 are related to these various contexts (blue = theory, orange = conceptual and red = practice). Researchers place much emphasis on activities in the practice context, that is, on field research. We also see a variety of activities in the conceptual context. In terms of the RPM, we see this both in activities to 'understand and create' and in activities to 'explore and test.' Activity in the theoretical context is largely focused on 'understand and create.' A few studies involved lab experiments, as in the *FoodSampler* and *Track, Trace, Trigger* projects. The following depiction of the RPM grid indicates that a variety of different types of activities are placed in each square.

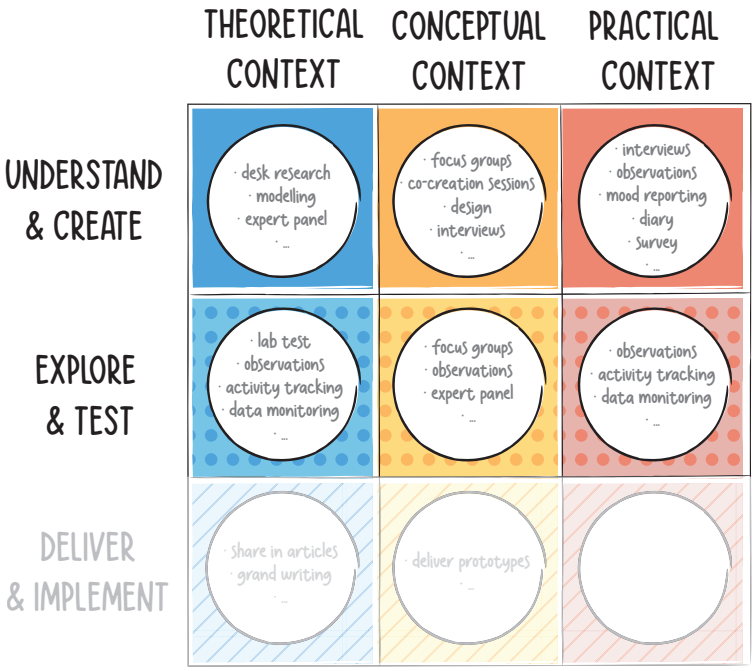


Figure 3.3: Various activities in the top two rows of the RPM matrix ('Understand & Create' and 'Explore & Test').

This variety of activities can be organized in line with their orientation, be it future or present. The future orientation is particularly pronounced in the various generative methods that are used to help individuals to express their needs and desires. Co-constructing stories is an example of the generative method. It is central to the Healthy Storytelling project, but it was also used in FoodSampler: 'We incorporated this in our interviews, and it was the most successful method we had. It is a way to be able to ask about intimate things without asking about themselves but about someone else. It did not take more than two minutes before people started talking about themselves.' Introducing a prototype to practice is also a good way of gaining information on user needs. In Box 3.3, which follows, we illustrate this proposition by reference to the Everyday Sounds of Dementia project, in which various prototypes were used to elicit responses that are hard to obtain through inquiry.

GENERATIVE WAYS OF DOING USER RESEARCH

BOX 3.3

Project: *Everyday Sounds of Dementia*

The final Tumbler study concerns a co-design process that involves three couples. The researcher works with various generative methods.

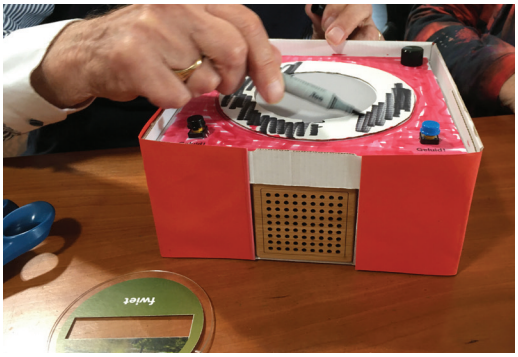


Figure 3.4: the Soundbox that was personalized in the co-design sessions in the Tumbler study.

With each couple, we did an activity in which we personalized the soundscapes. In each session, we built further on their reactions. We began with a very generic soundscape. This elicited all sorts of personal reactions, with people talking about their holidays in Spain at the sea. We personalized the soundscape by adding Spanish sounds. We did three sessions like this. To do each session, we developed a sort of sound box with switches that we could personalize.

In Figure 3.5, we added this 'perspective' to the RPM as an additional layer. The two layers show the difference between a future-oriented and explorative perspective (the top layer) and a now-oriented and pre-structured approach (bottom layer). We found four main strategies for addressing these different perspectives. They are described in the following sections.

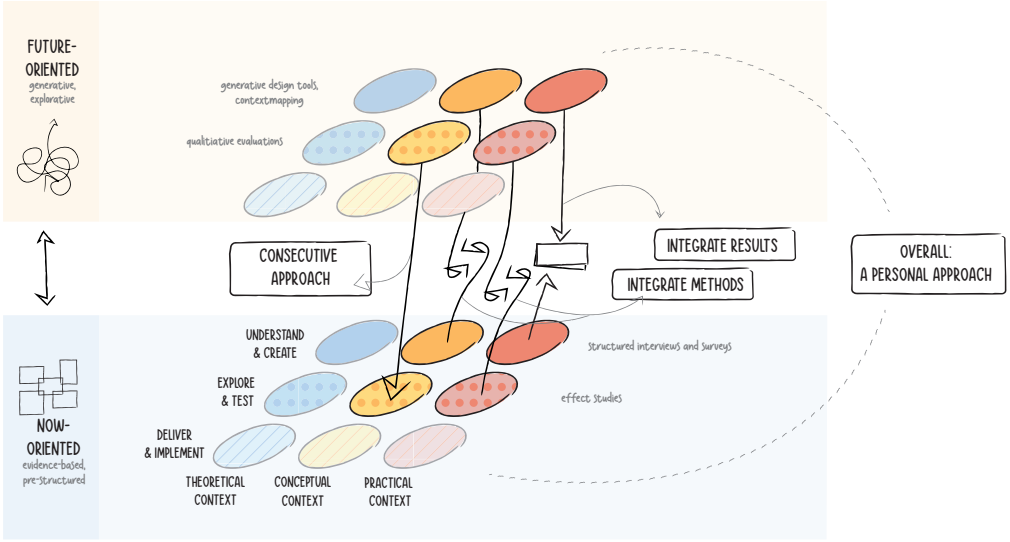


Figure 3.5: 'Perspective' as an additional layer of the RPM. Various strategies were found to address these different perspectives in the categories 'Create & Understand' and 'Explore & Test.'

A SEQUENTIAL APPROACH

The first approach is to work consecutively: first do one thing, then another. In 'explore and test,' the strategy is often to perform the more qualitative evaluation first and to conduct an effect study later. Most researchers structure their evaluations so as to obtain indications of effect, usability or use experience. In Box 3.4, we illustrate this proposition by reference to the *Healthy Storytelling* project. The design partners are experienced in evaluating prototypes that are still in development qualitatively, whereas the health partners are experienced in evaluating the effects of developed interventions. Combining this phase of designing and developing an intervention with an effect evaluation within the scope of these projects turns out to be challenging. A conclusive effect study is often planned as a follow-up. In effect studies and in many qualitative studies, most projects aim at evaluations in real-life contexts. An evaluation in a real-life context is still planned for the *FoodSampler* project. The researchers conducted an evaluation with professional experts within the projects, using concrete prototypes.

BOX 3.4

QUALITATIVE EVALUATING ON THREE LEVELS

Project: *Healthy Storytelling*

In the second study of this project, the researchers designed an intervention for primary school that is aimed at healthy eating. It takes the form of a teaching package. Stuffed toys called Torries are central elements of this package. The Torries are introduced to the children as having arrived from an imaginary island. The children need to take care of their Torries at home. With this intervention, the researchers aim to reach not only children but also their parents.

Figure 3.6: the stuffed toys named 'Torries' as part of an intervention in primary schools towards healthy eating.

They evaluated the intervention on three levels: *'We looked at the usability of the intervention ("Is it doable for teachers?"), at the experience for the children ("How was their involvement?") and, finally, at the effect ("Is there a learning outcome or a behavioral change?").'*

The researchers reported, '*Evaluating generated knowledge with [dieticians] by means of design artifacts proved to be successful in discussing more deeply the pros and cons of possible concepts. This allows them to be more concrete with regards to their expectations and concerns of the concepts.*'

The researchers on the *PACO* project merged the strategies for integrating results and took a sequential approach. The project began with a co-design approach to developing a virtual agent, which was evaluated in a randomized control study to determine its effect. This evaluation was inconclusive, but it did provide some indications of the effects and pointed to relevant directions for further development and evaluation. In fact, the researchers combined different perspectives in the evaluation study of the virtual agent that was developed during the project. They used different methods. Each took a different perspective to evaluating the agent (see Box 3.5).

BOX 3.5

DIFFERENT PERSPECTIVES ON EVALUATING A VIRTUAL AGENT

Project: *PACO*

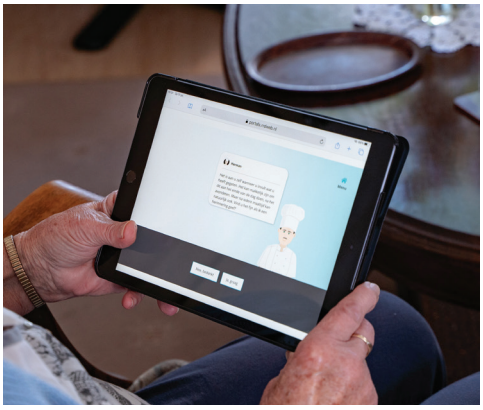


Figure 3.7: one of the virtual agents in the developed app: Herman, the cook.

In order to evaluate the prototype of the virtual agent that was developed during the project, the researchers combined questionnaires with qualitative interviews. The evaluation focused on the qualities of the interaction as well as on indications of effect.

We studied the use: could we explain why people use the app or why they don't, and how this is related to the use experience, how they though privacy was handled, how the agent looked and so on. We also wanted to know whether they felt less lonely or had started to eat more healthy. We did not want a questionnaire of 20 pages, which is very usual in the food field. This limited us in what we could ask. The interviews provided much more insight, especially about food and loneliness. People made very specific changes: they started to cook with fresh ingredients. Some described the use of the app as a wake-up call. (Researcher, PACO*)*

In this way, the two research methods had different foci. The interview focused more on the qualities of the interaction, and the questionnaire focused more on indications of effect.

In this approach, the quality of the handover is a challenge. Each party needs to understand the input of the other. A particular challenge is to transfer insights so as to inform designers. This is especially difficult when there is a clear cut between phases, such as a handover of design requirements to other project partners or even beyond the project. Usually, such requirements or guidelines evolve gradually during a project. A warm handover to those responsible for design and development is helpful.

INTEGRATING RESULTS

The second strategy is to integrate the results of different activities into joint results. We find this in 'understand and create.' Several projects show that grounding a design process in previously developed models and theories while keeping an open mind and learning from users is challenging. One of those projects is *PACO*. A researcher explained, *'It is a tension. Co-creation is a nice technique to connect to the everyday reality of your target group, but it still gives a fairly limited representation of this group at a particular moment, while, at the other hand, you have scientific literature about behavior, about behavior change, about what is and isn't effective. This is sometimes not in line with what you find in co-creation.'* A researcher on the *Track, Trace, Trigger* project described a similar tension: '*There is not really a satisfactory way to draw up requirements, especially requirements that are derived from both user research and literature.'* The researchers involved project partners with different backgrounds, especially ones that possess technical expertise, in the project in order to integrate these different types of input into the requirements.

One of the ways in which results can be integrated is illustrated by the *DDD* project. In this project, the social researchers aimed to conduct longitudinal research with a pre-structured focus. They combined this with a context-mapping approach that the design researchers introduced. In the studies, this resulted in cross-fertilization between different orientations. Box 3.6 describes how the results were integrated in various steps, a 'ping-pong' approach.

BOX 3.6

A PING-PONG APPROACH TO LONGITUDINAL RESEARCH

Project: *DDD*

The project aimed to capture changes in technology use among individuals with dementia in relation to their social participation. During the project, the focus came to lie more on mapping the (desired) social networks of individuals in the early stages of dementia. The focus on technology became less prominent.

In this research, the social researchers aimed to conduct longitudinal studies and to capture

changes in this use of technology over time. Researchers returned to ask the same questions over a period of time. To attain rich insights and to explore design opportunities, the design researchers proposed to conduct more explorative context-mapping activities. Combining the orientation towards the present of the first approach with the future orientation of the second posed a challenge. They combined the two by adopting an approach in which they alternated between context-mapping activities and more traditional interviews. This resulted in a 'ping-pong' approach, in which the focus of the co-design studies was determined by the preceding interview. Both activities contributed to a shared set of insights, which developed gradually during the process. These insights were one-on-one insights about several individuals.

In Godfroij et al. (2022), the researchers elaborate on the process of creating shared understanding through this approach. For instance, they write on the role of design tools and tangible objects.

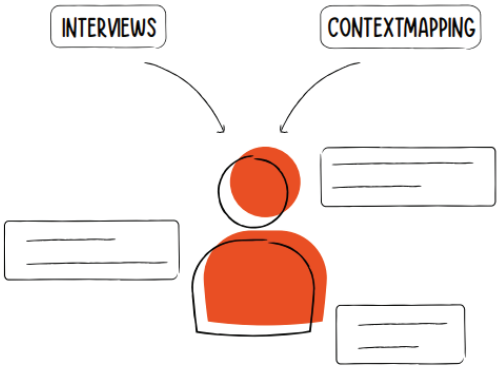


Figure 3.8. In the project, persona creation was shaped by both the longitudinal interviews and the context-mapping activities.

INTEGRATING METHODS

The third approach is to integrate different ways of working into a combined method. We find this in 'understand and create' and in 'explore and test.' In particular, user research is almost never a unidisciplinary effort by one of the partners. Often, we see health actors and creatives combine ways of working. In projects that are not led by creative partners, they are brought in to design but also to conduct user research and to report on the perspective of users, that is, to capture rich insights on what individuals find important. The health partners provide access to the target group and domain expertise. What do we know about a certain target group or health domain? What are the sensitivities, and what works best? In the FoodSampler project, the dietary expertise of one university and the contextual-inquiry expertise of another were used to set up and execute interviews jointly. This required some effort to be expended in order to find a method that both parties would be comfortable with: "Their understanding of running interviews was very different from ours. For them, an interview was more a matter of closed questions, very structured, so they could compare the different participants. We work with contextual interviews, cameras and pencils so they

can map things. It took a bit of time to find our combination, but I think it was one of the nicest studies we did, in terms of the data it generated. We had to learn from each other's method and to come to a method that we were both comfortable with to run. The main issue was not that they did not believe in what we were doing, but [that] they did not feel comfortable running something like that" (Researcher). The researchers also conducted joint analysis sessions, in which they also had to integrate different data analysis practices.

A PERSONAL APPROACH

The last approach can be used in various research stages. Common ground between the health and design domains is found by using a person-centered approach. Such an approach of N=1 (or N=low) is helpful in several projects. This approach can be helpful when it is difficult to access a target group (e.g. individuals with dementia) and when it is necessary to build a more durable relationship with participants. In the *NATALIE* project, the first iteration in one of the design cases was even conducted with a single older adult.

BOX 3.7

VITA CUSHION: DIRECT INTERACTION BETWEEN RESEARCHER AND PARTICIPANTS USING A PROTOTYPE

Project: *Everyday Sounds of Dementia*

In the second study, the researchers wanted to explore the context of the care homes in which individuals with dementia live. They used the prototype VITA cushion to achieve this goal. The researcher explains how they focused on working directly with the individuals with dementia:

Figure 3.9: a research participant in interaction with the VITA cushion

Many evaluation studies are conducted by proxy: the caregivers use a prototype for a certain period and report on the use. This is biased because the success of the product is perceived from the perspective of the caregivers or within a care organization.

I entered a care home as a design researcher and was able to offer the VITA cushion directly to the person with dementia. I sat with this person and observed how they interacted with the cushion. This way, you find out things that you don't discover when you take only the perspective of the caregiver. Of course, we also add the other perspective. Beforehand, we did a workshop with caregivers about their views on the prototype, and we did exit interviews with them afterwards.

In *Everyday Sounds of Dementia*, the researchers also opted for a personal approach in all three studies. Box 3.7 describes how this worked out in the second study. The researcher explained how some insights about effect indications, about usability and about use experience can only come to light when researcher and participants interact directly with a prototype. In this way, the researcher can observe developments that a care professional would fail to notice or ones that a participant would not report. Building a relationship right from the start can be very useful when researchers need to work closely with the same individuals over a long period of time, as in longitudinal interviews or in co-design trajectories. The final study from *Everyday Sounds of Dementia* shows how a person-centered approach can be used throughout all phases and with a small set of participants. In that study, the researchers worked with three couples. Chapter 4 zooms in on various service-based ways of working and added value for research participants.

This personal approach also helps in framing the research for various domains. Publishing design research can be challenging, especially when researchers wish to reach an audience beyond the design field, for instance by publishing in health journals. The co-design approach can be particularly difficult to frame. A researcher on Everyday Sounds of Dementia noted, 'It is a challenge to let design research land in other domains. We describe a process from co-design to prototype to evaluation. Usually, we get the feedback that each of these steps is not thorough enough. Medical journals do not even see this as proper research! In the human-computer-interaction field, you see a lot of qualitative, often ethnographic studies, and many evaluation studies. Studies that take you along in such a co-creation process are not easy to find.' Emphasizing the person-centered approach helps to provide a frame because it is recognized in different domains.

CONCLUSIONS: MIXING METHODS

We find four successful ways of dealing with the differences between the various practices from now-oriented and future-oriented perspectives. We find them in several activities through the projects. In these combinations, appropriate use is made of the strengths of different areas of expertise, such as those of health and design and of research and practice. The four strategies are as follows: a sequential approach (first one, then the other), the integration of results, the integration of methods and a personal approach. The first can be recognized as a *multidisciplinary* approach, as described by Choi and Pak (2006). The second can be recognized as *interdisciplinary*, and the third as *transdisciplinary*. The personal approach can be applied to all levels of disciplinarity. The examples in this study show how different levels of disciplinarity can be found within a single project.

The sequential approach is mostly found in evaluations. They are mostly conducted sequentially, in line with the work of Blandford and colleagues (2018). Evaluations that are aimed

at gaining indications of effect, usability and use experience provide rich information at an early stage. For a full-blown effect study, the prototype needs to be in a more final form and not in the development phase. In some cases, a combination is found.

The integration of shared results is found in user research and design activities. The combination of different types of evidence is a prominent challenge. Along similar lines, Austin and colleagues (2020) suggest four strategies for combining evidence-based and experience-based inputs. When the requirements for a specific design appear to be conflicting, the options are to satisfy one need but not the other (selecting), to retain multiple options in the design (combining), to design a new and coherent functionality that serves both needs (integrating) and to redefine perspectives (reframing).

We found examples of the integration of methods and a *transdisciplinary* approach in every project phase. In several projects, researchers combined methods to conduct user research and to analyze findings together. Finding a method that both parties are comfortable with requires some effort.

Overall, taking a personal approach is a recurring strategy in which design and health researchers find each other. The N=1 (or N=low) approach is not very popular in design research, but it was found to be helpful in several projects. This approach also resonates with the values of each domain. Smeenk and colleagues (2022) provide a tool for operationalizing this perspective, the empathy compass. Insights about working with a small number of participants in times of social distancing (due to Covid) are described in a white paper by Godfroij et al. (2020).

Finally, it is important that research partners discuss the various methods, because methods, particularly in the design domain, are not clearly defined (Sanders, 2008). Such discussions help to understand what the methods entail better as well as to identify means of combining them.

Table 3.2 summarizes the main insights, the ways to mix methods that we found in the projects and the relevant literature. The following section focuses on the role of prototypes within these methods.

MIXING METHODS			
TOPIC	INSIGHT	LITERATURE	BEST PRACTICE FROM THE PROJECTS
Mixing methods in all phases	Mixing methods is mixing perspectives	Differences between human-computer interaction and healthcare (Blandford et al., 2018); interpretations of methods (Sanders, 2008); future orientation of design (Koskinen et al., 2011); levels of working with multiple disciplines (Choi & Pak, 2006).	• Discuss the difference between a future-oriented and a now-oriented perspective to facilitate discussion about strategies for addressing them.
Grounding in both evidence and experience	Grounding in both literature and user research is a challenge and requires the active participation of both disciplines.	Challenges in identifying user needs and development (Groeneveld et al., 2019; Van der Lugt & Van der Laan, 2017); combination strategies: selecting, combining, integrating or reframing the bottom-up and top-down evidence (Austin et al., 2020).	• Interdisciplinary integration of results, for instance through a ping-pong approach (example of DDD). • Transdisciplinary integration of methods, for instance by preparing and conducting interviews, co-design sessions and analysis sessions jointly.
Different forms of evaluation	Health research aims to produce effect studies; design research is aimed at effect indications and insights on usability and use experience.	Differences between human-computer interaction and healthcare (Blandford et al., 2018).	• A multidisciplinary and sequential approach (preferably with a warm handover): first qualitative evaluations of indications of effect, usability, use experience and RCT as follow-up effect study. • Transdisciplinary integration of methods: combining a study of effects and of quality of interaction.
Personal approach	Some insights can only come to light when researcher and participants engage in direct and personal interactions.	Empathy compass (Smeenk et al, 2022).	• A personal approach when researchers need to work closely with the same individuals over a longer period of time, as in longitudinal interviews or in co-design trajectories.

Table 3.2: Insights on ways to mix methods in eHealth projects. Emergent practices from the projects and references to the relevant literature are added.

3.5 PROTOTYPES WITH VARIOUS FUNCTIONS

"FOR US, PROTOTYPES ARE FOREMOST RESEARCH MEANS. WE CALL THEM ARTIFACTS, PROBES OR PROTOTYPES..."

-RESEARCHER, DDD

The previous sections have already shown that artifacts and prototypes play a central part in these projects. This section zooms in on this variety of prototypes. Three different types, which have different purposes, can be distinguished: products as solutions, research artifacts and proofs of concept. We found that each type requires a different way of working.

DIFFERENT PURPOSES OF PROTOTYPES

When it comes to the results of some projects, the eventual development of a specific product or technology as a solution to a practice problem is of primary importance. The virtual agent in the *PACO* project provides one example, and the VR environment in the *Growing Roots* project provides another. These types of prototypes are meant to be delivered as products that will eventually produce a *solution* to the practice problem. The idea is that these products, being solutions, will eventually be developed into functioning and market-ready products. Development into market-ready projects takes time. Researchers on the *Everyday Sounds of Dementia* project described the VITA cushion as a previously developed research product, and they explained how it is different from an actual commercial product: *'There is no company, no production chain, no service model. But we have used it now for over two years.'* The actual market rollout of a final prototype is certainly the goal of the long-term innovation path, but it is often not attained within the timeframe of a research project. Sometimes, achieving the outcome in question requires several consecutive projects. In the projects that are presented in this book, the focus is on thorough theory development to ground the final product or technology. For instance, the key question in the *PACO* project is whether the digital virtual agent leads to behavioral change.

In other projects, prototypes have the primarily goal of enabling a phenomenon to be studied and are used to trigger responses and interactions. We call these *research artifacts*. The *Healthy Storytelling* project and *Everyday Sounds of Dementia* supply salient examples of such research artifacts. In these projects, these artifacts are used to study the respective

phenomena of the role of storytelling in discussions of obesity, and the relationship between sound and wellbeing. Other examples are the GameBus app in *GOAL* and some of the prototypes in *FoodSampler.* In the latter project, several research artifacts were intended as means of gathering knowledge about a specific aspect of an interaction through the use of a monitoring device, which is described in Box 3.8. The resulting design proposals often incorporate knowledge that is hard to convey exclusively through words. That is why in some cases, these prototypes are used as *demonstrators* to communicate with an audience that is outside of the project.

BOX 3.8

EXPERIENTIAL PROTOTYPES

Project: *FoodSampler*

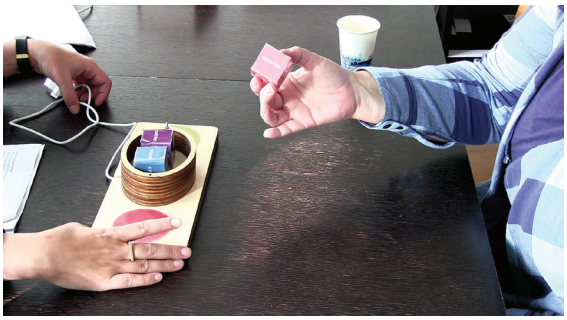


Figure 3.10: one of the research participants in interaction with an experiential prototype in a lab setting.

An initial framework was developed early in the project. This framework included the contextual factors that influence dietary behavior and the specific needs of overweight and obese individuals regarding the way they report about dietary behavior.

Several prototypes were developed in one of the explorative studies. The prototypes all address very specific aspects of the framework. The researcher explained, *'Two prototypes explore the concept of engagement, another one the concept of efficiency, another does a bit of both. So, we're understanding different aspects of this idea of efficiency and engagement.'*

The prototypes were described as experiential prototypes. The term 'experiential' means that they are mock-ups, developed purely to study an interaction. The researchers use them in lab studies and as video demonstrators, in combination with narratives, to provide context.

This approach also determined the scope of the analysis of the results from the user research. This research was not aimed at identifying requirements for a specific product but at finding out which themes were relevant to the exploration: '*The main goal of this analysis was to extract the themes we wanted to bring into the design interventions.*'

To complicate matters, some prototypes start out as *research artifacts* but end up as *products as solutions*. Some of them receive such a warm welcome by practitioners that they decide to develop them further as products. The Torries from *Healthy Storytelling* were intended as research artifacts to be used at primary schools within the context of the study. The municipality expressed considerable interest in them. As a result, they may be developed further as a tool to reach parents and children and inform them about the topic of healthy eating. Of course, researchers are pleased by this interest, but they have limited opportunities to engage in further development. Living Moments from *DDD* is another example of a research artifact that might become a product.

In some cases, prototypes are meant to demonstrate the feasibility of certain technologies or methods or of the opportunities that they create. These are indicated to be *proofs of concept* or *technology sketches*. The prototype Tumbler in *Everyday Sounds of Dementia* is an example of this tendency. The prototype demonstrates the opportunities for everyday sounds and design in home environments. One of the researchers explains, '*I would call it a technology sketch. It is a first manifestation of the insights that we gained during an intensive co-design process.*' In this case, the insights concern the ways in which social activities can be used to explore selfhood and identity. In the project *Track, Trace, Trigger,* a technology sketch was developed to visualize the concept of novel and unobtrusive at-home monitoring technology. This project investigates the possibilities of using unobtrusive monitoring to support older adults who live independently as well as their caregivers. In this early stage of the innovation path, developing a product proposal would be immature. One of the researchers said that they were glad that the call did not require 'jumping to solutions' and that it provided an opportunity for thorough investigation. The project followed two parallel paths. One explored the aspects of daily life that can be measured accurately by using unobtrusive tracing technology; the other inquired what potential users need and how they would perceive and accept the technology.

The technology sketch serves as an input for studies of the target group. However, it was not meant as a solution because the insights from the user research had not yet been integrated.

DIFFERENT PROTOTYPE FUNCTIONS REQUIRE DIFFERENT WAYS OF WORKING

Developing eHealth solutions often requires work with digital prototypes. It takes expertise and effort to develop such prototypes, especially eHealth prototypes, which require much technology in forms such as apps and platforms. Projects often combine the expertise of researchers and practice partners to facilitate prototyping. We find different ways of working to be appropriate for different types of prototypes: three ways of working are appropriate for developing *research artifacts*, and one way of working is appropriate for developing prototypes into *products as solutions*.

First, researchers can develop new, quick-and-dirty and low-fi prototypes as research artifacts. These allow for easy, quick and local adaptations. Such adaptations can work well when researchers need to study an aspect of a particular phenomenon, as in the *FoodSampler* lab studies that involved experiential prototypes.

Researchers can also develop high-fi working prototypes as research artifacts. This development can produce better insights, especially when research is conducted in the real-life-practice context in order to understand the broader setting of an experience. The prototype Living Moments in *DDD* is an example. A design researcher states, '*Quick-and-dirty prototyping is often used in co-design, while a working prototype provides more in-depth insights in the experiences at the time of use.*' A partner with extensive design expertise is needed to develop such prototypes. This individual should be either a design researcher or a practice partner from industry. In the *Healthy Storytelling* project, the design-practice partner took an active role in the development of the Torries as part of the second main study. Professional design agencies provide the expertise that is necessary to develop a solution that is genuinely useful and practically feasible.

Using existing prototypes or products (digital or physical) can save effort and time in design. The VITA cushion that was used in *Everyday Sounds of Dementia* (Figure 3.9) provides an example. In the *GOAL* project, an existing eHealth platform, GameBus, was used as a basis. The researcher explained, *'I am quite happy that we did that, that we did not start from scratch. We kept adding creative ideas to this platform and evaluating these. That was the continuous cycle: learning from this, which triggers new ideas, implementing these in the platform, see what it does. Does it work, how does it help? Learn and adapt.'* Using existing products can also prove difficult. In the *NATALIE* project, the aim was to conduct research with an existing eHealth product. As in the *FoodSampler* project, using an existing platform made it difficult to introduce the quick adaptations and explorations that were intended. A researcher on the *NATALIE* project explained, '*We thought that we would be able to*

prototype in a very agile and flexible way with an existing product, but this turned out to be harder than we thought. This is really a clash with how creative industry works, especially with things that are up and running. That is why we used more rudimentary and easily changeable prototypes in the end.' Students and design researchers developed these early and explorative low-tech iterations of *FoodSampler.*

In some cases, researchers work with a practice partner from industry that has a vested interest in the eventual product. In the Growing Roots project, the design-practice partner (a game developer) was involved in the continuous adaptation and finetuning of the VR environment throughout the project (Box 3.9). As illustrated by this example, such partners do not necessarily implement the particular prototype in question as a product, but they can use its elements in similar products. The PACO project followed a similar approach, in that an R&D company was involved in the long-term development of the virtual agent. The expertise and the facilities of these professional technology developers contributed to a digital platform that provided a stable basis for the research. In Everyday Sounds of Dementia, the researchers sought the light involvement of various partners from the design industry who had similar products. They hosted a few sessions with these partners, and their advice helped to improve the prototype that was used within the research project. At the same time, the sessions were used to share insights from the project with these practice partners.

ADAPTING AND FINETUNING THE VR ENVIRONMENT

BOX 3.9

Project: *Growing Roots*

This project focused on the creation of a virtual nature environment. The researchers had the goal to develop an evidence-based environment, which inspires feelings of connectedness and stimulates social contact amongst frail elderly.

Figure 3.11: research participants with the virtual nature environment.

A game development company was involved in the development of this VR environment. To fine-tune to the specific context, and to the specific needs of older adults, this environment had to facilitate dynamic adjustments so as to allow for quick iterations. The professional game developer was involved throughout the project in a continuous adapting and finetuning of the VR environment, based on the input from the researchers.

The design professional was especially interested in the focus of this project on building an evidence-base. In his practice of developing (serious) games within healthcare, he finds that is very important: *"That is the first thing healthcare clients ask for: evidence-base"*. He explains how he will not necessarily implement this particular VR environment as a product, but he can use elements of the developed content: "*This was a chance to develop an evidence-based mechanic that we can seamlessly implement in other games and VR environments that we make*". This is also of interest for a broader design practice audience.

CONCLUSIONS: THE ROLE OF PROTOTYPES

Working with prototypes is characteristic of the ways of working that predominate in the creative domain. Making tangible things can facilitate shared understanding considerably, but it can also lead to confusion. Partners from other domains are familiar with prototypes as first versions of eventual products. However, prototypes have other functions, such as the elicitation of responses and interactions. We showed how a single project can involve prototypes with different purposes and how these different purposes require different ways of working.

It is important to discuss the purpose of the prototypes in the project, especially when working with high-fi prototypes and practice partners. Will a care institution end up with a working solution for their local situation? Can the high-fidelity prototype that their clients love stay with them? For funding parties, it is important to recognize the need to work with an existing platform or product and to facilitate involvement.

Table 3.3 summarizes the main insights, the ways to deal with the prototypes that we identified in the projects and the relevant literature. The next section focuses on the final theme, namely the manner in which projects are iterated.

THE ROLE OF PROTOTYPES			
TOPIC	INSIGHT	LITERATURE	PRACTICE FROM THE PROJECTS
Prototype functions	• Prototypes can have different functions, which require different ways of working. Differentiate between: • Product as a solution: to develop (eventually) into functioning and market-ready products; • Research artifact: to study a phenomenon and to trigger responses and interactions *"a prototype to explore the concept of engagement, another one the concept of efficiency";* • Technology sketch: to demonstrate the feasibility of certain technologies or methods and the opportunities that they create *"It is a first manifestation of the insights that we gained".*	• Prototypes in RtD (Stappers & Giaccardi, 2017); prototyping as a means of inquiry (Wensveen & Matthews, 2015); prototyping to cross boundaries (Reay et al., 2017).	To study a phenomenon with a *research artifact:* • Develop new, quick-and-dirty and low-fi prototypes *"we used more rudimentary and easily changeable prototypes in the end"* • Develop a high-fi working prototype *"a working prototype provides more in-depth insights in the experiences at the time of use"* • Use existing prototypes or products if they allow for quick adaptations *"We kept adding creative ideas to this platform and evaluate these"* To develop successive and incremental versions of an eventual *product as solution:* • Work with partner from industry with a vested interest in the product/platform

Table 3.3: Insights on ways of dealing with the role of prototypes in eHealth projects. Emergent practices from the projects and references to the relevant literature are added.

3.6 ITERATIONS AND THE RESEARCH PATH OVER TIME

"THE STRENGTH OF DESIGNERS IS THAT THEY WORK ITERATIVELY: LEARNING FASTER BY MAKING MISTAKES FASTER. THIS WAY, YOU PROCEED MUCH FASTER."

-DESIGN RESEARCHER

The previous sections described how the project partners work towards the various goals, how they mix methods along the way and how they use various types of prototypes. The path that they take while doing this always exhibits some features of iterative processes. In Chapter 2, these research paths were depicted in a simplified manner and as fairly linear. As we zoom in on them in this section, the different types of iteration become clearer. We show how these differences are related to the different types of evidence that are sought and to the way in which activities move between the three contexts.

DIFFERENT GOALS REQUIRE DIFFERENT ITERATIVE PATHS

In the projects, we found two main ways of iterating. The first is the iterative development of a specific eHealth innovation that is evidence based. The second is the iterative process of filling a conceptual framework through design explorations.

Several projects focused on the development of a specific eHealth innovation. A single design case was central throughout those projects. *Growing Roots*, in which a VR environment for older adults was developed, provides an example, as does the *PACO* project, which aimed to produce a virtual dietary behavior coach for older adults. The iterative process in *PACO* is outlined in Figure 3.12. The prototype that was developed during the project can be seen as a *product as a solution* (see Section 3.5): a prototype that is created with an eye on eventual development into a specific product or technology. In particular, this approach is used in projects that are led by researchers from healthcare or the behavioral sciences who aim to develop evidence-based interventions. Integrating the insights from user research as well as from scientific evidence into the development process (see Section 3.3) is a matter of particular concern in projects that pursue such goals. This problem is addressed through the iterative process.

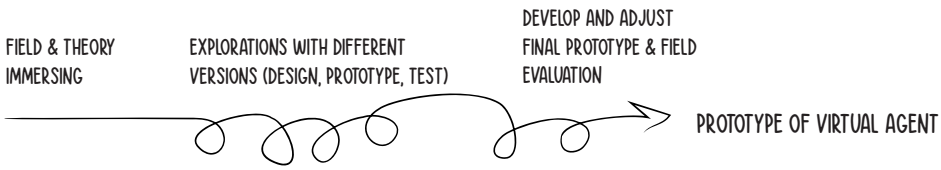


Figure 3.12: The iterative pathway of the PACO project, in which a virtual agent was developed.

In other projects, an iterative approach is used not only at the product level but also at the theory level. Design cases function as iterations or loops through which a theoretical framework is gradually developed. In the *Healthy Storytelling* project, the design iterations are intended to explore a storytelling approach to design (see Figure 3.13). Both of the two main design cases are iterations that develop this framework. The prototypes in these studies are primarily *research artifacts* (see Section 3.5) that purport to trigger responses and interactions. Since both were received favorably in the practice context, they might also evolve into actual products. The spin-off project *Dikke Onzin* ('Fat Nonsense') was directed more towards a product as a solution, in the form of a website for overweight individuals. Each design case also entails the use of an iterative process to arrive at prototypes. This type of iterative approach is also used in several other projects that are led by design researchers. These projects are particularly unpredictable and difficult to plan. A researcher explains, '*It's an iterative process in which ends and means alternate. So, you need to check every couple of months. Where am I? Can I go to the next phase? This is more difficult to manage than a tight evaluation study.*'

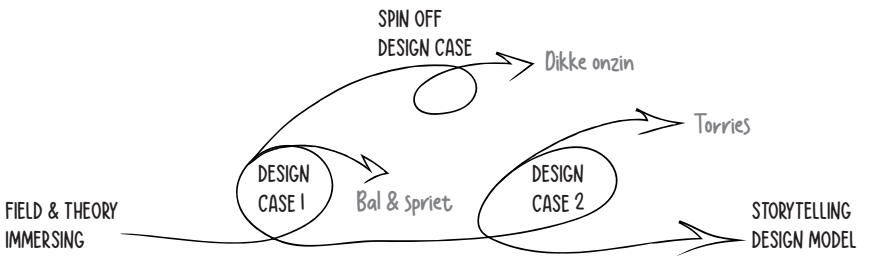


Figure 3.13: The iterative pathway of the Healthy Storytelling project, in which a storytelling design model was developed.

MOVING BETWEEN THREE CONTEXTS

These two different ways of iterating also entail different ways of moving between the three contexts of theory, concepts and real-life practice. We illustrate this by using the 3x3 matrix of the RPM. The first type of iteration, which is directed towards evidence-based innovation, is depicted on the left-hand side of Figure 3.14. The iteration is aimed at developing a prototype that is grounded in both theory and practice. This prototype is tested thoroughly, preferably in a real-life-practice context. The iterations loosely follow a pattern whereby the movement is from theory through concepts to practice. The other type of iteration starts with a theoretical framework. Explorations can take place in various contexts and always lead to conclusions that are related to the framework. This pattern alternates between various contexts but always loops back to the theoretical one.

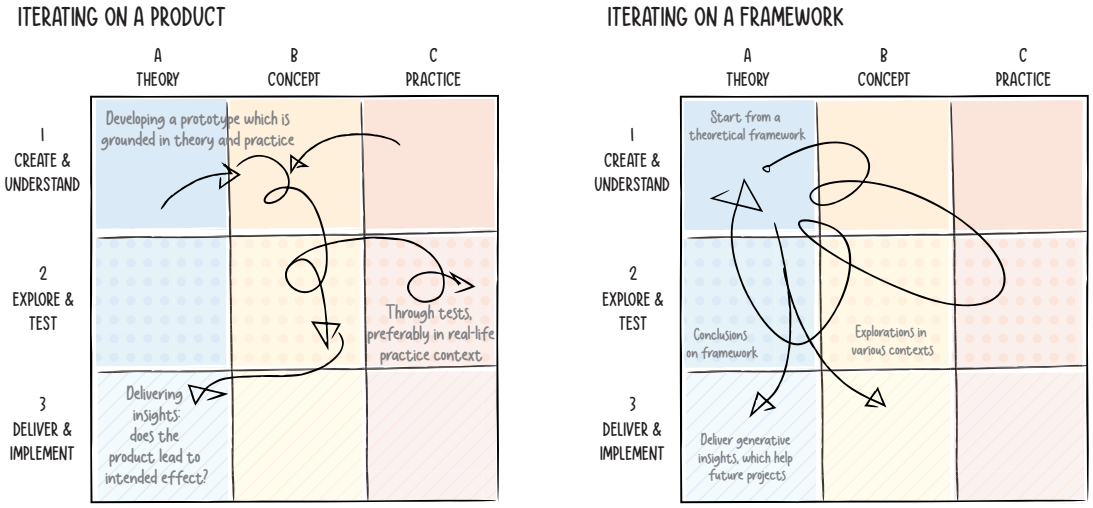


Figure 3.14: Two ways of iterating and moving between contexts. Left: iterations that are aimed at developing a testable prototype, which is evaluated favorably in practice context but sometimes in a conceptual context. Right: iterations that start from a theoretical framework, whereby explorations from various contexts produce conclusions that are relevant to the framework.

The timelines in Chapter 2 also show that, as far as these contexts are concerned, every study has a different orientation. The representations of some studies are replete with yellow dots (the conceptual context), whereas others contain more red dots (real-life practice).

Sometimes, researchers can start engaging with real-life practice early. The project NATALIE, in which researchers worked with existing client-communication software, provides an example. The Everyday Sounds of Dementia project supplies an illustration of the different orientations of the three studies (see Box 3.10). In each study, choices were made for various reasons. Such choices depend on goals as well as on opportunities.

STUDYING SOUNDS AND DEMENTIA IN VARIOUS CONTEXTS

BOX 3.10

Project: *Everyday Sounds of Dementia*

The project is oriented towards developing knowledge about the relationship between sounds and dementia. The project consists of three studies that have different orientations.

1. *The Soundboard* was developed to study a theoretical concept and concerns the theoretical and conceptual contexts. *The Soundboard* was used as research artifact, in focus groups and in workshops.

2. The second study has a sharper focus on practice. The researchers used the VITA cushion in the care-home context. The co-design sessions that explored how the cushion could be used in that context took place in a conceptual setting.

3. The third study, *Tumbler*, focuses on opening a solution space, that is, on exploring how solutions can be developed in close contact with individuals who have dementia. To this end, the research took place in a real-life-practice context, that is, in the homes of individuals. In this case, both development and testing took place in a real-life practice context.

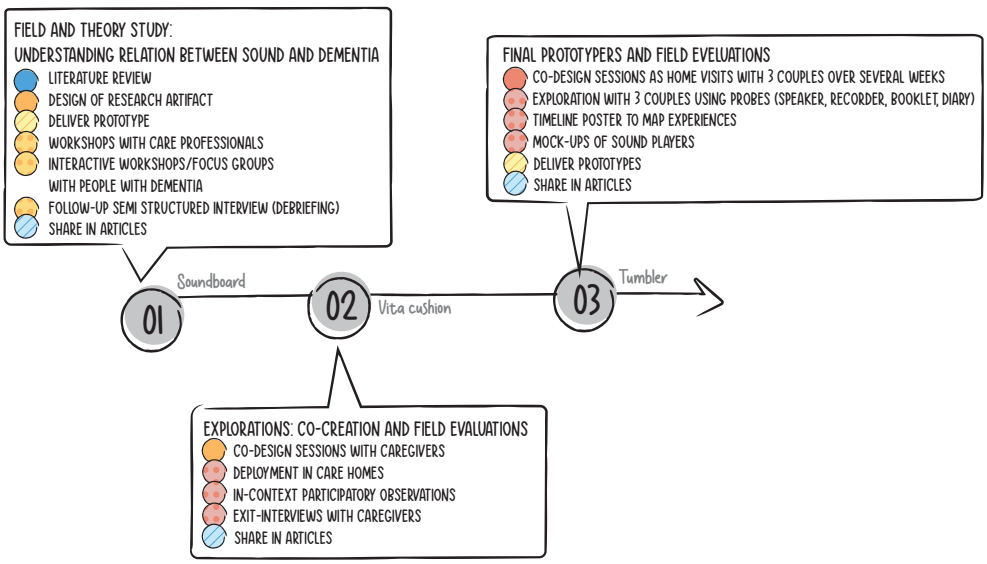


Figure 3.15: Timeline of the Everyday Sounds of Dementia project, in which the colored dots depict the various contexts in which the activities took place. The first study is directed primary at the conceptual (yellow) context. The other two studies are directed chiefly at the real-life-practice (red) context.

In some cases, studies run in parallel because each calls for work in a different context. This held true in the *Track, Trace, Trigger* project. The researchers planned parallel engineering and qualitative user-oriented studies from the start. The technical study concerned the theoretical context, with tests and development in a laboratory setting. The qualitative study, conversely, unfolded in the conceptual and real-life-practice realms.

CONCLUSIONS: RESEARCH PATHWAYS OVER TIME

Iterating is characteristic of design research, and we find evidence of this proposition in all of the projects. There are different ways of iterating. The examples show how different goals require different ways of iterating. The RPM helps to show these differences because we can map the manner in which the research pathways operate differently across the three contexts. We find two main pathways, which are both non-linear processes of moving between the three contexts. The first way entails the iterative development of a specific evidence-based eHealth innovation. In this approach, we recognize both the design science approach and the evidence-based approach of healthcare studies. The other way is the iterative process of fleshing out a conceptual framework by conducting explorations in design, in line with the process described by Stappers and colleagues (2015). Section 3.2 showed how both health and design research are geared towards theory, although the types of theory differ. The two different approaches show that the term 'theory oriented' can also be operationalized in different ways.

Table 3.4 summarizes the main insights, the ways of iterating that we found in the projects and the relevant literature.

ITERATING: "WORK ITERATIVELY: LEARNING FASTER BY MAKING MISTAKES FASTER"			
TOPIC	INSIGHT	LITERATURE	PRACTICES FROM THE PROJECTS
Ways to build evidence over time	Different goals require different ways of iterating. There is always a non-linear process of moving between theory, concepts and practice.	Iterating in health vs HCI (Blandford et al., 2018); design and research interwoven in RtD (Stappers & Giaccardi, 2017; Zimmerman et al., 2007); agile approach in multidisciplinary healthcare innovation teams—agile process in design sprints (Hermsen et al, 2020); explorations with frameworks (Stappers et al., 2015).	• Explore a framework through open and explorative approach: iterating between theoretical, conceptual and practical context (to open solution space and develop theory; *"an iterative process in which ends and means alternate"*
			• Develop an evidence-based prototype iteratively that moves, roughly, from theory through concept to practice *"a chance to develop an evidence-based mechanic'"*

Table 3.4: Insights on ways of iterating in eHealth projects. Emergent practices from the projects and references to the relevant literature are added.

3.7 MAIN INSIGHTS

This chapter addressed the following research question: *how do the ways of working in eHealth research projects add value to the quality of the process?* We distinguished between several practices that can help to address the challenges in Create-Health collaborations, as identified by Blandford and colleagues (2018) or Groeneveld and colleagues (2019). These practices are organized in four themes. We found that Create-Health ways of working can be characterized by 1) a focus on theory, with a wide range of outputs for various audiences and, in light of these goals, by 2) various ways of working with prototypes, 3) method mixing in all phases and with different levels of disciplinarity and 4) an iterative research path over time.

The practices from each theme are presented in Figure 3.16. In the early stages of a project, research partners can discuss the four themes to create common understandings. They can use the overview of the emergent practices as an inspiration for their own efforts in innovation and research. Funding bodies can consider these topics when formulating criteria for

calls, when steering projects and when monitoring and assessing them as well as when they create opportunities for follow-up projects.

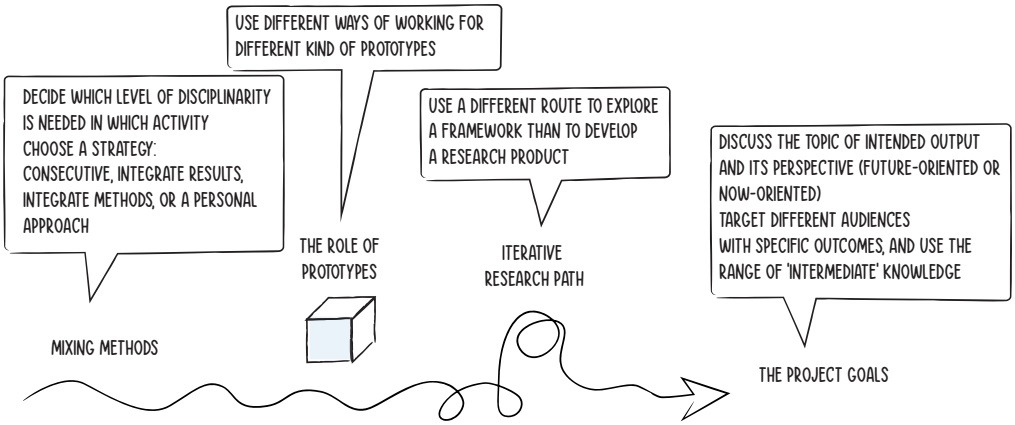


Figure 3.16: Tips on ways of working in eHealth projects that emerge from the four themes.

CREATE-HEALTH WAYS TO INVOLVE PEOPLE IN RESEARCH PROJECTS ON EHEALTH

WILKE VAN BEEST

"WITH A TARGET GROUP OF ELDERLY PEOPLE, YOU HAVE TO MAKE SURE THAT YOU INVOLVE THEM WITHOUT ASKING TOO MUCH OF ANYONE. IF YOU HAVE A TANGIBLE PROTOTYPE, IT COULD BE A GOOD TIME TO INVOLVE THESE OLDER ADULTS; BUT IF YOU DON'T HAVE THAT YET, IT MIGHT BE TOO ABSTRACT, AND IT COULD BE BETTER TO WORK WITH REPRESENTATIVES."

-TRACK, TRACE, TRIGGER PROJECT

4.1 INTRODUCTION

The Create-Health ways of working strongly emphasize the life experiences of those whom the innovation may affect. Therefore, the aim is often to involve the target group and other stakeholders in the research projects. Active collaboration with users in the innovation process supports the development and implementation of technologies that are suitable for the context and which are of high quality and of established value (Pagliari, 2007). There is evidence to suggest that the involvement and engagement of actors at an early stage of the innovation process leads to improvements in both healthcare practices and outcomes for the target group of patients (Boaz et al., 2018; Kok et al., 2016).

Early stakeholder involvement, interdisciplinary collaboration and business modeling are essential for the implementation of eHealth innovations (Pieterse et al., 2018). Stakeholder engagement is considered important. However, in healthcare, it is problematic in the early stages of innovation processes (Concannon et al., 2019). Creating long-term value in eHealth is often a complex task. All key stakeholders have to agree on and commit to a plan to create value with the eHealth application in the context of their own situations or interests, which is often problematic due to conflicting values (Geissbuhler, 2013).

Zooming in on the early stages of eHealth innovation processes and the role that research projects play in eHealth, a variety of studies have shown that the contributions and efforts of actors have to be taken into account (e.g. Kok & Schuit, 2012; Saapen & Van Drooge, 2011). At the same time, involving stakeholders from multiple disciplines and with disparate interests in eHealth research projects is challenging (Nielsen & Mathiassen, 2013; Van Limburg et al., 2015). Many research projects on eHealth are still monodisciplinary and expert driven, and the need to involve a diverse range of stakeholders is often neglected in practice (Pieterse et al., 2018). Moreover, even when stakeholders are involved in the early stages of an eHealth innovation processes, they are not always involved in setting the goals of the project, which would enable them to co-create value for themselves. Therefore, even if stakeholders are involved in research projects on eHealth, the question of when, how and in which role to involve them still poses challenges (Pieterse et al., 2018).

One specific aspect of co-creation has to do with the manner in which stakeholders can benefit directly from participating in activities in research projects on eHealth, besides the ultimate benefits of the implemented results of such innovation projects (Nicolas et al., 2019). Elderly individuals are mostly assumed to accept what designers and researchers offer to them, and it is therefore the tasks of designers and researchers to understand and meet their needs as participants who co-create (Peine et al., 2014; Sanders & Stappers, 2008). This chapter investigates the Create-Health ways of working that were adopted to involve the target group and other stakeholders in research projects on eHealth as well as the manner in which stakeholders can benefit directly from participating in project activities. It answers the following question: *how do the Create-Health ways of working create value for the target group and other stakeholders during their involvement in research projects?*

In research projects on eHealth, involving the target group and other stakeholders is often not straightforward. We studied the following dimensions in order to involve individuals in the 10 research projects of the Create-Health program:

- Ways to find and involve individuals who can participate and
- Ways to create value for the target group and other stakeholders when they participate.

The aim of this chapter is to find ways in which the research projects can be of value to actors who are involved in the process of co-creative research. Before we delve into the examples, which are drawn from the 10 research projects, we discuss the two themes from a theoretical perspective. We start with the theoretical perspective on ways to find and involve the target group and other stakeholders. Then, we discuss the value that is created for all stakeholders in research projects on eHealth.

4.2 THEORETICAL PERSPECTIVE ON THE TWO THEMES

Understanding how Create-Health ways of working can support the involvement of the target group and other stakeholders in research projects on eHealth and the manner in which stakeholders can benefit directly from participating in activities in such research projects requires two problems to be discussed. The first concerns the means of finding and involving the target group and other stakeholders into Create-Health and the research pathway of research projects on eHealth. Therefore, in Section 4.2.1, we investigate the theory of stakeholder participation. In Section 4.2.2, we discuss service-dominant (SD) logic as a way to rethink the role of researchers in creating value for everyone who is already involved in eHealth research projects.

4.2.1 STAKEHOLDER PARTICIPATION IN RESEARCH PROJECTS ON EHEALTH

In this section, we discuss the roles of the individuals who are involved in research projects on eHealth. The Create-Health program involved four types of stakeholders in each of the 10 projects: 1) research partners from the healthcare domain, 2) research partners from the design domain, 3) creative partners (at least one undertaking) and 4) representatives of the target group. There is a growing consensus among scholars that research-based innovation projects require an iterative process of interaction between scientists and stakeholders, which should entail reciprocity in terms of knowledge and experience (D'Este et al., 2018; Nijland et al., 2011). Therefore, it seems relevant to explain which stakeholders are important and what their various roles during the project are (D'Este et al. 2018).

The literature provides a few typologies of actors in healthcare. Several frameworks advocate a user-centered approach that focuses on the needs of two actors as end users of innovations, namely patients and healthcare professionals (Van Gemert-Pijnen et al., 2011). Other frameworks refer to a variety of actors in order to document the complex relationships between political, social, organizational and technical contexts in innovation (Van Gemert-Pijnen et al., 2011). The labels for actors that are used in the literature include 'patients,' 'healthcare professionals,' 'informal caregivers,' 'buyers,' 'sellers,' 'producers,' 'suppliers,' 'managers' and many other specific terms.

However, the use of these restrictive pre-assigned labels does not do justice to the complex and evolving nature of the healthcare context (Vargo et al., 2020). Therefore, Vargo and colleagues (2020) refer to stakeholders as 'actors' that provide services to each other. Vargo and colleagues (2020) provide a classification of these actors that is sensitive to their role in

the value exchange that service provision entails. They are thus classified as economic actors, social actors and beneficiary actors. This classification seems appropriate for research projects on eHealth, in which different complementary interests play a role (Pieterse et al., 2018). The health expert or professional may be associated with social actors. IT specialists, such as software and hardware developers as well as designers, may be associated with economic actors. The patient, their relatives and informal caregivers may be associated with beneficiary actors. Institutional arrangements may be connected to consortia, in which researchers work alongside different actors, but also with the wider system (e.g. the government or health insurance companies).

Beyond actor types, it is useful to account for the types of interactions that occur between actors and project. Actors can engage in the innovation process at different stages and to different degrees. Dewaele and colleagues (2021) argue that the more involved an actor, the more likely it is that the research-based innovation project will meet their needs, that it will be picked up and that it will have an impact. However, Merkel and Kucharski (2019) contend that full involvement is not always feasible and manageable. Therefore, researchers should ask themselves who to involve and when as well as how and why they should involve these actors. The target group of older individuals provides a salient example (Merkel & Kucharski, 2019). By asking these questions, researchers are able to identify the forms of interaction that are most suitable for a particular actor during specific phases of the research-based innovation project (Deweale et al., 2021).

Arnstein's 'ladder of participation' (1969) can be used as a tool for analyzing participation levels in the healthcare context (De Wit et al., 2015; Lemmens et al., 2015). Smits and colleagues (2020) make several adjustments on the basis of a narrative review so as to design a practical tool that is intended for research projects. Instead of 'levels,' they write about 'roles.' To emphasize the equality of the roles, they position the ladder horizontally rather than vertically and only include roles that involve working together on a project, which means that respondents (who are present without possessing any real understanding of the project) are excluded. The five roles are: listeners, who are given information; co-thinkers, who are asked to share their opinions; advisors, who provide (un)solicited advice; partners, who work as equals; and decision-makers, who take the initiative and/or make decisions (Smits et al., 2020).

In summary, we include three types of stakeholders that participate in research projects on eHealth: economic actors, social actors and beneficiary actors (Vargo et al., 2020). Researchers who coordinate research projects on eHealth should ask themselves whom they should involve from which of the three actor groups and when as well as how and why they should involve them (Merkel & Kucharski, 2019).

In Section 4.3, we delve into examples from the 10 projects to find ways to involve individuals in research projects on eHealth. However, we first discuss SD logic in Section 4.2.2. It provides a theoretical perspective that enables us to rethink the role of researchers in creating value for everyone who is already involved in research projects on eHealth.

4.2.2 SERVICE-DOMINANT LOGIC AS A WAY TO ADD VALUE FOR EVERYONE INVOLVED

Researchers can use the theory of service-dominant (SD) logic (Nicolas et al., 2019; Vargo & Lusch, 2004) to rethink the relationship between themselves, the actors and their role in research projects on eHealth. Vargo and Lusch (2004) introduce SD logic as an alternative to the theory of goods-dominant (GD) logic. In doing this, they propose a shift from a goods-centered model that focuses on the value that is created by the exchange of products towards a service-centered model. SD logic and the service-centered model assume that value is created during the performance and exchange of services, that is, the application of competences for the benefit of others, and which may—or may not—occur in tandem with the application of products (Vargo & Lusch 2004, 2008). Vargo and Lusch (2004) argue that when services are exchanged, value is always co-created rather than created and subsequently delivered by a single actor. The exchanges that take place between individuals who are involved in the project may unfold throughout the entire innovation process, from the idea phase to commercialization and beyond (Aarikka-Stenroos & Sandberg, 2012; Reypens et al., 2016).

Joiner and Lusch (2016) point out that GD logic dominates healthcare innovation, and its primary focus is still on the delivery of goods: '*GD logic as applied to healthcare is about nouns. Hospital rooms, outpatient clinics, medications, medical devices, medical images, laboratory tests, doctors, nurses, electronic health records, accountable care organizations, genomics, and on and on. SD logic is about verbs: healing, caring, monitoring, resting, walking, talking, eating, sleeping, visiting, learning, feeling, curing, thinking, sharing, recovering, and dying'* (Joiner & Lusch, 2016, p. 27). In the context of eHealth, for example, the GD logic focuses on tools rather than on the value that they create when they function. The language that is used in healthcare are in line with the values behind eHealth tools, such as preventing obesity, living at home for a longer time and reducing loneliness. These values are not applicable solely to the moment in which an eHealth tool is implemented in practice; they can also play a role in research-based innovation projects.

In particular, in innovation processes, such as research projects on eHealth, the term 'service' in SD refers to the way of working during an innovation process (Vargo & Lusch, 2016). Therefore, in this case, 'service' means the exchange of competences (knowledge, skills and

tools) during the process. The focus is not on the output of projects (Vargo et al., 2020). The SD logic thus emphasizes the application of knowledge and skills as well as of supportive products, artefacts or prototypes for the benefit of others, all in line with the values behind the project, in our case obesity, living at home with dementia for longer periods of time and reducing loneliness (Vargo & Lusch, 2004). Previous research has established that researchers and/or designers can play a role in the coordination of the co-creation process, in order to understand and meeting the needs of other actors in the process (Peine et al., 2014; Sanders & Stappers, 2008).

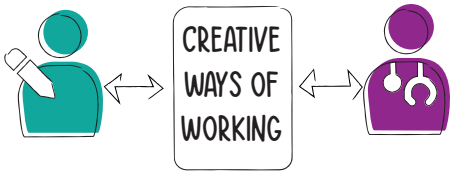


Figure 4.1: Exchange of knowledge, skills and tools between disciplines.

The theoretical perspectives on stakeholder involvement in eHealth research projects are summarized in Table 4.1.

RESEARCHERS SHOULD THINK OF WHO, WHEN, HOW AND WHY THEY SHOULD INVOLVE SPECIFIC ACTORS:	
SECTION 4.3 OF THIS CHAPTER:	
Who are involved:	• Creative industry partners • Health and welfare partners • The target group
In which specific research step in the research pathway (when)?	
How are they involved:	• Listener • Co-thinker, • Advisor • Partner • Decision maker
SECTION 4.4 OF THIS CHAPTER:	
	Why are they involved: the value for the actor involved

Table 4.1: Stakeholder involvement in research projects on eHealth.

As Table 1 shows, in Section 4.3, we explore examples from the 10 projects to find ways to involve individuals in eHealth research projects. Section 4.4 discusses ways to create value for those individuals.

4.3 WAYS TO RECRUIT INDIVIDUALS AND INVOLVE THEM IN PARTICIPATING

Several researchers from the 10 projects experienced the recruitment and involvement of participants from the target group as a difficult task, especially when it came to engaging members of the target group of the intended eHealth innovation, such as overweight individuals (especially those with a lower SES), individuals with dementia or individuals with feelings of loneliness. The example from the *PACO* project in Box 4.1 concerns attempts to approach such individuals.

BOX 4.1

ATTEMPTS TO APPROACH MEMBERS OF THE TARGET GROUP

Project: PACO

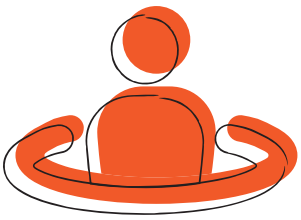
Figure 4.2: Co-creation session, PACO project

A researcher on the project explained that it had been difficult to find members of the target group, that is, individuals who want to lose weight: *'We tried to find people via various ways: via social media, we tried to find people… In some newspapers, we were allowed to publish a two-page article with a photo and all, and we had received a call list from the National Foundation for the Elderly for people who were open to research and whom we were allowed to call to ask if they wanted to participate. Via these diverse ways, thousands of people were contacted. In the end, it only resulted in 52 people who were actually registered. We really aimed for a minimum of 60, preferably 70, so that we could still correct for*

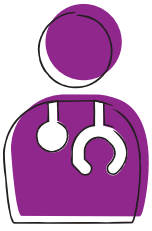
the dropouts during the research projects. So, we had hoped for more participants but were unable to find more. At a certain point, we also had to start the study, to prevent further delays.' Furthermore, not only was it often difficult to find members of the target group, it was also often difficult to keep the target group engaged during the research project, as in *PACO*: *'I found it remarkable that participants who participated in the co-creation session indicated what they would like to see in an application. We then developed this further, but then they no longer wanted to participate in the evaluation of the app.'*

In the example in Box 4.1, individuals were able to think about their needs and preferences for an application but did not want to be involved in the evaluation study for that application. In this section, we discuss ways to recruit individuals and ways to keep them involved in research projects on eHealth.

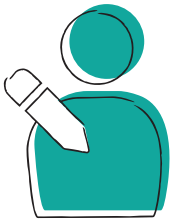
When we looked at the types of stakeholders within the 10 projects, we saw similarities and differences. In some projects, the primary researchers were all from the same single discipline (either health research or design research). Other core project teams encompassed a combination of disciplines. However, if we look at the three types of stakeholders that we saw as being theoretically necessary in research projects on eHealth (see Section 4.2.1), it is clear that they feature in all projects (also because the research call prescribes their involvement). We stated that there were three types of actors: economic actors (creative partners), social actors (healthcare or welfare organizations) and beneficiary actors (the target group, their relatives and/or informal caregivers). For ease of exposition, we retain the terms that were used in the ZonMw call and refer to the target group alongside their relatives and/or informal caregivers (beneficiary partners) as well as to healthcare and welfare organizations (social partners) and creative partners (economic partners), as in Figure 4. 3.



TARGET GROUP: PATIENTS, CLIENTS AND INFORMAL CAREGIVERS AS WELL AS CITIZENS OR REPRESENTATIVES OF TARGET GROUPS



HEALTH PARTNERS: HEALTHCARE ORGANIZATIONS, WELFARE PARTNERS AND MUNICIPALITIES



CREATIVE PARTNERS: PROFESSIONAL DESIGN AGENCIES, PROFESSIONAL TECHNOLOGICAL DEVELOPERS AND CREATIVE INDUSTRY PARTNERS

Figure 4. 3: Types of stakeholders in the 10 projects.

Returning to the roles identified by Smits and colleagues (2020), all of the researchers in the core teams of the 10 projects were decision-makers. Researchers (mostly professors) who hold roles on advisory boards or as supervisors of the PhDs who were involved were also engaged within the 10 project consortia. As discussed in Section 4.3.1, researchers who coordinate research projects on eHealth should ask themselves which of the three actor groups to involve and when as well as how and why they should involve them (Merkel & Kucharski, 2019). The choice of research methods and ways of working in the projects had several motivations, which involved specific actors (creative partners, healthcare and welfare organizations (including healthcare professionals), and the target group with their relatives and/or informal caregivers) in specific roles, namely as listeners, as co-thinkers, as advisors, as partners and as decision-makers. We use the RPM to map the specific actors and their roles in the research projects on eHealth.

As noted in Chapter 3, activities in all of the projects took place in all three contexts that the RPM distinguishes (see Table 4.2), namely the theoretical context, the conceptual context and the real-life-practice context. The colored dots on the timelines in Chapter 2 are related to these contexts (blue=theory, orange=conceptual and red=practice). In the actor maps in Chapter 2, actors are also placed in these contexts. Mapping the actors by reference to the RPM (Van Beest et al., 2021) provides insights into the questions of who should be involved in research steps and in certain contexts as well as when and how they should be involved. To understand the reasons for involving the target group and stakeholders in certain research steps, we discuss how members of the target group and other stakeholders were recruited and engaged in the projects for each research context.

	THEORETICAL CONTEXT	CONCEPTUAL CONTEXT	REAL-LIFE PRACTICE CONTEXT
CREATE & UNDERSTAND	Create theoretical understanding Methods e.g.: • Desk research • Modeling • Literature review • Expert panel • Delphi study	Create concept Methods e.g.: • Focus groups • Co-creation sessions • Co-design sessions • Design interviews	Create understanding of real-life practice Methods e.g.: • Interviews • Observations • Mood reporting • Diaries • Surveys
EXPLORE & TEST	Explore or test theory or concept in controlled environment Methods e.g.: • Lab tests • Observations • Activity tracking • Data monitoring	Explore or test a prototype Methods e.g.: • Pilots • Co-design sessions	Explore or test solution in real-life practice context Methods e.g.: • Observations • Activity tracking • Data monitoring • RCT
DELIVER & IMPLEMENT	Deliver theory or knowledge Methods e.g.: • Dissemination activities: conference contributions, papers, presentations • Guidelines • Knowledge building blocks	Deliver a prototype Methlods e.g.: • Prepare follow-up research • Deliver prototype to developer • Deliver algorithm to research team	Implement change in real-life-practice context Methods e.g.: • Data monitoring • Evaluation research • Change management

Table 4.2: RPM (Van Beest et al., 2021), supplemented with methods from Chapter 3

4.3.1 INVOLVEMENT IN THE THEORETICAL CONTEXT

The theoretical context of the RPM is about research activities, with a focus on theoretical concepts or on gaining, testing and/or sharing knowledge in a controlled environment (living lab research) or in a controlled manner (literature reviews, Delphi studies and publications). In general, the involvement of the target group and other stakeholders in the theoretical context is limited. As we explained in one of our earlier works, '*In the theoretical context the research is focused on creating, exploring and delivering a better understanding of problems and related propositions for solutions, which are advanced and not verified in practice yet*' (Van Beest et al., 2021, p. 9). When the goal of research is to find out more about the way a tool works or about its working mechanism, regardless of how the tool in question works in the actual environment, it could be helpful to conduct tests in a controlled setting first or to conduct literature research on possible working mechanisms. However, it is possible to involve stakeholders or research participants in the theoretical context, alongside the researcher, for example by engaging in joint analysis, by publishing or by engaging research participants in a living lab situation. Testing in a controlled environment (*'Explore a concept or a theory in a controlled environment')* with students or colleagues, for example, could be a suitable solution that avoids the need to disturb the target group in some cases. By explaining involvement in the theoretical context in relation to the 10 research projects on eHealth, we discussed the parties who were involved, the steps in which they were involved and the roles of the stakeholders and the participants in the research.

Who is involved in the theoretical context?

In most projects, both creative and health researchers were active in the theoretical context. In Chapter 5, we elaborate on the cooperation between these disciplines. In the *PACO* and *Healthy Storytelling* projects, the practice partner was also involved in theory development. In the *PACO* project, the practice partner was a research and development company. In that project (*PACO*), the representative of the target group was involved in theory development as well. In *Healthy Storytelling*, the practice partner was from the creative industry. In both projects, healthcare partners were not involved in the steps of the research that concerned the theoretical context. Some projects, such as *Track, Trace, Trigger* as well as *Growing Roots* and *FoodSampler,* involved students or young individuals in some research steps. In some cases, these individuals acted as representatives of the target group. Sometimes, this was done for practical reasons, say because the target group was difficult to reach. Sometimes, a conscious decision was made to have a conversation about future scenarios with younger target groups. These representatives of the target group were also involved in research activities that were related to this theoretical research context, such as lab tests and activity tracking.

In which steps are people Involved in the theoretical context?

In two projects (*Storytelling* and *PACO*), the practice partner was involved in research activities to create theoretical knowledge. The *PACO* project also involved a representative of the target group in this step. In this project, the representative of the target group, who was a PhD student, was co-authoring a paper on the research methodology of co-design.

BOX 4.2

TEST WITH REPRESENTATIVES OF THE TARGET GROUP

Project: *Growing Roots*

In the project *Growing Roots* the researchers were first looking for the mechanisms of the experience of nature in a VR environment as the researcher explained: *"In order to map the experience of nature, we were more looking for generalizable effects of that experience of nature in the VR environment, before we want to explore this with the aging population"*. In the project *Growing Roots* researchers deliberately chose for a representation of the target group in the theoretical context in which students or middle-aged people represent the target group in a living lab study or in online research settings. The prototype in figure 4.4 was used on a screen. The future VR environment will be part of the room as in figure 4.5, another experience which was not the focus in this phase of the research project.

Figure 4. 4: VR environment on a laptop screen

Figure 4. 5: VR environment in a room

Some projects involved the participants in the research step *'test or explore theory or a concept in a controlled environment.'* The reason for choosing to conduct research with the participants in the theoretical context is that the usability of the tool or concept (the potential scenario) should be tested by individuals from outside of the project team in order to understand more about the manner in which individuals in general experience future solutions, such as Wi-Fi monitoring. In some projects, the future scenario was too abstract for the target group, and the research was too fundamental, as in the example that is described in Box 4.2.

Depending on the research question, it was sometimes more helpful to test technologies, low-fidelity prototypes or mechanisms with a more neutral target group in the early phase of the eHealth innovation process. However, not all projects saved the target group for more fundamental questions. In the *Healthy Storytelling* project, a deliberate choice was made to conduct research with the intended users, with research methods adapted to the target group. It is unclear whether every type of research lends itself to target-group involvement. The requirements for evidence-based innovations in the healthcare context, when combined with ethical dilemmas, raise questions about the burden that is imposed on the target group.

In some of the projects, the creative partners had a role in the *'Deliver and Implement'* step. One example is the *Everyday Sounds of Dementia* project, which did not involve design-creative partners. Instead, creative practice was reached by the network partner who was responsible for dissemination.

The actors and the research methods are mapped onto the RPM in Table 4.3. In all projects, the researchers published research papers, guidelines and requirements. The target group and the other stakeholders were not involved in this step.

THEORETICAL CONTEXT		
Create theoretical understanding	ACTORS: Researchers and, in one project, a practice partner	Research activities or methods: scoping review, literature review, field and theory immersion
Create understanding of a theory or concept in a controlled environment	ACTORS: Researchers and, in three projects, representatives of the target group	Research activities or methods: living lab, machine learning, home-lab situation
Deliver theory or knowledge	ACTORS: Researchers, network partners, creative partner	Research activities or methods: delivering knowledge, building blocks, papers, conference visits, guidelines

Table 4.3: The theoretical context of the RPM

Role of individuals in the theoretical context

When we look at the role of stakeholders in the theoretical context, it becomes apparent that it differs with the type of stakeholder. Creative partners are involved in these research steps as partners in dissemination. Both the researcher and the practice partner have an interest in understanding theory. In the step *'Create understanding of a theory or concept in a controlled environment,'* the representatives of the target group are mainly involved as research participants.

4.3.2 INVOLVEMENT IN THE CONCEPTUAL CONTEXT

The conceptual context translates the presupposed solutions into a more specific prototype that is created, explored and made. In this context, researchers and other stakeholders provide (experiential or theoretical) knowledge to translate theory to prototype by themselves, together with the consortium and with or without the end users, but always in a protected niche such as a brainstorming room, a pilot environment or in the context of a pilot organization (Van Beest et al., 2021). The focus of the conceptual context is to understand needs, requirements and preferences about a technology. This was seen, for example, in the proposal for the *Growing Roots* project, which describes the main goal of the research: *'Based on staff and user feedback, aspects such as ease and type of interaction will be fine-tuned.'* The focus on the eHealth application could be partly explained by the specific demand of the funding agency for projects that work on creating the 'knowledge building blocks' that are needed to develop and/or implement eHealth applications. Similarly to Section 4.3.1.1, which concerns the theoretical context, we explain the involvement of individuals in the conceptual context, the steps in which they were involved and their roles in the 10 research projects on eHealth.

Who was involved in the conceptual context?

Creative researchers were active in the conceptual context of the projects in which they were involved. In four projects, the health researchers (who were mostly psychology oriented) were also active in the conceptual context. As mentioned previously, we elaborate on the cooperation between these disciplines in Chapter 5. All kinds of stakeholders, including the creative partners, healthcare and welfare organizations (including healthcare professionals) and the target group (alongside their relatives and/or informal caregivers) were involved in the conceptual context, as shown in Figure 4.6.

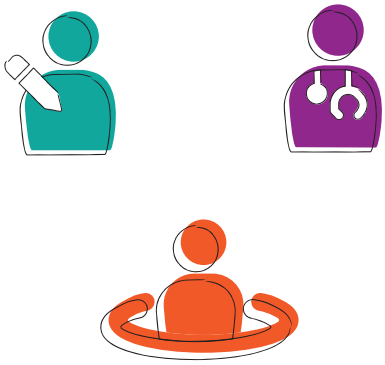


Figure 4.6: Stakeholders involved in the conceptual context, including creative partners, healthcare or welfare organizations (including healthcare professionals) and the target group (with their relatives and/or informal caregivers).

In which steps were individuals involved in the conceptual context?

In the contextual context, most creative partners were involved in the *'Create a concept'* research step (see Table 4.4). The healthcare or welfare organizations (including healthcare professionals) and the target group (with their relatives and/or informal caregivers) were also involved in this step as part of, among others, co-design sessions, interviews or focus groups. The creative partners were mostly involved in the development of prototypes. However, in the *FoodSampler* project, the collaboration with the creative partner focused on the development of design studies. The prototypes were meant as design artefacts that would generate knowledge (RtD) and therefore required flexible requirements and quick iterations. The university decided to develop the prototypes internally. Due to the ease of accessing the prototyping infrastructure and related resources, the university was more flexible in performing iterations than the creative partner. As a whole, the creative partners were largely not involved in the *'Explore and Test'* step and therefore had little interaction with the care partners, who were mainly involved in that step. In some of the projects, the creative partners had a role in the *'Deliver and Implement'* step.

CONCEPTUAL CONTEXT		
Create a concept	ACTORS: Researchers, target group, creative partners, healthcare and welfare organizations	Research activities or methods: Service design, technical design, interviews supported by the prototype, interviews to understand needs and preferences regarding a tool, co-design sessions, visualizing routines, sessions with experts on the solution, focus groups, contextual interviews, expert reviews, student design projects
Test or explore a concept	ACTORS: Researchers, target group, healthcare and welfare organizations	Research activities or methods: workshops with care professionals, workshops with the target group, use in pilot, usability study with target group, mock-up study
Deliver a concept	ACTOR: Researchers, creative partners	Research activities or methods: delivery of an algorithm, delivery of a prototype, working on follow-up project

Table 4.4: The conceptual context of the RPM

The practice partner in *DDD* was also involved in dissemination activities and in the delivery of a prototype. Initially, the aim of *DDD* was to deliver a low-fi prototype. However, COVID-19 restrictions resulted in one of the research artefacts being developed as a hi-fi prototype. The low-fi prototype required greater involvement on the part of the researchers because that prototype could not be used on its own—researchers had to be present.

However, this was not possible due to the COVID-19 contact restrictions. The project team decided to develop the prototype further so that individuals would be able to test it by themselves at home, without the researchers' help. In this case, conducting an iterative testing cycle with participants was not possible, so the step of delivering a prototype came earlier in the process. An application was also delivered in the *PACO* project, which was the basis of a new service that the practice partner would offer. The application will be developed further in the *PHArA-ON* project, in which it will be applied in practice. The practice partner will develop and implement the application on its own devices. The healthcare partners in some projects became enthusiastic and wanted to retain the prototype, with the support of practice-based research, in order to develop it further.

4.3.3 INVOLVEMENT IN THE REAL-LIFE-PRACTICE CONTEXT

The real-life-practice context concerns the setting in which researchers aim to understand the target group and its environment. Methods that have researchers observe the environment or conduct interviews aimed at understanding the target group are part of research on the real-life-practice context. In this type of research, tools or prototypes can be used as research artefacts or as RtD objects, but the 'thing' is mostly not intended to be developed further. The other methods that are applicable to this research context examine the functioning of a prototype or product in its intended environment, that is, the real-life-practice context. The issue is not whether an eHealth tool works but how it fits into the environment. A condition for this type of research is that the tool, process or intervention must have already been developed in such a way that practitioners can use it independently. Therefore, implementation research (or evaluation research) is also a part of the real-life-practice context. However, the 10 projects of the Create-Health program are aimed at delivering knowledge building blocks for the ultimate implementation of eHealth, not on implementing eHealth tools in the real-life-practice context.

Who was involved in the real-life-practice context?

In almost all of the projects, it emerged that it would be complicated to involve the target group. This was observed in respect of research activities in the conceptual context as well as in the real-life-practice context. It was complicated to involve the target group because topics such as obesity, dementia or a lower SES are delicate. An empathically non-judgmental tone and attitude are necessary during contact, which must be reflected in the research methods and in the design. A few projects revealed that flexibility is important for finding appropriate partners. In the *FoodSampler* project, researchers from the healthcare sector and end-user organizations that were partners of the project helped find healthcare professionals (mostly dietitians) and overweight individuals. The tendency to involve this target group and expert organizations and to work with them was helpful for finding the best individuals for the project.

COVID-19 made involving the target group, as well as healthcare and welfare organizations, in research projects more challenging. The challenges resulted from the burden on the healthcare sector and the need for social distancing. Since the healthcare sector was overloaded, there was less time to engage healthcare professionals, to recruit members of the target group and/or to facilitate the research project. In addition, many nursing homes, community centers and schools were closed. Therefore, the target groups of elderly and overweight individuals became more vulnerable.

In which steps were individuals involved in the real-life-practice context?

Several projects began by involving members of the target group in order to understand their needs and preferences about their situation and their views on the future. For example, in the *Track, Trace, Trigger* project, informal caregivers were consulted in interviews and through a survey (*'Create real-life understanding'*). Initially, the researchers would also carry out measurements in practice, but these could not continue due to COVID-19 and the resultant policies. In the *Healthy Storytelling* project, the researchers first built on their relationship with the target group and then invited them to co-creative sessions. As explained in Box 4.3, *'one could say that researchers' first step into the world of real-life practice is to understand the situation of the target group before they invited the target group into the world of concepts for a co-creative session.'*

BOX 4.3

FIRST STEP INTO THE WORLD OF REAL-LIFE PRACTICE BEFORE INVITING THE TARGET GROUP INTO THE WORLD OF CONCEPTS

Project: *Healthy Storytelling*

Researchers of the project Healthy Storytelling indicated that – in their case – involving people with a lower SES indication at individual level was stigmatising and it hindered the possibilities of contact with the target group. Therefore, they recommend that this criterion be applied mainly at the neighbourhood level and not at the individual level. An empathetic approach was essential to reach people of the target group*: "Before people from vulnerable groups can be included in co-creative sessions, it is first necessary to reach them. In this project we did this by building trust for a couple of weeks with the visitors of neighbourhood centres before introducing research methods."* In this example one could say that researchers first step into the world of real-life practice before they invited the target group into the world of concepts for a co-creative session.

Almost all projects involved the target group and healthcare partners in the research step *'Explore a solution in real-life practice'* (see Table 4.5), in which they would test a hi-fi prototype in the healthcare context together with the stakeholders associated with that specific context. The researchers on the *Track, Trace, Trigger* project took a different approach by involving different target groups at different points. The project began by engaging informal and formal caregivers (who also served as representatives of their loved ones or of clients with dementia). When the technological concept became more concrete, individuals with dementia and a broader group of relevant stakeholders were involved in focus groups and interviews, building on the previous steps: *'With a target group of older adults, you have to make sure that you involve them without asking too much of anyone. If you have a more concrete technology concept, it could be a good time to involve these more vulnerable group of people; but if you don't have that yet, it might be too abstract, and it could be better to work with representatives.'* The researchers acted in this manner on purpose because they knew from previous research that the timing of the involvement of end users and stakeholders is important. For instance, collecting the views of older adults on more concrete technological concepts often works better than asking them to envision abstract scenarios. However, the researchers did not choose to present a hi-fi prototype during the interviews and the focus groups because their goal was to enable participants to think beyond technical possibilities.

In the *Everyday Sounds of Dementia* project, the target group and the healthcare professionals were involved in the real-life-practice context (care homes). In the real-life-practice context, the researchers employed an existing product, which could be used by healthcare professionals and people with dementia. Both tools worked well during the research project and were appreciated by the intended end users, healthcare professionals and informal caregivers or relatives. However, in the real-life context, the participants did not always understand that there was no implemented product or implementation-ready solution yet.

REAL-LIFE-PRACTICE CONTEXT		
Create real-life understanding	ACTORS: Researchers, target group, healthcare and welfare organizations	Research activities or methods: surveys, longitudinal interviews, interviews, focus groups
Test or explore a solution in real-life practice	ACTORS: Researchers, target group, healthcare and welfare organizations	Research activities or methods: participatory observation, deployment in care homes, longitudinal testing at home, longitudinal field evaluation, testing research artefacts at schools, randomized controlled trials, evaluation research
Implement a solution in real-life practice	ACTOR: Researchers	Research activities or methods: mapping requirements for implementation, discussions with ethical committees of the EU, investigating possibilities for adaptations of laws and regulations

Table 4.5: The real-life practice context of the RPM

In this case, the real-life-practice context called for the implementation of a prototype, but the step of implementation was difficult to achieve and was therefore not pursued. As a researcher on the *Healthy Storytelling* project noted, *'The step from a demonstrator to a scalable product could not been taken in a few steps. We are now going to see whether it is possible to scale up on a small scale first, i.e. to 10 schools, maybe with an evaluation. Then, we need money, and [we] need someone who will carry out the evaluation. Then, we can apply for a quality mark from RIVM for the intervention, and then it could be scaled up much later afterwards, but then you do need parties that can manage it, and that is a bit of a problem.*' Although the transition from prototype to product is difficult (and therefore mostly not the intention of the researchers because of the focus on knowledge building blocks rather than end products), in some projects, such as *DDD*, the prototype was developed into a high-fidelity prototype that could be used by individuals (as we described in Section 4.3.2, p. 14) more rapidly than intended.

The implementation of products, services or processes was not the purpose of the projects. The set-up of the research call, for which researchers could submit applications, focused on knowledge building blocks *'for the purpose of developing fundamental knowledge – known as "knowledge building blocks" – on which to base the development or improvement and implementation of e-health applications which are intended to support the day-to-day functioning of people as they grow older, both now and in the near future*' (Research Call, p.14).

This resulted in various types of outcomes, ranging from theory and guidelines to prototypes (which we discussed in Section 3.3). In the *Track, Trace, Trigger* project, the researchers studied the conditions for implementation. This said, they were active in creating and understanding their solution and in testing technical possibilities in that phase of the project.

Role of individuals in the real-life-practice context

Many patients or clients are often no longer completely independent, which means that they were usually in the presence of another individual during data collection. This does not always work well, as observed in *Track, Trace, Trigger*: *'The subsidy provider advised us to include patients as well for the interviews, but it did not work in combination with the informal caregivers. Both do not really give their opinion about the situation in the presence of the other.'* In the *Everyday Sounds of Dementia* project, the combination of a client and an informal caregiver worked well during a workshop in which the client and the informal caregiver related sounds to memories. Nevertheless, it should be noted that, here too, the researchers had to prevent the informal caregiver from speaking for the individual with dementia. In this case, one could say that the individuals with dementia acted more as participants than as co-thinkers or listeners (Smits et al., 2021).

In the real-life practice context, the healthcare and welfare partners were involved in the research methods in which the target group was involved, as well as in participant recruitment and in facilitating the sessions. Some network partners, municipalities and target-group representatives were involved in the real-life-practice context by recruiting members of the target group.

4.3.4 INVOLVEMENT AS A LAYER IN THE RPM

The involvement of the target group and other stakeholders was recognized in the theoretical context, the conceptual context and the real-life-practice context. The target group was mostly involved in the steps *'Create a concept,' 'Explore a concept in a pilot,' 'Understanding real-life practice'* and *'Explore a solution in real-life practice.'* The healthcare and welfare partners were involved in the same research steps as the target group. The creative partners were mostly involved in the conceptual context. However, we saw that the creative partners, the healthcare partners and the target group were almost never involved together in co-design or other research activities (Figure 4.7).

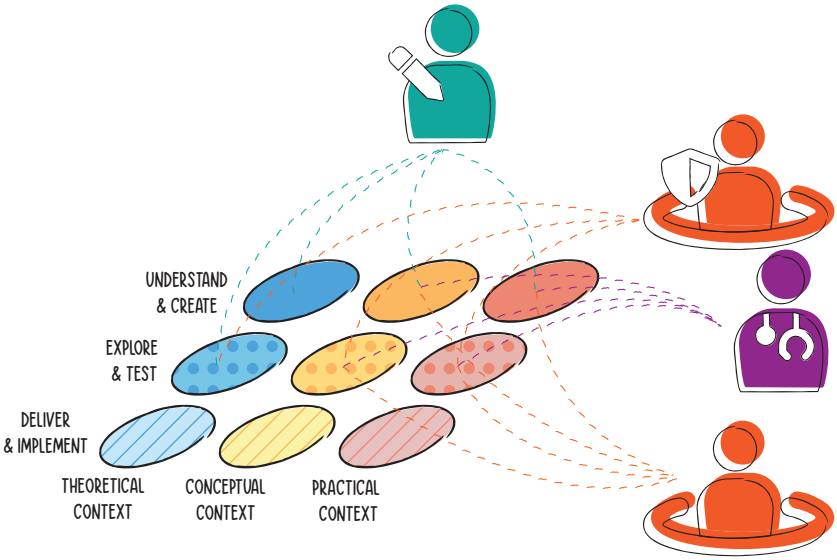


Figure 4.7: Involvement as a layer in the RPM.

In the next section, we delve into the role of researchers in creating value for everyone who is already involved in research projects on eHealth.

4.4 WAYS TO CREATE VALUE FOR THE TARGET GROUP AND OTHER STAKEHOLDERS WHEN THEY PARTICIPATE

The first part of our research was done in co-creation, and it was mainly about values. An application was to be developed about healthy eating, healthy living. How do you define these? Together with participants, who could be participants in that app, we formulated those values in co-creation. Therefore, of course, we needed participants, and asked the elderly fund to recruit these people. We wondered: in what kind of setting could we formulate those values? What would such a conversation look like? How can you discuss these values in a pleasant way for everyone? We thought it through carefully and opted for a rural setting at a location where food was used: at a farm with a tea garden. We made it a kind of relaxing trip in a pleasant environment. There, we interviewed the participants, had conversations. There was a lot of enthusiasm for that. We had enough registrations for this study; people wanted to participate in this (PACO project).

In this example, the researchers found a way to involve the target group in a manner that was pleasant for all involved actors. They found a way to create a reciprocal experience by

making individuals enthusiastic about the project activities, and they were able to formulate values together. We use the concept of SD logic (Vargo & Lusch, 2004, 2008, 2016) to analyze the manner in which research projects could create value for all stakeholders who are involved during a research project. In this way, we want to provide examples from the 10 research projects in which different stakeholders contributed and benefitted in such a way that the project was not just valuable for the researchers but also for everyone else who was involved.

From an SD-logic perspective, one could argue that the project in the example above integrated end values into a way of working. The project aims to change dietary behavior among older adults. By talking to individuals about their own values of healthy eating and healthy living, they were made to think about their dietary behavior, which is what the final app that the research project is intended to yield aims to do. For the research participants, participation in the study therefore also contributed to their healthy ageing independently of the eHealth application, which is being developed and may be implemented. This section explains why individuals would become involved in research projects on eHealth and why they would like to be so involved.

4.4.1 VALUES IN CREATE-HEALTH WAYS OF WORKING FOR THE TARGET GROUP

The projects involved the target group in data collection or in value co-creation. Some researchers chose research methods so that they would meet the needs of the participants directly. For example, some projects (like *DDD)* involved building a relationship deliberately in order to be able to conduct longitudinal interviews. Others opted for means of creating a comfortable environment, such as the *PACO* project in the example at the beginning of Section 4.4. Likewise, the project leader of a loneliness prevention project (*SQUEALED*) invited the elderly for coffee breaks, in which there was time to talk and to get comfortable: *'the first step is that the elderly receives a letter inviting them for a meeting with coffee and cake.'* In the example of *SQUEALED*, the researchers contributed to loneliness prevention by opting for a welcoming approach during interviews. We identify the interview method as a preferred way of working in projects that involve collaboration with the elderly as a target group. For example, in *Track, Trace, Trigger*, *'one of the lessons learned for us as researchers, was that an "old-school" interview worked the best for this target group. They want to talk about their experiences, their lives, and it brings us a lot of rich information.'* Exchanging values in an interview setting is recognized as a means of sharing experiential knowledge and of enacting the values that underlie the project, namely to prevent loneliness and/or to promote healthy ageing.
Personal contact between researchers and participants was also seen as an important means of involving the target group. The *PACO* project team concluded that personal contact

with participants (especially older ones) was very important for the smooth running of the study: *'during the evaluation study, for example, we called all participants after they had created an account to ask if everything was clear. This solved many problems, but also any miscommunication. We also made video messages, which were much appreciated.'* This example shows that the role of researchers in understanding and meeting the needs of actors was important not only during research activities but also before they had begun and after they had concluded. This example is in line with Vargo and Lusch's (2004, 2016) service concept, which is not about a product, a service or the execution of a method but about an entire process.

All these examples of value exchange with a view to meeting the needs of participants are related to service ways of working, that is, to interactions in which valuable contributions and benefits are produced with and for everyone who is involved. However, not all research methods are conductive to the attainment of this goal. Suitability seems to vary with the type of actor. In *Track, Trace, Trigger*, using surveys of informal caregivers to find out about their issues was perceived to work well. In *Growing Roots*, the use of a survey of elderly individuals was counterproductive. The elderly participants found it difficult to complete the questionnaire, and it disturbed them. In this particular example, one could say that value exchange was absent. As a result, the research team adjusted its strategy and adopted a service way of working by serving coffee and supporting an activity at the healthcare organization. Through these activities, the researchers collected data from the target group by conducting interviews in a manner that was pleasant for the target group. The survey in the *Track, Trace, Trigger* project operated in a different way and had a different target group. The researchers used a platform that enabled informal caregivers to collect survey data. The informal caregivers were already using the platform and could provide their perspective on the survey in a way that was not burdensome or time consuming. Eventually, both research teams (*Track Trace Trigger* and *Growing Roots*) collected data in a way that was attuned to the daily lives of the participants.

In sum, it is important to identify appealing forms of research activities that are appropriate to the needs and preferences of actors in order to involve the target group. On the whole, members of the target group favored involvement in the research projects as long as the research method focused on their own situation and on the present rather than the future. SD logic assumes that value is created during the performance and exchange of services. When a way of working fits into the daily life and the habits of the research participants (their own processes), they are enabled to exchange knowledge in a more equal way. It should be noted that surveys involve little direct exchange, an SD-logic prescription, but the example of *Track, Trace, Trigger* shows that informal caregivers participated in a survey that provided room for their (experimental) knowledge. Moreover, several respondents gave their contact details so that they could be contacted for follow-up research. In this particu-

lar example, the theory assumes that the research participants contribute by sharing their knowledge and benefit from being provided with a setting in which they can tell their story so that something can be done with it.

4.4.2 VALUES IN CREATE-HEALTH WAYS OF WORKING FOR HEALTHCARE AND WELFARE PARTNERS

The healthcare and welfare partners mostly contributed by recruiting members of the target group and by facilitating the data collection sessions as well as by sharing their knowledge and experience during focus groups and interviews.

In some projects, the researchers introduced a new working method or service into the healthcare organization. For example, in *Everyday Sounds of Dementia*, the researchers introduced a workshop for elderly individuals and their informal caregivers or relatives. The project team set up an activity together with the healthcare organization in which they supported contact between healthcare professionals, individuals with dementia and their relatives: *'We see that the activities we carried out in our design research are appreciated by the care partner and that the first workshops were even seen as a possible permanent activity within the program of the daytime activities.'*

We recognized that if the target group and the health and welfare organizations experienced a way of working that suited their daily practice, they would indicate that they want to use it or engage with it more often. However, we also recognized that the examples of implementing a service approach are mainly at the interpersonal level, with engagement limited to a few actors. The researchers on the *NATALIE* project wanted to implement a helpdesk at one of the healthcare organizations (at the organizational level) to support the elderly as well as healthcare professionals by using the prototype *in situ*. However, the implementation of the helpdesk was pre-empted by the active adoption of another tool at the organization at the same time. The interpersonal-level exchange supported value co-creation for those who were involved in research projects, but it was difficult to expand this value creation to other contexts, stakeholders or even phases of the research projects on eHealth.

Many researchers from the 10 projects acknowledged that the input from professionals was valuable and important in the healthcare context, especially when it came to implementation issues that affect the integration of new technology into that context, as in the *Track, Trace, Trigger* project. The technical staff at one of the healthcare organizations that were involved in this project was released from other work for a substantial number of hours in order to spend time with the researchers in order to identify the possibilities and the limitations of integrating eHealth at the organization. The researchers could only obtain this kind of information from individuals who were engaged in healthcare processes on a daily basis

and who had a bottom-up perspective on the systems and processes involved. Moreover, for the successful implementation of eHealth, the early involvement of technical staff, such as IT specialists as well as software and hardware developers, seemed essential to ensuring that everyone would be on the same page.

In sum, exchanges of knowledge, skills and tools were part of the collaboration between the healthcare and welfare partners and the researchers. We recognized that usefulness for the organization was an important factor for the healthcare and welfare partners who were involved in those projects. As a researcher on the *Track, Trace, Trigger* project explained: *'Usually, you have to entice healthcare workers to talk to you. That is difficult and time consuming. We had a completely different experience at a healthcare organization that we did not officially work with. They had people from the technical staff who really had time to think with us (...) Dedicated time from technical healthcare professionals, who contribute not directly scientifically, but really based on a practical question and need, that works well.'* Therefore, the involvement of healthcare and welfare partners created value not necessarily by facilitating data collection but rather by providing an equal partner who would think about the manner in which an eHealth application could be integrated into the healthcare context in the future. Similarly to SD logic, the theory recognizes the reciprocity of the relationship between the different stakeholders.

4.4.3 VALUES IN CREATE-HEALTH WAYS OF WORKING FOR CREATIVE PARTNERS

The creative partners were mostly involved in the development of prototypes. Some projects worked with an eHealth application that had already been developed by a creative practice partner. As may be expected, research on most eHealth innovations and their development take more time than the duration of the projects in this call. As a result, it is not yet certain whether the research product that is being developed will be implemented as a solution. Creative partners often do not benefit economically from research projects and may instead benefit from design guidelines and by gaining insights during the process.

Most of the creative partners invested in the design and development of a prototype with an eye on the outcomes of the project, in particular the implementation of the eHealth application. One of the researchers on the *Growing Roots* project mentioned the long-term investment of the partner who designed and built the prototype: *'Our partner invests hours, material, equipment, yet does not earn anything in the short term. I think he sees the benefit in the long term.'* We recognized that creative partners had to invest in Create-Health projects to develop the necessary research artefacts, prototypes and research products as solutions.

In sum, as far as the target group, the health and welfare organizations and the researchers are concerned, the benefit of involvement in research-based innovation projects seems to be related to service ways of working during the projects or in the near future. For creative partners, the benefits accrue in the long run, when the eHealth application is implemented and scaled up. Since the creative partners are often not the ones who reap the direct economic benefits of a project, it is desirable, in such cases, for researchers to consider how the project can be made as useful as possible for those partners.

4.5 OVERALL INSIGHTS

The involvement of the target group and the other stakeholders was recognized in all of the research contexts that we analyzed using the RPM (Van Beest et al., 2021), namely the theoretical context, the conceptual context and the real-life-practice context. However, we saw that the creative partners, the healthcare partners and the members of target group were almost never involved together in co-design or other research activities. One of the researchers (from the *Track, Trace, Trigger* project) mentioned that the connection between the stakeholder groups is important for finding solutions to healthcare issues successfully: '*The difficulty with this type of innovation is that the stakeholder groups also say, "something has to come that really connects all those groups." The easiest thing, and almost all researchers do [it], is to make something for informal caregivers and then again for professionals. Then, you end up on a website or a nice app, but we don't want that now. It really has to go a step further.*' In this quotation, the researcher mentioned that most eHealth applications are meant for a specific stakeholder group, but more stakeholder groups mostly deal with healthcare problems. Therefore, the solution to the issues in healthcare should target multiple stakeholders as well as the Create-Health ways of working. In Chapter 5 we delve into collaboration between stakeholders.

By studying the projects through the lens of SD logic, we found approaches to interaction through which we could create valuable contributions and benefits with and for everyone involved; working with a 'survey' as just a 'good,' that is, a 'thing' that is not underlain by service logic, worked less well. In our research, we found that the different stakeholders put different emphases on project values. The target group found value in the research activities during the project, the social stakeholders found it in the integration of activities into the daily healthcare process, either during the project or in the short term, and the economic stakeholders found long-term value in the evidence-based development of the eHealth application.

We found that, researchers are able to deliver value for their target group during projects, even in fundamental research projects of this kind. In this chapter, we provided some exam-

ples in order to present insights on the way in which SD logic can be used as a concept for rethinking the relationship between actors and researchers. We did not want to use SD logic as a prescriptive theory but as a way of seeing Create-Health ways of working from a service perspective by designing the research pathway as a process. We believe that researchers could use such service-based ways of working even more explicitly. The examples in this chapter can inspire them.

Not all of the researchers on the projects intended to follow a service-based approach. However, in the analysis of these 10 projects, the theoretical lens of SD logic highlights examples of researchers acting on the basis of the service approach and/or the value that is the ultimate objective of research and development, that is, supporting the day-to-day functioning of individuals as they grow older. We believe that it is valuable to embed these ways of working into projects, especially in fundamental research projects in which the collected knowledge is necessary for further development. Earlier research shows that target groups are mostly assumed to accept what designers and researchers offer (Peine et al., 2014; Sanders & Stappers, 2008). In our research, we recognized the importance of understanding and meeting their needs as participants who already engage in co-creation during the process of data collection. In a number of projects, we found that a deliberate choice was made not to work with patients or clients but with informal caregivers, relatives or representatives of the target group—the subject of the study was still too abstract or too hypothetical. Overall, we found that the needs of the target group can be met by identifying appealing forms of research activities that are suited to the preferences of the actors and by adopting service ways of working, mainly at the individual and interpersonal level.

THE ADDED VALUE OF COLLABORATING ACROSS BOUNDARIES

BERIT GODFROIJ

> *It took a bit to find our combination, but I think it was one of the nicest studies we did in terms of data it generated. We had to learn from each other's method and to come to a method that we were both comfortable with to run (Researcher, FoodSampler).*

This chapter focuses on the manner in which partners from various backgrounds work together across disciplinary boundaries and on the benefits that such collaborations bring for a project. It investigates the following question: *how do project partners in Create-Health innovation collaborate across boundaries, and how does it add value to interdisciplinary collaboration?* It addresses the close collaborations between researchers and practice partners from the creative and the healthcare sector within the project.

As noted in the introductory chapter, intensive collaboration between different disciplines is often not without obstacles—healthcare and creative professionals come from different worlds that are not automatically aligned. This chapter describes these collaborations by focusing on boundary crossing. The term 'boundary crossing' was introduced to denote the manner in which professionals at work may need to *'enter onto territory in which we are unfamiliar and, to some significant extent therefore unqualified'* (Suchman, 1994, p. 25) and *'face the challenge of negotiating and combining ingredients from different contexts to achieve hybrid situations'* (Engeström et al., 1995, p. 319). It includes the efforts made by individuals or groups who occupy boundaries to establish or restore continuity in action or interaction across practices (Bakker & Akkerman, 2013).

This chapter describes the way that Create-Health collaboration took shape across disciplinary boundaries. It provides examples of boundary crossing from the 10 projects, with the objective of stimulating learning in the creative and health sectors on creative ways of working on interdisciplinary projects.

5.1 BOUNDARY-CROSSING LEARNING MECHANISMS

To investigate how partners collaborate in eHealth innovation, we adopted the theoretical lens of boundary crossing theory (Star, 1988). To analyze and structure the data from this theoretical perspective, we took four potential learning mechanisms that can unfold at boundaries: identification, coordination, reflection and transformation (Akkerman & Bakker, 2011). Akkerman and Bakker (2011) examine boundaries in education-research terms, for example by studying interdisciplinary student projects, but these learning mechanisms can also be applied to understand the development of interdisciplinarity in the Create-Health research teams. According to Akkerman and Bakker (2011, p.132) *'these mechanisms show various ways in which sociocultural differences and resulting discontinuities in action and interaction can come to function as resources for development of intersecting identities and practices.'* Table 5.1 summarizes the four potential learning mechanisms by distinguishing between meaning-oriented and practice-based mechanisms. Meaning-oriented mechanisms focus on sense-making and on understanding perspectives and identities, that is, on understanding other ways of working in other disciplines, and practice-based mechanisms focus on activities, such as the integration of tools into a combined way of working (Akkerman & Bakker, 2011). The first type of mechanism includes identification and reflection, which address, among others, creating understanding and reflecting, over time, on what partners contribute and in what way. The second type of mechanism includes coordination and transformation, which address the division of tasks, learning from the other discipline and novel ways of working.

MEANING ORIENTED	PRACTICE BASED
FOCUS ON PERSPECTIVES AND IDENTITIES	FOCUS ON ACTIVITIES
Identification: • Diverse practices • Constructing and reconstructing boundaries • Explication and visibility	Coordination: • Cooperative exchanges • Transcending boundaries • Smooth, effortless and routine process • People or objects moving back and forth
Reflection: • Expanding perspectives • Transcending boundaries • Explication and visibility	Transformation: • Co-development of (new) practices • Transcending boundaries that need to be encountered and contested • Confrontation • Continuous joint work

Table 5.1. Boundary-crossing learning mechanisms (adapted from Akkerman & Bakker, 2011).

To capture the specific meaning of each mechanism more precisely and to recognize the relevant activities more easily, we operationalized the mechanisms as processes in which the actors who are involved *identify* complementary practices and expertise, *coordinate* tasks within the structure of the consortia, *reflect* on the evolving dynamics of the collaboration, and *transform* ways of working by interdisciplinary learning. Table 5.2 shows the structure of this chapter, which follows these mechanism processes.

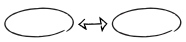
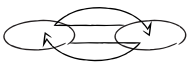
SECTION	SUBJECT (APPLIED TO EHEALTH INNOVATION RESEARCH PROJECTS)	BOUNDARY-CROSSING LEARNING-MECHANISM PROCESSES	
5.2	Identification of different practices in Create-Health collaboration	(Re)construct boundaries 	The process of creating an understanding of the manner in which diverse practices differ and the way in which partners with different backgrounds explicate differences and make them visible to (re)construct boundaries (identification in Akkerman & Bakker, 2011).
5.3	Coordination of tasks within research projects	Connect practices 	How do project partners connect practices and organize smooth collaboration between them, aiming at cooperative exchange (e.g. making use of the same data) and different practices that can generate benefits (e.g. by applying different methods of analysis; coordination in Akkerman & Bakker, 2011)?
5.4	Reflection on collaboration	Exchange evolving perspectives 	Explicitly redefining and exchanging evolving perspectives over time and making these processes visible, resulting in expanded perspectives that inform future practice (reflection in Akkerman & Bakker, 2011).
5.5	Transformation by interdisciplinary learning	Integrate practices 	Changing practices or even creating new in-between practices with continuous joint work at the boundary that needs to be encountered and contested. Often starts with a confrontation, with a deficit or with a boundary problem (transformation in Akkerman & Bakker, 2011).

Table 5.2: Structure of chapter, in line with the four boundary-crossing learning mechanisms (adapted from Akkerman & Bakker, 2011 and Akkerman & Bruining, 2016).

The next four sections describe findings for each of the specific mechanism processes that are listed in Table 5.2, as well as contextualizing them within the relevant literature. The findings in each of the four sections describe differences and discontinuities in action

and interaction between the practices that were involved in the 10 Create-Health research projects, thus identifying boundary-crossing issues and the development of intersecting identities and practices in the projects. This chapter concludes (Section 5.6) by summarizing the lessons on collaborating across boundaries that were learned from the 10 Create-Health research projects.

5.2 IDENTIFICATION OF PRACTICES IN CREATE-HEALTH COLLABORATIONS

Akkerman and Bakker (2011) define *'identification'* as coming to know what the diverse practices are about in relation to one another and as being about constructing and reconstructing boundaries. Identification mainly reflects meaning-oriented learning processes by focusing on perspectives and identities. According to Akkerman and Bakker, identification, which involves the explication and visibility of perspectives, seems *'conditional for transformation, because in the latter boundaries need to be encountered and contested before being put to use for codeveloping practices'* (2011, p.151). In the Create-Health projects, the diverse practices, as demanded by the call, originated from creative and health research organizations, representatives of the target group (e.g. patients, clients, or organizations for the elderly) and practice partners (undertakings), such as technology partners and design-practice partners. The project partners operate in the context of science and academia, in healthcare, and in technology and design, which are domains that demand interdisciplinary and cross-sectional work (Akkerman and Bakker, 2011).

(RE)CONSTRUCTING BOUNDARIES

In the 10 Create-Health projects, we observed two differences between diverse practices and our expectations: 1) there is much nuance in and overlap between research disciplines, and 2) the identification of practices takes place between and within research and practice organizations as well as within domains. Table 5.3 summarizes these findings, which we will discuss shortly by relating them to the relevant literature.

TOPIC	INSIGHT	LITERATURE	EMERGENT PRACTICE FROM THE PROJECTS OR LITERATURE
(Re)constructing boundaries: the identification of practices in Create-Health collaborations is time consuming.			
Much nuance in and overlap between research disciplines	Many researchers did not identify themselves with 'creatives' or 'health.' In many cases, it was difficult to identify the origins of ways of working.	Value is always co-created, jointly and reciprocally, in interactions between providers and beneficiaries through the integration of resources and the application of competences (Vargo & Lusch,2008)	• It takes time and effort to develop shared understandings of differences in interests. • The ways to explicate differences and discontinuities to cross boundaries are e.g.: • Evaluation sessions, • Lengthy discussions, • Listing differences.
Differences in practice between and within organizations	Identification of practices takes place between and within research and practice organizations as well as within domains. Project partners exchange knowledge but can have different interests and approaches, and creativity can be a part of individuals, regardless of the research discipline in which they work.	Boundary-crossing learning mechanisms on the organizational, interpersonal and intrapersonal levels (Akkerman & Bruining, 2016) Integration of knowledge, skills and attitudes (Baartman & De Bruin, 2011) Knowledge from academic design research projects does not always help design professionals to improve their work (Zielhuis et al., 2022)	• Identification includes an inquiry into the manner in which different practices contribute to Create-Health research collaborations. • Collaboration across boundaries includes the identification of competences, capabilities and skills that individuals bring to a project.

Table 5.3: Insights on the identification of practices that are related to (re)constructing boundaries in Create-Health research collaborations. Emergent practices from the projects and references to the relevant literature are added.

MUCH NUANCE IN AND OVERLAP BETWEEN RESEARCH DISCIPLINES

The interests and approaches observed in the 10 Create-Health projects did not, strictly speaking, originate from the creative or the health sector. In fact, in many cases, it was difficult to identify their origins (see also card sort, Chapter 1). For example, we observed social-science research organizations that provided knowledge about health and research organizations, which operated between domains.

Maybe it can be explained in that way because of the university faculty, which is an engineering faculty, yet I think we don't have to label ourselves like that! I don't feel affiliated with create or health. I am a technical business consultant. I do not have hardcore knowledge of health, and I am neither a designer. I know a bit about both, and I know people in both worlds. I try to navigate between them (GOAL).

We are categorized as 'health' in this project, but the kind of research we conduct is social research. The real healthcare partner is the social housing and care organization (SQUEALED).

It is not that I am the health researcher and he is the design researcher. I am a psychologist who had nothing to do with health until I got my PhD. Since then, I conduct technology acceptance research in health context. He makes things, and I investigate whether that is accepted and used (DDD).

Researchers explicated the differences between the practices that are involved in a project. For example, *'they seek for solutions, while we would like to understand the problem' (DDD)* and '*they immediately start to draw. And we, well, there are a lot of whiteboards here in the room, but nobody ever uses them' (SQUEALED).* In the *DDD* project, the researchers listed the differences between the interests of the practices (see Table 5.4).

BEHAVIORAL RESEARCHERS INTERESTS	DESIGN RESEARCHERS INTERESTS
Interviewing participants	Action research with participants
Finding problems	Seeking solutions
Understanding the present	Shaping the future

Table 5.4 Differences between the interests of behavioral and design researchers (listed by DDD researchers).

According to the *DDD* researchers, explicating differences was necessary because of a shared desire to publish about their experiences of collaboration in interdisciplinary outlets. They had a strong desire to combine the interests of behavioral and design research. As one researcher put it, *'I feel like we are pushing each other to do that. So, not letting go to achieve that.'* This process of explicating and identifying practices within projects takes time, in which researchers sometime (re)construct boundaries by resisting other practices.

'The design researcher immediately wanted to apply design activities in my field research. I am educated not to influence the field research, and I did not want participants of my field study to be influenced by design activities, in the sense that, in the journals [in which] I publish, that is not done, so I resisted for a long time' (DDD).

These processes of creating understanding by (re)constructing boundaries can be related to the literature on SD logic (e.g. Vargo & Lusch., 2008), which stresses that value is always co-created, jointly and reciprocally, through the integration of resources and the application of competences (Vargo & Lusch, .2008).

We observed various researchers in health research organizations, the social sciences and information-systems engineering, all of whom conducted action research. Furthermore, in the *DDD* project, a researcher in the social sciences and a design researcher created 'kind-of personas,' and the social sciences researchers in the *SQUEALED* project created vignettes, which is akin to persona creation, commonly known as a design activity. In this project, we also observed design partners with experience in health who had a theoretical advisory role rather than a creative (design solutions) one as well as design-practice partners that delivered data analysis in the form of graphs, activities that are often not directly recognized as forms of design. These examples from practice falsify assumptions about the differences between creative and health researchers (see Chapter 1). Boundaries between the specific practices were (re)constructed in each project.

DIFFERENCES IN PRACTICE BETWEEN AND WITHIN ORGANIZATIONS

Beyond the diversity of practices between creative and health research organizations, there is also diversity of practices within organizations (between individuals) and within individuals. For example, creative methods may be applied in health and engineering research organizations.

> *This project was more creative because of the iterative character, visualizing things, and we conducted kind of action research, while I normally start with ready-to-test interventions (SQUEALED).*

> *We have connections with industrial design, but we have also conducted creative activities ourselves. The creative exercise was not the same as a Van Gogh painting, but it was rather rational. The creativity includes translating how we could use creative ideas in a gamification setting (GOAL).*

According to Akkerman and Bruining (2016) boundary-crossing learning mechanisms can operate on the organizational, the interpersonal and the intrapersonal levels. The organizational level includes differences in interests between organizations, for example between creative and health research organizations. The interpersonal level includes differences within a project, such as those that occur when a social sciences researcher operates within a health organization or when a technical business consultant works at an engineering

faculty at a university. The intrapersonal level includes differences between people, such as those that may be observed when a non-designer engages in creative activity. Building on the work of Akkerman and Bruining (2016), Figure 5.1 illustrates how the diversity of practices within organizations, for example in the means or procedures that are employed to align distinctive participatory positions in multiple practices, can be a part of individuals.

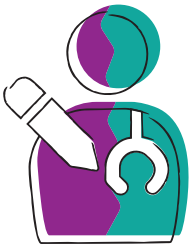


Figure 5.1: Intrapersonal aspects (adapted from Akkerman & Bruining, 2016).

We also observed differences between practices within individual domains, for example between design practice and design research. In the Create-Health projects, academics who work in design research and professionals who work in design practice exchanged knowledge, but they did not always speak the same language: *'I know what to tell my community, to design researchers, but I'm not that sure how I can tell it to design professionals, so it becomes relevant'* (*FoodSampler*).

As far as the collaboration between design practice and design research is concerned, researchers and/or students conducted design activities in five projects. The other five projects included professionals from creative agencies with backgrounds in the arts and user-interface technology, graphic design and user-interface technology, and information technology (Zielhuis et al., 2022). In brief, these creative agencies offer service design and develop applications, interactive experience platforms and games. Some of the design professionals who were involved in design research realized and explained that their approach and contribution to the project differed from that of design researchers: *'This project feels very academic to me, I see this more as building up knowledge for follow-up projects than that it helps us now'* (Design professional, *PACO*). In addition, design and health professionals explained that the real-life timeline and the academic timeline do not run in parallel. Companies asked whether they must really wait for years until they can obtain insights into the knowledge that had been generated, but the researchers pointed out that it is difficult to share articles that are not published yet. Therefore, some projects included intermediate dissemination activities, such as press releases (*GOAL*) as well as symposia and events that were organized during the course of the project in order to communicate evolving insights to other researchers, practice partners and (representatives of) the target group.

We found that having a design professional on board does not guarantee knowledge transfer. Knowledge from academic design research projects does not always help design

professionals to improve their work, and potential differences between academic and practice audiences in design are not always recognized (Zielhuis et al., 2022). Zielhuis and colleagues (2022) suggest that researchers and funding agencies should address impacts on design practice, articulate the specific needs of design practice, operationalize design-practice roles and reach out to a broader design-practice group from the start. Recognizing such differences can have two effects. First, the involvement of design professionals within a consortium requires the identification of appropriate activities as well as benefits that may accrue to them. Secondly, when insights are transferred to the design practice as an audience or as a target group outside of a project, it is necessary to determine what content is interesting for them and which forms are suitable for that audience.

5.3 COORDINATION OF TASKS WITHIN RESEARCH PROJECTS

The second boundary-crossing mechanism, *'coordination,'* has to do with creating cooperative and routinized exchanges between practices and with transcending boundaries. In focusing on activity, it mainly reflects a practice-based learning process (Akkerman & Bakker, 2011). The Create-Health research call demanded that creative and health research organizations work together and that the main applicant be supported by one of two research organizations. The research organizations had to involve representatives of the target group (e.g. via patients, clients, or organizations of the elderly), and practice partners (undertakings) in the consortium. This consortium had to be built on (preferably pre-existing) public-private partnerships between parties with complementary expertise that would jointly contribute needed knowledge, supplemented with additional expertise where necessary or desired. The structure of the consortium had to reflect the different perspectives of the various parties, which are important for the development of the project. Those parties would jointly guarantee the input of knowledge that was required for the whole project.

CONNECTING PRACTICES

In the 10 Create-Health research projects, we report three findings on connecting practices: 1) projects differ in the coordination of a core team in one or two research organizations, 2) projects differ in the way that governance is organized (steering committees and such like) and in the frequency with which governance institutions meet, and 3) projects differ in the number of practices that they are connected with. Table 5.5 summarizes these findings, which we will discuss shortly by relating them to the relevant literature.

TOPIC	INSIGHT	LITERATURE	EMERGENT PRACTICE FROM THE PROJECTS OR LITERATURE
CONNECTING PRACTICES: BEING LESS SHAPED BY AND/OR INVESTING TIME IN RESEARCH SEEM IMPORTANT FOR BOUNDARY SPANNING.			
Coordinating a core team in one or two research organizations	Some projects have a core team that is anchored in creative and health research organizations that connect practices from different domains. Other projects have a core team within one (creative or health) research organization. In both project structures, we observed researchers in the core teams who acted as boundary spanners.	Brokers, intermediaries, and boundary spanners (Watling Neal et al., 2021) Mediating role for junior design researchers (Godfroij et al., 2022)	• PhD researchers often act as boundary spanners, as do postdoctoral researchers and assistant or associate professors. • PhD researchers are less influenced by a distinctive discipline than senior researchers. • Investing time in research seems important for acting as a boundary spanner.
The way governance is organized	Projects differ in ways in which governance is organized, and researchers explained their roles as coordinating, communicating and translating various perspectives.		• Projects are organized in different ways, e.g.: • There may be a steering committee in which all disciplines are represented, • Core researchers can have regular meetings about daily issues, • Professors from the various disciplines can supervise the main researchers, • Responsibility for coordination may be joint, • One individual or partner may be responsible for all coordination, • A repository may be used as a means of coordination.
The number of connected practices	Projects differ in the number of practices that they connect with.	RPM (Van Beest et al., 2021)	• Projects are connected to practices in different ways, but all cross boundaries in the theoretical, the conceptual, and the real-life-practice context (see Chapter 7).

Table 5.5: *Insights on the coordination of tasks, which is related to connecting practices, in Create-Health research consortia. Emergent practices from the projects and references to the relevant literature are added.*

COORDINATING A CORE TEAM IN ONE OR TWO RESEARCH ORGANIZATIONS

Some projects have a core team that is anchored in creative *and* health research organizations that connect the practices of different domains through the collaboration of researchers from the different organizations. For example, *DDD* coordinated a core team of researchers in two research organizations and combined social behavioral scientists and design researchers in the core team. In this project, practices such as longitudinal field research and design research (co-design sessions) were conducted in parallel and informed each other. Researchers crossed boundaries by exchanging insights on both practices in order to keep each other in the loop and abreast of different perspectives. The other projects had a core team in one (creative *or* health) research organization and made connections to practice and research partners outside of the core team: *'We were really the core team. The supervisors and the partners around us were sparring partners'* (*GOAL*). In line with the requirements of the call, all projects involved (representation from) the target group and the practice partners (undertakings) that were involved in the consortium.

In both project structures, we observed researchers in the core teams that acted as *brokers* or *boundary crossers*, building relationships between domains, supporting the knowledge-sharing process and information flows, facilitating learning, and enabling exchange between the production and use of knowledge (Watling Neal et al., 2021). In at least three of the projects (*DDD*, *PACO* and *GOAL*), a PhD researcher in the core team connected disciplines by, among others, working intensively together with the project partners from the other domain while being supervised and coached by project partners from their own domain (*DDD*) or by becoming familiar with individuals from both worlds: *'I do not have hard-core knowledge of health and I am neither a designer. I know a bit about both, and I know people in both worlds. I try to navigate between them'* (*GOAL*). *DDD* researchers explained that a PhD student acted as a *mediator* because a postdoc and an assistant or associate professor may have been influenced more by their discipline (Godfroij et al., 2022). In other projects (e.g. *SQUEALED*), we observed assistant or associate professors as boundary spanners. They were responsible for the coordination of the project. The latter was described as '*a unique structure because of a concentrated core team without PhDs, with the advantage of investing your own time in the research, which makes it easier to involve practice partners like the municipality of Rotterdam'* (*Healthy Storytelling*). Therefore, researchers on some projects explained that the prerequisite of boundary spanning is 'not being shaped that much by a distinctive discipline,' while others explained that investing time is important.

THE WAY IN WHICH GOVERNANCE IS ORGANIZED AND FREQUENCY OF MEETINGS

We observed six different ways of organizing governance. More than one structure can occur in a project. The first structure that we observed is the use of a steering committee in which all disciplines are represented. For instance, in the *DDD* project, the steering committee met every six weeks and coordinated, monitored and structured the project. The second way is to install a project team that consists of the core researchers. That team convenes regularly to discuss daily issues (e.g. *Healthy Storytelling*). The third way entails the use of a core team, with professors from the various disciplines supervising the main researchers (e.g. *GOAL*). The fourth way of organizing governance is to make researchers from both disciplines share responsibility for project management, coordination and communication (e.g. *DDD*). A fifth approach is to make one individual or partner responsible for all coordination (e.g. *SQUEALED*). This person then often acts as a boundary spanner. Finally, researchers on one project (*FoodSampler*) explicitly mentioned the use of a repository to share progress documentation and deliverables as a means of coordination.

The frequency of consortium meetings differed between projects, ranging from one meeting every six weeks (e.g. *DDD*) to one meeting per annum (e.g. *SQUEALED*). Advice could be sought from consortium members between meetings: '*She expected me to work independently, but if I got stuck, which happened recently, I went to ask her for advice,' (DDD)* and *'she gave useful input at consortium meetings. In between, she was easily accessible, so we could have asked her more, but that was not necessary'* (*SQUEALED*).

The core team drew on complementary expertise where necessary or desired between meetings: '*Everyone together, that was once a year, but in between, it went back and forth' (SQUEALED).* The work on *SQUEALED* that took place between meetings included individual information-sharing meetings between an engineering partner, who delivered graphs of technical data, and two core-team researchers, who provided contextual information about the domestic situations of the participants (elderly individuals), which facilitated understanding and interpreting the data. The core team of researchers (who were working at the same research institute) were concerned with progression and continuing the project. They explained their roles as entailing the coordination of communication and as translating various perspectives: *'if you bring technical people and, for example, doctors together at one table, you hear very nice things and very different perspectives regarding technical possibilities. On [a] more abstract level, we researchers try to understand how things are useful'* (SQUEALED).

All projects were connected with the practices of creative and health research, with professionals, and with (representatives of) the target group. However, some projects involved academic practice to a greater extent (e.g. *DDD* and *Track, Trace, Trigger*), while others were more closely connected to practice, health organizations, governance, design and/or development (e.g. *GOAL*, *NATALIE* and *SQUEALED*). The case descriptions in Chapter 2 reveal differences in the number of practices involved in each case. Chapter 3 describes the different practices. Despite these differences in the involvement of practices, all projects entailed collaboration in the theoretical, the conceptual and the real-life-practice context, as is evident from the research paths (Van Beest et al., 2021) of *GOAL* and *DDD* (see Figure 5.4). Researchers on the *GOAL* project conducted eight experiments with practice and involved many governance-practice partners (e.g. municipalities in the Netherlands and Belgium as well as secondary schools). The *DDD* project combined academic research from two domains and involved research practice, namely a mental health organization and a local innovation network, to conduct user research and co-design with the target group.

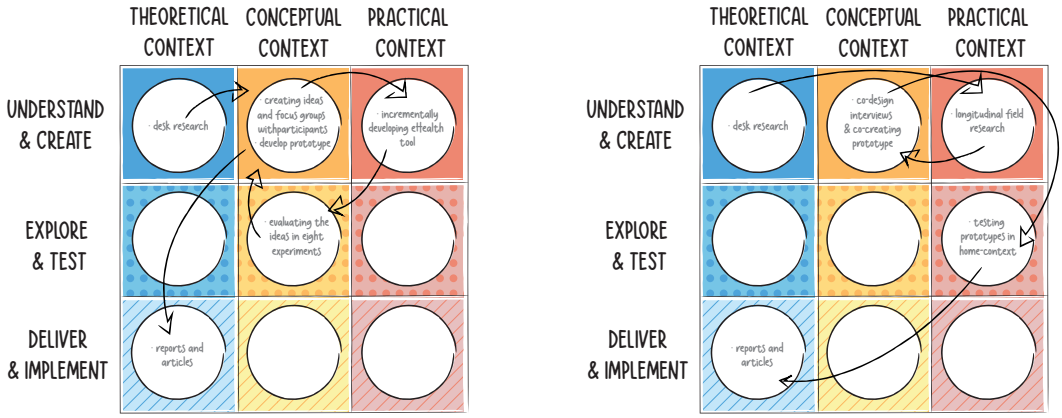


Figure 5.2: Various activities in the top two rows of the RPM matrix: 'understand & create' and 'explore & test.' Examples of research paths: GOAL (left) and DDD (right).

Figure 5.2 shows a simplified RPM of *GOAL* (left). Researchers on that project started their research path with 'understand and create' by performing a literature review (theoretical context), exploring different configurations for health games (conceptual context) and adding creative ideas to an existing eHealth platform called GameBus incrementally (practical context). Then, in 'explore and test,' they applied their ideas in eight experiments (practical context). Based on the findings of the experiments, they explored and tested a prototype of a toolbox called SciModeler (conceptual context) and captured the relevant insights in

knowledge building blocks (theoretical context). The simplified research path of *DDD* (see the right-hand side of Figure 5.4) also started with 'understand and create,' in that a literature review (theoretical context) was followed by longitudinal interviews with individuals in their own environments (real-life-practice context) and co-design interviews and sessions that aimed to create a prototype of an eHealth tool (conceptual context). This step was followed by 'explore and test.' The researchers conducted a longitudinal field evaluation to test the prototype in the domestic setting of the target group (real-life-practice context) then wrote reports and articles in 'deliver and implement' (theoretical context). These examples show that projects are connected to practices in different ways and have different research pathways, but all cross boundaries in the theoretical, the conceptual and the real-life-practice context. Chapter 7 describes the RPM as a tool.

5.4 REFLECTION ON COLLABORATION

The mechanism of *'reflection'* has to do with expanding one's perspectives on the practices and with transcending boundaries. Like identification, it mainly reflects meaning-oriented learning processes by focusing on perspectives and identities. It involves the explication and visibility of perspectives, and it seems to be a condition for transformation (Akkerman & Bakker, 2011).

EVOLVING PERSPECTIVES

In the 10 Create-Health projects, we report one main finding about the exchange of evolving perspectives: reflecting on collaboration dynamics in research projects fosters the integration of knowledge between disciplines. Table 5.6 summarizes the finding, which we will discuss shortly in relation to the relevant literature.

TOPIC	INSIGHT	LITERATURE	EMERGENT PRACTICE FROM THE PROJECTS OR LITERATURE
REFLECTING ON COLLABORATION: REFLECTION, WITH PROTOTYPING AS PART OF THE KNOWLEDGE-GENERATION PROCESS, FOSTERS COLLABORATION BETWEEN DISCIPLINES.			
Collaboration dynamics	Reflecting on collaboration dynamics in research projects fosters the integration of knowledge between disciplines.	Reflection is part of the process through which transferrable knowledge is developed (Durrant et al., 2017). Coupling, interweaving and decoupling dynamics (Basballe & Halskov, 2012). Understanding changing dynamics in an interdisciplinary RtD project (Godfroij et al., 2022). Ways to foster interdisciplinary collaboration in research (Andriessen et al., 2020). Boundary objects such as design tools, maps or prototypes (Carlille, 2002; 2004; Star, 2010; Star & Griesemer 1989) can support the collaboration process (Reay et al., 2017).	• Search for integrated approach by means of reflection sessions • There may be a search for additional or missing expertise in addition to the – preferably existing – partnerships between parties with complementary expertise • Prototyping, as a part of the knowledge-generation process, may facilitate collaboration and support boundary crossing

Table 5.6: Insights on reflection on collaboration, which is related to evolving perspectives. Emergent practices from the projects and references to relevant literature are added.

REFLECTING ON COLLABORATION DYNAMICS

In various projects, we observed that reflection was a very time-consuming activity that involved confrontation and continuous joint work. However, it also generates surprising collaboration, which may be integrated into practice. For example, the *DDD* project provides insights into the manner in which practices from different disciplines gradually merge, transitioning from longitudinal field research that informs the design process towards an approach that integrates tools from research design. The project explicitly paid attention to the crossover between disciplines, and the fostering of knowledge integration was mentioned in the research proposal.

By applying a Research through Design approach that combines retrospective and prospective analysis (Zimmerman & Forlizzi, 2014). More specifically: (a) Design activities and research in the project will take benefit of knowledge generated through conducting a technology acceptance study with people with dementia [...]; (b) Technology acceptance research will benefit from research-through-design activities.

Turning to the literature, Andriessen and colleagues (2020, p.17) found that *'strategies to foster interdisciplinary collaboration in research recommended in literature do not easily fit the unpredictability of design research projects and the complexity that comes from doing research in health practice*.' By explicitly reflecting on collaboration dynamics that foster knowledge integration between disciplines, the *DDD* project provides an example of interdisciplinary collaboration in research and a detailed example of the learning mechanism that Akkerman and Bakker (2011) call '*reflection.'* A sub-study within this single case yielded insights into the changing dynamics in interdisciplinary RtD, and, specifically, into the role of design researchers within the complex structure of actors who merge research and design activities across domains (Godfroij et al., 2022).

Research on the *DDD* project entailed reflection on the part of all researchers who were involved in it. They reflected on the dynamics of collaboration and found that they needed a more integrated approach, which they developed during the project, and that it was not the case that *'the psychologist tells the designer what to do, and the design researcher makes things'* (*DDD*). They reflected on the collaboration dynamics that are defined by Basballe and Halskov (2012), namely coupling, interweaving and decoupling. Basballe and Halskov (2012) define *'coupling'* as a dynamic that unites interests from various disciplines and establishes a common point of departure. They define *'interweaving'* as a dynamic whereby one activity or material informs the interests of various interests and *'decoupling'* as a dynamic that modifies foci by turning the interests of one discipline into the salient focus of the process.

There was less emphasis on reflection and collaboration dynamics in the other Create-Health projects, although we observed some dynamics, and the researchers explained them. For example, in the *FoodSampler* project, extensive attention was paid to interdisciplinary differences in approaches to analyzing research findings and means of enabling both disciplines to make use of alternative perspectives. Moreover, in most Create-Health projects, we observed that prototyping or the use of research artefacts fosters collaboration. The use of visual maps in the *DDD* project and the use of graphs and visualizations in *SQUEALED* provide two salient examples. The latter were made by a technical and a design partner of *SQUEALED* and were based on energy-consumption data that was gathered through longitudinal field research. The visual maps, graphs and visualizations fostered the integration of knowledge between domains (social sciences, technology and service design)

and functioned as 'boundary objects,' a concept that Star and Griesemer (1989) developed for *'objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites [...]. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation'* (Star & Griesemer, 1989).

> *Based on conversations with design professionals, so also visually with the graphs, we developed the vignettes with input from them, based on what they found and what was possible according to them. The nice thing about working with them is that they also must ask us a lot of questions because they only see that data. Of course, they do not know the content of those meanings from the care side. So, it is precisely this exchange, even if it is about data by means of graphs, that you still get further and gain new insights (SQUEALED).*

The aim of this fundamental research project was knowledge generation in the field of eHealth innovation with a view to preventing loneliness among the frail elderly and not the development of an eHealth product. In the *SQUEALED* project, prototyping was (implicitly) part of the process, which, according to Reay and colleagues (2017), facilitates collaboration and supports the boundary-crossing process. Moreover, reflection is part of the process of developing transferable knowledge (Durrant et al., 2017). In this knowledge-generation process, prototypes (artefacts and boundary objects) are research artefacts and not project goals in themselves (Godin & Zahedi, 2014). By developing knowledge building blocks, *SQUEALED* contributed to broader processes rather than just focusing on the creation of prototypes and products, which aligns with contemporary design (research) practice (Godfroij & Van der Lugt, 2020, Godfroij, 2021).

In *SQUEALED,* we also observed an evolving dynamic of coupling, interweaving and decoupling that was based on reflection during the project. When using the energy-consumption data that was collected from older individuals who were living independently, the analyses made it clear that many false notifications would be sent to family members and formal caregivers after the implementation of the system (see case portrait in Chapter 2). Therefore, the core team of researchers decided that it would not be useful to develop the eHealth system further into a product. In the last year of the project, they engaged a service design agency as a practice partner in the research process. In other projects, we also observed that additional partners had been engaged along the way and that the role of some project partners became less prominent over time. Therefore, the identification of practices (see Section 5.2) evolved during the projects as a result of reflections on collaboration and growing insights, with practices coupled, interwoven and decoupled over time.

5.5 TRANSFORMATION BY INTERDISCIPLINARY LEARNING

'*Transformation,*' the fourth mechanism, has to do with collaboration and the co-development of (new) practices, as well as with transcending boundaries. It involves confrontation and continuous joint work in which boundaries need to be encountered and contested. Like *coordination*, transformation mainly reflects a practice-based learning processes by focusing on activity, on which *identification* and *reflection* seem conditional (Akkerman & Bakker, 2011). Previously, the four learning mechanisms have been used successfully to identify the specific learning potential of various hybrid learning practices in vocational education (Bakker et al, 2016). Learning is defined as the process through which knowledge is acquired. The learning potential of an interdisciplinary research project stems from the fact that researchers can learn from another discipline and from practice partners that work at the boundary between research and practice. Engeström (1987) and Wenger (1998) stress that working at a boundary and boundary crossing engender strong learning potential. Transformation refers to ongoing two-way actions and interactions between contexts, such as the two-way knowledge transfer in the Create-Health collaborations in which research and design (both practical and academic) were merged. Most projects refer to this tendency as RtD (Stappers & Giaccardi, 2017; Zimmerman & Forlizzi, 2014). The merging of practices in the co-development of new ones is closely related to the '*interweaving*' that Basballe and Halskov (2012) describe as a process in which one activity or material informs the interests of various disciplines, in which boundaries are encountered and contested.

INTEGRATING PRACTICES

Some Create-Health projects involved more transformation than others. Although the call favored pre-existing partnership consortia and even though we observed that most partnerships consisted of individuals who had worked together in the past, getting to know processes together and learning from another discipline still takes time and effort: '*We had to learn from each other's method' (FoodSampler).* However, transformation, if it occurs, is inspiring, and it does generate surprising collaborations. We observed some projects in which there was intensive collaboration between disciplines and in which much (unscheduled) time was spent on sense-making and creating shared understandings. In these projects, we found transformation by interdisciplinary learning on two levels: within the projects on the organizational level and within individuals on the intrapersonal level (Akkerman & Bruining, 2016). The other projects, in which transformation occurred less, entailed information exchange between disciplines, and the project partners mainly worked in parallel on their own tasks and within their own disciplines. Table 5.7 summarizes the findings on the organizational and the intrapersonal level.

TOPIC	INSIGHT	LITERATURE	EMERGENT PRACTICE FROM THE PROJECTS OR LITERATURE
INTEGRATING PRACTICES: INTERDISCIPLINARY LEARNING ACROSS BOUNDARIES REQUIRES AN OPEN MINDSET TO LEARN FROM THE OTHER S KNOWLEDGE AND SKILLS.			
Transformation on the organizational/ project level	In interdisciplinary research collaborations, it takes time and effort to get to know the process together (also in existing partnerships) and to learn from the other discipline. However, transformation, if it occurs, is inspiring and generates surprising collaborations.	Interdisciplinary RtD is a complex collaboration process (Godfroij et al., 2022). Design activities play a formative role in the knowledge-generation process (Stappers & Giaccardi, 2017). Transferring, translating and transforming to manage knowledge across boundaries (Carlille, 2002, 2004).	· Researchers from the other discipline may not feel comfortable in applying methods in a specific way. · It may be difficult to find publication outlets or to identify interdisciplinary outlets that can be approached. Pushing each other may be helpful. · Codeveloping (new) interdisciplinary practices is a complex process.
Transformation on the interpersonal level	In transformation on the individual level, we observed open mindsets, openness to learning, enthusiasm and changes to ways of working, such as being more systematic or more creative.	Transformative learning requires critical (self-)reflection and openness to change (Baartman & De Bruin, 2011). Value is perceived experientially and differently by different actors (Vargo et al., 2020).	· Transformative learning in interdisciplinary collaboration across boundaries demands that knowledge, skills and attitudes be integrated, which can produce a valuable collaboration in which value is perceived experientially and differently by different actors.

Table 5.7: Insights on transformation by interdisciplinary learning, which is related to integrating practices. Emergent practices from the projects and references to the relevant literature are added.

TRANSFORMATION ON THE ORGANIZATIONAL OR PROJECT LEVEL

We observed organizational transformation in, for example, the *FoodSampler*, *DDD* and *PACO* projects. An example that illustrates the merging of activities that are conducted by creative and health research organizations that work together and in which the dietary expertise (health research) of the University of Applied Sciences and the contextual inquiry (creative research) of a technical university were deployed to set up and conduct interviews jointly. Finding a method that suited both parties demanded considerable effort.

Their understanding of running interviews was very different from ours. For them, an interview was more a matter of closed questions, very structured, so they could compare the different participants. We work with contextual interviews, cameras and pencils so they can map things. It took a bit to find our combination, but I think it was one of the nicest studies we did in terms of [the] data it generated. We had to learn from each other's method and to come to a method that we were both comfortable with to run. The main issue was not [that] they did not believe in what we were doing but [that] they did not feel comfortable running something like that (FoodSampler).

In this project, boundaries were encountered and contested, but codeveloping a method that suited both parties was also worthwhile: *'It took a bit to find our combination […] it was one of the nicest studies we did.'* Furthermore, this example emphasizes learning potential: *'We had to learn from each other's method.* The lead researcher in *FoodSampler* explained this learning mechanism as follows:

Knowledge, that I learned a lot from them. In every meeting, I was like 'oh my god, that makes sense.' You start putting things together. So, that is knowledge. Of course, I knew with whom I was working. So, I knew they were more systematic in how they do their research. They do more extensive analyses and literature reviews. All these things, they are very strict into that. So, that I knew, too, but it was also kind of nice to collaborate with that kind of different approaches. (FoodSampler)

The researchers on this project also conducted analysis sessions together. In those sessions, they had to integrate different data analysis practices.

We have a clear idea about the knowledge we want to gather. We would also let ourselves a bit open to see what other things were interesting within that path. So, I really highlight it, but the fact that I could work with health care researchers and practitioners… For them, in the beginning, it was a bit like… They couldn't really grasp it. They were like, 'just set up an experiment, run the experiment and that's it.' Not much qualitative approach. But they were also so open because they also saw the need… that they need to go beyond that. So, the ways of working were quite open to explore this. They were fascinated! Every time I organize a session here to run qualitative analysis, like wall analysis or thematic analysis, they would just enjoy, or more than that. They were taking pictures of themselves with all the post-its on the wall to send to their colleagues. They would be like 'ah, there is another day of this' (FoodSampler).

Another example that illustrates the merging of activities that are conducted by creative and health research organizations that work together originates from the *DDD* project. In that project, the lengthy discussions and reflections in the evaluation sessions included

confrontations but also many occasions on which researchers from both disciplines were *'pleasantly surprised and inspired'* (*DDD*). This project aimed to develop a (new) method, longitudinal co-design, which turned out to be very difficult and was a part of a larger process. The researchers in this project concluded that *'longitudinal co-design is complex and research findings need to be more fine-grained' (DDD).* However, the project encountered and contested boundaries successfully, and ways of working wound up interwoven. The lead researcher made the following observation:

> *I resisted for a long time to apply design tools within my field research, but insights have become increasingly sharp, also about what we cannot know. For example, whether a lack of initiative is a problem for people with dementia or whether they may not want to take the initiative at all… So, that's why those design methods are so good for getting ahead (DDD).*

Thus, the (re)construction of boundaries *('I did not want participants of my field study to be influenced by design activities'*) as described in the section on identification (see Section 5.2) were transcended after lengthy discussions and reflections within research teams, resulting into the integration of practices: *'An integrated work package WP1.5 that combines the work packages 1 and 2' (DDD).* The lead researcher on DDD stopped *'chopping in the sand'* because they became aware that they wanted to learn from the other discipline and that they *'will see where to publish articles.'*

The researchers on the *PACO* project also explained that they had contributed to method development by exploring steps in collaboration with other disciplines. In other projects, transformation, interweaving and the co-development of new practices were less dominant, although we observed that researchers engaged in a time-consuming sense-making process in various projects. They experienced it as a valuable process that they had not foreseen. The researchers were happy to learn from other disciplines, regardless of the time it took. For example, *'It was one of the nicest studies we did' (FoodSampler)* and *'it generated many occasions [on] which researchers from different disciplines were pleasantly surprised and inspired' (DDD).* Their experiences, which they explained, indicated that intensive collaboration is needed to produce outputs for interdisciplinary outlets. For example, publishing in domain-specific journals was difficult because '*the journals are nicely multidisciplinary for psychological terms, but not that creative, like "let's all start using design methods"' (DDD).* The researchers realized that they really needed to collaborate to reach interdisciplinary outlets: *'I feel like we are pushing each other to do that. So, not letting go to achieve that' (DDD).*

TRANSFORMATION ON THE INTRAPERSONAL LEVEL

On the individual level, we observed that some of the researchers became more open minded in their attitude towards research and that they now work more systematically or more creatively. For example, in the *DDD* project, the lead researcher changed their attitude: *'Over time, [the design researcher] convinced me to apply creative methods in my field [of] research, and I just wanted to do what seems good to me and to learn from a different approach' (DDD).* The members of the *FoodSampler* consortium already had an wscenario when they collaborated: *'We engaged even more happily in it'* (Researcher, *FoodSampler*). In this project, the lead researcher explained that they had a mindset that was very open to collaborating and to learning from each other: '*We would also let ourselves a bit open to see what other things were interested within that path […] they were also so open because they also saw the need… that they need to go beyond' (FoodSampler).*
Furthermore, the researchers on some projects explained that they had started to work more iteratively and creatively or that they had become more systematic.

> *I have started to work in a much more structured way. I tried to develop myself on that because if you're not on the same wavelength from the start, it stops right away' (GOAL).*

> *The data-management plan, that is my biggest learning. I don't start any project without it anymore, and we really use it as a live document. I think [it] is a nice learning. I sort of learned from [the research partners] but also, because of the demands of the project… that we had to really move in that direction. There is a lot of structure in [the] ways they sort their data, and also, because of the project, because we were asked to use the more fair principles and to publish all these data sets… The combination of these two things, I think that is my biggest learned, and I am very proud of it now. I am super-structured in how I collect my data, and I also try to publish it in that way (FoodSampler).*

In addition, the enthusiasm of the individual actors who were involved in the projects and learning potential were important for interdisciplinary collaboration: *'Everybody is super-enthusiastic about the project and that is noticeable in the collaboration and during meetings. Everybody puts in all the time that is needed' (SQUEALED).*

Therefore, on the intrapersonal level, we observed transformation processes with an open mindset and a learning attitude. Baartman and De Bruin (2011) suggest that a learning process is transformative when it requires critical (self-)reflection and openness to change. They refer to a learning process that is directed towards the integration of knowledge, skills and attitudes. Building on Chapter 4, in SD logic, service is a reciprocal process between actors, not an intangible product. For example, value creation and interweaving may emerge from

a data analysis session that informs researchers from various disciplines about their research interests. In this analysis session, design researchers may be interested in the thematic analysis on the wall, while medical and social-science researchers may be interested in coding data fragments. The two are not mutually exclusive: the analysis session, as an activity, and transcripts or other data sources, as material, can be used to inform various interests, and researchers can apply different competences (knowledge, skills and attitudes) to create value for everyone. Create-Health researchers may learn from each other's knowledge, skills and methods in such analysis sessions, which can produce a valuable collaboration in which 'value is perceived experientially and differently by diverse actors' (Vargo et al., 2020, p.17).

5.6 CONCLUSIONS: COLLABORATION WITH INTERSECTING IDENTITIES AND PRACTICES IN EHEALTH INNOVATION

This chapter provides insights into the learning mechanisms of boundary crossing in Create-Health collaborations by answering the following question: *how do project partners in Create-Health innovation collaborate across boundaries, and how does it add value to interdisciplinary collaboration?* The Create-Health call focused on research collaborations between creative and health research organizations that involve representation from the target group (e.g. organizations of the elderly) and practice partners (undertakings) in the consortium. The findings improve the understanding of the processes of (re)constructing boundaries, connecting practices, exchanging evolving perspectives and integrating practices.

In order to explain how the project partners in Create-Health innovations collaborate across boundaries, we must first report the finding that the process of creating shared understandings about the differences between diverse practices is time consuming. We found many nuances in and overlaps between research disciplines with different interests on the organizational, the interpersonal and the intrapersonal level as well as between practice and research. Boundaries between the specific practices were (re)constructed for each project, for example in evaluation sessions and lengthy discussions as well as by listing differences. Recognizing differences has an impact on the involvement of various professionals from practice and research and in transferring insights to creative and health practice.

Secondly, we found that PhD and postdoctoral researchers play a crucial role in organizing and smoothening collaboration between practices. Being less influenced by a distinct discipline than senior researchers and investing much time in the research project seem to be prerequisites for boundary spanning. We observed researchers who acted as boundary

spanners, brokers or mediators, both in projects in which a core team was coordinated by one research organization and in projects that required two research organizations to coordinate a core team. Projects differ in the ways in which governance is organized, and the researchers explained their roles as coordinating, communicating and translating various perspectives. The examples of forms of governance include steering committee in which all disciplines are represented, daily meetings between core researchers, professors from various disciplines supervising the main researchers, joint responsibility for coordination, entrusting one individual or partner with all coordination, and/or the use of repositories as a means of coordination.

Thirdly, we found that reflection fosters knowledge integration between disciplines and that (the identification of) the partners that are involved in the project may change over time because of evolving perspectives and emerging insights. Practices couple, interweave and decouple over time, based on reflection, and there can be a search for an integrated approach and/or additional or missing expertise. Reflection on collaboration dynamics, prototyping or the use of research artefacts may facilitate the knowledge-generation and boundary-crossing processes.

Fourthly, we observed that, even in pre-existing partnerships between individuals who knew each other had worked together in the past, getting to know the process of Create-Health innovation together, learning from the other discipline and integrating practices in combined or new ways of working still required time and effort. Not all researchers were able to work continuously and jointly at the boundaries of change or to create (new) practices together. However, in some projects, we observed intensive collaboration between disciplines, with much unforeseen time being spent on sense-making and creating shared understandings. In this process, we found transformation on two levels: within the project on the organizational level, for example in the form of an integrated work package or an attempt to become comfortable with combined ways of working, and within people on the intrapersonal level, in forms such as changes in mindset, openness to learning from another discipline and beginning to work more systematically or creatively.

To answer the question of how Create-Health collaboration across boundaries adds value to interdisciplinary research projects, we report two main findings that concern the importance of 1) learning potential and 2) the ability to generate and communicate knowledge. Learning potential demands an open mindset, enthusiasm and inspiration. Researchers explained that they wanted to learn from different approaches and had to study the methods of others. Being able to generate and communicate knowledge requires reflection on collaboration dynamics as well as coupling, interweaving and decoupling practices that are based on growing insight. Intensive collaboration across boundaries creates value because interdisciplinary outlets that transcend specific domains can be reached. Domain-specific

journals are not always open to creative research methodologies, and integrated methods are not always accepted. Therefore, researchers must work together to connect and integrate practices as well as to engage in dissemination activities and to publish works.

Despite the finding that many aspects of collaborating across boundaries are unforeseeably time consuming, all that time and effort are worthwhile! Researchers explained that the study was among the most pleasant that they had participated in and that it had resulted in surprising collaborations.

CONCLUSIONS

DAAN ANDRIESSEN

For over three years, we followed 10 research projects in which researchers and practitioners from the creative and the health sector combined forces to develop knowledge building blocks for eHealth applications. We wanted to learn how the Create-Health ways of working that were employed within these research projects contributed to innovation, research processes and the endeavors of the parties that were involved. This chapter summarizes our main findings on three topics: the difficulty of defining 'creative ways of working,' the many ways of creating impact for the public and the importance of recognizing and using the unique contribution and way of working of each partner. Based on these insights, we provide recommendations for researchers and funding organizations on getting the best out of Create-Health collaborations in research (Section 6.4).

When we started our research, the funding agency invited us to look specifically at 'creative ways of working.' However, 'creative ways of working' are difficult to define, an important insight. In the 10 projects, we found many ways of working that, in one way or another, can be described as 'creative,' but they do not necessarily have one common characteristic. Therefore, there does not seem to be an intrinsic defining characteristic of 'creative ways of working.' In addition, it is also not possible to associate a way of working with a person's background. We did not find typical creative or healthcare ways of working. Many participants in the 10 projects were from mixed backgrounds and could not be classified easily as creative researchers, professional or health researchers or as professionals (Zielhuis et al., 2020).

At the same time, we find that collaboration between parties who work in the creative and health sectors does produce some interesting and maybe even unique approaches to innovation and research in which ways of working are 'mixed.' Therefore, instead of trying to identify typical creative ways of working, we opted to study the ways of working within the projects as Create-Health ways of working. This should not be taken to imply that there are no differences between the creative domain and the health domain.

Blandford and colleagues (2018)and developing and evaluating each intervention. Two of the central areas of expertise required are Health (broadly defined pinpoint several differences, drawing on their personal experiences of deploying effective interactive digital-health interventions. For example, they state that development processes in health tend to be viewed as linear and evidence based, while in human-computer interaction and software engi-

neering, they tend to be much more iterative and focused on fitness for purpose. However, in the projects that we studied, this boundary was not so clear cut. In all 10 Create-Health projects, the development process was iterative, even when it was not a designer but a health researcher or a behavioral scientist who had taken the lead. In all projects, there was also an emphasis on creating evidence and using theory. Therefore, although differences in methodological approach exist, when creatives and the health sector work together to create knowledge building blocks, they adopt a common approach with elements from both domains, resulting in Create-Health ways of working.

Combining elements from both domains is not always easy. As we reported elsewhere (Zielhuis et al., 2020), such combinations can be challenging. For example, the open approach that is often required in design processes might interfere with the need to submit clear plans to ethics committees. At the same time, combining elements may lead to a best-of-both-worlds approach, for example when a survey study and an explorative co-design study are combined to create personas.

Our research question is as follows: *what ways of working are employed within research projects on eHealth innovations in which research and practice partners from both the creative and the health sector collaborate, and how do stakeholders benefit from these ways of working?* We answer this question by highlighting three aspects of Create-Health ways of working that together provide a comprehensive overview of the main characteristics of the 10 projects:

- The use of specific ways of doing research and innovation,
- The way beneficiaries and other actors who are involved are included in research activities, and
- The way collaboration between creative and health actors takes shape.

We summarize our main findings on all three aspects.

6.1 CREATE-HEALTH: WAYS TO INNOVATE AND CONDUCT RESEARCH

Several practices and worlds come together in research projects on eHealth such as those that are presented in this book. Since various challenges can arise when an attempt is made to integrate the ways of working that predominate in these worlds (Blandford et al, 2018; Groeneveld et al., 2019), researchers need more guidance on operationalizing their integration. We found several ways in which integration can be improved, and we discovered that this diversity of ways of working can be organized along the following dimensions:

- the goals of a project, which are directed towards meaningful eHealth innovation, and, in light of these goals:
- the mix of methods
- the role of prototypes
- the role of iterations.

What are the goals of the projects? The Create-Health call from ZonMw strongly focuses on theory development. Since earlier programs apparently focused too much on delivering solutions for practice, projects were sought that would produce *knowledge building blocks* in order to contribute to solving problems in healthcare practice. Many of the researchers who were involved welcomed this focus on theory development as an alternative to *jumping to solutions*. Design practice partners, as well as care organizations and care professionals, understand the need for an evidence-based approach to grounding healthcare innovations. However, most projects aim for a combination of generic knowledge and relevance to practice.

Knowledge outcomes can have three different objects: knowledge about a phenomenon, knowledge about design approaches or knowledge about solutions. They can also have different orientations—knowledge about how things are now as opposed to knowledge about possible futures. The various project partners within a project sometimes display a different interest in these various knowledge outcomes. Since most projects aim to impact multiple audiences, it is difficult to combine the different interests of those audiences, and this can complicate matters. Although this issue was resolved successfully in the 10 projects, we recommend discussing the various interests of the partners in relation to the goals of the research at the stage at which a consortium is formed. The tool in Chapter 7, which is based on the RPM, can help structure this conversation.

How do the projects combine methods? All 10 projects combine methods from different disciplines, but they do so in various ways. We identified four such ways. In a *sequential approach*, methods are combined sequentially. This approach can be recognized as *multi-disciplinary* (Choi & Pak, 2006)interdisciplinary and transdisciplinary teams are increasingly encouraged in health research, services, education and policy. This paper is the second in a series. The first discussed the definitions, objectives, and evidence of effectiveness of multiple disciplinary teamwork. This paper continues to examine the promotors, barriers, and ways to enhance such teamwork. Methods. The paper is a literature review based on Google and MEDLINE (1982-2007. For example, an iterative process of developing a prototype by using qualitative evaluations may precede a quantitative effect study. Both types of methods benefit the project. The challenge in this approach is the quality of the handover—each party needs to understand the input of the other.

Different methods are combined in strategies for *integrating the results* of different activities into joint results. This approach can be recognized as *interdisciplinary* (Choi & Pak, 2006) interdisciplinary and transdisciplinary teams are increasingly encouraged in health research, services, education and policy. This paper is the second in a series. The first discussed the definitions, objectives, and evidence of effectiveness of multiple disciplinary teamwork. This paper continues to examine the promotors, barriers, and ways to enhance such teamwork. Methods. The paper is a literature review based on Google and MEDLINE (1982-2007. For example, the outcomes of a systematic literature review may be combined with the results from context mapping (Sleeswijk Visser et al., 2005). The challenge is to ground a design process in previously developed models and theories *while* keeping an open mind and learning from users.

In a strategy that *integrates expertise* into methods, the method that is used requires expertise and inputs from different disciplines. This approach can be recognized as *trans-disciplinary* (Choi & Pak, 2006)interdisciplinary and transdisciplinary teams are increasingly encouraged in health research, services, education and policy. This paper is the second in a series. The first discussed the definitions, objectives, and evidence of effectiveness of multiple disciplinary teamwork. This paper continues to examine the promotors, barriers, and ways to enhance such teamwork. Methods. The paper is a literature review based on Google and MEDLINE (1982-2007. For example, the creative partners may introduce user research as a method, and the health partners can provide access to the target group and domain expertise. The challenge is to find a method that suits both parties.

A *personal approach* involves an N=1 (or N=low) study, which is a common method in both domains. Instances in which a first prototype is tested on one older adult provide a salient example. This personal approach helps frame the research for various domains. Because experts in both domains are familiar with this approach, using it in Create-Health projects is unproblematic.

We found combinations of these four strategies in all of the projects. This implies that a Create-Health project can sometimes be a multidisciplinary study and sometimes a transdisciplinary one, depending on the phase of the project and the objective of that phase. Therefore, Choi and Pak's (2006) well-known distinction between multidisciplinary, interdisciplinary and transdisciplinary research is not as clear cut as it seems. It is important that the research partners discuss various methods, particularly methods from the design domain, which are not clearly defined (Sanders, 2008). It is also necessary to discuss which level of disciplinarity is necessary for particular activities. This helps to understand what the activities entail, and it sheds light on the means of combining the various methods.

Publishing studies that are based on these mixed-methods approaches to research can be challenging, especially when the researchers wish to reach an audience beyond the design field, for instance by publishing in health journals. The co-design approach, in particular, can be difficult to frame in a manner that is appropriate for such journals.

What is the role of prototypes in the 10 projects? We found that all projects worked with some sort of prototype. This is a characteristic element of Create-Health ways of working. Making tangible things can facilitate shared understanding considerably. However, the manner in which prototypes are used can lead to confusion. Partners from other domains might think of prototypes only as tools that will be developed further into products. This is the prototype as a *product as a solution*. However, prototypes also have other functions. Some prototypes are used mainly to elicit responses and interactions. This is the prototype as a *research artefact*. In this program, we found several examples of such research artefacts. Beyond this program, there are even more different types of research artefact, such as *provotypes*, which are intended to provoke (Mogensen, 1992). Finally, we saw several examples of prototypes that are *technology sketches* or proofs of concept. A single project can contain prototypes with different roles. To complicate matters, some prototypes start out as research artefacts but end up as products as solutions.

It is important to discuss the purpose of the prototypes in a project, especially with the practice partners but also with the funding agency. Will a care institution end up with a working solution for their local situation? Can they keep the high-fidelity prototype that their clients love? Will the technology be supported in the long run, or will the research artefact have to be returned once the study concludes? Do the researchers intend to develop a

prototype further after the project, and how much development will this take? Alternatively, is the prototype meant to describe the design case as a demonstrator that illustrates a theory?

What is the role of iteration in the 10 projects? Although iteration is present in each of the 10 projects, we found two different ways in which it took shape. This has to do with the goal of the project and the role of the prototype. Projects that are aimed at developing an eHealth prototype result in work on a product-as-a-solution prototype and use iteration to integrate the insights from user research and scientific evidence into the product. We find that this approach is particularly popular in projects in which researchers from healthcare or the behavioral sciences take the lead and try to develop evidence-based interventions. In projects that are aimed at developing theory, design cases are used as iterations or loops through which a theoretical framework is gradually developed. This type of iterative approach is used in projects in which design researchers take the lead. These projects are particularly emergent and difficult to plan.

Whether the focus of a project is on developing a working prototype or on developing a theoretical framework, the research pathway never proceeds from theory to practice in a linear fashion. There is a constant process of hopping between the theoretical, the conceptual and the practical context. The theoretical context is used to ground a prototype in theory, and the practical context is used to ground it in user experience. However, combining both types of grounding in a single project is difficult within a three-year timeframe. Additional research into the effectiveness of the prototype is always needed.

It is important to consider the point at which a research path ends and the steps that need to be taken to produce a result that can be used in practice. Iterating towards an evidence-based prototype often requires further validation but also a practice partner that can facilitate its financial, organizational and technical implementation. When iterating towards theory, it is often necessary to translate theoretical insights into guidelines or insights that practice partners can use. It is important to discuss what the research pathway should look like, what the role of all partners in the various research steps will be and what the final destination of the research path will be with potential consortium partners. Clarity about the research pathway is needed to manage expectations and to prevent disappointment along the way. The RPM tool that is described in Chapter 7 can facilitate such conversations.

To summarize, we found several means of combining ways of working in Create-Health collaborations. We provided practical guidance for dealing with the challenges of such collaborations. It is also important that research partners make sure that they involve the right partners (e.g. professional designers), who must possess appropriate expertise on particular ways of working, in order to be successful. We have highlighted several ways of attaining this objective.

6.2 CREATE-HEALTH: WAYS TO INVOLVE INDIVIDUALS IN RESEARCH PROJECTS ON EHEALTH

The creative sector has a long tradition of *co-design*: involving end users and stakeholders in design processes. The health sector has developed a tradition of *patient participation* in research. According to Blandford and colleagues (2018)and developing and evaluating each intervention. Two of the central areas of expertise required are Health (broadly defined, there is an important difference between user involvement in the creative domain and user involvement in the health domain. In the creative sector, researchers are trained to focus on the user, reflecting the presupposition that the user is an expert on their own life. In the health sector, researchers who are developing an intervention start with existing knowledge and expertise, and their task is to get the user to engage, adhere and comply.

Because of these differences, we investigated the involvement of end users and stakeholders in the 10 Create-Health projects. Brett and colleagues (2014) show that the participation of patients in research is conducive to the attainment of user-focused research objectives, the development of user-relevant research questions, the identification of more appropriate recruitment strategies for studies, the generation of consumer-focused interpretations of data and to improvements in the implementation and dissemination of study results. In light of these potential benefits of end-user and stakeholder involvement in research, one of the terms of the Create-Health call referred to the inclusion of four types of stakeholders in each of the 10 projects: research partners from the healthcare domain, research partners from the design domain, creative partners (at least one undertaking) and healthcare or welfare organizations. Another condition was to involve end users and health professionals in the formation and execution of the research. In our research, we look at the benefits of end-user and stakeholder involvement that accrue to the participants. What value do they get out of participating in the projects?

An important finding is that all projects encountered difficulties with recruiting and involving members of the target group, namely overweight individuals (especially with a lower SES),

individuals with dementia or individuals who experience loneliness. It is difficult to find and contact such individuals and to keep them engaged during the study. In addition, researchers on some projects had to change their approaches during the COVID-19 lockdown. We identified several ways to find members of the target group during social distancing (Godfroij et al., 2020). The following approaches may also be valid under ordinary circumstances.

- The target group can be expanded to spare the vulnerable.
- Co-design sessions can be moved from a lab setting to the domestic setting of the target group.
- Small-scale research (sometimes even N=1) in homes can provide rich insights. Generally, individuals feel more comfortable sharing their experiences at home.
- Online contact with the target group (via video calls) increases flexibility and can be alternated with home visits and/or telephone contact.
- It helps to involve the target group remotely to capitalize on existing resources and technology with which they are already familiar.
- It is possible to teach members of the target group how to deal with technology, for example by sending out manuals or by calling them and making the digital transition together with them. It is helpful to inform the members of the target group of the way in which the session works beforehand.

How are the target group and other stakeholders involved in the 10 projects? We distinguish between involvement in the theoretical context, involvement in the conceptual context and involvement in the practice context of the research. We find that the involvement of members of the target group and other stakeholders in activities in the *theoretical context*, such as desk research, lab experiments or the publication of scientific results, was limited. These activities are mainly conducted by researchers. Furthermore, lab experiments often take place in the early stages of research, and what is tested is often still very abstract or too technically underdeveloped to be tested directly with the target group. Consequently, a more neutral audience (such as students) is often used. Furthermore, ethical considerations, such as the need to avoid placing too heavy a burden on participants, are taken into account when a decision is made not to involve the target group directly.

Creative partners, healthcare organizations, healthcare professionals and the target group (with their relatives and/or informal caregivers) are much more involved in the *conceptual context*. They help to create the basic concepts for prototypes by participating in interviews, co-design sessions, visualization routines, focus groups and such like. When it comes to exploring and testing a prototype, healthcare partners are more involved than creative partners. As a result, in most projects, the creative partners had little interaction with health partners. The exploration and testing of a prototype are usually conducted through work-

shops with care professionals or the target group, usability studies with the target group, mock-up studies and so on. The involvement of the target group and their relatives in the conceptual context is mixed, ranging from the more passive roles of listeners or co-thinkers to the more active ones of partners who execute a part of the research. In this context, healthcare professionals are mostly involved as facilitators of the target group or as co-thinkers in interviews or focus groups.

As can be expected, the involvement of the target group and healthcare partners is even more intensive when the research projects enter the *practice context*, that is, when an attempt is made to understand the practice situation and to test prototypes in a real-life setting. All but one project included these groups in testing in the real-life-practice context. Here, too, ethical considerations play an important role. When there is no tangible prototype to test, one needs to consider whether it is ethical to involve a vulnerable target group in testing. There is also the risk that the target group and health professionals expect the hi-fi prototype to become available as a commercial product, while that might not be the case. This tendency requires expectations to be managed carefully. Involving a target group of individuals who are no longer completely independent poses further challenges. Often, the presence of another individual is necessary, but it may cause participants to give responses that they believe to be socially desirable.

How do the participants from the target group benefit from the projects? It is clear that the researchers and the research projects benefit from the participation of the target group in terms of data gathering and the validation of prototypes. We find that researchers on several projects also tried to make sure that the participants would benefit from participating in the research. The examples of such activities include conducting several interviews over a longer period of time in order to build a relationship with individuals with dementia, inviting the elderly for coffee breaks or adopting a personal approach to interviews with individuals who are experiencing loneliness. These are examples of two-way value exchanges between researchers and members of the target group.

How do the health sector partners benefit from the research? The health sector is under enormous pressure, which increased considerably when the pandemic started. This pressure makes it even more difficult to involve health professionals in activities that are not directly related to healthcare practice. This said, health professionals benefitted directly from their participation in several projects, especially when the research entailed the introduction of a way of working that complemented their daily practice, such as workshops for the elderly and their relatives. However, these benefits mainly accrue at the personal level, and new ways of working were not implemented systematically at the organizations.

How do the other creative sector partners benefit from the research? Creative partners

are mostly involved in the development of prototypes. Most creative partners invest in the design and development of a prototype with an eye on potential tangible outcomes in the future. There is no immediate return in the short term. In part, this is a consequence of the call and its focus on the development of knowledge building blocks.

To summarize, our research shows that the value of participation differs between the various stakeholder groups. For the beneficiary stakeholders, value is found in the research activities that occur during the project. For social stakeholders, the value lies in the integration of activities into the daily healthcare process during the project. Economic stakeholders derive value from the long-term development of eHealth applications. It is important that researchers think about the ways in which participating parties can benefit from the research while it is ongoing and not only from potential future products, especially in fundamental research projects such as the ones that are presented in this book.

Our research refines the idea of patient participation in research. The projects show that increasing target-group participation in all phases of research is not always needed or desirable. We find that the researchers on a number of projects deliberately chose not to work with patients or clients but instead focused on informal care givers, relatives or students as future beneficiary actors. Our research also refines the idea that creative ways of working always entail co-designing solutions together with the target group. Members of the target group were involved in the 10 projects, but not in every stage of the research and not always as partners or decision-makers. The reasons are often valid. Researchers who coordinate research projects on eHealth should ask themselves who they would like to involve as well as when, how and why they should involve specific actors from the three actor groups (beneficiary actors, social actors and economic actors). The decision process should not focus only on methodological considerations—ethical issues and the question of how a collaboration can be turned into a win-win situation should also be taken into account. Thinking about the research project as a process of mutual value exchange can help. In the Research Pathway Tool that is presented in Chapter 7, we pay special attention to the roles of the various partners and to the services that can be exchanged during a project.

6.3 CREATE-HEALTH: WAYS OF COLLABORATING

Intensive collaboration between different disciplines is often not without obstacles, and healthcare and creative professionals come from different worlds that do not automatically align. Partners from different fields participated in the 10 projects, as depicted in Figure 6.1. In our research, we looked at the manner in which this collaboration unfolded, especially the ways in which actors 1) created understandings of the differences between diverse

practices, 2) connected practices and organized smooth collaboration between practices, 3) explicitly redefined and exchanged evolving perspectives over time and made these processes visible and 4) changed practices or even created new in-between ones through continuous joint work at the boundary.

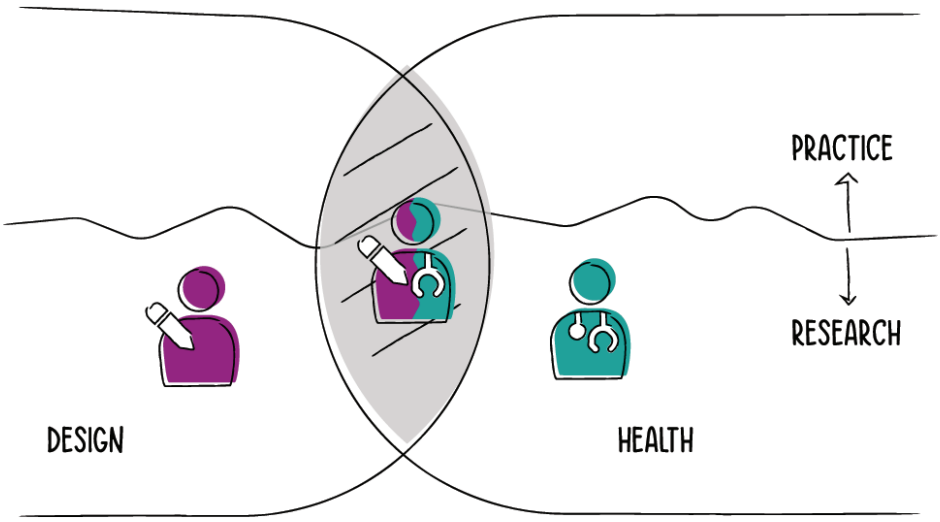


Figure 6.1: When creative and health sectors unite

How do the various actors in the 10 projects come to know what the diverse practices are and how they differ? First, we find that many researchers do not identify strictly with a single domain and that creativity can also be a part of individuals, regardless of the research discipline in which they work. It is important to identify the competences, capabilities and skills that individuals possess, irrespective of their formal position. That is not to say there are no boundaries between disciplines. It does take time to get to know the ways of working of others. Moreover, different partners may have different interests or points of view. For example, companies do not want to wait for access to knowledge, but researchers do not want to share articles that are not published yet. Design researchers want participants in field studies to take part in design activities, while behavioral researchers do not want them to be influenced by such studies because that influence may reduce the validity of measurements.

How do the 10 projects create cooperative and routinized exchanges between practices and transcend boundaries? The first element of coordination entails assigning the coordinating role. In most projects, coordination was conducted by a researcher from the research organization of the main applicant. Some projects aimed for shared project management that would be anchored at two research organizations in order to equalize contributions

and to stimulate boundary crossing. The position of the coordinator is another element of coordination. In many cases, the coordinator was a PhD student. Some of those students deliberately tried to act as boundary brokers by moving physically between two institutions. In other cases, the coordinators were associate professors, and this allowed them to spend more time on the project then they would if one of their PhDs had taken the lead. The way in which the governance of the projects is organized constitutes the third element of coordination. Six different ways of organizing were used, and some projects applied more than one. The first is the use of a steering committee in which all disciplines are represented. The steering committee meets at key moments and coordinates, monitors and structures the project. The second way is to establish a project team that consists of core researchers who hold regular meetings about daily issues. The third way is to use a core team of professors from various disciplines who supervise the main researchers. The fourth organizational approach is to share responsibility for project management, coordination and communication between researchers from both disciplines. A fifth way is to make one individual or partner responsible for all coordination. This person then often acts as a boundary broker. Finally, one project explicitly mentions the use of a repository to share progress documentation and deliverables as a means of coordination.

How do actors in the 10 projects redefine their perspectives during the collaboration? Collaborating in Create-Health projects is not 'the health researcher [telling] the designer what to do, and the design researcher [making] things.' We observe an evolving dynamic of coupling, interweaving and decoupling within the projects. For example, in most projects, we observe that additional partners were engaged along the way and that the role of other project partners would become less prominent over time. The reasons included a need for additional expertise or a realization that it was not useful to develop an eHealth tool further, which rendered the technical practice partner obsolete. It is desirable to realize that there may be a search for additional or missing expertise that ought to extend beyond the (preferably pre-existing) partnerships between parties with complementary expertise that were sought in the call.

Researchers on one of the Create-Health projects explicitly reflected on collaboration dynamics. They found that they needed a more integrated approach, which they developed during the project. Explicitly reflecting on collaboration dynamics to foster knowledge integration between disciplines is an appropriate means of optimizing interdisciplinary collaboration in research, especially since the strategies that are recommended in the literature do not easily fit the unpredictability of design research projects and the complexity that results from conducting research on health practice.

Beyond reflection on the knowledge-integration process, we also find that prototypes are used as boundary objects to bridge gaps in understanding between disciplines. These

objects can include graphs and visualizations as well as physical prototypes. Creating an object to which various disciplines can attach meaning helps to create common understanding and to foster knowledge integration between domains.

How do the 10 projects co-develop new practices and transcend boundaries? The co-development of practices and the overcoming of boundaries involves confrontation and continuous joint work in which said boundaries must be encountered and contested. This transformation occurs more frequently in some projects than it does in others. We observe transformation on two levels: within the projects on the organizational level and within people on the intrapersonal level. On the organizational level, transformation occurs when two parties from different backgrounds work together to find a method for data gathering that suits both. Although boundaries are encountered and contested, this can be worthwhile, and it can offer a learning opportunity. The prerequisites are a willingness to get to know each other, time to learn each other's trades and a belief that the other is better at something. For example, a health research partner who is known to be more systematic in the manner in which they conduct their research, with more extensive literature reviews and stricter ways of working, may collaborate with a design research partner who uses more open contextual interviews as well as cameras and pencils to map problems. In various projects, we observe that researchers went through a time-consuming sense-making process that they did not foresee but which turned out to be valuable. That process may induce irritation and misunderstandings, but it can also create tangible benefits such as design tools that can be used to gain a better understanding of the manner in which members of the target group experience certain situations. We find that researchers are happy to learn from other disciplines, regardless of the process being time consuming.

On the personal level, transformation occurs when researchers become more open minded in their attitudes and when they start to work more systematically and creatively. Design researchers admit that they have started to work more systematically than before, and health researchers report that they have become more iterative and creative. The prerequisites are enthusiasm about a project, seeing its learning potential, critical (self-)reflection and openness to change. Although it takes time and effort to get to know the process together and to learn from the other discipline, transformation, when it occurs, does generate surprising collaborations and inspiration. This may lead to intensive collaboration between disciplines in which a lot of unscheduled time is spent on sense-making and creating shared understandings.

To summarize, we found several ways to operationalize the collaboration process, which are not always easy. Success requires an appropriate mix of competences, capabilities and skills that individuals bring. It also requires coordination and a coordinator who acts as a boundary broker. This process requires a willingness to get to know each other, time to learn the

trades of the other and a belief that the other is better at something. It also requires enthusiasm about a project, a recognition of the learning potential of individuals, critical (self-) reflection and openness to change. Most importantly, these projects show how collaboration can create better results and personal learning.

6.4 CONCLUSIONS AND RECOMMENDATIONS

We had a unique opportunity to follow 10 research projects on eHealth innovation, on which research and practice partners from the creative and the health sector collaborated. We set out to describe the characteristics of their ways of working, to assess the benefits of the projects for stakeholders and to derive recommendations for future cooperation between the two sectors. We encountered 10 unique projects in which ways of working from the design sciences, the health sciences and the behavioral sciences were combined into unique mixtures of research.

WE DRAW THREE MAIN CONCLUSIONS

Creative ways of working are difficult to define and cannot be captured by terms such as 'iterative' and 'designerly.' We found that the ways of working of researchers from different disciplines are more similar than we thought in some respects, which provides opportunities for collaboration. However, one cannot always pinpoint differences in advance. A tool or method can have the same name and the same basic characteristics but a different paradigmatic foundation. For instance, design *tools*, which have become widespread by the notion of 'design thinking,' are not similar to designerly *ways of working*. This carries the risk that the *essence* of some ways of working can be overshadowed. Understanding Create-Health ways of working requires all partners to develop a contextual understanding of *why* and *how* methods and tools are used.

Our research refines the idea of patient participation. Often, the direct participation of end users in the innovation process is promoted as a way to improve the quality of outcomes. However, determining *if* and *when* the target group should participate directly is a balancing exercise. We show that Create-Health research projects typically exert an impact on many different levels, on different actor groups and audiences (which can be both academic and practical), during the process and with different outcomes. In our view, it is not only through direct participation in every phase of every project that end users benefit. The impact that a project has on the academic and the professional parties involved will, eventually, also induce older individuals to adopt healthy living practices and improve their quality of life.

Finally, it is important that research partners take time to recognize and use their unique contributions and ways of working. This means that the collaboration process will always require explicit effort and attention, even in projects in which the partners have collaborated in the past. The design and health disciplines have different customs when it comes to reporting results and sharing findings. This said, they can find each other in several ways when they operationalize their research efforts. Both draw on various fields. Nevertheless, we argue that that both fields need to emphasize their unique contributions and press on to share the results of multidisciplinary cooperation beyond the limits of professional fields.

RECOMMENDATIONS

There are several things that the parties who are involved in Create-Health projects on eHealth innovation can do to improve their chances of success.

In the formation process of the research, make sure to clarify the following elements of the research with all partners:

1. The goals of the research and the role of prototypes in reaching those goals;
2. The required mix of methods, the role of iterations in mixing them and the intensity of the research collaboration in each phase;
3. The roles and tasks of the project partners and the way in which the collaboration is organized across disciplines;
4. The way in which the target group will be involved.

The RPM can be used as a tool to facilitate this conversation. The tool is described in Chapter 7.

For the collaboration to be successful, it is important that all participating parties, including end users, benefit from the research. This collaboration begins by posing the following question to each participating party at the start of the project: what is in it for you? Thinking about the project as a service exchange may help in this conversation. This approach then shapes the way in which the project is set up and the methods that are used. Being conscious of added value for end users may lead to the conclusion that their participation in all phases of the research is not always wise.

The foregoing yields a recommendation for funding agencies. There seems to be a tendency among funding agencies to demand participation by end users in every piece of research and in every phase. That may not always be beneficial for the participants or for the research. Careful consideration of the pros and cons of patient participation is needed.

Moreover, optimizing the contribution of end users to research requires time for everyone to get to know each other. Budgets should allow for that.

In executing the research, several measures can be taken to ensure cross-fertilization across disciplines. Working across disciplines requires time to learn about others' paradigmatic views on knowledge and ways of working and time to reflect regularly on the cross-disciplinary collaboration and the learning processes that take place. One or more specifically appointed members of the team could assume the role of boundary broker. This also means that funding agencies should recognize that the cross-disciplinary effort should be reflected, in terms of time and money, in proposals.

Finally, we promote learning communities as practices that can take this cross-disciplinary collaboration beyond the scope of the project, as we saw in some of the projects that are presented in this book. Learning communities of this type unite various disciplines and contextualize insights from research and practice. These communities provide a platform for sharing project outcomes, which are often contextualized.

These recommendations could help research partners to get the best out of Create-Health collaborations and to provide actionable knowledge, both for those partners and for academic and professional audiences, so that the solutions that the public need can be created.

HOW TO USE THE RESEARCH PATHWAY TOOL

THIS CONVERSATION TOOL HELPS TO MAP YOUR RESEARCH PATHWAY AND TO DEFINE THE SCOPE OF YOUR RESEARCH.

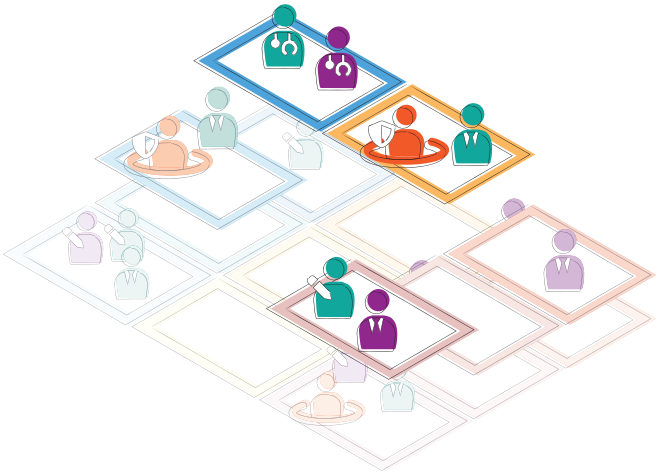


Figure 7.1 Layers of the Research Pathway Model

INTRODUCTION

The Research Pathway Tool (RPT) is designed to structure conversations between research partners about the research pathway. This research pathway consists of the research steps and the activities that are undertaken to achieve the goals of the research. The tool helps to explore and articulate the many different goals that the partners who are involved have adopted in relation to the project as well as the various ways of getting there that they identify. By doing this, partners are able to pinpoint difficulties in advance.

After you have worked with this tool, you will know more about your research. For instance, you will be able to answer the following questions:

- What do all parties have in mind with this project?
- What (common) goals are you working towards?
- What (research) activities will you conduct?

- In what order will you achieve the goals that you have set?
- Who is involved in which research step?

Consequently, you could also use this tool to plan your project, to discuss changes during the project, to evaluate and/or to map activities to outcomes retrospectively. Doing so could help determine your next steps, such as learning more about what the problem your next research project may need to solve, be it practical problems, further prototype development or delivering knowledge.

Figure 7.2 Research Pathway Tool

BACKGROUND

The Research Pathway Model (RPM) is a process model that explains the type of outcome that follows from different research steps. This helps to create a better shared understanding of a research project. The model consists of two axes (research contexts on the horizontal axis and research activities on the vertical axis) and nine research steps (Figure 7.1).

We discern three research contexts.

- The theoretical context, in which the research is focused on creating, exploring and delivering a better understanding of problems and related propositions for solutions that are advanced and not yet verified in practice.
- The conceptual context, which translates the presupposed solutions into a more specific prototype that is created, explored and made. In this context, researchers, project partners and other stakeholders provide experiential knowledge to translate theory to prototype by themselves, together with the consortium and with or without the end users, but always in a protected space such as a brainstorm room, a pilot environment or in the context of a pilot organization.
- The real-life-practice context, which concerns the context in which the prototype is tested in the world of professional practice and/or the living environment of the end users.

In addition to the three research contexts, the model identifies three overarching research activities.

- Understand and Create refers to research goals, with the aim of improving the understanding of the problem and creating an idea that can be used to solve it. These goals can be realized by engaging in research activities throughout the whole research pathway, whereby it is possible to iterate a research goal during the iterative process. The examples of research activities include performing a literature review ('create theoretical understanding'), co-designing a prototype ('create a concept') and observing end users in their domestic setting ('create understanding of real-life practice').
- Explore and Test refers to research goals, with the aim of exploring an idea, concept, construct or solution by performing research activities. The examples include laboratory research and tests in a controlled environment ('explore theory or a concept in a controlled situation'), evaluating a prototype in a pilot ('explore a concept') and testing a prototype in the environment of the end user ('explore a solution in real-life practice').

- Deliver and Implement refers to goals that are related to the delivery of insights as part of the research pathway. The examples include publishing research papers or grey literature ('deliver theory or knowledge'), delivering a prototype ('proof of concept') to developers or another research project ('deliver a concept') and working on an implementation strategy for an organization ('deliver change in real-life practice').

This results in a 3x3 matrix of nine squares. Each square represents a particular type of research step in a particular context. The matrix does not prescribe an ideal sequence of steps. The resulting pathway might well be an iterative process in which a specific square appears in various steps. The RPM can be used as a process model to map activities, patterns and the linkages between them. By using such a process model, researchers are able to design their research pathways prior to planning their actual research activities. In addition, it helps them to engage in monitoring along the way and to evaluate activities after concluding the research project. The matrix makes it possible to map the activities that contribute to the implementation of the innovation project, whereby contributions to the real-life-practice context, the conceptual context and theoretical context can be made explicit.

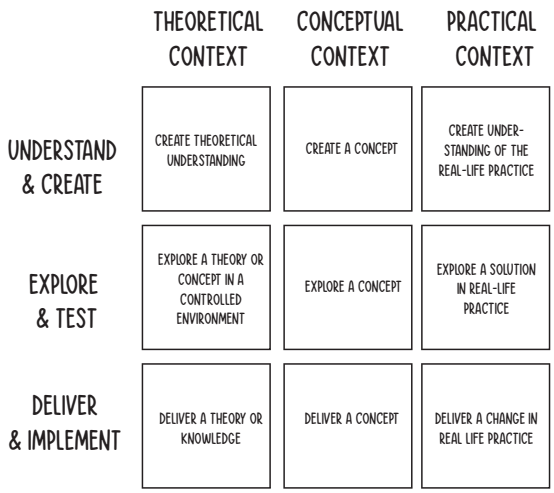


Figure 7.3: Research Pathway Model

HOW TO START WITH THE RESEARCH PATHWAY TOOL?

You start with a research question or a real-life problem. With this tool, you will put together the pathway for this project. Therefore, ask yourself what the ultimate goal and the purpose of the project are. This may be the same goal, but more often it is not. Most innovations take longer to develop. For each phase, it is important to consider what the goals are, who will be involved and what (research) activities are appropriate for a given phase of the innovation process.

The following five steps will help you to create a research pathway for your own project. You can also use the tool to explore a specific part of your research project, such as the involvement of the target group. Another important point to note is that the RPM mandates no specific order, obligation or purpose for all the steps. The same is true of this tool. We can imagine instances in which it is more appropriate to start by defining the target group or to restrict the use of the tool to the conversation about who does what within the consortium or project team.

By asking yourselves questions in each step or each phase, you could spark a conversation between the research partners.

Figure 7.4: Components of the RPT

STEP 1 : IDENTIFY STAKEHOLDERS, INCLUDING THE TARGET GROUP

The tool is designed to facilitate conversations with stakeholders. Therefore, start the conversation with each other. Who is at the table, and why? What are the different motives of each of the participants in the research project? What are their different fields of expertise and their goals in the project? For who are you going to develop an innovation, product, service or change? Are they the individuals for whom the innovation is intended? Are they already involved in setting goals?

In Chapter 3, we discussed the goals that projects and their stakeholders have in relation to the research pathway. The RPT can help to clarify the goals of each stakeholder and their involvement during the process. For example, are stakeholders primarily involved in the real-life-practice context because they have a role in understanding the context for which an innovation is intended, or do they have a role in the co-design process in the conceptual context, for example because they want to be involved in the formulation of ideas about a solution?

In Chapter 4, we discussed the values of projects and their stakeholders within the research pathway. Will any value accrue to them directly within the process of the research project?

The RPM could also help to identify stakeholders. When you have an overall picture of the research pathway, it becomes clear which stakeholders are essential to each of the steps of the research (Figure 7.2).

Figure 7.5: Stakeholders

Discuss the context(s) in which everyone who is involved would be engaged and the ones in which they feel most comfortable. Again, for each actor, you could discuss everyone's preferences about the nine steps in which they can be involved. Use a figure for each actor in the steps below, and discuss the pathway together.

In which steps is the target group involved?

- How will they be involved?
- How will they contribute to the project?
- Will there be any direct value for them within the process of the research project?

In which steps are the other stakeholders involved? Use the figure.

- How will they be involved?
- How will they contribute to the project?
- Will there be any direct value for them within the project?

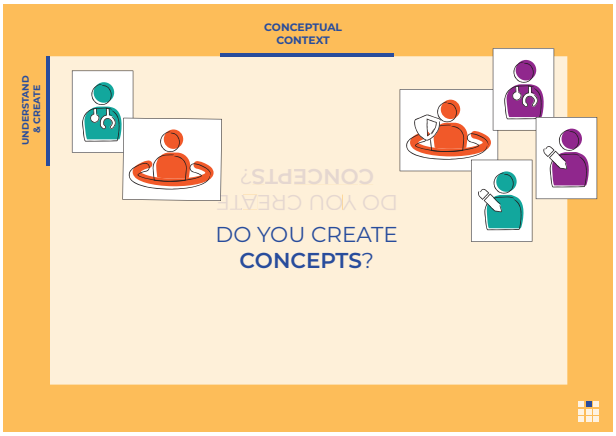


Figure 7.6: Stakeholders placed in the RPT

STEP 2: DEFINE YOUR RESEARCH GOALS

Each square raises a question about the research goals of every step of the research. Do you plan or envision that you will perform a certain step at some point in the research project? If the answer to this question is 'yes,' the research pathway will involve this square. If the answer is a definite 'no,' the square is not relevant to this particular project. If all or some partners disagree, then discuss the question further.

Figure 7.7: Checked boxes for the steps you want to explore

When you have printed the tool (Figure 7.4), you can remove the steps you do not use and move on to the ones you want to explore further.

STEP 3: DETERMINE ACTIVITIES FOR EACH RESEARCH GOAL

How can you make sure that all of the activities are performed so as to support the ultimate goal of the research?

You could take the following actions:

- Incorporate previous research results or project outcomes;
- Outsource an activity and collaborate with an organization, an entrepreneur or a professional;
- Define the activities, desired results, the stakeholders that are involved and the person who is responsible for each step of the research pathway.

To work towards the goals, you can combine methods from different disciplines in various ways (See Chapter 3 for examples from the projects). These varied activities can be organized according to their orientation in time: they can be aimed at the future or at the present. The future orientation manifests clearly in the various generative methods that can be used to help individuals express their needs and desires, for example by *co-constructing stories*.

The present orientation is focused on evidence-based and pre-structured methods, for example by introducing a hi-fi prototype to practice. Both orientations provide appropriate means of gaining information on user needs, but the orientations and the expectations of the participants are different.

You can discuss the following questions:

- What kind of methods will you use?
- Are these methods future oriented or now oriented?
- Are the methods typical of a specific research discipline?
- Are the methods particularly relevant to science, practice or both?

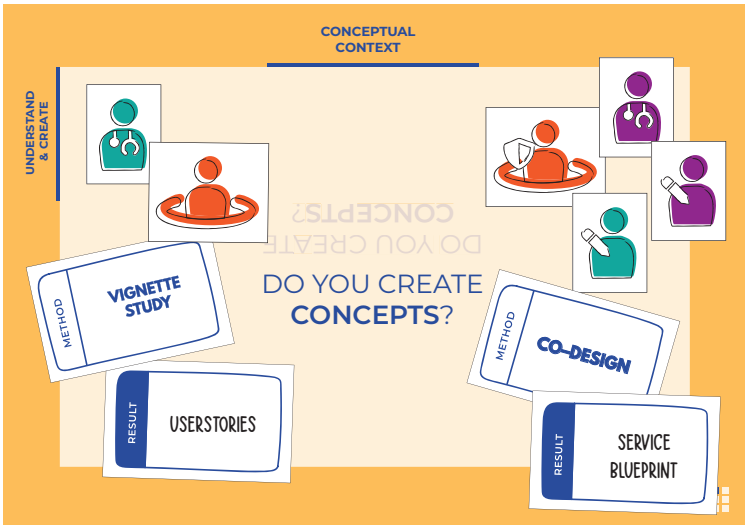


Figure 7.8: Research activities and research results, and stakeholders involved placed in the RPT

STEP 4: THINGS

Many projects work with 'things.' Three different types of things can be distinguished, namely products as solutions, research artefacts and proofs of concept (see Chapter 3). They have different purposes and require different ways of working. Therefore, it is important to discuss the kinds of things that you want to develop or use as well as your reasons.

Figure 7.9: Type of 'things' you want to develop

You can discuss the following questions:
What type of 'things' will you develop or use during the project?

- Do you see them as means or as ends within a square? Position the figure in the relevant squares, next to the 'methods' or 'results' cards.

Do you (fore)see any differences in goals or expectations?

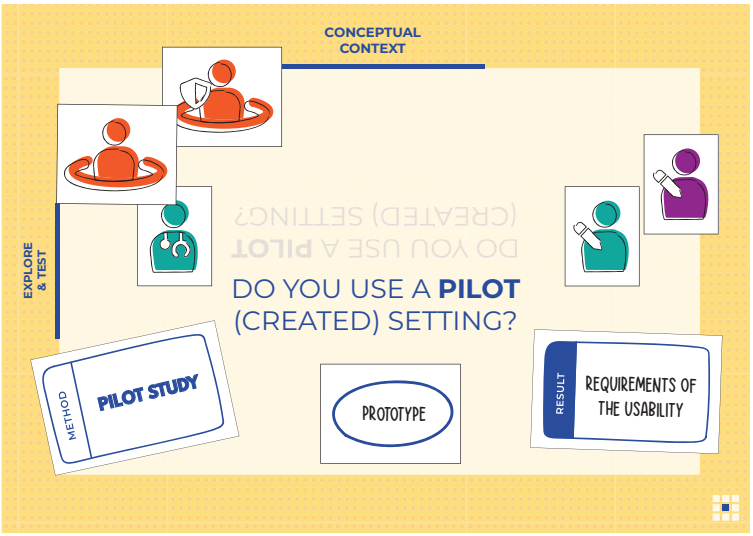


Figure 7.10: The 'things' placed in the RPT

STEP 5: PATHWAY OVER TIME

Iterating is an activity that is characteristic of innovative research projects. However, there are different ways of iterating. Chapter 3 provides examples from the 10 projects that show how different goals require different ways of iterating. The RPM helps to highlight these differences because you can map the differences in the manner in which research pathways move between the three contexts.

In the research that we presented in this book, two main ways of moving between the three contexts, which are non-linear processes, emerged: 1) the iterative development of a specific evidence-based innovation into a product (see Example 1, Figure 7.11) and 2) the iterative process of fleshing out a conceptual framework by conducting design explorations (see Example 2, Figure 7.12). The examples are described in Chapter 3. However, other pathways are also possible as long as they are helpful in your project.

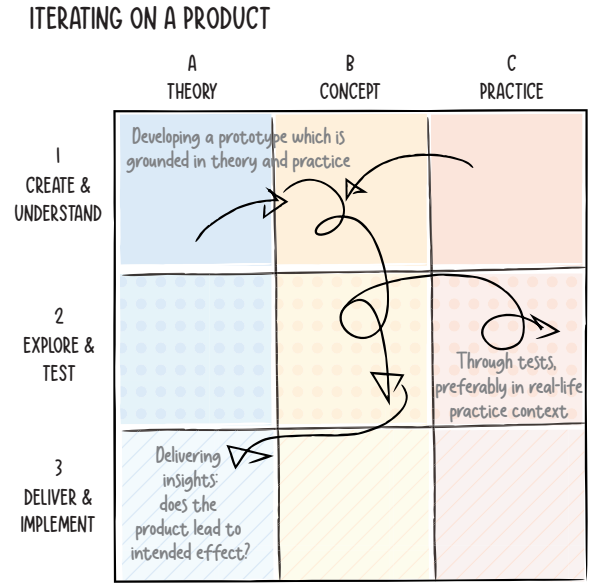


Figure 7.11: Example of the iterative development of a product

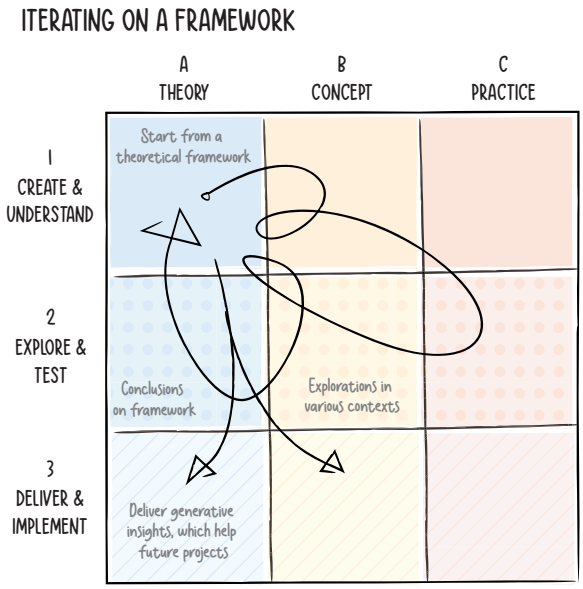


Figure 7.12: Example of the iterative development of a conceptual framework

You could discuss the following questions:

- Which pathway through the 3x3 matrix will you take? Map a path and discuss it.
- Will there be parallel paths?
- Where will the iterations take place?

During the project, research pathways, stakeholders, actors and partners may change, for example because the results of a particular research step call for a revision of the plan. You can use the Research Pathway Tool to consider your plans and to discuss the changes that are needed to arrive at the desired contributions to and benefits from the project as a whole and in relation to each individual actor.

In the following pages you will find all components of the Research Pathway Tool in a printable format. You could print out these specific pages on A4 or A3 paper size.
A pair of scissors will do the rest.

DO YOU CREATE **THEORY**?

¿THEORY DO YOU CREATE

DO YOU USE A **CONTROLLED** SETTING?

¿SETTING **CONTROLLED** A USE YOU DO

DO YOU DELIVER
THEORY?

DO YOU CREATE
CONCEPTS?

DO YOU CREATE
CONCEPTS?

DO YOU USE A **PILOT**
(CREATED) SETTING?

DO YOU USE A **PILOT**
(CREATED) SETTING?

DO YOU DELIVER A **PROTOTYPE**?

DO YOU DELIVER A **PROTOTYPE**?

DO YOU CREATE UNDERSTANDING OF **REAL-LIFE** PRACTICE?

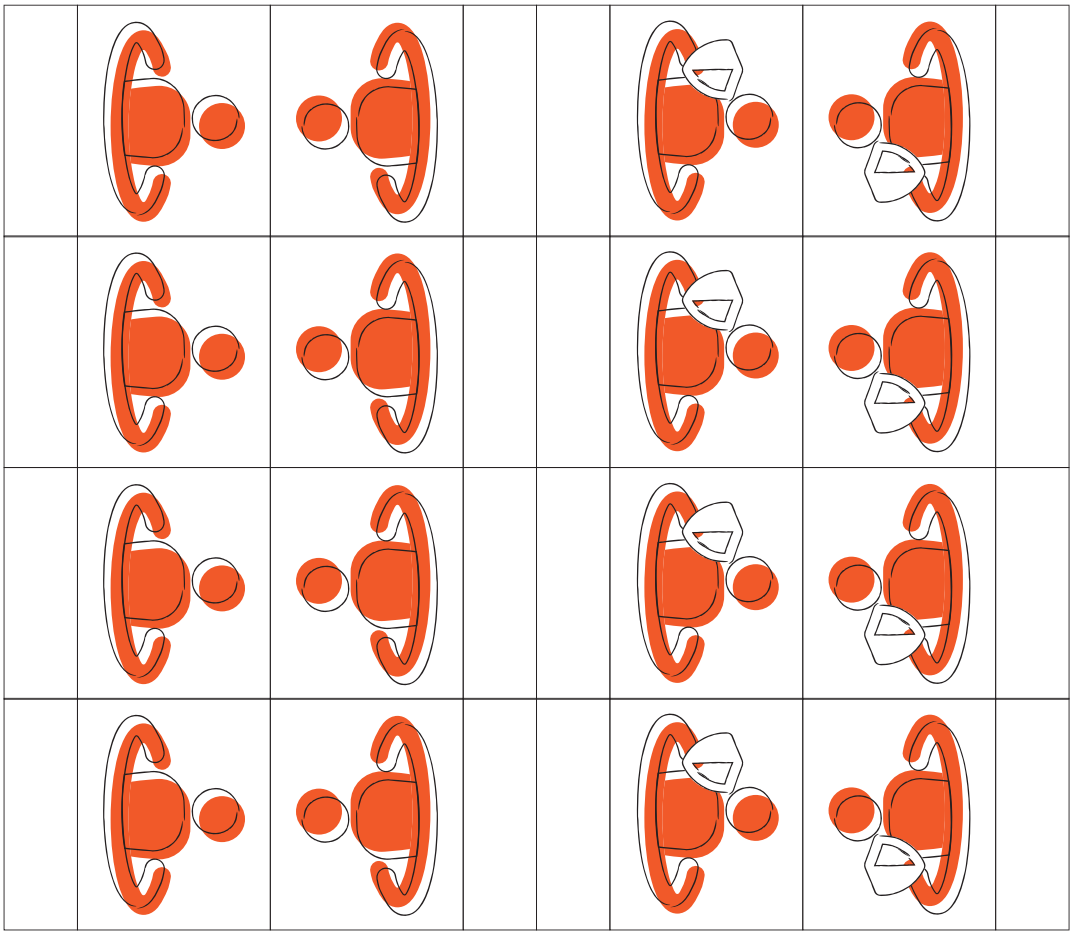
DO YOU CREATE UNDERSTANDING OF **REAL-LIFE** PRACTICE?

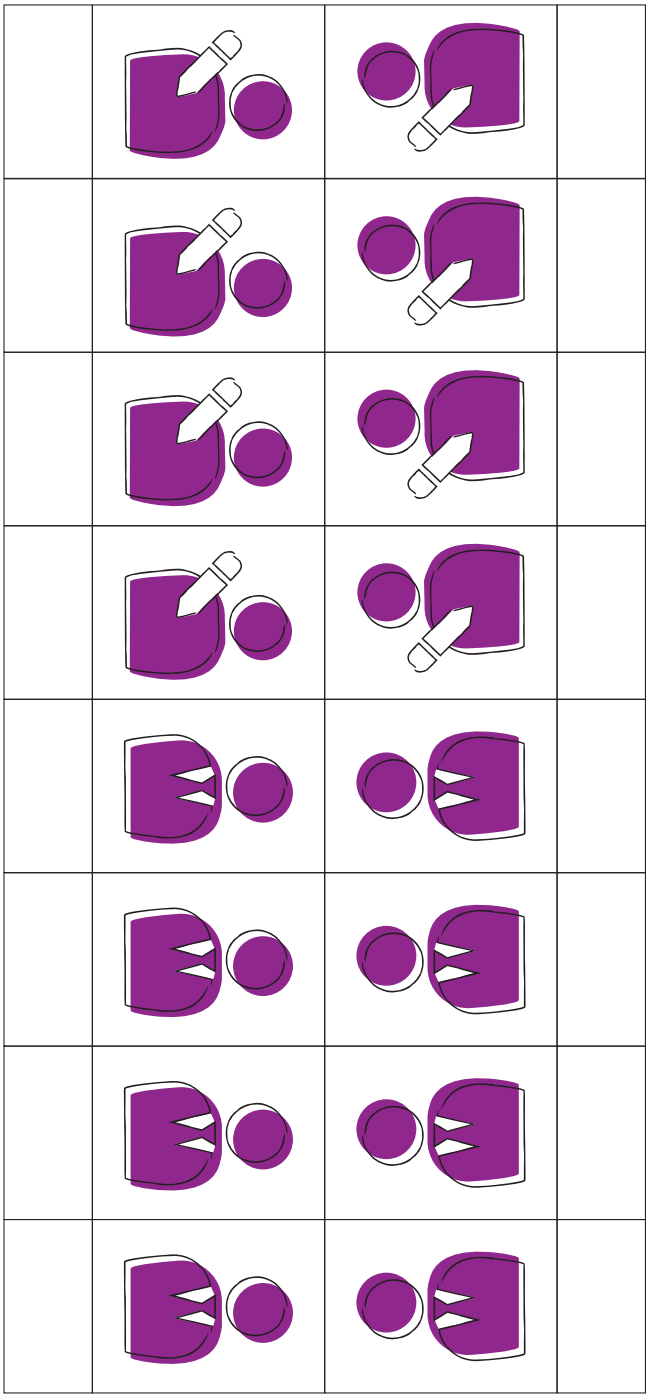
DO YOU USE A **REAL-LIFE** SETTING?

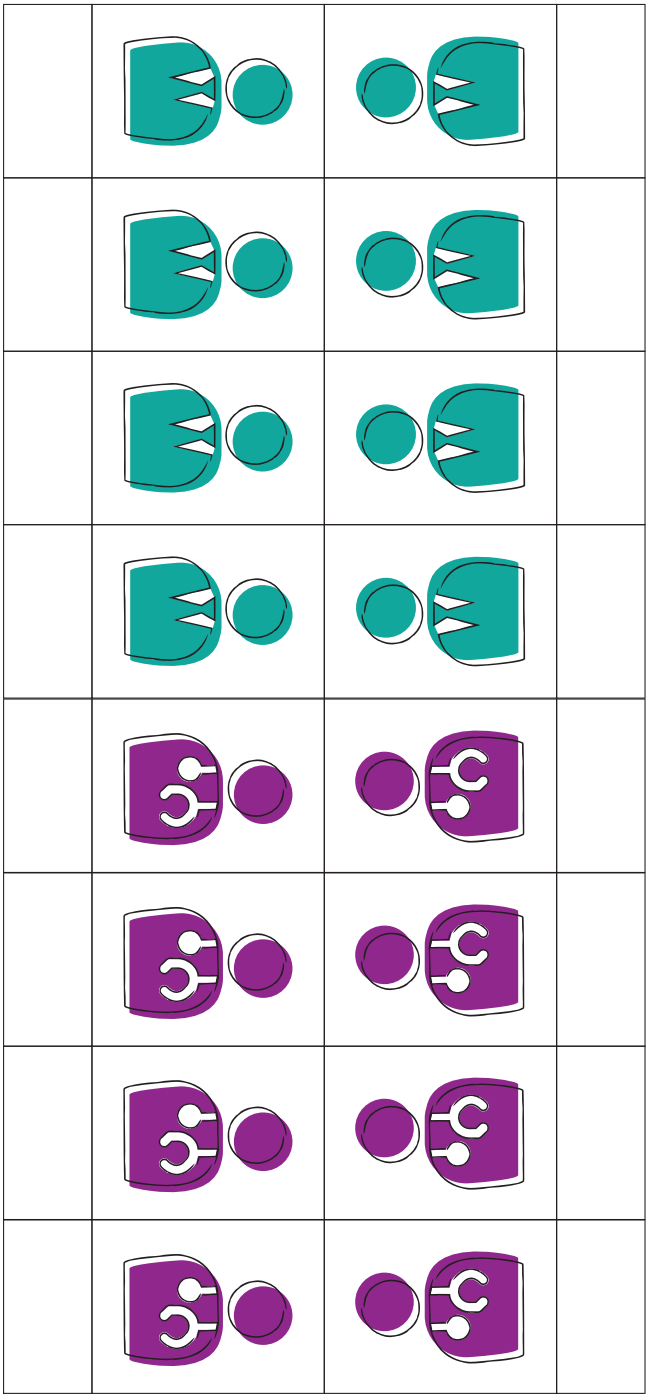
DO YOU **REALIZE**
CHANGES IN PRACTICE?

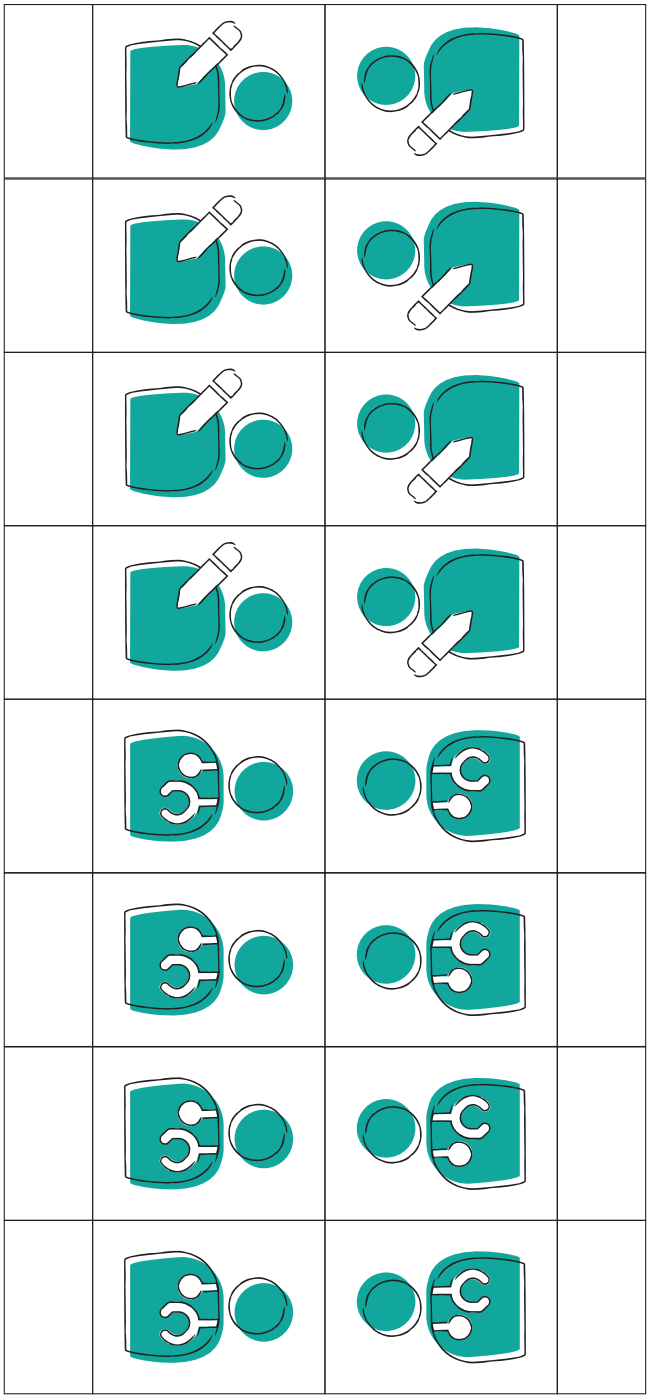
DO YOU **REALIZE**
CHANGES IN PRACTICE?

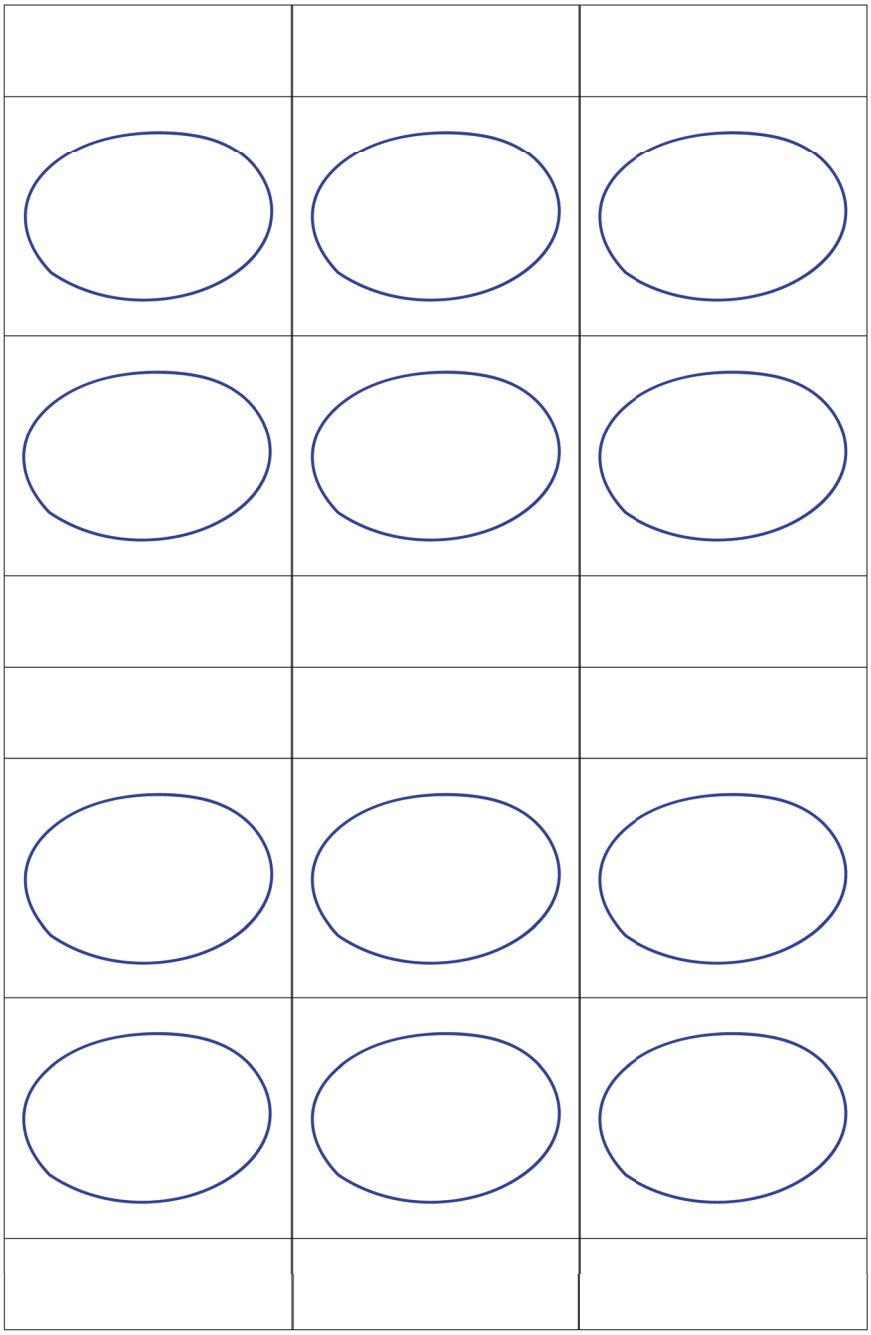

UNDERSTAND & CREATE
DO YOU CREATE UNDERSTANDING OF REAL-LIFE PRACTICE?
PRACTICAL CONTEXT

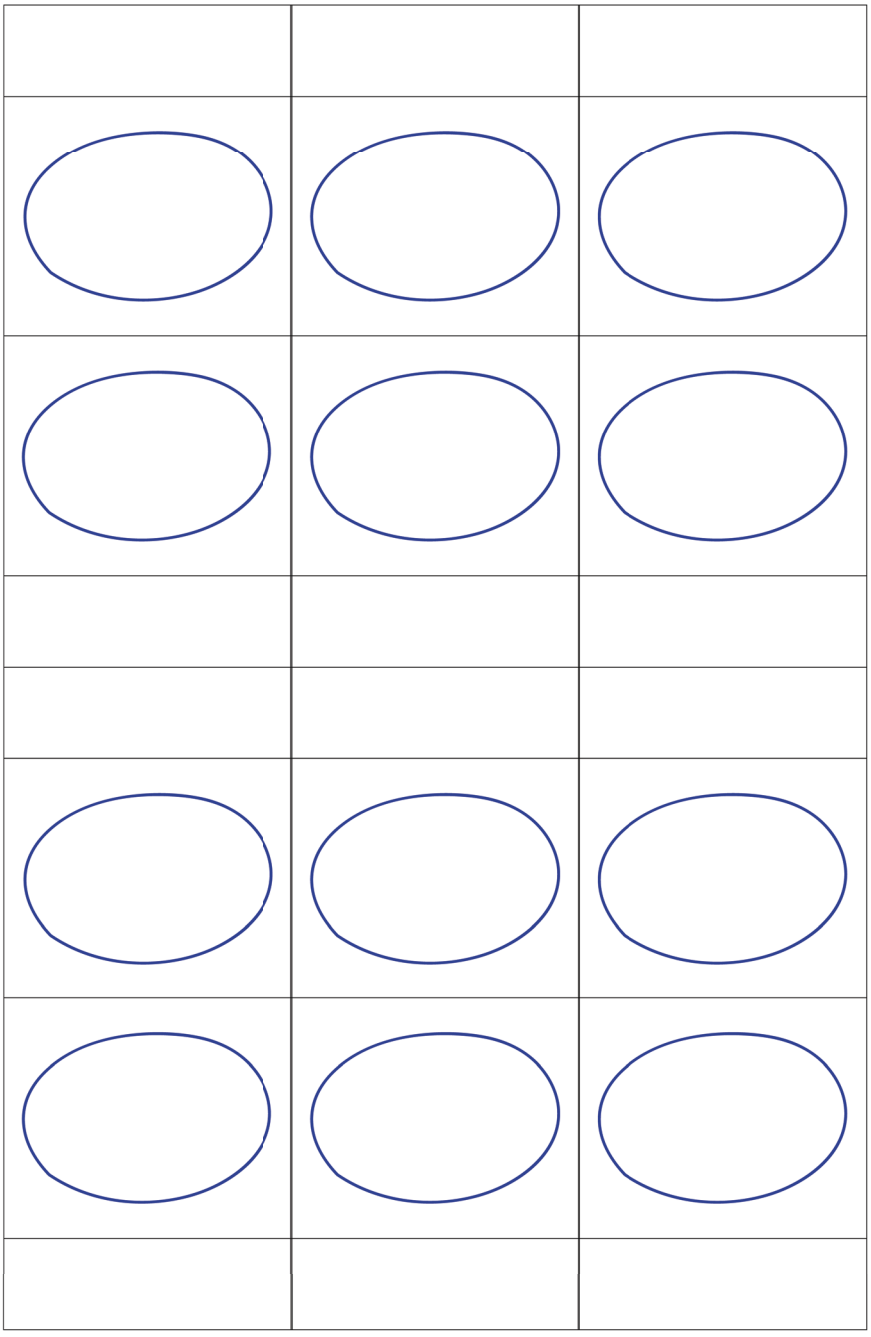


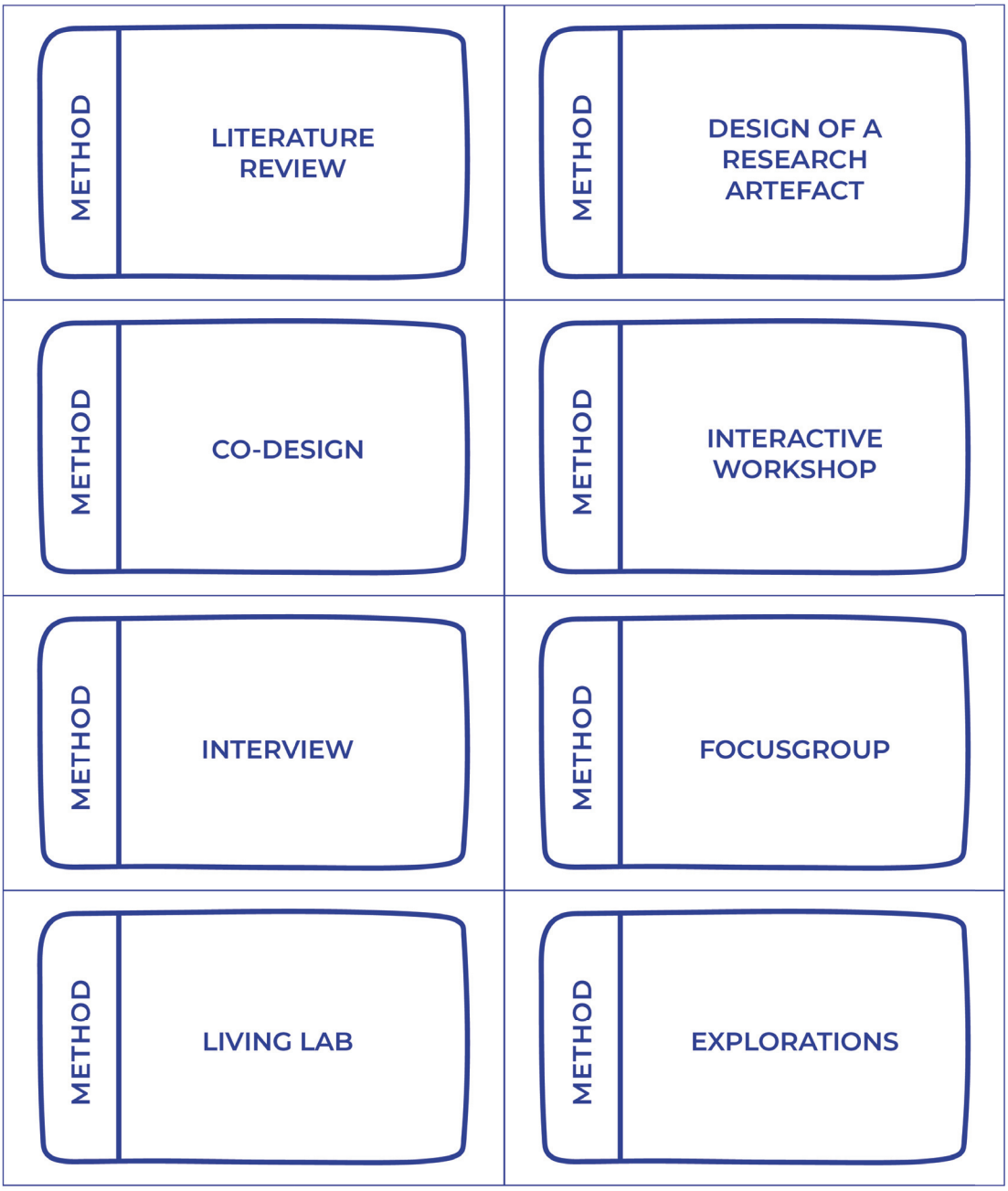








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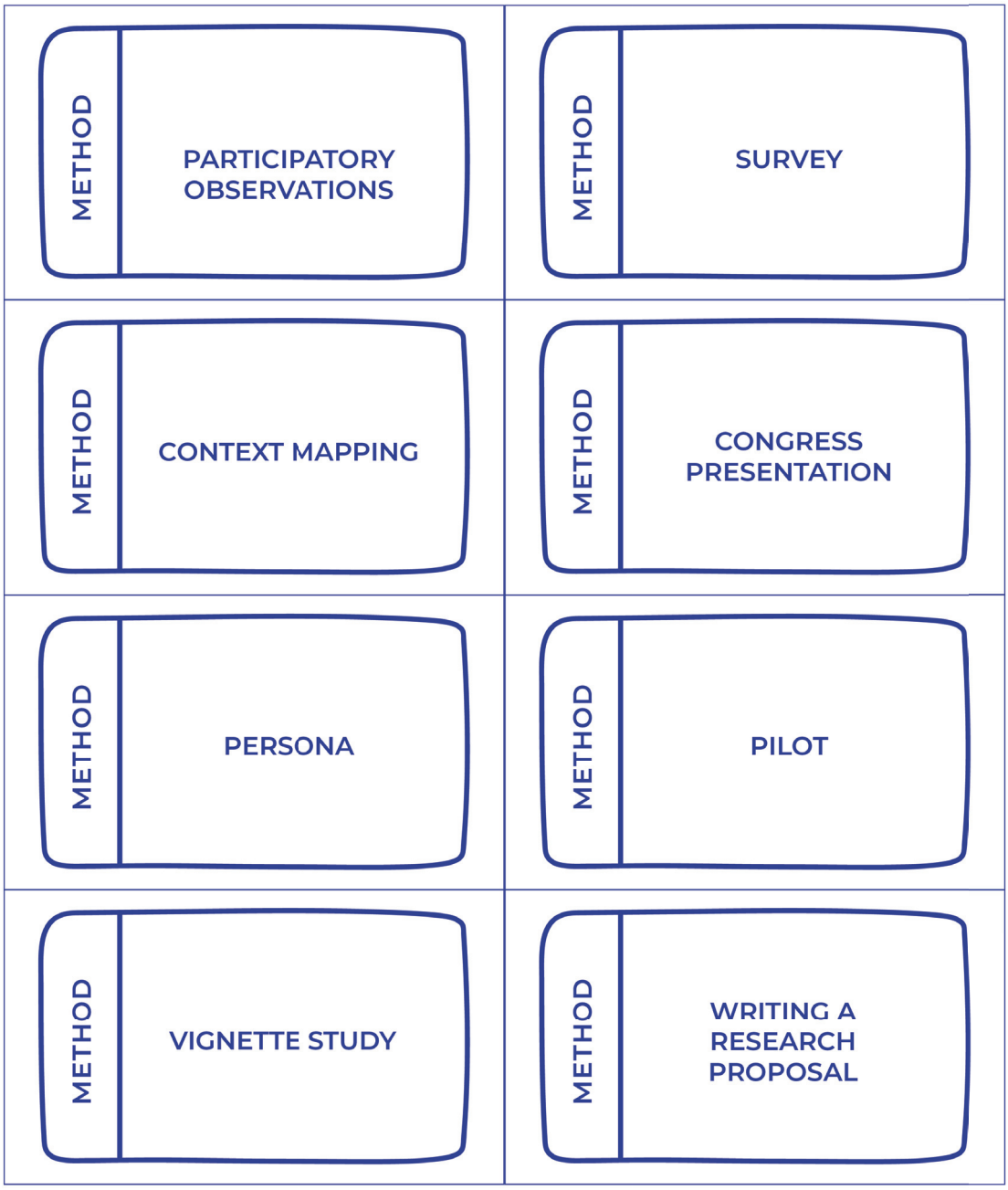
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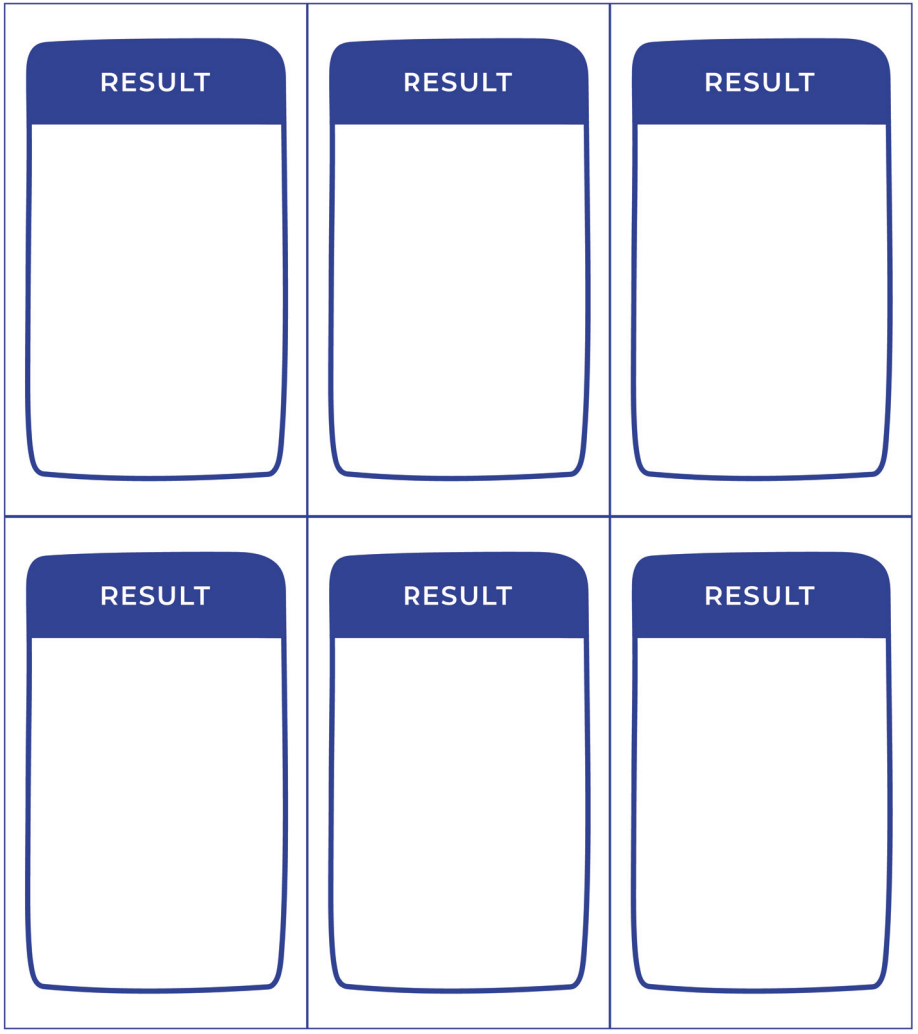
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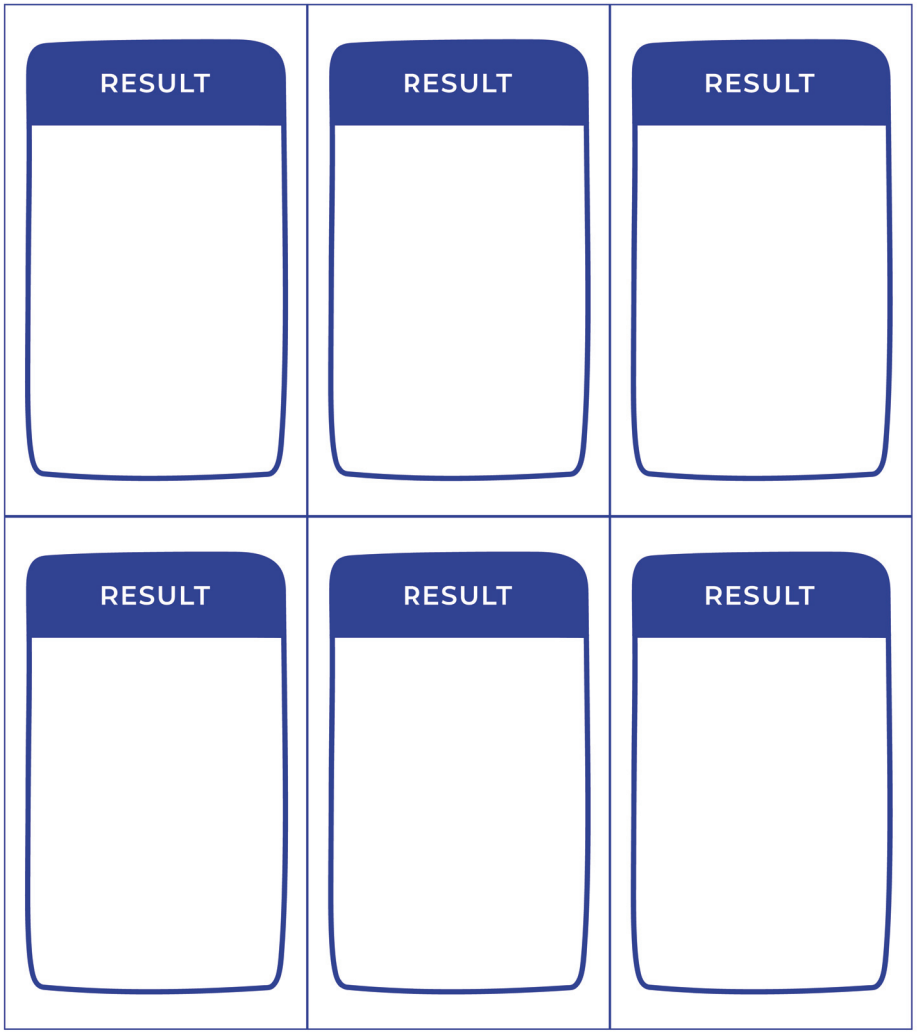
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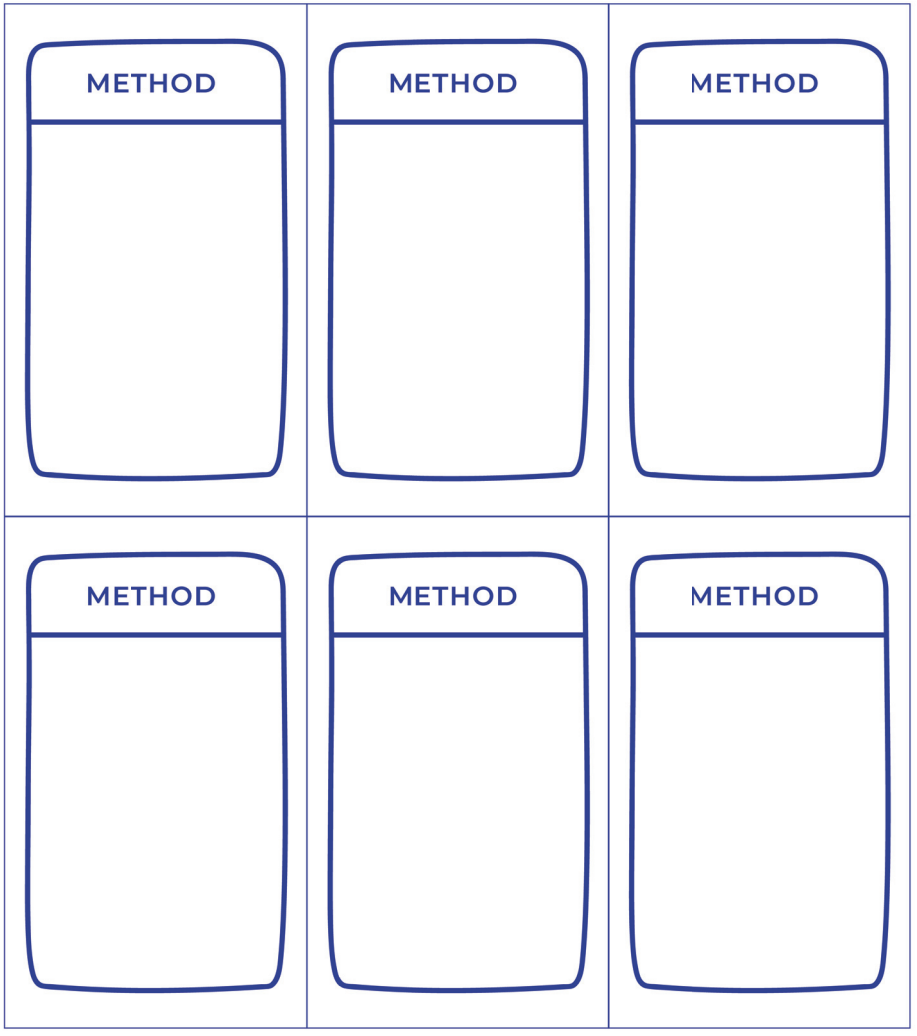
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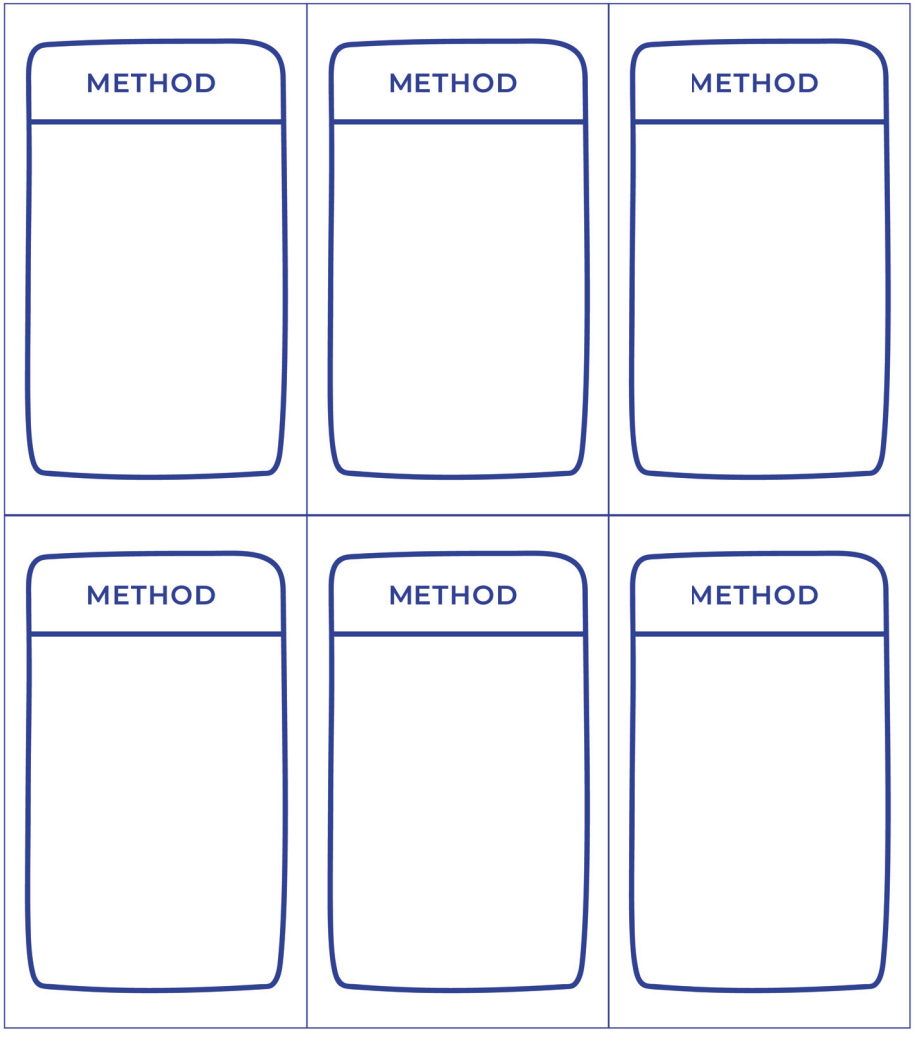
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CHAPTER 2

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