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Design Recommendations for  
Social Engagement Platforms: Towards  
Enhanced Technology Adoption by  
Elderly People and Long-Term Engagement

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Dissertation presented in fulfilment of the  
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## Abstract

The number of people aged 65 or older, both within Europe and globally, is projected to increase substantially by 2050, nearly doubling from the 2018 figure of 101 million. At the same time, elderly are looking to stay in their homes as long as possible, which increases the need for a different level of support. Services that are focusing on volunteering and helping others can be of great importance in this regard. The COVID-19 pandemic also showed the vulnerability of elderly who suddenly were recommended not to meet too many people and to avoid stores. As a result, they became dependent on other people, even for tasks that they might have been able to do by themselves. As physical meetings had to be avoided, the importance of digital social engagement platforms has become clearer. However, the use of digital social engagement platforms poses two problems: 1) There are indicators that older people are lagging behind in adopting new technologies, while computer and internet-based services have become prevalent in the modern world and in particular during the COVID-19 pandemic; and 2) The acquisition and especially retention of volunteers is not without challenges.

In this dissertation, we have addressed both problems from a computer science point of view. First, we investigated what is required to make digital social engagement platforms that are focusing on requesting and offering help for everyday tasks more accessible to elderly. For this, we used a comprehensive view at the topic covering both social as well as technical and design issues, but dealing with them from the perspective of computer science. To address the first problem, we first took an in depth look at technology adoption factors focusing on older users. Next, we looked at current usability guidelines focusing on designing technologies for elderly and investigated their relevance for modern technology. To deal with the second problem, we searched and explored techniques that are known or could be used for motivating and engaging users. More specifically, gamification, persuasive strategies, and nudging were considered.

After having studied the two problems from a general point of view, we returned to our concrete use case, social engagement platforms. The COVID-19 pandemic brought several social engagement platforms to the spotlight, including existing ones as well as new ones. An extensive evaluation of several of these platforms has been conducted to examine how well they address the two problems mentioned. This evaluation was performed by means of hands-on evaluations, interviews with representatives from five platforms, and user surveys conducted on three of the platforms (resulting in more than 800 responses, from users in Finland and Belgium).

Based on all the results, we compiled a list of recommendations on how existing social engagement platforms might become more accessible to elderly, and could stimulate the long-term engagement of their users. A pilot study with elderly was performed to evaluate some of our key recommendations.

Finally, we also discussed and proposed a new approach on how gamification could be utilized in this context for bridging inter-generational divides. The concepts are illustrated by the means of an early proof of concept.

The core contributions of this dissertation are:

- An up-to-date overview of the research field on the adoption and use of digital technology by elderly.
- An up-to-date list of usability design guidelines for elderly users, evaluated with experts.
- An overview of gamification, persuasive technology, and nudging, and their effectiveness as reported in the literature.
- A thorough evaluation of existing social engagement platforms.
- A list of recommendations on how social engagement platforms might become more accessible to elderly as well as on how they could better stimulate the long-term engagement of their users, together with a first evaluation.
- A new approach for using gamification in these types of platforms to stimulate long-term engagement and with the potential to bridge inter-generational divides.

## Preface

Great care has been taken in structuring this dissertation to show the coherence between the problem statement, the individual research questions, and the steps taken to answer them. However, like most things in life, the real process was not as linear as the structuring suggests. This PhD dissertation originally started with the Nosville project. We planned to set up an environment to test our approach to use loosely coupled platforms as a method for improving long-term engagement. Based on a series of meetings with Sarah Dury from the department of Educational sciences of our university, we had decided to do this in the context of volunteerism for helping elderly. The plan was to create a simple platform wherein elderly users could request for help and volunteers could respond, and that, as a result of successfully completed requests, would generate digital rewards for a separate, loosely coupled, game platform. The goal was to evaluate the platform with some volunteering organizations.

The development of a proof of concept environment was started but the original planning was somewhat disrupted by COVID-19. First, adopting a user-centered development approach became difficult as the elderly were very vulnerable and physical contact was forbidden. As the lockdown lengthened, we decided to give up on our original plan of using a user centered development approach. In late spring of 2020, a new plan was drawn up. Instead of contacting elderly to establish the requirements for the environment, we would focus on existing literature and existing research work to establish the requirements for such an environment (i.e., desk research). This became our main focus point for the next 8 months.

We were aware of the existing social engagement platforms from the start of our research project. Over the summer of 2021, the known list of platforms was further expanded with a more focused survey, during which all the discovered platforms were sent requests for an interview. We were pleasantly surprised when not only one, but eventually five of the platforms responded and agreed to be interviewed by us during early autumn in 2021. Because at that time we already had gathered quite some insights from our desk research, we decided to combine general questions about the use and development of the platform with questions that gauge for their opinion about recommendations to improve the platform. The same approach was used in the user surveys, which again was a welcome surprise that three platforms actually gave us a green light on this endeavor (during the interviews, one last question presented was always whether a survey with the platform's users could be done). However, for the sake of the structure of the dissertation, the reporting about the interviews and the surveys have been split in two: one part focuses on the questions related to the current state of the platform and a second part on the recommendations. For the user surveys, the earlier developed prototype environment, called Nosville, was adapted to incorporate the recommendations that would be subject to questions. In this way, it was also possible to present Nosville as a proof of concept for the next generation of social engagement platforms.

To put it shortly, the journey for this research project begun from where it also ends: the Nosville project. Due to the global pandemic, changes to the original plan were required. However, the focus on improving technology adoption for elderly users and in the context of volunteerism and elderly users encouraging a more long-term engagement of both parties, remained the same.

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אבל בכל זאת אני יודע עשית כמיטב יכולתך.  
אני מתגעגע אליך

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## Acronyms

ADOPT	Accelerating Diffusion of Proven Technologies
BCT	Behavior Change Technique
CREATE	Center for Research and Education on Aging and Technology Enhancement
DBCI	Digital Behavior Change Intervention
PSD	Persuasive System Design
PT	Persuasive Technology
RQ	Research question
UX	User Experience
UI	User Interface
UID	User Interface Design
SE	Social Engagement
UCD	User Centered Design
TAM	Technology Acceptance Model
TAM2	Extension of the Technology Acceptance Model
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology

# Contents

<b>1</b>	<b>Introduction</b>	<b>15</b>
1.1	Research Objective and Questions . . . . .	17
1.2	Dissertation Outline . . . . .	19
1.3	Publications . . . . .	20
<b>2</b>	<b>Designing Software for Elderly: Up-To-Date List of UI Design Guidelines and Their Relation to Lee’s Adoption Factors</b>	<b>23</b>
2.1	User Design Guidelines for Elderly Users . . . . .	24
2.1.1	Designing for Elderly Users - State of the Art . . . . .	24
2.1.2	Towards an Up To Date Set of Usability Guidelines . . . . .	26
2.2	Technology Adoption of Elderly Users . . . . .	37
2.2.1	Technology Adoption Models . . . . .	37
2.2.2	Technology Acceptance Model (TAM) . . . . .	38
2.2.3	Unified Theory of Acceptance and Use of Technology (UTAUT & UTAUT2) . . . . .	39
2.2.4	Technology Adoption Models for Elderly Users . . . . .	40
2.2.5	Lee’s Factors . . . . .	42
2.3	Reference Model for Design Guidelines for Elderly . . . . .	43
2.3.1	Literature Review of Web Design Guidelines . . . . .	43
2.3.2	Reference Model . . . . .	44
2.4	Summary . . . . .	48
<b>3</b>	<b>Digital Engagement Techniques: A Meta Review of Gamification, Persuasive Technology &amp; Nudging</b>	<b>50</b>
3.1	Background . . . . .	51
3.1.1	Engagement . . . . .	51
3.1.2	Motivation . . . . .	52
3.1.3	Gamification . . . . .	53
3.1.4	Persuasive Technology . . . . .	55
3.1.5	Nudging . . . . .	61
3.2	Meta-Review: Methodology . . . . .	61
3.2.1	Planning . . . . .	62
3.2.2	Conducting the Paper Selection . . . . .	62

3.2.3	Data Extraction and Synthesis . . . . .	63
3.2.4	Terminology . . . . .	64
3.3	Meta-Review: Findings . . . . .	64
3.3.1	Gamification . . . . .	65
3.3.2	Persuasive Technology . . . . .	71
3.3.3	Nudging . . . . .	76
3.3.4	Targeted Age Groups . . . . .	80
3.4	Discussion . . . . .	82
3.4.1	On the Elements . . . . .	82
3.4.2	On Effectiveness of Elements . . . . .	83
3.4.3	On Overlap of Elements . . . . .	84
3.4.4	Limitations . . . . .	84
3.4.5	Directions for Future Work . . . . .	85
3.5	Summary . . . . .	86
<b>4</b>	<b>Existing Social Engagement Platforms: An Evaluation</b>	<b>88</b>
4.1	Introduction . . . . .	88
4.2	Methodology . . . . .	89
4.2.1	Finding and Selecting Social Engagement Platforms . . . . .	90
4.2.2	The Interviews . . . . .	90
4.2.3	User Surveys . . . . .	92
4.2.4	Hands-on Evaluation of the Platforms . . . . .	93
4.3	Selected Platforms . . . . .	94
4.4	Survey Results . . . . .	97
4.4.1	Response Rate . . . . .	97
4.4.2	Age & Gender Distribution . . . . .	97
4.4.3	Frequency of Use . . . . .	98
4.4.4	Device Used (P4) . . . . .	98
4.4.5	Help Requests . . . . .	99
4.4.6	Help Request Success Rate . . . . .	100
4.4.7	Number and Types of Help Requests . . . . .	100
4.4.8	Ease of Help Request Process . . . . .	101
4.4.9	Response Rates to Help Requests & Offering Help . . . . .	103
4.4.10	Ease of Offering Help . . . . .	104
4.4.11	Barriers to Asking & Offering Help . . . . .	105
4.4.12	Motivation to Help . . . . .	107
4.4.13	Feature-specific Results . . . . .	107
4.5	Results of Hands-On Evaluation and Interviews . . . . .	109
4.5.1	Emotion . . . . .	110
4.5.2	Independence . . . . .	113
4.5.3	Usability . . . . .	115
4.5.4	Value . . . . .	119
4.5.5	Experience . . . . .	121
4.5.6	Social Support . . . . .	122
4.5.7	Technical Support . . . . .	125

4.5.8	Confidence . . . . .	127
4.5.9	Affordability & Accessibility . . . . .	129
4.5.10	Trust & Security . . . . .	130
4.5.11	Dormant Users . . . . .	132
4.6	Other Studies . . . . .	134
4.6.1	Study on Hoplr . . . . .	134
4.6.2	Studies on Nappi Naapuri . . . . .	134
4.7	Discussion . . . . .	135
4.8	Conclusions . . . . .	136
<b>5</b>	<b>Design Recommendations for Improving Social Engagement Platforms for Elderly</b>	<b>138</b>
5.1	Introduction . . . . .	138
5.2	Methodology . . . . .	138
5.3	Recommendations . . . . .	139
5.3.1	(R1) Points with purpose (Emotion) . . . . .	139
5.3.2	(R2) Show activity (Emotion, Dormant Users) . . . . .	141
5.3.3	(R3) Guiding (Independence) . . . . .	142
5.3.4	(R4) Onboarding (Independence) . . . . .	143
5.3.5	(R5) Usability guidelines (Usability) . . . . .	144
5.3.6	(R6) Handling user feedback (Usability, Trust & Security) . . . . .	145
5.3.7	(R7) Audio & video messages (Usability) . . . . .	146
5.3.8	(R8) Customization (Usability, Experience) . . . . .	147
5.3.9	(R9) Clear value (Value) . . . . .	147
5.3.10	(R10) Transparency (Trust & Security) . . . . .	148
5.3.11	(R11) Support & encourage communication (Social support, Confidence) . . . . .	149
5.3.12	(R12) Help manuals (Technical Support) . . . . .	150
5.3.13	(R13) User roles (Technical support, Emotion, Dormant users) . . . . .	151
5.3.14	(R14) Safety features (Trust & Security) . . . . .	152
5.3.15	(R15) Area of visibility (Trust & Security) . . . . .	153
5.3.16	(R16) Provide activities (Dormant Users) . . . . .	153
5.3.17	(R17) Account creation (Usability) . . . . .	154
5.3.18	Summary of the Recommendations . . . . .	155
5.3.19	Possible Other Recommendations . . . . .	157
5.4	Conclusions . . . . .	159
<b>6</b>	<b>Evaluation of Selected Number of Recommendations</b>	<b>160</b>
6.1	Introduction . . . . .	160
6.2	Methodology . . . . .	160
6.3	Results of the Survey-based Evaluation . . . . .	163
6.3.1	Adoption Factor: Emotion . . . . .	163
6.3.2	Adoption Factor: Usability . . . . .	169
6.3.3	Adoption Factor: Security & Trust . . . . .	175

6.3.4	Adoption factor: Dormant Users . . . . .	180
6.3.5	Missing Features . . . . .	182
6.4	Results of the Interview-based Evaluation . . . . .	182
6.4.1	(R1) Points with a purpose (Emotion, Dormant Users) . . . . .	183
6.4.2	(R2) Show activity (Emotion) . . . . .	184
6.4.3	(R5) Usability guidelines: Message Feed (Usability) . . . . .	185
6.4.4	(R7) Audio & video messages (Usability) . . . . .	185
6.4.5	(R15) Safety features (Security & Trust) . . . . .	186
6.4.6	(R13) User roles (Dormant Users) . . . . .	187
6.5	Discussion . . . . .	187
6.5.1	(R1) Points with purpose . . . . .	187
6.5.2	(R2) Show activity . . . . .	188
6.5.3	(R5) Usability guidelines . . . . .	189
6.5.4	(R7) Audio & video messages . . . . .	189
6.5.5	(R12) Help manuals . . . . .	190
6.5.6	(R14) Safety features: Soft barriers . . . . .	190
6.5.7	(R14) Safety features: Meetings . . . . .	191
6.5.8	(R15) Area of Visibility . . . . .	191
6.5.9	(R13) User roles and (R16) Provide activities . . . . .	191
6.5.10	General Remark . . . . .	192
6.6	Conclusions . . . . .	192
<b>7</b>	<b>Nosville: Proof of Concept Social Engagement Platform</b>	<b>194</b>
7.1	Introduction . . . . .	194
7.2	Nosville . . . . .	195
7.2.1	TICKLE Framework . . . . .	195
7.2.2	Overview of Nosville . . . . .	196
7.2.3	Help Requests . . . . .	197
7.2.4	Language Use . . . . .	200
7.2.5	Guidance . . . . .	200
7.2.6	Map View . . . . .	201
7.2.7	The Game . . . . .	202
7.3	Nosville Evaluation . . . . .	204
7.3.1	Methodology . . . . .	204
7.3.2	Results of Pilot User Study . . . . .	208
7.3.3	Discussion Pilot User Study . . . . .	212
7.3.4	Results Game Evaluation . . . . .	213
7.3.5	Discussion Game Evaluation . . . . .	217
7.4	Conclusions . . . . .	217
7.5	Summary . . . . .	218

<b>8</b>	<b>Conclusions and Future Work</b>	<b>220</b>
8.1	Summary & Findings . . . . .	220
8.2	Contributions . . . . .	224
8.3	Limitations . . . . .	225
8.4	Future Work . . . . .	226
8.5	Conclusion . . . . .	228
<b>A</b>	<b>Tables and Figures</b>	<b>252</b>

# Chapter 1

## Introduction

*“I’ve come up with a set of rules that describe our reactions to technologies:*

- 1. Anything that is in the world when you’re born is normal and ordinary and is just a natural part of the way the world works.*
- 2. Anything that’s invented between when you’re fifteen and thirty-five is new and exciting and revolutionary and you can probably get a career in it.*
- 3. Anything invented after you’re thirty-five is against the natural order of things.”*

---

Douglas Adams, How to Stop Worrying and Learn to Love the Internet

According to the European ageing report (Eurostat, 2019), 20.3% of the EU population was aged 65 years or over in 2019. Additionally, according to the same report, it is estimated that the total number of elderly people (people aged 65 years or older) will rise from 101 million (2018 figure) to 149 millions by 2050, with the number of people aged 75–84 years increasing by 60.5%, and the population of very old (85 years or more) is expected to more than double to 31.8 million.

Also, according to an EU survey conducted in 2017 (Eurostat, 2019), the current level of technology adoption is still changing slowly. According to the survey, 48% of the older EU population (ages 65-74) had not used the Internet in the three months preceding the survey. The report also stated that older people were three times as likely as the average adult (16–74) to not have used the Internet. This was also the case for countries with overall high levels of digital use.

At the same time, in some countries such as Belgium there has been a shift in the attitude of elderly who now want to stay in their homes as long as possible instead of moving to care homes (Dury, 2018). This has brought the need for more assistance to elderly, ranging from help with small tasks, such as shopping or dispose of waste, to major tasks, such as cleaning the

house or maintaining the garden. Social engagement platforms and services that aim to recruit volunteers to help elderly people at their homes can be of great help in this regard. However, the acquisition of volunteers is not without its difficulties (Dury, 2018, Nakagawa et al., 2011). Depending on the type of volunteering, acquisition and training can be expensive (Miller et al., 1990), and retaining volunteers over time is not evident (Warburton and McDonald, 2009, Dury, 2018), which may be crucial for the stability of the operation of such an organization as a whole (Chacón et al., 2007).

Several volunteer projects exist to aid elderly people, such as “time banking” (Dury, 2018) or “co-living” (Quinio, 2018). However, the COVID-19 pandemic worsened the situation, such as increasing loneliness of all age groups, but in particular of elderly people (Heidinger and Richter, 2020). A number of community-oriented platforms such as Hoplr, Nextdoor, and ¿Tienes sal? focus on providing more assistance to these groups, by introducing tools for formulating help requests. Also, additional services solely aimed for this either came into the spotlights (like Nappi Naapuri in Finland) or were launched (Nachbarschaft (Germany), Facebook Help Hub (U.S)). However, none of these platforms were originally designed with elderly users in mind.

Increased loneliness (of all age groups) is not a problem that can be easily solved. It requires systematic effort from various levels of a society and collaboration of several sectors, organisations, and groups of people (Hardy, 2014, John, 2018, Baarck et al., 2021). Creating a digital platform that effectively connects elderly people with each other and with their local community can contribute to the solution but is not a trivial undertaking. There are several challenges, especially the usability of the platform for elderly and dealing with adoption factors such as trust and perceived security. Despite the fact that basic usability requirements for systems intended for elderly users have been rather thoroughly considered by numerous studies and evaluations, the apparent slow adoption rate of technology by elderly suggests that there is still more work to be done in this field (Eurostat, 2019). Secondly, and as we already indicated, acquiring and also retaining volunteers to help elderly people is not easy. Motivations of volunteers to join vary and are known to a certain extent, but reasons for quitting are less known (Dury, 2018).

Identifying and investigating the factors that need to be understood to make digital social engagement platforms successful, especially in the context of elderly users (ages 65 and up), is the subject of this dissertation. By successful we mean that the platform is capable of creating a sustainable social capital. Our definition for social engagement platform is based on the definition of social engagement given by Zhang et al. (2011):

*“Social engagement is the commitment of a member to stay in the group and interact with other members.”*

Zhang et al. (2011) goes on to write on the difficulty of what activities can be count as social engagement. Our definition for a social engagement platforms is essentially the same as the definition given for social engagement by Zhang et al. (2011) but with the following addendum: “*interaction of people is enabled by a digital platform*”. Additionally, “activity” in our context refers to volunteerism, especially creation and responding to help requests.

## 1.1 Research Objective and Questions

To bring people together that do not know each other and who might also be very diverse in background and age, is not easy as witnessed by several projects in the Brussels Region performed in the context of the Co-Creation program of the Brussels research funding agent [innoviris.brussels](https://innoviris.brussels)<sup>1</sup>, for instance the CITIZENDEV<sup>2</sup> and the MaN’ Aige<sup>3</sup> projects, and volunteer organizations like BuurtPensioen<sup>4</sup>. However, these projects usually focus on creating networks with a physical meeting place and regular meeting moments. While the possibility of physical encounters is an essential component for certain target groups, it is rather an obstacle for another part of the population who may not have the time for this or do not feel addressed by this. In addition, physical meetings were just not possible during the pandemic. Therefore, our focus will be on digitally connecting people. In addition, we also want to address the retention rate for participation in such networks.

Therefore, our main research objective is **to digitally connect elderly users with other members of their community and nurture a long-term engagement between the two groups**. In order to realize this, a number of research questions need to be answered. We formulate and justify them in the rest of this section.

As we explicitly target elderly users as part of the target audience, it is necessary to ensure that our ‘digital technology’ is suitable for elderly users. Therefore, the first major research question concerns this main target audience:

- **RQ1** How to ensure that digital technology will be adopted by elderly?

To answer this research question, we need to know which aspects are important to take into consideration when designing software for the elderly. This resulted into two sub-questions with which we want to identify what has already been researched in this context and to investigate whether current means cover all aspects.

- **RQ1.1** What aspects have already been identified as important to take into consideration when designing a digital application for elderly users?

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<sup>1</sup><https://innoviris.brussels/news/co-creation>

<sup>2</sup><https://www.cocreate.brussels/nl/projet/citizendev-2/>

<sup>3</sup><https://www.cocreate.brussels/nl/projet/manaige-3/>

<sup>4</sup><https://www.kenniscentrumwwz.be/wat-het-buurtpensioen>

- **RQ1.2** What tools (e.g., guidelines, theories) currently exist for designing technology for elderly users, and do they cover all aspects identified in RQ1.1?

Based on the findings, we will seek to give an answer to the question which aspects to use for our research objective and how they can be organized to provide guidance when developing software for elderly users.

- **RQ1.3** How can we provide more guidance to developers when developing software for elderly users?

Next, engagement is a crucial part of any successful digital technology. Engagement of users with digital technology has been researched since it became accessible to the average consumer and several approaches have been formed around this issue, i.e. gamification, persuasive technology, and nudging being the most important ones. Therefore, it is imperative to investigate how effective these approaches are, and which one would be usable for our purpose and our specific target audience, i.e., elderly users as the core focus, but also volunteers who can be from varied age-groups. This resulted into the following research question:

- **RQ2** What kind of long-term engagement techniques are available and how effective are they for different user age groups?

Since several social engagement platforms became available due to COVID-19, it is useful to take a look on what they do right, or wrong in terms of the main objective of such a platform in order to learn from this and to improve on this in our proposed solution. This results in the following research question and sub-questions:

- **RQ3** What is the current state of existing social engagement platforms?
- **RQ3.1** How well are existing social engagement platforms tailored towards elderly users?
- **RQ3.2** Which long-term engagement techniques are used by existing SE platforms?
- **RQ4** What aspects could be improved in the evaluated SE platforms and which of these can we provide to developers as recommendations to take into consideration when developing SE platforms focusing on elderly users?

## 1.2 Dissertation Outline

In this section, we give an overview of the chapters in the dissertation and what they entail. Chapters 2 to 7 cover the work done for this dissertation; **Chapter 1** (the current chapter) provides the introduction and **Chapter 8** presents conclusions, limitations and possible future work.

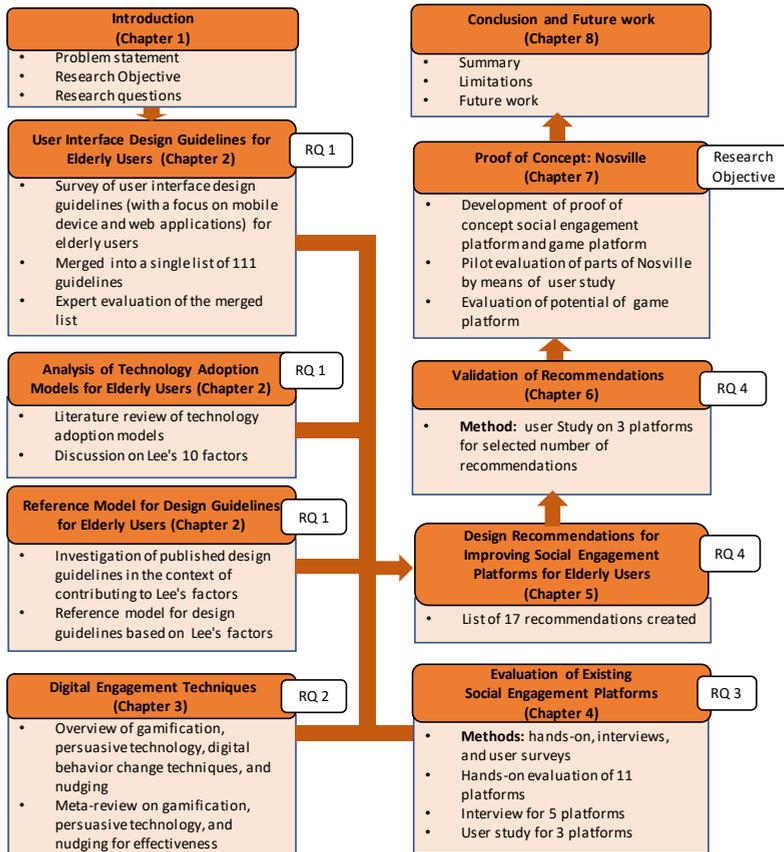


Figure 1.1: Illustration of the structure of this dissertation

As we touch on numerous topics in this dissertation and provide contribution to several areas, this dissertation has been split into chapters that present individual topics independently. This is also done to make each chapter easier to understand and to provide relevant background information and related work in a clear manner. Figure 1.1 provides an overview of the content of the different chapters and illustrates how these chapters are connected to one another; arrows are used to indicate that the output of one or more chapters is used as input for another chapter. As can be observed, chapters 2 to 4 pro-

vide input for Chapter 5 where we present our design recommendations. The chapters 6 and 7 have the recommendations as their input. Labels are used to indicate the research questions considered in a chapter.

**Chapter 2** focuses on answering research question **RQ1** and its sub questions **RQ1.1** and **RQ1.2**. We first look at our target audience, i.e., elderly users and their current state of technology adoption, and we discuss different technology adoption models, as well as current user interface design guidelines and practice. Next, we present our contributions to this field, which answers **RQ1.3**. First, we present our reference model of guidelines for elderly based on technology adoption factors, and next, we present an up-to-date list of heuristics and checks that developers could utilize when designing either a web platform or touchscreen application for this user group. For constructing this list, we investigated existing guidelines and heuristics for developing user interfaces for web or touchscreen applications. The list was evaluated by experts and is available online.

**Chapter 3** focuses on **RQ2**. We present the current status of the most popular digital approaches intended to increase and elicit user engagement in digital platforms: gamification, persuasive technology, nudging, and (digital) behavioral change intervention techniques. Our contribution to this area is an overview of these fields, their current status, their general level of effectiveness when discussing outcomes, and the observation that there is a lack of focus on specific age groups.

**Chapter 4** focuses on **RQ3** and its sub-questions. We provide the current state of existing social engagement platforms. We performed several evaluations, i.e., surveys, interviews, and a hands-on evaluation, to answer **RQ3.1**, **RQ3.2**, and **RQ3.3**.

In **Chapter 5**, we formulate our recommendations based on what we have learned in previous chapters. This answers **RQ4**.

A selection of the recommendation were evaluated by means of user surveys and interviews. The results can be found in **Chapter 6**.

Finally, **Chapter 7** presents Nosville, the proof of concept solution for our research objective.

## 1.3 Publications

A number of publications have emerged throughout working on this dissertation, some directly related to the work and some being opportunities that emerged through different collaborative endeavours that also contributed to the research objective. For each related publication, the relevant chapter, is indicated inside parenthesis.

### Related Articles & Publications

(**CH 2**) Renny S. N. Lindberg and Olga De Troyer. 2020. Towards a Reference Model of Guidelines for the Elderly Based on Technology

Adoption Factors. In 6th EAI International Conference on Smart Objects and Technologies for Social Good (GoodTechs 2020), September 14–16, 2020, Antwerp, Belgium. ACM, New York, NY, USA, 6 pages. doi: 10.1145/3411170.3411240

(CH 2) Renny S. N. Lindberg and Olga De Troyer. 2021. Towards an Up to Date list of Design Guidelines for Elderly Users. CHI Greece 2021: 1st International Conference of the ACM Greek SIGCHI Chapter. Association for Computing Machinery, New York, NY, USA, Article 8, 1–7. doi:<https://doi.org/10.1145/3489410.3489418>

(CH 3) Teemu H. Laine and Renny S. N. Lindberg. 2020. Designing Engaging Games for Education: A Systematic Literature Review on Game Motivators and Design Principles. IEEE Transactions on Learning Technologies, 13(4), 804–821. <https://doi.org/10.1109/TLT.2020.3018503>

(CH 7) Renny S. N. Lindberg, Jan Maushagen, and Olga De Troyer. 2019. Combining a Gamified Social Engagement Platform with a Digital Game in a Loosely Way to Increase Retention. In Proceedings of the 21st International Conference on Information Integration and Web-based Applications & Services (iiWAS 2019). Association for Computing Machinery, New York, NY, USA, 679–683. doi: 10.1145/3366030.3366117

(CH 7) Olga De Troyer, Jan Maushagen, Renny S. N. Lindberg, Jaël Muls, Beat Signer and Koen Lombaerts. 2019. A Playful Mobile Digital Environment to Tackle School Burnout Using Micro Learning, Persuasion & Gamification. 19th International Conference on Advanced Learning Technologies (ICALT 2019), Maceió, Brazil, 2019, pp. 81–83, doi: 10.1109/ICALT.2019.00027.

(CH 7) Olga De Troyer, Jan Maushagen, Renny S. N. Lindberg and David Breckx. 2020. Playful Learning with a Location-based Digital Card Environment: A Promising Tool for Informal, Non-formal, and Formal Learning. Information 2020, 11, 157.

### Unrelated Publications

We also want to list the following unrelated publications as this dissertation is presented in pursuit of a doctoral degree.

Joo Chan Kim, Renny S. N. Lindberg, Teemu. H. Laine, Ewa Charlotte Faarinen, Olga De Troyer and Eeva Nygren, “Multidisciplinary Development Process of a Story-based Mobile Augmented Reality Game for Learning Math”, 2019 17th International Conference on Emerging eLearning Technologies and Applications (ICETA), 2019, pp. 372-377, doi: 10.1109/ICETA48886.2019.9039962.

Olga De Troyer, Renny S. N. & Pejman Sajjadi. TrueBiters, an educational game to practice the truth tables of propositional logic: Development, evaluation, and lessons learned. *Smart Learn. Environ.* 6, 27 (2019). <https://doi.org/10.1186/s40561-019-0105-2>

Olga De Troyer, Renny S. N. Lindberg, Jan Maushagen and Pejman Sajjadi, "Development and Evaluation of an Educational Game to Practice the Truth Tables of Logic", 2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT), 2019, pp. 92-96, doi: 10.1109/ICALT.2019.00032.

Renny S. N. Lindberg, Teemu h. Laine, & Lassi Haaranen. (2019). Gamifying programming education in K-12: A review of programming curricula in seven countries and programming games. *British Journal of Educational Technology*, 50(4), 1979-1995.

## Chapter 2

# Designing Software for Elderly: Up-To-Date List of UI Design Guidelines and Their Relation to Lee’s Adoption Factors

The world is getting grayer; globally there were 727 million people aged 65 or over in 2020 with the number projected to double to 1.5 billion by 2050 according to a report by UN Department of Economic and Social Affairs, Population Division (2020). The number of elderly people will affect all regions; within the EU, the expected increase is from the 2018 number of 101.1 million to 149.2 million (Eurostat, 2019). When we move closer to 2050, the elderly users will be more familiar with technology than their predecessors, but as things stands the level of technology adoption still varies. As we already mentioned in Chapter 1 according to the EU “Ageing Europe” report (Eurostat, 2019) there is a “digital divide” with 40% of older people (aged 65–74) who had never used a computer. Similarly, according to the same report, in 2017 almost half of the older EU-28 population had not used Internet during the three months preceding the survey.

Some studies have suggested that lack of technology adoption by the elderly population is not due to lack of interest or willingness from these people to adopt technology but because their expectations are not properly met (Niemelä-Nyrhinen, 2007, Lee, 2015). However, overall the factors for technology adoption are numerous and complex, such as confidence, level of income, and education (Anderson and Perrin, 2017). Generally speaking, elderly people appear to see technology in a positive light (Anderson and Perrin, 2017,

Niemelä-Nyrhinen, 2007), especially if a family member has introduced or mitigated the adoption process (Anderson and Perrin, 2017).

In this chapter, we review the state of the art with regard to the development and adoption of software by elderly and how we can provide guidance to developers of software for elderly users. The structure of this chapter has been divided into three distinct, but related sections: First, in Section 2.1, we provide an overview of design guidelines and heuristics for user interface of web platforms and smart devices that focus on elderly users. Second, in Section 2.2, we look at relevant technology adoption & acceptance models and especially ones aimed for elderly users. Third and last, Section 2.3 is where we bring our findings from both looking at design guidelines and adoption frameworks together. This chapter aims to answer the research questions RQ1.1, RQ1.2 and RQ1.3. The chapter ends with a summary.

## 2.1 User Design Guidelines for Elderly Users

In this section, we start by investigating the state of the art for designing digital technology for older users. We found that there are several sources with numerous checks and guidelines, often overlapping and some more up to date than others. Therefore, we decided to integrate them into a single and more up to date list of guidelines.

### 2.1.1 Designing for Elderly Users - State of the Art

There are numerous checks and guidelines published for developers and designers that cover essential requirements a digital technology should have to be more usable. In this section, we will take a look at existing guideline frameworks for the Web and touchscreen devices. We also discuss the use of a User Centered Design approach, which is recommended to be used when designing for elderly.

#### Web Technology Guidelines

WCAG is an official set of guidelines from the World Wide Web Consortium (W3C). Since the original version, WCAG 1.0, it has had to change with times, as accessing websites shifted largely to mobile platforms. WCAG 2.0 became the official W3C recommendation in 2008. However, soon afterwards, some problems were identified especially for guaranteeing accessibility for people with disabilities (Rømen and Svanæs, 2012). The latest version, WCAG 2.1<sup>1</sup> released in 2018, focuses on mobile accessibility, people with low vision, people with cognitive and learning disabilities, and fixing some of the grievances.

WCAG provides its guidelines split into four layers: (1) Principles - POUR, the four principles of accessibility: Perceivable, Operable, Understandable and

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<sup>1</sup><https://www.w3.org/TR/WCAG21/>

Robust; (2) Guidelines - that are split into 13 categories. They are not testable, but provide a framework and overall objectives; (3) Success Criteria - For each guideline a testable success criterion is provided. Three levels of conformance are defined: A (Lowest), AA, and AAA (Highest); (4) Sufficient and Advisory Techniques - A list of techniques that are sufficient, and a list of techniques that are advisory are given. A working draft of WCAG 3.0 was published in December 2021. Overall, WCAG is a very encompassing set of accessibility guidelines that aims to ensure accessibility for all user types. Variations of WCAG have been either adopted or recommended by numerous countries.

Over the years, several other guidelines and heuristics have also been published. For example, SilverWeb (Zaphiris et al., 2007), which itself was based on several academic papers and expert evaluations. It resulted in 38 guidelines, called SilverWeb 2.0. Other older guidelines are, just to name some: Usability Guidelines for Accessible Web Design (Nielsen and Pernice, 2014) and Research-Derived Web Design Guidelines for older People (Kurniawan and Zaphiris, 2005). Notably all these guidelines were published during the period of WCAG 1.0 when a number of accessibility issues specific to elderly users were not as well covered by WCAG 1.0.

### **Touchscreen Technology Guidelines**

Touchscreen devices come in many shapes and sizes, their screen size and button placement may vary from model to model, and some are more responsive than others. At the same time, especially mobile devices are largely becoming the main method of accessing Web platforms (Eurostat, 2019).

In 2019, Nurgalieva et al. (2019) published an extensive list of guidelines focused on touchscreen devices, derived from a literature review of 434 research-derived design guidelines, identified from 52 research articles focusing on older adults. The authors also created four design categories: Behaviors, Displays, Effects, and Context & Forms, as well as four capability models: Motor, Psycho-motor, Perceptual, and Cognitive. Using their own set of criteria the authors additionally deemed 23% of the guidelines to be “good” in terms of reliability, 31% as optimal, and only 11.5% as validated. The collected guidelines were published online under the name design4all<sup>2</sup>. One caveat mentioned in the author’s work is that the assessment heuristic employed was based on previous literature. Numerous other heuristical studies on touchscreen devices had been done before design4all that simply collected most of them together. One such study worth mentioning and that was not included in design4all, probably due to its specific areas of focus, was the work on creating the Mobile Launcher Guidelines (Al-razgan et al., 2014, Al-Razgan et al., 2012). The list was consolidated by conducting a literature review of nine papers. The consolidated list had 46 guidelines in total, divided into three main categories: Look & Feel, Interaction, and Functionality.

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<sup>2</sup><https://design4all.herokuapp.com/>

Note that WCAG does not directly cover touchscreen devices but provides “informative-guidelines” for mobile devices in general and how some of the guidelines can be applied on mobile devices. Additionally, the 2.1 version does have guidelines that also have a light focus on touchscreen devices.

## **User Centered Design (UCD)**

When designing interactive applications, a recommended method is user centered design (UCD). The idea is to put the requirements of the users central in the design process and involve the user as much as possible. Interpretation on how to actually go about this somewhat varies, but the core principle is always the same: evaluate often and keep the users in the loop (Lee, 2015). It has been proven to be an effective method in various design cases for elderly (Lum et al., 2017, Brox et al., 2017, Balakrishnan et al., 2012) but it also has notable caveats. Recruiting a representative group of users for evaluations and/or involvement in the design is not always straightforward, especially with older users (Zajicek, 2004). Similarly, the evaluation in itself becomes more demanding as the researchers have to be more attentive to potential limitations (e.g., of visual, auditory, cognitive, or motor skills) that may influence the interaction (Zajicek, 2004, Chuter, 2008). Lastly, gaining the trust of the participants of evaluations is important to receive objective feedback. Older people may be more suspicious and more inclined to please the interrogator/developer. Clearly communicating to the users that anything going wrong with the application is the developers fault is important in this respect (Brox et al., 2017). Additionally, external circumstances may require a complete overhaul of the common practices to apply UCD, as seen with the COVID-19 pandemic. On the one hand, as one of the worst hit and vulnerable groups the need to create and provide supporting technology for the elderly has increased during the outbreak, but on the other hand it also has compromised the traditional UCD techniques as it was downright dangerous for these user groups to have unnecessary physical contacts. Consulting and conducting evaluations via online or via the social network of the elder could be a viable alternative, but this does bring about entirely new challenges. Limiting the contact and the evaluations to only the group of people technologically savvy enough to communicate over the Internet could heavily bias the results and could bring about wrong assumptions.

### **2.1.2 Towards an Up To Date Set of Usability Guidelines**

In this section, we present the work done on getting towards an up to date list of usability guidelines for elderly users. We start by explaining the methodology used, followed by the results.

## Methodology

To come to an up to date list of usability guidelines, we started with an initial phase that combined and integrated all guidelines found into a single list. Next, this list had to be evaluated in some way.

Expert evaluations have been shown to be a very powerful tool especially when validating heuristic foundations of a technology (Sivaji et al., 2011, Nielsen, 1995, Kientz et al., 2010) or when performing evaluations with target users is difficult to organize. For example, the 2020 COVID outbreak made organizing evaluations with elderly users practically impossible due to the inherent danger for the elderly as well as countries having varying levels of lockdown (Sauer, 2021).

Several expert evaluation methods exists, such as:

- **Brainstorming** a technique where experts produce ideas together with the idea of doing problem solving and merging of ideas (Diehl and Stroebe, 1987).
- **Nominal group technique**(NGT) is using experts who gather physically and by the guidance of a facilitator, they discuss, rank and vote on the elements of the analyzed problem (Carney et al., 1996).
- **Delphi method** uses a group of experts to reach consensus through successive rounds of discussions or questionnaires (von der Gracht, 2012).
- **Didactic interaction** is used for cases of yes/no decisions. Physical meetings are organized where experts are divided into for and against teams, and expressing their views and discuss them, after which they shift to opposite positions. The aim is to move the groups toward a consensus (Torrecilla-Salinas et al., 2019).
- **Expert walkthrough techniques**(EWT) is used for the evaluation of a specific design. There are different ways to perform an expert walkthrough, but it is quite similar to the technique of cognitive walkthrough performed by users. Experts take the place of the user discussing on how they might react (Petrie and Bevan, 2009). This method is less appropriate for our purpose.

These expert evaluation methods are focused on either solving an unclear problem (Brainstorming), streamlining opinions (Delphi, Didactic), or require experts to be available for a conversation amongst each others and the testers (NGT, EWT). In our case, a list of heuristics had been compiled and organizing discussions, or even interviews with experts was not feasible, meaning that a custom approach was required, which will be explained in detail in the following sections.

### Initial Phase: Creating a First Combined List of Guidelines

Before starting to combine guidelines, we created a list of all individual guidelines from the four sources discussed in Section 2.1.1: WCAG, SilverWeb 2.0,

Design4All, and the Touch-based Mobile Heuristics. This resulted in 594 individual guidelines (with a major bulk coming from Design4All). In the initial list, WCAG 2.0 was used, but the 14 additional guidelines of the 2.1 version were later integrated in the list.

Each guideline was given a code to make future tracking easier. After this, we started to merge guidelines. Merging of guidelines was done incrementally. A first group considered for merging were guidelines that were clearly about the same issue, e.g., about the size of elements that the user could interact with. These guidelines were grouped together keeping references to the previously given reference code. The guideline texts were grouped, or the most relevant snippets of them (in case of longer text, as was sometimes the case) to come to a single description. After this initial merging of guidelines, a so-called check statement was formulated for each guideline that would allow developers or evaluators to check whether the guideline is satisfied in an application. Such a check statement is in the form of a question, for example: “Are all clickable items large enough?”.

The newly formed list of combined guidelines was then inspected by four experts with knowledge from the field of usability and user interface design. The main objective for this initial evaluation was to ensure that guidelines were combined in a sensible way. At this stage, we had a list of 143 guidelines.

We repeated the steps of going through the guidelines and rewording & merging them, as well as dropping guidelines that were deemed too “specific”, such as guidelines focusing on users’ cognitive disability or on blind users. This was repeated and evaluated by the experts until the list was deemed ready for a broader expert evaluation, i.e., no comments were given anymore by the four experts. In this way, the list was reduced to 110 individual guidelines.

## **Phase 2: Finding & Contacting Experts**

For the broader expert evaluation, expert recruiting was done in three phases. A first list of experts was gathered in three ways: 1) Word of mouth: people working in the relevant field that were recommended by colleagues or we were already aware of; 2) Computer Human Interaction University Departments: Searching university departments working in usability design or otherwise seemingly relevant field; and 3) Relevant publications: We listed publications that looked specifically into usability design towards elderly users and collected their authors. This first list of proposed experts was checked by the four experts involved in the initial phase to judge the credibility of the proposed experts, and to add suggestions for other experts. Finally, we reached out to 68 experts. However, overall turnout was quite disappointing, as only seven eventually contributed to the evaluation. We had highest hope, in terms of participation, for the first group of experts, but generally the number of volunteers divided rather equally from all three groups.

### Phase 3: Preparing & Performing the Evaluation

When preparing for the evaluation, it quickly became evident that providing the experts with a list of 110 guidelines and asking them to give detailed feedback on all of them would be tedious and could easily discourage them from participating in the evaluation. Hence two actions were taken to make the evaluation process as easy as possible. 1) We decided to focus the evaluation on the importance of the guidelines. As the guidelines in the list are based on existing guidelines from literature, and in this way have already been evaluated in a sense, we decided that it was more important to allow the expert to indicate the importance of an individual guideline/check over giving general feedback. 2) A decided web application was created to allow the experts to easily consult the guidelines and to provide feedback. See Figure 2.1 for a screenshot of a part of the interface. All relevant data was made available –check statements, guidelines, original guideline statements and when relevant some comments (i.e., `auth_note` in the interface)– The only piece of data that was hidden from the experts was the exact number of research works referencing a guideline, as this could have influenced their opinion on the importance of that particular guideline. The original guideline statements were hidden by default to make the page more easy to read, as shown in Figure 2.2, but the comments could be easily made visible with a toggle.

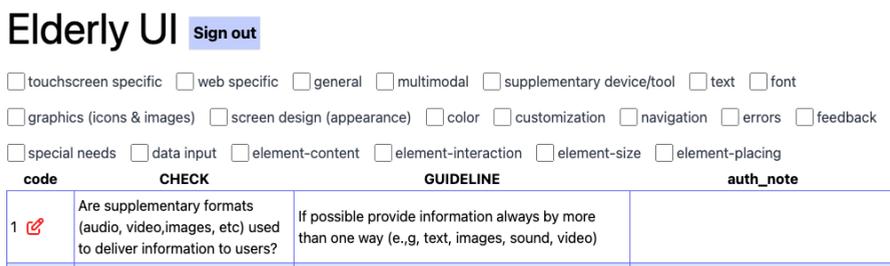


Figure 2.1: Screenshot of the guideline evaluation web application

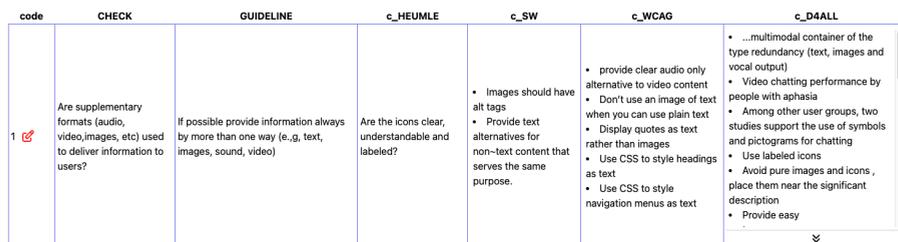


Figure 2.2: Screenshot of how a guideline appears to the evaluator

Comment: 1

CHECK:

Please make a comment...

GUIDELINE:

Please make a comment...

Do you see this guideline important?

Strongly agree

Agree

Disagree

Strongly disagree

Close

Figure 2.3: Evaluator response view

As one can also see in Figure 2.1, filters were added to allow to concentrate on guidelines for a particular aspect of a design, e.g., design guidelines for the use of color (“color” checkbox in the interface). This would allow the evaluators to inspect related guidelines at the same time. It would also make the list more accessible in terms of readability (shorter lists instead of a massive wall of guidelines) and it could allow the evaluators to break down their evaluation task into smaller parts, i.e., an evaluator could filter specific topic areas for making the process shorter. In the process of creating the filters, the four experts who participated in the initial phase checked the filters, both from a naming point of view (i.e., the keywords used) as from the assignment of the correct keywords to the correct guidelines. As of now, 20 filtering options (keywords) are provided. In Table 2.1, the keywords are listed and explained. Note that a guideline may be given several keywords.

The experts were asked to use the Likert scale of “Strongly agree”, “Agree”, “Disagree”, “Strongly disagree” to indicate how important they thought the guideline/check in question to be and could also leave feedback (see Figure 2.3).

## Results

In total 11 experts participated in the evaluation, out of whom roughly eight evaluated the whole list, i.e., with the exception of the first six guidelines, the average number of participants that evaluated the majority of the guidelines was between seven and eight participants. The original list of 110 guidelines was further shrunk to 100, by merging six guidelines and removing four guidelines based on expert feedback.

Table 2.1: Keywords used to filter our guidelines and their descriptions

touchscreen specific	Guideline that concerns touchscreen devices
web specific	Guideline that concern web platforms
multi-modal	Guideline that touches on non-text communication, such as sound, video & images
supplementary device/tool	Guideline that specifically touches upon assistive tools that function alongside the system being designed
text	Guideline that focuses on the use of text in any way
font	Guideline that focuses on the use of fonts
graphics (icons and images)	Guideline that focuses on the use of icons and/or images
screen design (appearance)	Guideline that focuses on the overall appearance of the system
color	Guideline that focuses on the use of color
customization	Guideline that focuses on how the user can change or customize the interface or the system
navigation	Guideline that focuses on how the user can navigation within the system
errors	Guideline that focuses on error handling and communicating errors to the user
feedback	Guideline that focuses on providing feedback to the user
special needs	Guideline that focuses on users with special needs, such as poor vision
data input	Guideline that focuses on user data input handling
element content	Guideline that focuses on the content representation within individual elements in the system
element interaction	Guideline that focuses on elements within the system that the user is able to interact with, such as buttons
element size	Guideline that focuses on the size of elements within the system
element placing	Guideline that focuses on how elements are organized and presented to the user

Figure 2.4 shows the results for the guidelines in terms of importance, grouped by the keywords given in Table 2.1. The results show that the experts scored the majority of the guidelines as being “important” (i.e., scores “Strongly Agree” and “Agree”). Note that in case of some groupings, an equal number of experts marked the guidelines as “agree” and as “disagree”.

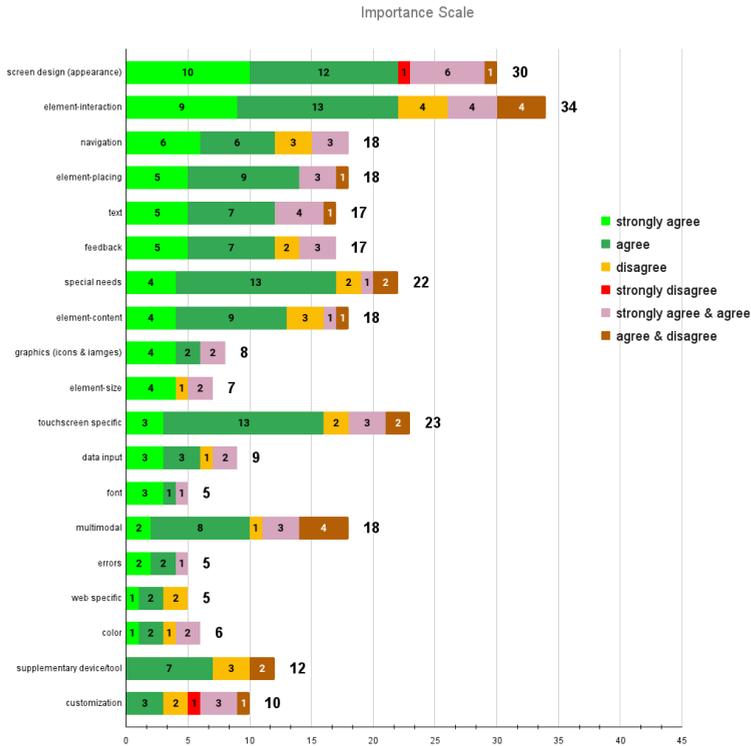


Figure 2.4: Evaluators’ Likert results for importance sorted from highest to lowest (number of strongly agree votes).

Note that the groups of guidelines related to the keywords may overlap (a guideline may be associated to several keywords). But generally, results for individual guidelines are very similar to results grouped by the individual keywords (see Table 2.2).

Giving feedback on the checks and guidelines was optional. As already indicated, this was because the guidelines were based on existing guidelines from literature. Not a lot of feedback was given, except to point out some unnecessary guidelines when focusing on elderly users and suggestions for merging some guidelines.

Table 2.2: Expert evaluation results divided into three categories using the vote results as general weights

Category	No. of Guidelines	Weighing factors
very important	51	strongly agree > agree strongly agree = agree
important	41	agree strongly agree = agree = disagree strongly agree = agree (w. disagree votes)
nice to have	8	disagree strongly disagree disagree = agree

## Discussion of the Results

Table 2.3 lists all the check statements for which the number of the score Strongly Agree was the highest. Also included in this list are the 14 results (30 to 44) where the number for Strongly Agree was equal to the number for Agree.

Table 2.3: List of checks marked as very important by the experts

<b>1</b>	Are supplementary formats (audio, video, images, etc) used to deliver information to users?
<b>2</b>	Sufficient color contrast and combinations used between foreground and background?
<b>3</b>	System offers help/instructions for every major step & function?
<b>4</b>	Irrelevant of the screensize are all clickable items large enough?
<b>5</b>	Text content is easy to understand by the target users?
<b>6</b>	No unnecessary visual distractions?
<b>7</b>	Elements (any currently visible container in a view, such as: buttons, input field, label) does not change or disappear without user's permission?
<b>8</b>	There is enough space around clickable items to avoid erroneous clicks?
<b>9</b>	Is the font large enough?
<b>10</b>	Is textual information given in a clear and condensed manner?
<b>11</b>	On touchscreen devices familiar and/or common gestures are used for actions (such as navigating between views) ?
<b>12</b>	Core functions are directly & easily accessible?
<b>13</b>	Are functions & information structured clearly?
<b>14</b>	Is overall design consistent?
<b>15</b>	User can customize elements or their content size easily?
Continued on next page	

Table 2.3: List of checks marked as very important by the experts

<b>16</b>	User confirmation on major steps (submit, delete, login/out, etc)?
<b>17</b>	Text formatting & presentation is clear?
<b>18</b>	On touchscreen devices, magnifying a view is easy?
<b>19</b>	Always a way out/back ?
<b>20</b>	Inputting data is made easy for the user?
<b>21</b>	Main navigation links are consistently available?
<b>22</b>	User knows their current location in the system?
<b>23</b>	Icon or image purpose is clear and easily recognized by the user?
<b>24</b>	Functionality of interactable elements (buttons, etc) is consistent throughout the system?
<b>25</b>	Error/confirmation messages are clear, simple and do not blame the user?
<b>26</b>	If multimedia content is used, can the user control/customize it (volume, fast forward, etc) ?
<b>27</b>	All input fields and information fields are labeled clearly without breaking aesthetics?
<b>28</b>	Element placement is consistent ?
<b>29</b>	Navigation elements' purpose is clear?
<b>30</b>	Is there enough space between text lines?
<b>31</b>	Clickable items do not require double clicking?
<b>32</b>	Interactable elements give a clear indication of being interactable and their purpose?
<b>33</b>	On touchscreen devices, if gestures are used does the system responds smoothly to them?
<b>34</b>	If a button is pressed multiple times within a short time period, it is only registered as once click?
<b>35</b>	If a system has several modes, is the user aware of the one currently active?
<b>36</b>	Clear instructions are available for more novel gestures (drag & drop, pinch, etc)?
<b>37</b>	Limited use of animated graphics?
<b>38</b>	On touchscreen devices, more complex gestures can also be performed with buttons/other gestures?
<b>39</b>	Unfinished tasks are saved by the system?
<b>40</b>	Elements do not flash?
<b>41</b>	Page titles are clear and helpful?
<b>42</b>	Amount of navigation links in a single page is not excessive?
Continued on next page	

Table 2.3: List of checks marked as very important by the experts

<b>43</b>	If a single element is made larger, do others follow? larger text → larger buttons
<b>44</b>	Navigation destination is consistent?
<b>45</b>	Audio content is not played automatically?
<b>46</b>	Tasks with more than one step have a progress indicator?
<b>47</b>	Images & Icons are large enough?
<b>48</b>	Confirmation window's buttons are not directly aligned with their call button?
<b>49</b>	Accidental button press cannot make the user log out or close a system?
<b>50</b>	System gestures do not clash with OS' own gestures?
<b>51</b>	Cursor is always visible & noticeable?

As stated in the methodology, the evaluators were asked to focus on stating whether they considered the individual guidelines important or not, but they were also given the opportunity to give feedback on either the check statement or the actual guideline. As already indicated, not a lot of feedback was given, but during the initial phase of our evaluation, we did receive suggestions for additional guidelines, see Table 2.4. Both suggestions were reviewed favourably in the actual evaluation, though neither of them was given the score “Strongly agree”.

Table 2.4: Checks &amp; Guidelines added to the list at the initial phase

All video content has a resolution that is high enough?	Ensure that the resolution of video content is high enough so that the video content is also view able on larger screens in good quality
In case of a service providing system, the user can contact the service provider for assistance?	User should be able to ask for assistance, e.g. by chat or a “help” option

Guidelines about the use of touchscreen devices gestures received mixed scores. Checks such as: “On touchscreen devices with small screen, do simple gestures replace buttons?” roughly received equal amount of for and against scores. All guidelines that the majority of evaluators scored with “Disagree” are listed in Table 2.5.

### Missing Guidelines

Interestingly, security does not appear in the guidelines. There can be several reasons for this, such as the fact that inputting of passwords & username, or

Table 2.5: List of guidelines (showing here only the Check statement) that the majority of the evaluators marked as not important (score “Disagree”)

1	On touchscreen devices, can a stylus be used?
2	User can customize how (sound/text/audio only, or specific combination) or when feedback is given?
3	User can distinguish between visited & not visited links?
4	Device can be secured with a cable?
5	Questionnaires use the multiple-choice style?
6	Scrolling for information is avoided?
7	Interface can be provided vocally to user?
8	If applicable, is user aware of different navigation opportunities?
9	Can the system be controlled with a keyboard?
10	System allows multimodal interaction (e.g. voice commands)?
11	On touchscreen devices with small screen, do simple gestures replace buttons?
12	Website conforms to HTML standards
13	Buttons are more wide than high?
14	On touchscreen devices, gestures can be turned on/off or adjusted?
15	On touchscreen devices, no interaction is required when user is moving (walking)?
16	User can move elements?

other login info are considered as belonging to “data input” and/or “instructions” and thus the guideline is considered to cover this, leaving the details to the designer. However, the average user already struggles to remember their password and thus often opts for unsafe and simple passwords. Therefore, it is safe to assume that an elderly user is even more likely to fall for unsafe password management practices. Biometric security methods have solved this issue to some extent on mobile platforms, but at least for now, safe and accessible security practices are certainly something that must be considered when creating web applications for elderly users.

In the wider spectrum of technology adoption by elderly users (Lee, 2015), discussing the place of security might be a worthwhile task. Security is an aspect that could impact the adoption of technology, an area that we will look in further detail in the next section (Section 2.2). Some of the aspects of technology adoption can be embedded in design guidelines while others not or only partially. So, the question is whether security issues can be or should be covered by design guidelines.

### Limitations & Future Work

Though the process of combining guidelines was done in collaboration with other researchers, likely still several of the existing guidelines and checks can

be reworded better and/or merged with others. This is something we will continue to work on. Additionally, although filters were provided in the web application to allow concentrating on a particular design aspect, one of the bigger stumbling blocks for this evaluation was the sheer number of guidelines, which likely turned away a number of potential evaluators. The long list might have exhausted some of the evaluators, thus possibly affecting scorers given towards the end. This was somewhat circumvented with our web application.

## 2.2 Technology Adoption of Elderly Users

In this section, we look at existing Technology Adoption Models, especially the one of Lee (2015) focusing on elderly, and additionally how well web focused interface design guidelines cover these adoption factors.

### 2.2.1 Technology Adoption Models

Technology adoption relates to a persons' willingness to accept and use a certain technology. The term is sometimes used separately from technology acceptance that reflects more on how technology is perceived in terms of attitude, but for most parts the two terms are used interchangeably (Lee, 2015).

Numerous studies have sought to identify factors that affect how people approach technology. Groundwork for this was largely done by Rogers (2010) in his work on Diffusion of Innovations, originally published in 1962. The framework explains how people adopt new ideas over time as a product or idea gains momentum. The general idea is that new concepts are not adopted in one swoop, but is rather a process where some people adopt it sooner than others. These adoption patterns are connected with individual characteristics of people, which are an important factor to consider when introducing a group of people to a new concept or product. His model divides individual adoption decisions into five intrinsic categories:

- **Relative Advantage:** The degree to which an innovation is seen as better than the idea, program, or product it replaces.
- **Compatibility:** How consistent the innovation is with the values, experiences, and needs of the potential adopters.
- **Complexity:** How complex to use or understand the innovation is perceived to be.
- **Trialability:** How easy is it to test the innovation before committing to using it.
- **Observability:** The extent the innovation can be observed and provide tangible results.

The model also provides a five-step process that an individual goes through when accepting or rejecting a new innovation; these steps are:

- **Knowledge:** First exposure to an innovation.

- **Persuasion:** Forming an opinion on the innovation.
- **Decision:** Engaged with choices for and against the use of innovation.
- **Implement:** Using the innovation.
- **Confirmation:** Confirmation of whether a right choice was made.

Diffusion of Innovations is a general model used successfully in various fields. We will now move on to models directly intended for use in the field of technology.

## 2.2.2 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is among the most influential models of technology acceptance (Davis, 1985). Cited over 8000 times, the model has been used in numerous studies that have shown evidence on relationship between ease of use and system use. The model itself is an extension of Theory of Reasoned Action (TRA) (Ajzen, 1980), an attempt to explain relationship between attitudes and behaviors within human action. TRA suggests that an individual's attitude and subjective norms affect his or her behavioral intention. TAM essentially takes this model into the field of technology, and use it as its theoretical base.

TAM places weight on three factors: perceived usefulness, ease of use, and attitude, which are also influenced by user motivation. For example, a person who is perceiving a new technology as too difficult and not very useful, will have low intention to use it, which then drops the likelihood for the actual use even lower. Figure 2.5 illustrates this flow.

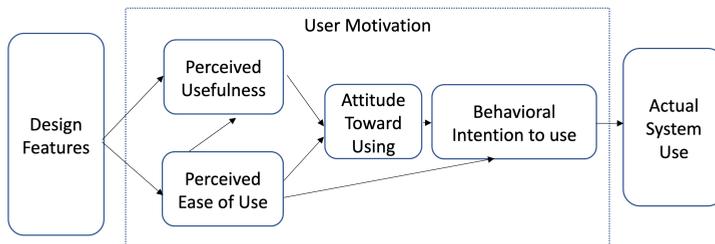


Figure 2.5: Technology Acceptance Model (TAM) (based on figure by Davis (1985))

TAM has been studied and expanded since its creation with major upgrades being Extension of the Technology Acceptance Model (TAM2) and Unified Theory of Acceptance and Use of Technology (UTAUT). TAM2, shown in Figure 2.6, kept the core of the model but added numerous new outside influences: Subjective Norm, Image, Job Relevance, Output Quality, Result Demonstrability. TAM2 further evolved the theoretical base of TAM, which was TRA (Venkatesh and Davis, 2000), by placing importance on social influence. Subjective Norm represents “a person’s perception that most people

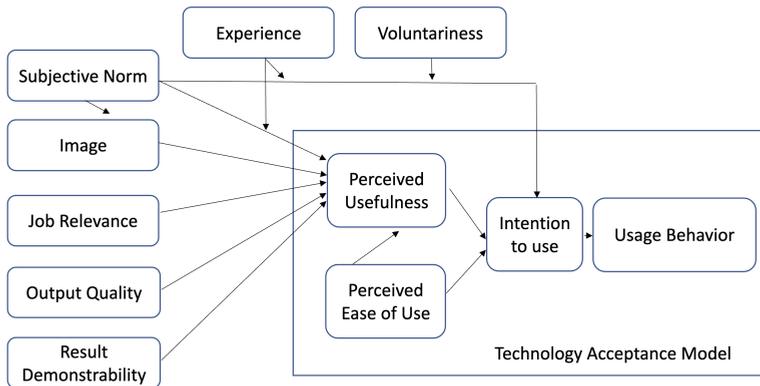


Figure 2.6: Extension of Technology Acceptance Model (TAM2) (based on figure by Venkatesh and Davis (2000))

who are important to him think he should or should not perform the behavior in question”, which in turn affects both Perceived Usefulness and Intention to Use. Social influence factors affect also each other and are affected partly by Experience and Voluntariness.

### 2.2.3 Unified Theory of Acceptance and Use of Technology (UTAUT & UTAUT2)

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) is a culmination of earlier models, with emphasis on interrelation of various factors, such as Gender, Age, Experience and Voluntariness of use, which have influence over direct determinants towards use. Figure 2.7 shows the model.

Performance Expectancy is the degree to which an individual believes that using the system will help him or her to attain gains in job performance. It is the strongest predictor of intention. Effort Expectancy is the degree of ease associated with the system. Social Influence is the degree of which an individual perceives that others think that she or he should use the system. Facilitating Conditions is the only factor that does not affect intention but directly influence Use Behavior. It is defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of a system. In total, UTAUT combines eight technology acceptance models, including TAM, TAM2 and TRA. UTAUT2 further adds to the model: Hedonic Motivation, Price Value, and Habit and Facilitating Conditions now also affect Behavioral Intention instead of just Use Behavior (Venkatesh et al., 2012). UTAUT2 is intended for understanding consumer behavior, where the first UTAUT model was more focused towards work environments. Hedonic Motivation is defined as the fun or pleasure derived from using a technology

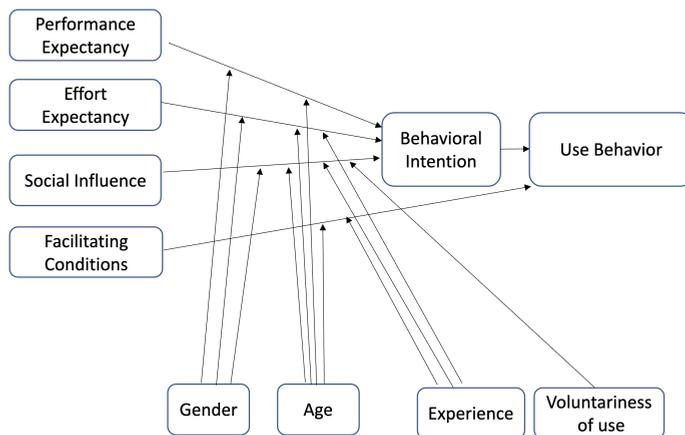


Figure 2.7: Unified Theory of Acceptance and Use of Technology (UTAUT) (based on figure by Venkatesh et al. (2003))

and is listed as an important role in determining technology acceptance. Price value is added as unlike in corporate settings, consumer usually pays for the product by themselves, which means that the cost and the perceived value play a role in technology use. The scale is simple, benefits of technology should outweigh the cost. Habit is something a user does automatically because of learning (Venkatesh et al., 2012). The authors also list Experience together with Habit because it can lead to a habit. Experience is divided into three levels based on time: beginning, one month, and three months. Figure 2.8 shows the model in more detail.

## 2.2.4 Technology Adoption Models for Elderly Users

Focus on elderly users' adoption of technology has only gained more traction around 2015 (Lee, 2015). One reason suggested for not been investigated earlier, has been the general view of considering elderly people as weak and reluctant to adopt new technologies (Niemelä-Nyrhinen, 2007). However, according to a recent 2017 study in the US, elderly people generally view technology in a positive light (Anderson and Perrin, 2017). According to Lee et al. (Lee, 2015), there is a dichotomy between what elderly users need and what designers and developers provide, with expectations and needs getting lost in stereotypes. For example, the current focus lies largely on application in the context of safety, health and physical assistance, despite elderly people valuing independence and social interaction.

Some models have been suggested that are meant for assisting technology adoption especially by elderly users. The conceptual model, called Accelerating Diffusion of Proven Technologies (ADOPT), uses seven strategies with user friendliness, value, sustainability of business model, promotion and mar-

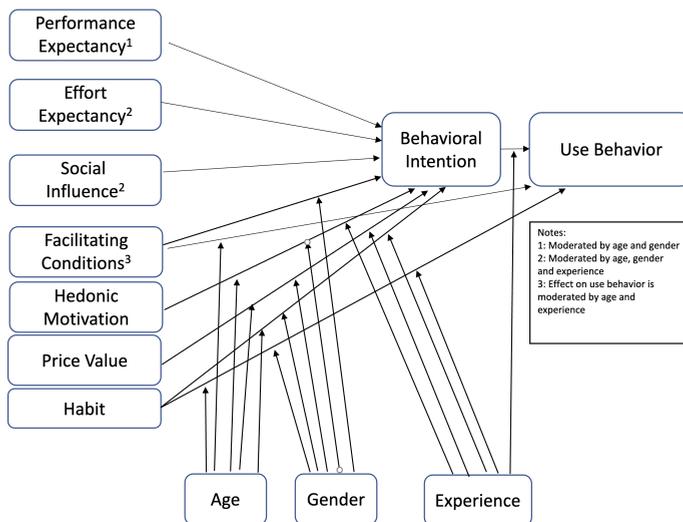


Figure 2.8: Unified Theory of Acceptance and Use of Technology2 (UTAUT2) (based on figure by Venkatesh et al. (2012))

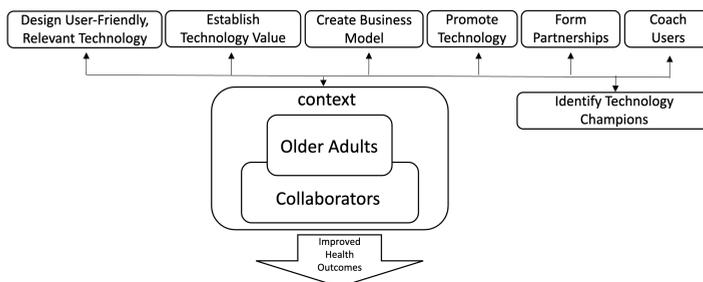


Figure 2.9: Accelerating Diffusion of Proven Technologies (ADOPT) (based on figure by McCreadie and Tinker (2005))

keting, partnerships, technology champions, and coaching listed as facilitating factors (Wang et al., 2011). The model is shown in Figure 2.9. The seven diffusion strategies are actions that technology developers, designers and providers can take to facilitate the adoption process, whereas three factors cannot be directly controlled, but affect the adoption nonetheless: health of an individual, technology literacy of the individual, and presence of collaborators willing to assist. Lastly, there is the context of the living conditions. Aspects such as privacy concerns, reimbursements from the government, and access to resources (perceived and actual) are part of context.

Other (earlier) models suggested are: A Model of Acceptability of Assistive Technology (McCreadie and Tinker, 2005) and The Center for Research and

Education on Aging and Technology Enhancement (CREATE) (Rogers and Fisk, 2010). Both consider the relationship between environment and user as important. The model of McCreadie and Tinker (2005) places more emphasis on the flow from needing a system to assessing ease of access to weighing the quality of the technology itself.

### 2.2.5 Lee's Factors

In her dissertation, Lee (Lee, 2015) focuses on the technology adoption of elderly users, by looking at existing technology adoption models and performing a literature review on older adults' technology adoption. From this, Lee constructed "factors of older adults' technology adoption", showed in Table 2.6. Note that Lee's factors will be used in this dissertation to steer the improvement of the adoption of SE platforms by elderly.

Table 2.6: Lee's Technology Adoption factors and their description

<b>Value</b>	The degree to which a technology is perceived as useful and communicated as potentially beneficial
<b>Usability</b>	The degree to which a technology and its interfaces are easy to learn, use, and interact with
<b>Affordability</b>	Perception of costs and expenses related to purchase and use of a technology in relation to potential benefits
<b>Accessibility</b>	Awareness and knowledge of a technology's existence and availability in the marketplace
<b>Technical Support</b>	Availability and quality of professional support throughout learning, purchasing, using, and keeping a technology
<b>Social Support</b>	Support and endorsement from family, peers, or social communities toward use of a technology
<b>Emotion</b>	Perception of a technology's potential roles for providing emotional benefits such as entertainment, enjoyment, and peace of mind
<b>Independence</b>	Expectations around how the use of a technology may or may not involve social stigmatization and stereotyping
<b>Experience</b>	The degree to which a technology's features and operations resemble user's prior experiences with relevant systems
<b>Confidence</b>	The degree to which a technology's features and designs prevent user from feeling anxious or intimidated

Additionally, Lee identified potential additional factors that were derived from interviews:

- System reliability: A technology’s ability to work overtime without problems
- Service trust: The degree to which a user may trust a technology, as well as the organization behind it
- Interoperability: How well technology works with other technology and related products. Is the transition cumbersome, or seamless?
- Lifestyle fit: Expectations on how well technology fits the user’s life pattern. Does the technology require the user to change their daily or weekly routine?
- Conceptual fit: The degree to which technology’s operation design and language match user’s mental model and perception of the world around them

## 2.3 Reference Model for Design Guidelines for Elderly

In this section, we present a reference model that can be used to organize design guidelines for elderly, but also as a guide to uncover new guidelines. The reference model is based largely on the ten factors of Lee (2015). To come to this reference model, we performed a literature survey of web design guidelines and checked how well they cover Lee’s adoption factors.

### 2.3.1 Literature Review of Web Design Guidelines

First we looked at current web design guidelines intended for elderly users. We used the search word “web design” in conjunction with the many manifestations for elderly user, i.e. “aged/ageing/older /elderly/senior user”. We conducted the survey on ACM Library, IEEEExplore, and Google Scholar. Timeline was restricted to the last 10 years. In a first sweep we downloaded up to ten papers with each combination, or until matches clearly became off topic. The next phase was to weed out all papers not specifically focusing on our topic; only papers that presented design guidelines in the context of web applications were kept. In case of two papers discussing the same topic, we would go with either the one presenting clear guidelines, or otherwise the latest publication. Lastly, we removed two duplicates that Lee et al. used in their survey as these were already discussed in their paper (Zaphiris et al., 2007, Czaja et al., 2006). This left us with a final count of 20 papers out of the original 161.

The papers consist of varied topics focusing on designing different services to elderly users. Our main point of interests was simply to see whether they considered any of Lee’s factors. The results are given in Table 2.7 where we list any paper that provides some sort of guideline fitting to a specific factor. Any

Table 2.7: Literature survey results

Factor	No	References
Usability	20	(Anderson, 2016, Goswami et al., 2010, Trewin et al., 2010, Sharit et al., 2011, Abdul Razak et al., 2012, Sato et al., 2011, Patsoule and Koutsabasis, 2012, Balakrishnan et al., 2012, Molnar, 2014, Tai, 2016, Cas, 2016, Lum et al., 2017, Avi, 2017, Meng et al., 2017, Antonelli et al., 2018, Rodrigues et al., 2018, Syeda et al., 2018, Wilkinson and Cornish, 2018, Yu et al., 2018, Gatsou et al., 2018)
Social Support	3	(Trewin et al., 2010, Syeda et al., 2018, Lum et al., 2017)
Emotion	1	(Goswami et al., 2010)
Independence	1	(Wilkinson and Cornish, 2018)

factor left empty was removed from the table, as the full factor list is given in Table 2.6. These findings give weight to Lee et al.’s criticism on overly focusing on Usability and though we did not explicitly included Mobile devices, our results from looking at survey’s such as Nurgalieva et al. (Nurgalieva et al., 2019) (Section 2.1) would yield very much similar results. A number of factors are not covered at all by the papers we surveyed. For Value, Affordability, and Accessibility, this can be explained by the nature of most research projects, where there is little intention to bring the product on the market, at least not in that stage of the research. For other factors, the studies might touch upon some factors, but do not provide any specific guidelines on these.

### 2.3.2 Reference Model

From the previous sections it can be deduced that creating a coherent all encompassing set of design guidelines for elderly users is a complex task and will result in a large amount of guidelines. In order to structure this task, we propose to use a reference model that allow to organize such guidelines. A reference model is a generic conceptual model that formalise recommended practices for a certain domain (Rosemann, 2003).

To create this reference model for User Interface Design (UID) guidelines for elderly that takes technology adoption factors into account, we start from the ten technology adoption factors developed by Lee (2015), presented in Section 2.2.1. Some of these factors focus on the deployment and maintenance phases of the software life cycle and are therefore less relevant during the design phase or need to be considered in the earlier phases of the software development, such as during the requirement analysis. For instance, the choice for a particular operating system, which may influence a number of the adoption factors, should be part of the requirement analysis and will influence the actual

design but it is not subject of the design decisions. The price of a product or the organization of the technical support are typical examples that are also out of the scope of the design. Therefore, we distinguish between three categories of factors. **UID irrelevant factors** are factors for which it is not possible to meet them by means of user interface design decisions. **UID partially relevant factors** are factors that can be met partially by user interface design decisions but for which, in general, also other actions are needed. **UID fully relevant factors** are factors that can be completely satisfied by user interface design decisions. In the following subsections, we discuss which factors belong to these different categories and give examples of how they can be supported by design guidelines. Table 2.8 provides a summary of how Lee’s factors are divided.

### UID Irrelevant Factors

**Affordability & Accessibility** are both valid concerns, especially for commercial products, but during design of the user interface these factors can be ignored. Of course, they should be considered at some point in the development of a product, as for instance the need to have a high-end smartphone to run an application will have a considerable impact on the affordability, as well as the limitation to a particular operating system, or the use of expensive software licenses. However, in general these decisions will be part of the requirements analysis. Once these decisions have been taken, the user interface design should follow them but the actual design will not influence these aspects anymore.

**Additional factors.** We also consider Lee’s “Additional factors” to belong in this category, as they largely focus on either the individual’s current state of being (*lifestyle fit*), which is something technology can’t easily affect. Lee also presents these as more of avenues of future interest and are not discussed in depth by the author in (Lee, 2015).

### UID Partially Relevant Factors

**Value** as defined in Lee’s work is the perceived usefulness of a product and how this is communicated. Ensuring that a product is useful is part of the requirement specifications, as requirements should be formulated that when satisfied will allow to satisfy the needs of the users. However, there are different ways to satisfy a requirement and this is part of the design. Design guidelines should make sure that users indeed perceive products as useful. This can be achieved by means of a good usability, but also through communication inside the application, such as by indicating or highlighting the usefulness of functionalities and features.

**Technical Support** involves supporting users and potentially providing supplementary learning tools and materials to enhance the use of a product. At first side, this looks to be outside the scope of the user interface design.

However, more and more we see that accessing technical support and learning material is incorporated into products. For instance, a person can shake with one's smartphone to reach technical support, or a step-by-step explanation is provided when a product is used for the first time. Incorporating an easy way to reach technical support or to find learning material is especially important for elderly, as they may not know how to do this. As such, guidelines are needed to ensure that certain aspects of technical support are incorporated into the design. Furthermore, it may be useful to consider that older people often prefer printed material (Barnard et al., 2013). Digital manuals do have multiple advantages that can be implemented, as Lee also discusses, but they do have a caveat of being additional thing that the user would need to learn to use. Paper manuals have the added benefit of being familiar to elderly. They of course have their own problems, such as the fact that mistakes cannot be simply corrected, nor can any additional information be added. Hence, a hybrid solution would likely be optimal, with the paper manual only explaining the core functionalities and providing clear access method for supplementary information that is also easy to print.

**Social Support** can also be approached from two angles. If a friend, family member or acquaintance supports the use of technology by working as a “technical support” or as a “champion” (Wang et al., 2011), this can convince elderly to try and stick with a technology. However, social support can also be incorporated into the design. Especially in web-based technology, including social support is relatively easy to achieve. If the technology supports social interaction by design (Syeda et al., 2018) or clearly helps the user to get in touch with “real people”, this could be a significant boost.

**Experience** also affects the adoption. Ideally, technology should resemble the user's prior experience with other systems. However, in practice this can be difficult to achieve, especially when users have diverse experiences. Compatibility with the style of a specific system can be formulated as a requirement, but it is also possible to realize this through personalization (Blom, 2000), which can for instance be achieved by means of using a profile or set of preferences which allow to adapt the interface either statically or dynamically to the user's preferences.

**Confidence** is very important for elderly as they easily feel vulnerable and become apprehensive when they are unsure of (possible threats caused by) technology. So, the fact that the product can be trusted should be guaranteed by external organizations, but it should also be supported by the design. For instance, the information asked (like personal information or an image of the user) and the way this is done should not create suspicion. In addition, despite not being completely against trial-and-error (Leung et al., 2012), older users do prefer to have a clear understanding of the consequences of each action, because they are afraid that any misstep can be harmful. It is also paramount to carefully formulate any feedback message to not scare or stigmatize the user.

Table 2.8: Summary of our presented reference model

<b>Fully Relevant Factors</b>
Usability
Emotion
Independence
<b>Partially Relevant Factors</b>
Confidence
Experience
Social Support
Technical Support
Value
<b>Irrelevant Factors</b>
Affordability
Accessibility

### UID Fully Relevant Factors

**Usability** remains a core factor for the adoption of any product. As we have seen in the previous sections, this has been researched extensively and numerous design guidelines have been formulated to enhance usability for various user groups. In our case, the design guidelines presented earlier in this chapter cover the usability requirements. However, note that focusing on achieving 100% coverage in a software product would likely be challenging and might not even guarantee user satisfaction (Hart, 2004, Lee, 2015, Rømen and Svanæs, 2012).

**Emotion** deals with the potential role for providing emotional benefits such as entertainment and enjoyment. More and more, this is recognized as an important aspect: using a product should be pleasant, not a tricky chore. The notable attention to gamification (Hamari et al., 2014) is an example of this, but emotional benefits can also be realized in other ways, for instance by providing playful interfaces (Kuts, 2009).

**Independence** is an important concern for many older people. In principle, technology that is intended for assistance of some sort will support this independence, however care should be given on how this is presented to the elder user. For instance, the language used in an application should avoid stigmatizing the user. Older people who feel vulnerable or dependent on others may easily perceive an application as a threat to their independence or feel being patronized by the application.

## 2.4 Summary

In this chapter, we reviewed existing user design guidelines and technology adoption models and have presented two significant outcomes: an up to date list of design guidelines and a reference model for design guidelines based on technology adoption factors, both aimed at elderly users.

Firstly, in section 2.1 we have presented our work of gathering 594 existing guidelines from literature into a single integrated list of 110 guidelines combined with a check statement for each guideline. Next, we reported on an expert evaluation that has been performed. Eleven experts participated in this evaluation, which was using a web application created for this purpose to ease the evaluation. The focus of the evaluation was on investigating which guidelines were still considered as important and which seemed to have lost their relevance for modern application running as web apps or as native apps. Our research suggests that despite the fact that the expert indicated that the majority of the guidelines are still valid, times are changing and a number of them are slowly becoming less relevant, while a need for adding new ones might come sooner than anticipated.

The presented guidelines can be used directly for designing applications by developers, as they are an amalgamation of existing current guidelines. However the current method of presenting our guidelines is also well suited for checking whether these guidelines have been used in an application, as each guideline is accompanied by a check statement. Furthermore, such an integrated list is easier to maintain and to keep the list up to date. The websites created as part of this work<sup>3,4</sup> are available for researchers.

Next, in Section 2.2.1 we presented different technology adoption models and systematically went through Lee's 10 technology adoption factors, especially targeting elderly users. Outside these factors, there are likely a number of additional variables that might also affect the adoption process, some of these were already mentioned by Lee (2015), such as age, gender, educational background, and culture. On top of these, security management, such as password management and login method, can be an additional factor.

Lastly, we proposed a reference model for design guidelines for elderly based on technology adoption factors. This reference model allows to link design guidelines to technology adoption factors and can also guide researchers in uncovering missing design guidelines.

An overview of how this chapter contributes to answering our research questions (given in Chapter 1) is given in Table 2.9.

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<sup>3</sup><https://elderly-ui.web.app/>

<sup>4</sup><https://elderly-stats.web.app/>

<sup>5</sup>see footnote 3 and 4

Table 2.9: Revisit to our research questions and short summaries of our answers

<p><b>(RQ1.1)</b> What aspects have already been identified as important to take into consideration when designing a digital application for elderly users?</p>	<p>An in depth look to both technology adoption models was taken, especially that of Lee. Additionally, design guidelines focusing specifically on web and touchscreen devices were surveyed and merged together into a up to date list of 110 guidelines. The list of guidelines was evaluated by experts and modified over a period of several months.</p>
<p><b>(RQ1.2)</b> What tools (e.g., guidelines, theories) currently exist for designing technology for elderly users, and do they cover all aspects identified in RQ1.1?</p>	<p>We identified a large number of user design guidelines but we concluded that most of them were focusing on usability and that for instance security was not covered. Furthermore, different technology adoption models were discussed. Especially, the 10 factors identified by Lee (2015) are important for elderly users, but additional factors may be useful.</p>
<p><b>(RQ1.3)</b> How can we provide more guidance to developers when developing software for elderly users?</p>	<p>Our list of merged guidelines provides a useful tool for developers of digital technology for elderly and identifies the needs of modern elderly users. The current version of website with all the results, as well as the evaluation page, with an up to date version of our guidelines are both accessible<sup>5</sup>. Additionally, our reference model based on Lee's factors provides a high level view on how technology adoption factors and user design guidelines relate, and which factors can be covered by means of design guidelines.</p>

## Chapter 3

# Digital Engagement Techniques: A Meta Review of Gamification, Persuasive Technology & Nudging

In the previous chapter, we have considered technology adoption models, as well as different usability guidelines, which aim to outline some of the basic principles for “good” software; good from the perspective of user adoption and usability. However, good design alone is not always enough to achieve continued use of an application, especially when there are a number of applications that are offering the same or a very similar service or functionality, or when the user is simply not very motivated to perform the task(s) offered. The continued use of software, or long-term engagement, is relevant for most software. Commercial platforms use a myriad of techniques to try to retain their user base, such as making user progress visible to other members, or by using the “fear of missing out” feeling. These techniques mostly fall under the approaches known as gamification, persuasive technology, and nudging.

These three approaches have mostly similar aims, but their individual techniques differ somewhat. Gamification is essentially about the use of game elements in non-game environments (Deterding et al., 2011). Persuasive technology and nudging aim to guide user behavior toward a desired goal, with nudging in general being slightly more blunt than persuasion. Due to the divergent bases of the three approaches, it is not always easy or clear for practitioners to decide which approach would best fit their needs. In order to clarify the differences, similarities and the overall status of these fields, we have performed a meta-review of 34 review papers focusing on of these approaches. From the analysis, we have gathered valuable information on (1) the current

state of each approach, (2) the popular techniques used by each approach, (3) the amount of focus on different age groups, such as elderly users, as well as (4) outcomes, especially on the impact of specific techniques on engagement and motivation. The definitions that we used for engagement and motivation will be given later in this chapter.

The remainder of this chapter is organized as follows: Section 3.1, Background, first looks at the concepts of engagement and motivation: definitions used, ways to evaluate them, and current problem areas. The rest of the section describes the foundations of the three approaches and various frameworks and taxonomies focusing on them. Section 3.2 explains and justifies the methodology used to conduct our meta-review. Sections 3.3 and 3.4 report and discuss our findings, respectively. This chapter aims to answer the research question RQ2. The chapter ends with a summary.

## 3.1 Background

This section starts by defining and exploring the concept of engagement. We then provide the foundations of and popular frameworks for gamification, persuasive technology, and nudging respectively.

### 3.1.1 Engagement

User engagement is not a new concept, it is however a rather elusive term that often appears with various synonyms. Studies also often report engagement as an outcome along side with one or more synonyms for it, such as attention, fun or pleasure, interactivity, interest, flow (O'Brien and Toms, 2008, Perski et al., 2017, Attfield et al., 2011). Hence, we will first take a look at some of the definitions and different aspects of engagement.

In a well-cited research article on user engagement, O'Brien and Toms (2008) define engagement as follows:

*Engagement is a category of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, inter-activity, and perceived user control.*

The authors also took a look at other, earlier definitions and proposed a model of engagement that consists of four stages through which the user may cycle through several times during a session: The Point of Engagement; The Period of Engagement; Disengagement; and Re-engagement.

Attfield et al. (2011) define user engagement as:

*User engagement is the emotional, cognitive and behavioural connection that exists, at any point in time and possibly over time, between a user and a resource.*

These authors' definition was intentionally broad due to the many factors and relationships that users might create with a system.

A more recent study on engagement from the viewpoint of Digital Behavior Change Interventions (DBCI) by Perski et al. (2017) defines engagement as:

*Engagement with DBCI is (1) the extent (e.g. amount, frequency, duration, depth) of usage and (2) a subjective experience characterised by attention, interest and affect.*

These authors also identify numerous factors that affect engagement, as can be seen in their conceptual framework of engagement with DBCI. Among other things, the context of use is considered important, which in itself is composed of numerous other factors, such as social, psychical, psychological and demographic factors. Additionally, the DBCI system itself could also affect engagement by its design, content, and delivery methods, among other things.

We see all three definitions as valid, but for the sake of clarity on what exactly is meant by engagement in the context of this dissertation and meta-review, we have opted to use the last of these definition, i.e., the one given by Perski et al. (2017).

Measuring subjective concepts such as engagement is challenging, but qualitative evaluation methods such as interviews (Perski et al., 2017, Lalmas et al., 2014), questionnaires like the User Engagement Scale questionnaire (O'Brien and Cairns, 2015), and think-aloud methods (Perski et al., 2017, Lalmas et al., 2014) provide some insights. The findings of qualitative studies can then be supported or disputed by raw data collected from the system, such as eye-tracking data, mouse clicks, the number of logged-in times of the user, and general user activity (Perski et al., 2017, Lalmas et al., 2014).

Since engagement is among the key determinants on whether a user will keep actively interacting with a system, it has often been a focal focus of studies (Looyestyn et al., 2017, Escobar and Urriago, 2014, Da Rocha Seixas et al., 2016, Shih et al., 2015, Gouveia et al., 2015, Wang et al., 2016). The difficulty of maintaining long-term engagement, or ensuring that the engagement measured is not just the result of disruption in the day-to-day humdrum (novelty factor), are not new challenges. Both remain persistent sources of concern in studies (Gouveia et al., 2015, Shih et al., 2015, Karapanos, 2015, Lee et al., 2018, Wang et al., 2020).

### 3.1.2 Motivation

For motivation we use a slightly modified version of the definition of Laine and Lindberg (2020), where the focus was on learners and learning. Our definition is: *“motivation is defined as the reason for the user to become and remain engaged with technology”*. Like Laine and Lindberg (2020), we also consider both *“extrinsic”* and *“intrinsic”* motivation (Ryan and Deci, 2000). Extrinsic motivation arises from external sources, such as rewards, whereas intrinsic motivation come from the persons, for instance because the want to achieve

something or out of curiosity. Intrinsic motivation is stronger and more likely to last longer (Csikszentmihalyi, 1990).

Similar to engagement, motivation is also difficult to measure and the techniques are largely the same, such as surveys (Agrifoglio et al., 2012). Also a number of motivation measurement scales do exist, such as, Motivation Assessment Scale (Mark Durand and Crimmins, 1988), The Situational Motivation Scale (Guay et al., 2000) and The Revised Achievement Motives Scale (Lang and Fries, 2006).

### 3.1.3 Gamification

The Gamification approach is largely based on a definition—*the use of game design elements in non-game contexts*—given by Deterding et al. (2011) that now is probably the most well known and used definition of Gamification. In principle, gamification includes multiple techniques and game elements (Laine and Lindberg, 2020), but only a handful have become nearly synonymous of this approach: i.e., points and badges & leaderboards (Hamari et al., 2014, Alhammad and Moreno, 2018, Pedreira et al., 2015). The wide use of these elements has even evolved into a somewhat derogatory term “pointification”, which is often used to criticize some shallow implementations of gamification (Alhammad and Moreno, 2018, Seaborn and Fels, 2015, Pedreira et al., 2015). Generally, the range of gamification techniques is wide, from the more shallow pointification approaches to very complex systems with internal economies or social hubs, such as seen in commercial platforms like Valve’s Steam platform<sup>1</sup> or Duolingo<sup>2</sup>.

Despite gamification not being originally based on any specific framework, several frameworks have been proposed for it over the years. In a systematic literature review by Mora et al. (2017), 40 gamification design frameworks were identified. In this section, we will go through two of the more popular frameworks: the 6D Gamification Framework and Octalysis. Taxonomies have also been proposed for the motivator and design principles of gamification. In a study by Laine and Lindberg (2020) gamification was divided into 13 categories: challenges, control, creativity, exploration, fairness, feedback, goals, profiling and ownership, relevance and relatedness, resources and economy, social play, storytelling and fantasy, and learning (see Table 3.1 for details). Based on these categories, we will organize our own findings on gamification in Section 3.3.

Popular gamification frameworks are:

- **6D Gamification Framework:** According to Mora et al. (2017), the 6D Gamification Framework (Werbach and Hunter, 2012) is among the most popular gamification frameworks. Its simplicity is probably a key reason for its popularity, as the framework does not go into abundant

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<sup>1</sup><https://store.steampowered.com/>

<sup>2</sup><https://www.duolingo.com/>

Table 3.1: Brief descriptions of the 13 gamification design principles identified in a taxonomy study by (Laine and Lindberg, 2020)

<b>Resources &amp; Economy</b>	Game mechanics involving game resources, such as points, badges, achievements, and other virtual properties.
<b>Profile &amp; Ownership</b>	Provision of access to individual gameplay data through the player’s profile.
<b>Challenges</b>	Tasks suited to the user’s skill level. Often getting incrementally more difficult.
<b>Goals</b>	Must be clearly stated with clear pathways to success. They can be intermediary (part of a bigger task), or final (the bigger task).
<b>Social Play</b>	Social aspects, most commonly interaction, cooperation, and competition. Gamification elements that connect users in any form follow this principle.
<b>Feedback</b>	Any response to user action, commonly presented as reminders, notifications, suggestions, and warnings.
<b>Control</b>	Covers two aspects: (i) the player’s ability to make choices in game play, and (ii) the input mechanisms through which the user interacts with the game.
<b>Storytelling &amp; Fantasy</b>	Historical information-sharing tools, now also recognized as useful instruction methods. Wrapping a topic within a classic fantasy or sci-fi setting can provide an immersive experience.
<b>Exploration</b>	Inspires curiosity as a motivator through exploration of the game world and its contents. Also popular in some games in real-world contexts (e.g., location-based games).
<b>Fairness</b>	Attempts to ensure that all players enjoy the game in a fair manner.
<b>Creativity</b>	Rewards and encourages player experimentation both inside and outside the game.
<b>Relevance &amp; Relatedness</b>	Ties the game experience with the real-world context, making it more relevant and increasing player relatedness.
<b>Learning</b>	Design principles that aim to support the learning process of the player.

details. It starts with six elements: *Define business objectives, Delineate target behavior, Describe your players, Devise activity loops, Don't forget the fun, and Deploy appropriate tools.*

In the end, a lot of the work is left for the designer as this framework only outlines very general objectives to keep in mind. Also noteworthy is that the 6D framework is very much intended for use within companies.

- **Octalysis:** While the 6D-framework is somewhat general in its approach, Octalysis (Chou, 2016) takes a very different approach by defining some rather specific gamification mechanics and approaches. Octalysis defines eight core motives for motivation, hence the name. The author also lists a number of examples for each motives, but here we will only briefly explain the motives themselves:
  - **Epic Meaning.** Being part of something bigger.
  - **Accomplishment and development** combines the challenge of a task with the reward given for overcoming it, as well as providing a way for users to track their progress.
  - **Empowerment of creativity and feedback** challenges that reward creativity and an environment that reacts to this accordingly.
  - **Ownership and possession.** According to Chou, owning something drives the owner to improve upon it. Similar feelings can be evoked with customizing one's avatar.
  - **Social Influence and Relatedness.** Comparing skills, working together with friends among other numerous social approaches that involve more than a single user are part of this motivation.
  - **Scarcity and Impatience.** Wanting something because you can't have it. Making something seemingly hard to get, or scarce to give it more perceived value.
  - **Unpredictability and Curiosity.** Wanting to know what happens next. Where experimenting and exploring is potentially rewarded, Chou notes that also gambling can be perceived to belong to this group.
  - **Loss and Avoidance.** Wanting to avoid something negative from happening. This also means opportunities that seemingly will fade away if you do not act soon enough.

### 3.1.4 Persuasive Technology

Fogg (2002) defines persuasive technology as *“Interactive information technology designed for changing users' attitudes or behavior”*. Oinas-Kukkonen and Harjumaa (2009) define persuasive systems as follows: *“Persuasive systems may be defined as computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without using coercion or deception”*. Persuasion in itself is clearly as good or bad as its intended

use, thus the authors felt the need to add explicitly “without using coercion or deception”. For instance, Facebook and Twitter, among other similar platforms, have risen ethical questions on how they influence their users (Whitney, 2020). There is even a word for a more ‘malicious’ approach, called *dark pattern* (Mathur et al., 2021).

In the following sections, we present some of the more popular models and principles in the context of persuasive technology and behavior change, i.e., Cialdini’s Science of Persuasion (Cialdini, 2004), Fogg’s Social Actor & Behavior Model (FBM) (Fogg, 2002, 2009), Eyal’s Hook Model (Eyal, 2014), Persuasive System Design (PSD) (Oinas-Kukkonen and Harjumaa, 2009), and Digital Behavior Change Interventions (DBCI) (Michie et al., 2013).

### Cialdini’s Science of Persuasion

Cialdini’s principles in his Science of Persuasion (Cialdini, 2004) can be considered to be among the first building blocks of persuasion strategies that later evolved into more technology-focused models.

Cialdini lists six tendencies that generate positive responses in people. It should be noted that these are very generally applicable and his focus was not by any means intended specifically for use in technology.

- **Reciprocation:** People are prone to give back and respond to a request of someone who has given something for free first. An example are free taste samples.
- **Consistency:** Making users to commit to something by their own acknowledgement. Cialdini’s example is a study where people were first informed and convinced of an issue and at a later stage approached to gather money to combat the said issue, doubling the gains compared to previous such events without informing and convincing people.
- **Social Validation:** People are likely to follow in suit of a large group of people. The need to avoid going against general social tide can be a powerful persuasive tool.
- **Liking:** People like to say “yes” to those they like. Word of mouth, friends, or familiarity are all examples of this.
- **Authority:** People are more likely to listen to someone who is or appears to be speaking from a position of authority. Cialdini’s example includes the use of heroic or famous people to convey a message.
- **Scarcity:** A real or perceived scarcity of an item might make it more sought-after. Classic examples of this are “limited edition” products that are perceived to be more valuable. A recent occurrence might be the general hoarding during the first months of COVID-19 pandemic (Baddeley, 2020).

## Fogg's Social Actors & Behavioral Model (FBM)

Fogg's FBM (Fogg, 2002, 2009) was among the first attempts to create clear connections on how modern technology was and could be used to persuade users through "Persuasive Design". First, Fogg listed five primary social cues that a user might perceive from a software: Physical, Psychological, Language, Social Dynamics, and Social Roles.

- **Physical** refers to making the user's eyes or mouth move, or by simply appearing attractive by design, a technology may be more persuasive.
- **Psychological** refers to the "personality" of the technology. By conveying personality to the user, a technology can have more sway over them. This can be done via more human-like messages and emoticons. Fogg also presented two studies that he conducted and that suggested that the more the users see themselves in the computer, the more effective the persuasion is.
- **Language** refers to the way technology acknowledges the user by name, offers positive feedback at every turn and overall responds to actions done by the user. It similarly also refers to the overall liveliness of the messages and feedback provided by the system. One very simple technique is to praise the user often.
- **Social Dynamics** refers to creating a similar feel to "brick & mortar" stores in how an e-shop might respond to users actions of clicking through the purchasing steps. Also, reciprocity, the need to give concessions or discounts to people whom a person has received favors from, belongs to this category. Quite a common modern method is giving out gift cards, or special deals with wording that makes it feel more personal.
- **Social Roles** refers to computers taking over a role. An important example given by Fogg shows that a successful representation of authority might have enhanced persuasive powers.

Later, Fogg published his Fogg's Behavioral Model (FBM), which he stated to be "useful to analysis and design of persuasive technologies". The core of the model is quite simple and consists of three factors: *motivation, ability, and triggers*. A user with high motivation and ability for a certain behavior is likely to respond more positively to a trigger to actually perform the behavior than a user with low motivation or ability. Triggers represent the outside world trying to influence the user in some manner; this could be something as simple as a reminder to complete walking daily 10 000 steps with additional data showing that the user is already half way. Additionally, Fogg lists some *core motivators* for FBM:

- **Pleasure / Pain:** Fogg emphasizes that this motivator is primitive in nature: people like to have pleasure and will try to avoid pain. A good modern example for this could be found in Tinder<sup>3</sup>.

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<sup>3</sup><https://tinder.com/>

- **Hope / Fear:** this motivator, according to Fogg, may at times be more powerful than “Pleasure or Pain”. Overall, it is about anticipation of either gaining or losing something.
- **Social Acceptance / Rejection:** comparing oneself with other’s success and the need to fit in with others as well as the fear of falling out of a social circle are both strong motivators.

As a part of FBM, Fogg also lists *simplicity factors* that relate to the user’s ability and that might make a task more simple or complex:

- **Time:** The more time a task requires, the less likely the user will be interested in investing in it.
- **Money:** The more resources a task requires, the less likely the user will be interested in investing in it. This also requires the understanding of the average economical capacity of the user, as it heavily influences the concept of “expensive” for the user.
- **Physical Effort:** How much physical activity the task requires from the user may influence the likeliness to take up the activity. For instance, scanning a bar code of a product, or typing in their details to keep track of daily calories eaten can make a big difference.
- **Brain Cycles:** The same applies for how much thinking the activity requires. This likely varies between personalities, but overall requiring to think in a new way or deeply can be difficult for people.
- **Social Deviance:** If a task requires going against social norms it is also less likely that the user will do this.
- **Non-Routine:** A task that is outside of a user’s regular activity may appear as more complex or demanding to the user.

Lastly, Fogg also divides triggers into three distinct groups: *sparks*, *facilitators*, and *signals*. A spark is a trigger that focuses on the motivators and aims to trigger via one specific motivational element. A facilitator is a trigger for users with high motivation, but low ability. The aim is to lessen the effort for the user to do the task. A signal trigger is optimal for a user who has high motivation and ability, and just needs a little push or reminder to perform the designated task.

### Eyal’s Hook Model

The Hook Model (Eyal, 2014) identifies four key components required for habit forming: *incentive*, *action*, *variable remuneration* and *investment*. The model is based on cycles to form or maintain a habit. Each cycle starts with either an internal or external trigger. External triggers, as the name suggest, originate from outside. These can be messages, prompts, or essentially anything that either presents an opportunity for triggering the user to perform a desired action, or attempts to remind him/her of it. Internal triggers stem from the user’s own needs. In a perfect situation, they emerge on themselves after

repeatedly going through the cycles, i.e., the external triggers are not needed anymore. For example, checking Facebook feeds when one feels lonely.

The Hook model is built on top of FBM and focuses especially on what should happen after a trigger has successfully reached its target. The model relies not only on building a habit by replacing external triggers with internal triggers but also by letting the user invest in something in the application each time. The more a user has invested in an application (this can be resources, time, or the building of experience or reputation), the less likely it is that (s)he will stop using it. Additionally, the process of successful triggers should also include a reward of some sort to increase the likelihood that the user will go through the cycle again with the next trigger. Eyal lists three potential reward types:

- **Rewards of the Tribe** focus on gaining acknowledgements and prestige from other users, for example, a social network notification.
- **Rewards of Hunting** is about a physical object, information or resources, such as a discount coupon.
- **Rewards of the Self** is about sense of competence and overcoming obstacles. A classic gamification way to do this is with badges, levels, and progression bars.

### Persuasive Systems Design (PSD)

Persuasive Systems Design, outlines of which were published in 2008 (Oinas-Kukkonen and Harjumaa, 2008), and was more fully defined a year later (Oinas-Kukkonen and Harjumaa, 2009) by Oinas-Kukkonen and Harjumaa, is among the more popular design guidelines that focuses on persuasive systems. Four of the eleven review papers we looked at focused solely on PSD. The PSD paper lists 28 design principles that are divided into four categories. The authors use Fogg as a basis, but aim to make it more systematic and defined. They criticize Fogg's design principles for not explaining how to transform them to software requirements and how to go about implementing them. The four categories are:

1) **Primary Task Support** supports the user's task. Primary task support should drive the system behavior and guide the user. Its principles are as follows:

- **Reduction:** Reduce the complexity of the task, either by splitting the task into smaller and simpler tasks, or by an overall design approach.
- **Tunneling:** Provide guidance to the user, drawing users toward the wanted behavior pattern.
- **Tailoring:** Provide users with information that best suits their individual needs.
- **Personalization:** System offers personalized content; this is closely related to Tailoring.

- **Self-Monitoring:** Track the users' progress and status and display the results.
- **Simulation:** Show the causes and effects to users via simulations.
- **Rehearsal:** Enable the user to practice and gain familiarity with the system's functionalities.

2) **Dialogue Support** includes feedback methods that improve the persuasiveness of the system. Feedback such as **praise, rewards, reminders,** and **suggestions** are self-explanatory; terms needing more explanation are:

- **Similarity:** Similarity feedback reminds the users of themselves; for example, the system might use familiar slang words.
- **Social role:** A system that plays a social role, such as a virtual specialist, can be more convincing to users.

3) **System Credibility Support** concerns the design of credible systems. The design principles are **trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsement,** and **verifiability.**

4) **Social support** motivates users through social influence. Its design principles are summarized as follows:

- **Social Learning:** Enables users to see and learn from other users performing the same task.
- **Social Comparison:** Allows users to compare their own status with those of other users.
- **Normative Influence:** Synonymous with peer pressure, normative influence attracts individual users to like-minded users adopting a particular behavioral pattern.
- **Social Facilitation:** Encourages participation by showing the number of people currently working on the same task.
- **Cooperation & Competition:** Exploits the natural drive of humans to cooperate or compete.
- **Recognition:** Publicly recognizes an individual or group effort.

### **Behavior Change Technique (BCT) & Digital Behavior Change Interventions (DBCI)**

BCT and DBCI are closely connected and it could be argued that at times DBCI is simply a “digital” extension of BCT, as largely the same group of researchers are behind both terms (Yardley et al., 2016). They can be seen as yet another approach for mapping potential methods for changing user behavior. BCT can also be coupled with PSD as one of the review papers (Asbjørnsen et al., 2019) showcased.

BCT is a result of the work of Michie et al. (Michie et al., 2013) who conducted a Delphi-type expert evaluation. Out of 124 collected BCTs that

a first group of experts rated by labels and definitions and a second group organized in an open-sort task, a total of 93 BCTs were clustered into 16 groups as shown in the Appendix in Table A.10. The authors define BCT as:

*“By BCT, we mean an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behavior; that is, a technique is proposed to be an “active ingredient” (e.g., feedback, self-monitoring, and reinforcement)”*

In a book specifically preparing the reader for developing and evaluating DBCT (West and Michie, 2016), the authors define it as such :

*“... a product or service that uses computer technology to promote behaviour change.”*

### 3.1.5 Nudging

Nudging generally adopts a pushier approach than persuasion. A nudging system gently but firmly encourages the user to adopt a certain behavioral pattern. Nudging was introduced by Thaler and Sunstein (2009) who defined it as *“aspects of the choice architecture that alters people’s behavior in a predictable way without forbidding any options or significantly changing their economic incentives”*.

Nudging is widely adopted in policy making Hansen and Jespersen (2013). In the present review, nudges are divided into automatic and reflective thinking based on dual process theory (Thaler and Sunstein, 2009). Hansen and Jespersen (2013) defined automatic thinking as *fast, instinctive...* and reflective thinking as *slow, effortful...* Automatic thinking is performed quickly and without hesitation, whereas reflective thinking is a ponderous process requiring active mental processing.

Out of the three approaches, nudging is also the most likely to manifest the use of unethical techniques to achieve their purpose (Weinmann et al., 2016). Design choices resulting in unethical nudges could be done accidentally (such as a difficult to locate button), or deliberate, for instance to drive the user towards purchases that are not directly beneficial to them (Weinmann et al., 2016). There is even discussion on the ethics of nudging (Sunstein, 2015), which highlights the importance of ensuring that design choices taken have a beneficial impact on the user.

## 3.2 Meta-Review: Methodology

The goal of this chapter is to report on a conducted literature study on gamification, persuasive technology, and nudging in order to obtain an overview of the state of the art in these fields, in particular in terms of techniques used

and their effectiveness given the user’s context and the target group. Due to numerous review papers already existing in these fields, doing yet another review on individual studies in these areas would not add much in itself. This is why we decided to focus on already existing review papers to investigate by means of a meta-review the overall state of these three separate, but similar fields. For performing the meta-review, we adapted the methodology proposed by Kitchenham and Charters (2007) who described detailed guidelines for planning, conducting, and reporting systematic literature reviews in software engineering. In the following sections we explain how the steps were performed in our review.

### 3.2.1 Planning

Firstly, the focus of this chapter, being RQ2 “*What kind of long-term engagement techniques are available and how effective are they for different user age groups?*”, Can be divided to three separate points of focus:

1. **RQ2.1.** What persuasive technology, gamification and nudging techniques are commonly used in digital applications?
2. **RQ2.2.** What kind of long-term engagement techniques are available and how effective are they for different user age groups?
3. **RQ2.3.** Do studies focusing on these techniques consider users’ age? Were elderly or younger users explicitly targeted?

**Databases used:** The main database used for finding publications was Scopus, as it indexes all the relevant databases: ACM, IEEE Xplore, and Springer. Additional independent queries were performed separately on all these databases, as well as on Google Scholar.

**Search strategy:** Scopus allows for complex queries with patterns, as well as the Boolean AND and OR operators. The full query is available at<sup>4</sup>.

**Inclusion criteria:** The following criteria were used for the filtering:

1. The study must be in English
2. The review must be peer-reviewed
3. The review must cover papers that have implemented gamification, nudging or persuasive technology in a system<sup>5</sup>.

**Data analysis:** An iterative workflow for the data analysis was devised and is explained in more detail in the next section.

### 3.2.2 Conducting the Paper Selection

**Identification of research:** The online databases were queried in May 2020 at the Vrije Universiteit Brussel. The search was conducted with the predefined string of search words. This resulted in 3595 hits. These were checked

<sup>4</sup><https://doi.org/10.6084/m9.figshare.13143401.v1>

<sup>5</sup>The system area was not deemed important to our study

by scanning the titles and applying the inclusion criteria, which resulted in 398 papers. Additional independent querying of the databases was conducted with the main query words; the first 50 results were downloaded, or up to a point where the results clearly became irrelevant, resulting in another batch of 218 papers. After title screening the 218 dropped to 187. The total collected tally, after checking for duplicates from and within the two groups was 287.

**Selection of primary and quality assessment:** We proceeded to narrow the papers to only those that reviewed implemented Gamification, Nudging, Behaviour Change Interventions, or Persuasive Strategies in a digital application. A criteria-driven iterative workflow was applied:

- Read the abstracts of the studies and apply the inclusion criteria, mentioned above.
- Skim through the contents of the studies that passed the first round and apply the inclusion criteria again. Follow relevant references.
- Read through the studies that survived the second round and perform final filtering.

Eventually, after the workflow, we ended up with a total number of 34 papers of which 20 focused on gamification, 12 on persuasive technology, and 2 on nudging. A visualized representation of the methodology is given in Figure 3.1.

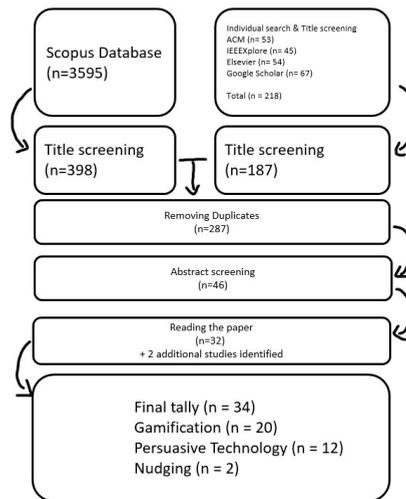


Figure 3.1: Visualization of the methodology used to acquire the review papers

### 3.2.3 Data Extraction and Synthesis

First, the following data extraction categories were devised: authors; publication year; publisher; title of study; focus; topic; definitions used; gamifica-

tion, persuasion or nudging elements listed. Then, results of implementations, additional noteworthy findings and remarks by review paper authors were extracted. Results were also confirmed by other researchers.

### 3.2.4 Terminology

Terms that carry similar meaning are often used in literature, to keep our meaning clear we use the word *element* to refer to all gamification mechanics, game elements, affordances, persuasive principles, behavior change intervention techniques, and nudging principles listed by the review papers. However, this convention is occasionally broken, when directly referencing a specific paper and the term used by the authors of the said paper in context. Furthermore, the term *study* is used to refer to an individual paper covered by one of the review papers. Similarly, we use the term *review paper* to refer to papers that we analyzed in our review.

## 3.3 Meta-Review: Findings

Before discussing the finding, we first make a note on the term “effectiveness”. Most of the review papers only briefly cover what they meant with “effectiveness”. For a majority of the review papers, effectiveness boils down to looking at outcomes, both positive and negative, and analysing how well each study reported on achieving behavior change. Some used more elaborate definitions for effectiveness, such as Falkner and Falkner (2014) who state:

*Any benefit must go beyond simple enjoyment (engagement without effective knowledge development is not a long term strategy for success) and must have visible and repeatable effect.*

Reporting on the various outcomes varied greatly among the review papers. Overall, most were simply reporting them as they were listed by the studies. In the case of persuasive technology, the lens of perspective varied somewhat between the reviews. For example, Kelders et al. (2011) looked at websites through PSD, but these studies were not designed with this specific principle in mind.

When looking at the outcomes and how they were reported, gamification review papers reported clearly the most wide range of different outcomes, as highlighter in Table 3.2. The table shows on which aspects the outcomes were reported by reviews in all or in a combination of approaches, and which only by reviews in an individual approach, for example (user) Behavior outcomes were reported by all three approaches, whereas for the aspect of Self Efficacy an outcome was only reported in a persuasive technology review. Some types of outcome could arguably be considered as synonyms but as definitions for outcomes were lacking in general, no outcomes were combined.

When looking at specifically engagement and motivation. With the exception of (Hervas et al., 2017), all gamification review papers reported on outcomes for both engagement and motivation. When looking at the Persuasive Technology review papers, outcomes for engagement and motivation were also reported by a majority of the review papers, but their overall focus was mainly on the impact on the behavior of users in and outside the system. None of the Nudging review papers reported on engagement as a direct outcome, but motivation was mentioned in (Caraban et al., 2019). To conclude, effectiveness in this meta-review means the positive and negative outcomes and achieved level of behavior change.

The following subsections present our findings on gamification, persuasive technology, and nudging. Our findings refer to the research questions presented in Section 3.2.1. For each approach, we first review the elements used (answering **RQ2.1**). Second, we present the outcomes and the remarks made by the authors of the papers (answering **RQ2.2**), and we conclude with the current state of the investigated research approach. Next, examine the overall findings in terms of the user groups targeted in the studies (section 3.3.4 (answering **RQ2.3**)). Lastly, theoretical foundations can be found in the Appendix (Table A.9).

Table 3.2: All reported positive outcomes from Gamification, Persuasive Strategies and Nudging. [x] = number of review papers mentioning this positive outcome

<b>Gamification</b>	<b>Persuasive Technology</b>	<b>Nudging</b>
Behavior (user) [17], Knowledge[6], Motivation[27]		
<b>Gamification</b>	<b>Persuasive Technology</b>	
Adherence[4], Compliance[1], Attitude[8], Awareness[7], Affective[2], Engagement[23], Empowerment[5], Habit[2], Learning[7], Persuasion[3], Physical activity[3],		
<b>Gamification</b>	<b>Nudging</b>	
Appeal[2], Behavior (System)[4], Performance (User)[6]		
<b>Gamification</b>		
Activity[1], Attendance[1], Boost Adoption[1], Develop creativity[1], Degree of Happiness[2], Effectiveness[1], Enjoyment[9], Ease the fixing process[1], Enhance monitoring[1], User experience[3], Flow[1], Immersion[3], Interest[2], Interaction[2], Playfulness[1], Physical activity[2], Psychological States[1] Productive (learning experience)[1], Perceived added value[1], Performance (System)[4], Participation[6], Recognition[1], Task involvement[1], Sense of accomplishment[2], Sense of Achievement[2], Social[6], Satisfaction[3]		
<b>Persuasive Technology</b>		
Cognitive Restructuring[1], Skill building[1], Comprehension and practice of program content[1], Self efficacy[2], Intention[1], Belief and Perception[1]		

### 3.3.1 Gamification

The 20 review papers on gamification gathered for this analysis collectively covered 737 gamification studies. We begin by grouping the gamification ele-

ments into the categories of game design principles as presented in an earlier study (Laine and Lindberg, 2020). We then discuss the effectiveness of the gamification elements, and overview the current state of gamification research. Table A.7 in the Appendix presents the details of each gamification review paper, including the number of studies covered, area and focus, main results, and the important remarks made by their authors.

### Gamification Elements

Table 3.3 presents the overall statistics of the gamification elements contained in gamification studies, and Table 3.4 lists the element names used in the review papers. In both tables, the elements are sorted using the categories of (Laine and Lindberg, 2020) and presented in the previous section (Table 3.1). The *Resources & Economy* category was overwhelmingly popular; over one-half of the combined studies (on average) implemented at least one element in this category. The most commonly implemented elements were *points* and/or *badges*. The *resources* category was noticeably less popular, being only occasionally observed.

The second most popular category was *Profile & Ownership*. This result was expected, because *profile & ownership* contains the *leaderboard* element (Table 3.4), a recognized staple of gamification (Koivisto and Hamari, 2019). Just over half of the studies implemented a Leaderboard. The third-most popular category was *goals*, with just over half of the studies implementing an element from this category. Different from the previous two categories, in which the results were clearly attached to three popular elements (Points, badges and leaderboards), the results of the goals category were roughly divided between “levels”, “stages”, and synonyms of goal (such as quest, missions, tasks, meaning).

### Outcomes and Effectiveness of Gamification Elements

Almost all of the review papers reported positive for outcomes. Six review papers divided the outcomes into positive, partially positive/mixed, and negative. In five of these papers, negative findings were few or absent, but the sixth paper (Falkner and Falkner, 2014) reported no positive results. The paper focused only on a single element, *badges*, in the computer science education context, and stated that “no clear evidence was found”. Another review paper (Wen et al., 2015) did not focus on the outcomes or effectiveness of gamification elements, but on the quality of the reviewed studies.

Outcomes were reported as overwhelmingly positive in six of the review papers (Hassan and Hamari, 2020, Johnson et al., 2017, Sardi et al., 2017, Seaborn and Fels, 2015, Hamari et al., 2014, Koivisto and Hamari, 2019), although Hassan and Hamari (2020) considered that researchers are potentially reluctant to report negative findings, and should be encouraged to report such results in future. A number of the review papers highlighted shortcomings in

Table 3.3: Summaries of all categories, showing the mean ( $\mu$ ), standard deviation ( $\sigma$ ), median ( $\eta$ ), and extrema (Max and Min) of each category. The numerical Max and Min give the highest and lowest number of elements in a single review paper, and their percentages express their proportions among all reviews (more detailed numbers and percentages are given in Tables A.2, A.3, A.4, A.6 and A.5)

	<i>Profile &amp; Ownership</i>				<i>Goals</i>			
	<i>Avatars</i>		<i>Competence</i>		<i>Levels</i>		<i>Goals</i>	
$\mu$	4.85	12%	18.50	51%	7.5	21%	12.37	29%
$\sigma$	9.38	16%	24.98	26%	13.2	20%	20.65	26%
$\eta$	1.50	7%	10.50	60%	5	21%	6	21%
Max	36	58%	114	89%	59	67%	91	100%
Min	0	0%	0	0%	0	0%	0	0%

	<i>Social Play</i>							
	<i>Voting</i>		<i>Interaction</i>		<i>Collaboration</i>		<i>Competition</i>	
$\mu$	1.2	1%	6.25	14%	3.8	6%	3.45	8%
$\sigma$	4.06	3%	12.08	19%	10.68	10%	6.99	14%
$\eta$	0	0%	0	0%	0	0%	0	0%
Max	18	14%	49	59%	47	33%	25	43%
Min	0	0%	0	0%	0	0%	0	0%

	<i>Challenge</i>		<i>Fairness</i>		<i>Feedback</i>		<i>Creativity/Control</i>	
	$\mu$	12.75	22%	2.1	4%	7.7	19%	2.2
$\sigma$	32.47	23%	5.96	7%	13.81	26%	6.9	16%
$\eta$	3.00	17%	0	0%	2.5	8%	0.0	0%
Max	146	67%	25	43%	57	93%	29	73%
Min	0	0	0	0%	0	0%	0	0%

	<i>Relevance and Relatedness</i>		<i>Storytelling &amp; Fantasy</i>		<i>Exploration</i>	
	$\mu$	4.0	5%	2.80	8%	1.10
$\sigma$	11.7	10%	4.99	8%	3.13	4%
$\eta$	0	0%	1.5	8%	0	0%
Max	51	33%	22	25%	13	15%
Min	0	0%	0	0%	0	0%

	<i>Resources and Economy</i>					
	<i>Points</i>		<i>Achievements</i>		<i>Resources</i>	
$\mu$	18.4	50%	18.4	60%	1.8	4%
$\sigma$	29.3	28%	20.8	29%	4.2	10%
$\eta$	11.0	51%	13.0	64%	0.0	0%
Max	138	100%	98	100%	17	43%
Min	0	0%	1	7%	0	0%

Table 3.4: Element names found in the review papers on gamification, grouped into categories

<b>Resources &amp; Economy</b>	<b>Points</b>	Points, xp (experience points), point system, scores
	<b>Achievements</b>	Badges, achievements, medals, trophies, rewards, in-game rewards, prizes, awards, incentives, levels
	<b>Resources</b>	Virtual currency / economy / goods, coins, collecting, collection
<b>Goals</b>	<b>Levels</b>	Levels, stages
	<b>Goal/Challenge</b>	Quest, missions, tasks, clear goals, rules, meaning, challenge
<b>Storytelling &amp; Fantasy</b>	Story, storytelling, theme, meaningful stories, narrative, narration, dialogues	
<b>Social Play</b>	<b>Rating/Voting</b>	Peer rating, votes, voting, down-voting, collective voting
	<b>Interaction</b>	Social interaction/connection/networking features/sharing/network/media integration/features, connectivity, relationships, forum chatting, news feeds, emoticons, memes, user generated content
	<b>Collaboration</b>	Teammates, cooperation, teams, player communication, peer interactions, collaboration, guild
	<b>Competition</b>	Competition, duel, betting, battles
<b>Fairness</b>	Suggestions, tips, signposting, assistance, virtual helpers, making suggestions, onboarding, informational, replay or do over, retries, health, health points	
<b>Exploration</b>	Virtual territories/world, 3D world, game world, unlockable content	
<b>Feedback</b>	Immediate/frequent/avatar-based/performance feedback, notifications, dashboard, reminders, punishment, penalties, warnings, sms reminders/feedback,	
<b>Profile &amp; Ownership</b>	<b>Avatars</b>	Avatar, user profiles, character, virtual identity, customization, personalization, character upgrades
	<b>Competence</b>	Ranking, Leaderboards, user rankings, likes, social status, reputation system, social reputation, progress, progression, progress bar, status bar, skills tree, self monitoring
<b>Creativity / Control</b>	Role play, choice, customization	
<b>Relevance &amp; Relatedness</b>	Real world, financial reward, physical cards, real world interactive objects, physical objects as a resource, physical dice, motion tracking, exertion based, location tagging, check-ins, location data	
<b>Challenge</b>	Challenge, timer, quiz	
<b>Learning</b>	Learning	

the studies that compromise the legitimacy of some of the reported positive outcomes (discussed in more detail later in this subsection).

**Effectiveness of individual elements** is mostly unclear as most elements were combined with one or more other elements, and the effectiveness of individual elements was rarely considered. However, sporadic findings of potential element-related outcomes and their combinations were mentioned in some review papers. For clarity, we grouped the relevant discussions of individual elements into the categories of game design principles, following the taxonomy of Laine and Lindberg (2020):

**Resources and Economy:**

- *Points* is probably the most commonly implemented gamification element, but its effectiveness is unclear. Studies reporting positive outcomes for *points* suggest that the element is effective, but whether a simple combination of *points* and its popular compatriots *badges* and *leaderboards* benefits the implementation is uncertain. Johnson et al. (2016) reported that a combination of points and leaderboards increases the physical activity of users.
- Like points, *badges* was a popular element in the review papers. Although badges was usually not associated with other remarks, no element other than badges was the focus of a review paper. Falkner and Falkner (2014) studied the effectiveness of badges in computer science education. As stated above, the authors reported no positive effects of this element, but raised some interesting questions that were not found in the reviewed studies: 1) Is a Badge effective only up to some threshold, and how can we decide which actions should be awarded with badges and which should not? Falkner and Falkner (2014) considered that awarding publicly visible badges in an educational setting might negatively impact students who receive fewer badges.

Two review papers made direct positive remarks on badges. First, Rincón-Flores et al. (2019) reported that when students were awarded with badges in massive open online courses (MOOCs), their motivation increased. Second, Nah et al. (2014) reported on a single study in which students felt that badges improved their engagement and motivation.

**Profile & Ownership:**

- The popularity of the *Leaderboards* element was mentioned multiple times in the review papers. Johnson et al. (2016) reported that Leaderboards increased the physical activity of users. Conversely, Morschheuser et al. (2016) remarked that *leaderboards* lose their effectiveness over time, and deliver their greatest benefit over shorter intervals.

**Goals & Challenge**

- *Challenge* was mentioned briefly in six of the review papers (Seaborn and Fels, 2015, Sardi et al., 2017, Johnson et al., 2017, Rincón-Flores

et al., 2019, Klock et al., 2020, Sardi et al., 2017). It was considered that challenges incentivize engagement and intrinsic motivation.

- *Levels/Stages* was mentioned in (Nah et al., 2014). They concluded that user progress between levels does not necessarily translate to increased learning abilities.
- *Avatars* were mentioned as a motivating factor in three studies investigated by Johnson et al. (2016).

### **Social Play:**

- *Social Interaction* was reported to appeal to students and increase their social skills (Sardi et al., 2017). Additionally, Johnson et al. (2016) reported that social interaction enhances physical activity, mental health, and user experience (assessed as fun and motivational) in moderating alcohol consumption.
- *Social sharing & Competition* encouraged participants in a review focused on sustainable living by Johnson et al. (2017). They found two studies reporting these effects.

**Feedback** was rarely directly credited for positive outcomes, but in conjunction with other elements, many individual studies reported that feedback increased engagement (Hassan and Hamari, 2020, Nah et al., 2014, Sardi et al., 2017), (intrinsic) motivation (de Jesus et al., 2018), and the task completion rate of software testing (de Jesus et al., 2018). In studies that garnered mixed results, the feedback quality was identified as the likely culprit of non-positive outcomes (Seaborn and Fels, 2015). Johnson et al. (2016) reported a single study in which feedback was disliked when perceived as being exaggerated. Sardi et al. (2017) briefly discussed the benefits of instant feedback, and stressed that feedback should be dynamic and adaptable. Nah et al. (2014) and Sardi et al. (2017) similarly stated that the frequency and immediacy of feedback directly correlates with positive outcomes.

### **Stories & Fantasy:**

- *Stories* were reported to help immersion in three review papers (Koivisto and Hamari, 2019, Hassan and Hamari, 2020, Hervas et al., 2017), but the assertions were mainly speculative. Johnson et al. (2016) reported on two studies that combined narration with rewards, levels, and avatars. In one of these studies, narration increased the engagement of the user; in the other, it increased motivation.

## **Current State of Gamification Research**

Most of the 20 review papers on gamification focused on single areas: *health* (Sardi et al., 2017, Alahäivälä and Oinas-Kukkonen, 2016, Wen et al., 2015, Johnson et al., 2016), *education and learning* (Nah et al., 2014, Falkner and

Falkner, 2014, Dicheva et al., 2015, Rincón-Flores et al., 2019), *software development* (Pedreira et al., 2015, de Jesus et al., 2018, Alhammad and Moreno, 2018), *domestic energy consumption* (Johnson et al., 2017), *crowd sourcing* (Morschheuser et al., 2016), *e-participation* (Hassan and Hamari, 2020), *behavioral change* (Hervas et al., 2017), and *tailored gamification* (Klock et al., 2020). A minority of the papers adopted a general view of gamification (Klock et al., 2018, Seaborn and Fels, 2015, Hamari et al., 2014, Koivisto and Hamari, 2019).

**Shortcomings and Limitations:** A review paper by Hamari et al. (2014) reported several shortcomings: 1) the small sample sizes of some studies; 2) the lack of validated psychometric measurements when surveying experiences and attitudes; 3) sporadic use of control groups and reliance on user evaluations alone; 4) omission of controls when investigating relationships between gamification elements, which are often investigated together; 5) the use of descriptive statistics only; 6) short time-frames of experiments; 7) a lack of clear reporting; and 8) the lack of multi-level measurement models in some studies. Similar observations were made in other review papers, especially, the lack of empirical data (Pedreira et al., 2015, Wen et al., 2015, Sardi et al., 2017, Alhammad and Moreno, 2018), poor quality of the empirical data (Morschheuser et al., 2016, Rincón-Flores et al., 2019), improper evaluations (Johnson et al., 2017, Hassan and Hamari, 2020), both improper evaluations and poor-quality data (Dicheva et al., 2015, Seaborn and Fels, 2015), and omitted evaluations of individual gamification elements (Seaborn and Fels, 2015, Alahäivälä and Oinas-Kukkonen, 2016, Johnson et al., 2016). Some reviews provided recommendations for improving the evaluation designs (Seaborn and Fels, 2015, Johnson et al., 2016, Wen et al., 2015) and gamification elements (Nah et al., 2014, Klock et al., 2018, Wen et al., 2015). A more recent and rather extensive review by Koivisto and Hamari (2019) noted that although various shortcomings reported five years earlier by Hamari et al. (2014) remain unresolved, the approach has matured somewhat with the increased number of experimental research settings. Nevertheless, they mentioned that out of 227 reviewed studies, only 66 were controlled experiments.

### 3.3.2 Persuasive Technology

We analyzed 12 review papers on persuasive technology, covering 462 studies in total. Several review papers (Wiafe and Nakata, 2012, Kelders et al., 2011, Wildeboer et al., 2016, Win et al., 2017, Asbjørnsen et al., 2019) categorized their findings using PSD, whereas others (Orji and Moffatt, 2018, Dolhalit and Salam, 2014, Paraschivoiu et al., 2019, Almutari and Orji, 2019) included studies that were performed without PSD, so the resulting list contained both PSD and non-PSD terminologies. A third group of papers used the Behavior Change Technique (BCT) taxonomy of Michie et al. (2013) (Perski et al., 2017, Berry et al., 2018, Asbjørnsen et al., 2019) (Asbjørnsen et al. (2019) used both PSD and BCT). The following subsection presents our findings from all three

groups. The persuasive technology reviews are further detailed in Table A.8 (Appendix). That table gives the number of studies covered, their area and focus, important results, and remarks made by the authors.

### Persuasive Technology Elements

In Table 3.5 we observe that the most popular elements in PSD implementations were *tunneling*, *tailoring*, *self-monitoring* and *reminders*, whereas the *system credibility* category seems to have been overlooked by nearly all studies. The non-PSD studies included a rather substantial category of elements (see Table 3.6). Messaging elements such as *feedback* and the *social* elements dominated this group, but overall in smaller numbers than in PSD studies. Among the three review papers (Perski et al., 2017, Berry et al., 2018, Asbjørnsen et al., 2019) covering BCTs, only one (Asbjørnsen et al., 2019) clearly listed the elements reported in the studies. The number of elements in the studies reviewed by Berry et al. (2018) were estimated from the rough percentages given in their paper. Perski et al. (2017) also presented some elements, but did not systematically list them. Therefore, Table A.10 in the Appendix, shows only the elements derived from (Asbjørnsen et al., 2019) and (Berry et al., 2018).

### Outcomes and Effectiveness of Persuasive Technology Elements

As also noted for gamification, outcomes of the persuasive technology elements were mainly positive or partially positive/mixed. Even in the more reserved review paper (Kelders et al., 2011), no all-negative results were reported. Most of the review papers (Wiafe and Nakata, 2012, Kelders et al., 2011, Wildeboer et al., 2016, Asbjørnsen et al., 2019, Almutari and Orji, 2019, Paraschivoiu et al., 2019, Agnisarman et al., 2018, Berry et al., 2018, Perski et al., 2017) reported the outcomes in detail. The commonest positive outcome was adherence (Asbjørnsen et al., 2019, Orji and Moffatt, 2018, Kelders et al., 2011, Wildeboer et al., 2016, Win et al., 2017), likely because these studies overwhelming focused on health. Another expected outcome was behavioral change (Orji and Moffatt, 2018, Dolhalit and Salam, 2014, Agnisarman et al., 2018, Berry et al., 2018, Asbjørnsen et al., 2019). Two of the review papers (Paraschivoiu et al., 2019, Win et al., 2017) provided no fine details of the outcomes.

**Effectiveness of individual elements** was difficult to ascertain in these studies. Similarly to their gamification counterparts, most of the studies implemented several elements together, without evaluating their individual effectiveness. Below we list the elements reported as being effective in the review papers:

- **Self-Monitoring** was an integral part of many health-oriented studies, but its effectiveness remained somewhat vague. It was often combined with Reminders and Tailoring (Asbjørnsen et al., 2019). Some studies

Table 3.5: Summaries of all PSD-based persuasive technology elements (see Table 3.3 for a description of the statistics). Three papers (two that did not specify whether the elements listed were PSD, and one that focused on only three social support aspects) were excluded from this analysis.

	$\mu$		$\sigma$		$\eta$		min		max	
Tunneling	12.4	48%	11.8	43%	8.0	23%	3	5%	33	100%
Tailoring	17.4	48%	13.4	36%	10.0	54%	6	2%	33	94%
Personalization	6.8	18%	9.8	23%	3.0	6%	0	0%	24	53%
Self-Monitoring	15.6	40%	14.8	38%	9.0	36%	6	0%	41	91%
Simulation	7.4	12%	9.5	11%	2.0	15%	0	0%	23	51%
Rehearsal	1.8	5%	3.0	10%	0.0	0%	0	0%	7	16%
Praise	4.2	10%	7.3	14%	1.0	8%	0	0%	17	38%
Rewards	3.8	9%	5.0	9%	1.0	11%	0	0%	11	37%
Reminders	15.2	47%	10.6	36%	9.0	56%	5	0%	29	88%
Suggestion	11.8	33%	9.7	28%	7.0	31%	4	4%	27	60%
Similarity	3	8%	5.7	17%	0.0	0%	0	0%	13	39%
Liking	1.2	7%	0.8	7%	1.0	6%	0	0%	2	15%
Reduction	6.2	28%	0.8	25%	6.0	18%	5	2%	7	38%
Social Learning	7.6	24%	10.7	34%	3.0	8%	0	0%	26	79%
Social Comparison	5	15%	5.1	14%	2.0	15%	0	0%	11	33%
Normative Influence	0.6	3%	0.9	7%	0.0	0%	0	0%	2	15%
Social Facilitation	5	13%	8.7	27%	0.0	0%	0	0%	20	61%
Cooperation	1	8%	1.9	15%	0.0	0%	0	0%	4	9%
Competition	1	3%	1.8	6%	0.0	0%	0	0%	4	22%
Recognition	0	1%	0.4	1%	0.0	0%	0	0%	1	3%
Trustworthiness	1	5%	1.3	10%	0.0	0%	0	0%	3	23%
Expertise	1	5%	1.3	10%	0.0	0%	0	0%	3	23%
Surface Credibility	1	5%	1.3	10%	0.0	0%	0	0%	3	23%
Real-World Feel	0	3%	0.9	7%	0.0	0%	0	0%	2	15%
Authority	0	2%	0.4	3%	0.0	0%	0	0%	1	8%
Third-Party Endorsement	0	0%	0.0	0%	0.0	0%	0	0%	0	0%
Verifiability	0	0%	0.0	0%	0.0	0%	0	0%	0	0%
Social Role	2.6	8%	4.8	12%	0.0	0%	0	0%	11	15%

suggested that self-monitoring increases engagement (Perski et al., 2017) and motivation (Asbjørnsen et al., 2019).

- **Tailoring** was a popular element, but direct reports (Wildeboer et al., 2016, Asbjørnsen et al., 2019) of its effectiveness were somewhat sporadic. Tailoring was tied to increased engagement by Perski et al. (2017).
- **Reduction** was reported to diminish effectiveness when combined with Tunneling and Tailoring, and was redundant when combined only with Tunneling (Wildeboer et al., 2016).
- **Personalization & Customization** were linked to increased motivation in one review paper (Asbjørnsen et al., 2019).
- **Social elements** were evaluated in a few studies (see Table 3.6). One review paper on social support elements (Almutari and Orji, 2019) found that physical activity was promoted by certain social elements, most effectively by competition, followed by cooperation and comparison. An-

Table 3.6: Summary of non-PSD elements (see Table 3.3 for a description of the statistics). The “Others” column lists the individual elements that are not statistically interesting.

Auth.	Total	Goals and Objectives, Goals		Social Support, sharing, social persuasion, multi user, collaboration, cooperation, competition		Feedback, psychological cues, emoticons and persuasive images, positive/negative reinforcement, video based persuasion, email, poster, leaflet, advice/tips, verbal cues, robot, threat		Tracking and monitoring, surveillance, progress, leaderboard, ranking		Gamification		Others: binding, ease-of-Use, contiguity, information quality, individual persuasion, social network application, mobile application, narrative, interactivity, novelty, ambient or interactive displays
Agnisarman et al. (2018)	38	0	0%	16	42%	12	32%	0	0%	6	16%	
Paraschivoiu et al. (2019)	27	0	0%	10	37%	15	56%	17	63%	10	37%	
Orji and Moffatt (2018)	85	13	15%	37	44%	61	72%	41	48%	0	0%	
Dohalit and Salam (2014)	10	0	0%	0	0%	1	10%	0	0%	0	0%	
Asbjørnsen et al. (2019)	45	37	82%	25	56%	42	93%	0	0%	0	0%	
$\mu$		10	20%	17.6	36%	26	52%	11.6	22%	3.2	11%	
$\sigma$		16.11	36%	14.15	0.21	24.61	0.33	18.01	0.31	4.60	0.16	
$\eta$		0	0%	16	42%	15	56%	0	0%	0	0%	
max		37	82%	37	56%	61	93%	41	63%	10	37%	
min		0	0%	0	0%	1	10%	0	0%	0	0%	

other review by Perski et al. (2017) noted that social elements can improve engagement and motivation. Meanwhile, Wildeboer et al. (2016) found that social support elements yield variable results. The studies in their review identified Social Learning and Social Facilitation as the most popular combination, but Social Learning and Social Comparison were apparently more effective. However, in studies that omitted all three of these social elements, the results were equally positive. The authors of one review paper (Wildeboer et al., 2016) highlighted the need for further research into social elements.

- **Feedback** was listed as a separate element in two review papers focused on PSD (Asbjørnsen et al., 2019, Wiafe and Nakata, 2012), although feedback is not an official element of PSD. Several (if not all) of the PSD dialogue-support elements can be interpreted as instances of Feedback (Win et al., 2017), because Feedback is an open-ended term. Feedback has also been associated with increased engagement (Perski et al., 2017) and motivation (Asbjørnsen et al., 2019).
- **Reminders** was a popular element in persuasive technology, especially in health-focused studies (Win et al., 2017, Wiafe and Nakata, 2012, Asbjørnsen et al., 2019). Some studies hypothesized that reminders stimulate adherence (Win et al., 2017, Asbjørnsen et al., 2019). Some studies

listed by Perski et al. (2017) either demonstrated or hypothesized that reminders increase engagement, but the authors cautioned that over-reliance on reminders can lead to “email fatigue”. Agnisarman et al. (2018) raised similar concerns on “information overload”. Both of these outcomes will negatively affect the users’ performances.

- **Goals** have been associated with both engagement (Perski et al., 2017) and positive behavioral changes (Agnisarman et al., 2018). Goals are frequently employed as motivators in weight management studies (Asbjørnsen et al., 2019).
- **Shaping of Knowledge** was reported only by Asbjørnsen et al. (2019). They noted that knowledge shaping is a popular BCT intended for general suggestions, not for stimulating motivation or adherence. Nonetheless, knowledge shaping is considered as an important driver of behavioral change.
- **Repetition & Substitution** and **Prompts & Cues** might not influence effectiveness directly (Asbjørnsen et al. (2019)), but Asbjørnsen’s review speculated their role as support elements that enhance incentive-driven techniques.
- **Associations** were frequently mentioned as adherence stimulators in the studies reviewed by Asbjørnsen et al. (2019).
- **Rewards** reportedly stimulate motivation (Asbjørnsen et al., 2019), adherence (Asbjørnsen et al., 2019), and engagement (Perski et al., 2017). Wildeboer et al. (2016) also suggested that rewards can supplement suggestions in PSD.
- **Combinations** or lists of elements are difficult to separate in effectiveness assessments, so are usually evaluated together. In (Wildeboer et al., 2016), the most effective combination was considered to be Tunneling, Tailoring, Reminders, Social learning and Social Comparison. The Similarity and Reminders combination was also effective, particularly in specific contexts such as social phobias. Asbjørnsen et al. (2019) listed a number of elements tied to motivation (Personalization, Praise & Feedback), adherence (Associations), or to both factors (Rewards and Social Support). The following PSD and BCT elements were identified as the core drivers of behavior change: Self-Monitoring, Feedback, Goals and Planning, Tailoring, and Shaping Knowledge. Agnisarman et al. (2018) mentioned that Persuasive messages, Goal setting, Comparisons, Rewards, and Public display of data initiate positive and sustainable behavioral change.

## Current State of Persuasive Technology Research

Currently, persuasive technology appears to be splintered to some extent. Some studies have followed PSD and BCT (or its digital manifestation DBCI); others have simply used Fogg’s FBM or similar models. Persuasive technology studies appear to be highly focused on health oriented services, with seven re-

view papers in this category (Kelders et al., 2011, Wildeboer et al., 2016, Win et al., 2017, Asbjørnsen et al., 2019, Almutari and Orji, 2019). The remaining five studies focused on education (Dolhalit and Salam, 2014), sustainable living (Agnisarman et al., 2018) and persuasion technology in general (two studies, one using PSD (Wiafe and Nakata, 2012) and the other using BCT (Perski et al., 2017)).

**Shortcomings and Limitations:** Studies on persuasive technology seem to have the same limitations as those on gamification. Wiafe and Nakata (2012) who investigated the approach in general terms, found two main shortcomings: ad-hoc implementations, and lack of clear terminology for the definitions and elements. In the reviews of recent publications, which mainly focus on the health domain (Wildeboer et al., 2016, Asbjørnsen et al., 2019, Orji and Moffatt, 2018, Berry et al., 2018, Almutari and Orji, 2019), the main problem was the combination of several elements. When combined, the elements are difficult to evaluate individually, as already noted in 2011 by Kelders et al. (2011). Other problems are the unclear and/or poorly reported terminology (Asbjørnsen et al., 2019, Berry et al., 2018), and unreported outcomes (Asbjørnsen et al., 2019, Berry et al., 2018). To some extent, these problems reflect the issues raised by Wiafe and Nakata (2012). Additional shortcomings mentioned in the review papers were lack of long-term studies (Asbjørnsen et al., 2019, Orji and Moffatt, 2018, Agnisarman et al., 2018, Berry et al., 2018, Almutari and Orji, 2019), lack of a standardized evaluation approach (Orji and Moffatt, 2018, Berry et al., 2018), and small sample sizes (Agnisarman et al., 2018, Almutari and Orji, 2019). Finally, two review papers (Wildeboer et al., 2016, Orji and Moffatt, 2018) mentioned overly positive results, raising concerns of potential publication bias (i.e., the unwillingness to publish negative findings, or undue attention paid to the positive parts).

### 3.3.3 Nudging

Our search found only two relevant reviews on nudging. The topic was comprehensively reviewed by Caraban et al. (2019), who compiled 23 nudging techniques from a total of 73 papers. Hummel and Maedche (2019) performed a quantitative investigation on nudging, encompassing use-cases both inside and outside the digital domain. Caraban et al. (2019) distinguished 32 digital nudges in four categories, which we present in Table 3.7 along with the techniques identified by Caraban et al. (2019).

#### Nudging Elements

Caraban et al. (2019) presented 23 different types of nudges, grouped within six categories: *Facilitation* nudges naturally lessen the required ability of the user. Motivational nudges include *Confront*, *Social Influence*, *Fear*, and *Deceive*. Meanwhile, trigger nudges that coerce the user sufficiently to complete the wanted activity are *Reinforce*, *Confront*, and *Social Influence*. Another

Table 3.7: Elements listed in the nudging review papers: Caraban et al. (2019) identified six clusters of elements, and Hummel and Maedche (2019) simply discovered and presented four elements.

Caraban et al. (2019)	<b>Facilitate</b>	Facilitate decision making by diminishing physical or mental efforts	<i>Default-options, Opt-out policies, Positioning, Hiding, Suggesting alternatives</i>
	<b>Confront</b>	Attempt to pause user by instilling doubt; Breaking mindless behavior and prompting reflective choice.	<i>Throttling mindless activity, Reminding of the consequences, Creating friction, Providing multiple viewpoints</i>
	<b>Deceive</b>	Use of deception elements that affect how alternatives are perceived, or how activities are experienced	<i>Adding inferior alternatives, Biasing the memory of past experiences, Placebos, Deceptive visualizations</i>
	<b>Social Influence</b>	Exploits people's desire to conform and comply with what is believed to be expected from them.	<i>Invoking feelings of reciprocity, Leveraging public commitment, Raising the visibility of users' actions, Enabling social comparisons, Self-regulation</i>
	<b>Fear</b>	Evoking feelings of fear, loss and uncertainty to make user pursue an activity	<i>Making resources scarce, Reducing the distance</i>
	<b>Reinforce</b>	Increase the presence of wanted activity in individuals' thinking	<i>Just-in-time prompts, Ambient feedback, Instigating empathy, Subliminal priming</i>
Hummel and Maedche (2019)	<i>warnings/graphics, Pre-commitment, Reminders, Implement intentions</i>		

interesting contribution was to fit these nudges into Fogg's FBM (Fogg, 2009), by associating them to the three aspects (ability, motivation, and trigger) given by Fogg.

Hummel and Maedche (2019) focused more on the overall effectiveness of the nudging approach. They limited digital nudging to "user interface design elements", meaning that elements such as reminders are not considered as nudges. The authors quantified the reported outcomes by their effect sizes in percentages. Comparing the effect sizes of digital and non-digital nudges, they found negligible differences between the two types.

## Outcomes and Effectiveness of Nudging Elements

Caraban et al. (2019) listed 23 nudging elements. In this subsection, we present the elements that yielded reportedly positive outcomes, or achieved the wanted user behavior. When appropriate, we embed the findings of Hummel and Maedche (2019) into the description of a specific nudge element. The categories were introduced in Table 3.7.

### Facilitate

- *Default option* was deemed as a powerful element and was commonly adopted in the studies of both review papers (Caraban et al., 2019, Hummel and Maedche, 2019), although in Hummel and Maedche (2019), the studies implementing “facilitate” were not digital.
- *Positioning* was considered to enhance user interaction in applications with color coding. Similarly, grids instead of simple lists of objects appear to improve the mental valuation of users (Caraban et al., 2019)
- *Hiding and suggesting alternatives* were also noted as effective in individual studies. When unwanted objects were slightly more difficult to reach than wanted alternatives, the wanted products were successfully selected by users (Caraban et al., 2019). The relative effectiveness of hiding and making alternative suggestions was both supported and disputed by Hummel and Maedche (2019), who discovered studies with extremely high effect sizes for *Warning/Graphics*. After excluding the values exceeding 150%, the average effect size of these elements for nudge was 30%. They stated:

“... we note that the most extreme effect sizes occur when the dependent variable is an index (such as “password strength score”) and not a behavior ...”

### Confront

Small changes in the behavior and response of the user interface appear to yield the wanted responses from the users. For example, *throttling mindless activity* slows a current process, *reminding of the consequences* warns users of privacy issues, and *creating friction* changes the color of an input field depending on the amount of written text.

### Deceive

*Placebo* was shown to improve the users’ performance and diminish their stress in a game that (by an illusionary trick) gave users an inflated impression of their game control. In reality, the game was continuing without change.

### Social Influence

- *Invoking feelings of reciprocity* was shown to increase social interaction within a community.

- *Leveraging public commitment* increases task compliance and the goal achievement rate.
- *Precommitment* was among the elements yielding the lowest effect percentage in Hummel and Maedche (2019), although the authors noted that as the sample sizes of their reviewed studies were very small, conclusions were difficult to form.
- *Enabling social comparison* also improved the performance of nudging.

## Fear

- *Make resources scarce* was evaluated in a study that reduced the feedback when the user activity (i.e., device-checking) increased. The feedback reduction further increased the user activity.
- *Reducing the distance* plays sound cues that remind users of a certain topic. This element can potentially motivate users to purchase products.

**Other Nudges:** Two additional elements were reported by Hummel and Maedche (2019): *reminders* and *elicit implementation intentions*, with effect sizes of 28% and a notable 85%, respectively. The high effect of implementation intentions was suspect, as the sample size was small (8 studies) (Hummel and Maedche, 2019).

In addition, Caraban et al. (2019) listed the following ways by which nudging can fail:

- *Lack of educational effects:* If the nudge is removed, the behavior pattern of the user may revert to the original.
- *Effects not sustained over time:* Long-term exposure to overly manipulative nudges can lead to distrust and the effect of subliminal cues may degrade over time.
- *Unexpected effects and backfiring:* The nudge can affect behavior outside the intended area. For example, users of calorie trackers may start eating more, or reduce their overall commitments or statements if their data is visible to other users.
- *Intrusiveness and reactance (opposition):* Some nudges create deliberate friction in the task, which can irritate users and disengage them from the system.
- *Timing and strength of nudges:* Wrong timing, such as reminding a user of the effects of smoking after a cigarette has been smoked, can weaken the effect. Similarly, if the nudge is too easily circumvented, the effectiveness of the nudge will decrease.

## Current State of Nudging Research

Although both review papers focused on nudging in general, they did list some of the more popular application areas. The most popular area was health, followed by sustainable living. The third-most popular area was listed as

security (password management and others) in Caraban et al. (2019) and as privacy, finances and policy making in (Hummel and Maedche, 2019). In the latter review, how the digital nudges were divided between the application areas was not specified.

Caraban et al. (2019) gave a positive assessment of the overall effectiveness of nudging: 49 positive outcomes out of 79. However, only 18 of these studies covered a longer time period, and these studies considered only the post-nudge effects. Additionally, the authors found no relation between the nudging elements and the overall effectiveness of nudging. How nudging was implemented in a given context appeared much more important. The importance of context was echoed by Hummel and Maedche (2019), but these authors were less optimistic, stating that *“we assess the overall effectiveness of nudging and claim that it might be less effective than proclaimed”*. Note that this statement refers to the authors’ review as a whole, which is not directly focused on digital nudging. Finally, Hummel and Maedche raised the possibility of publication bias, namely, that some studies might be reluctant to publish negative findings.

**Shortcomings and Limitations:** Criticism of studies with nudging was mainly given by Hummel and Maedche (2019). Besides identifying problems such as partial omissions of statistical data, the authors suggested points of interest for future research. For example, can variables that can be indexed be separated from behavioral variables? How does personality affect a user’s reaction to certain nudges? The problems identified in gamification and persuasive technology were not reported in the nudging reviews, but neither study focused only on digital nudges. This research gap should be filled by future researches. Moreover, neither review considered the ages of the target users, possibly because age was considered to be out of context, or the studies did not distinguish the results of different age groups (in either case, further research is needed). Currently, nudging appears to require more in-depth reviews to confirm its level of maturity.

(Orji and Moffatt, 2018) was the only Persuasive Technology review paper to look into theoretical foundations in greater detail. The authors stated that in most cases more than one theoretical foundation was used and often parts of a theory were implemented, and that over half of the studies reviewed (55%) did not report using any theoretical foundation. Seaborn and Fels (2015) investigated the use of theoretical foundations in their gamification review, but reported that 87% did not use or mention them. This finding was echoed by Morschheuser et al. (2016) and Klock et al. (2018).

### 3.3.4 Targeted Age Groups

Comments on age groups appeared sporadic in the review papers. Table 3.8 presents the reviewed approaches, areas of focus, age groups of the participants in the studies, and age-related remarks given by the authors of the review papers. It appears that in all three areas, most of the studies evaluated adult users. The conclusion that older adults and younger user groups have been

Table 3.8: Age groups based on the Eurostat categorization: **Youth** (1–14), **Adult** (15–64), **Elderly** (65 and over). Depending on the review paper, either the number or percentage of implementations listed or “x”, if none. GM = gamification, DBCI = digital behavior change intervention, BC = behavior change, PT = persuasive technology, PSD = persuasive system design

Authors	Type	Area	Y	A	E	Remarks
Alahäivälä and Oinas-Kukkonen (2016)	GM	health	5	7	1	<i>demographics: age, gender, and experience need more attention</i>
Seaborn and Fels (2015)	GM	health	2	16	0	<i>“Some studies showed that demographic variables and the expectations attached to those variables had an impact on the effectiveness of gamification factors”</i>
Johnson et al. (2016)	GM	health	4	14	1	<i>“...the majority of studies were conducted with adults. Regardless, positive outcomes have been found for children”</i>
Sardi et al. (2017)	GM	health	x	x	x	<i>“Gamification solutions are not user-centered as they overlook the traits and demographic characteristics of potential users”</i>
Johnson et al. (2017)	GM	sustainability	x	x	x	<i>“...it is unfortunately not possible to effectively explore whether any relationship exists between key demographics (e.g., age) and the user experience of applied games as no studies test for this and many studies do not report the required demographic information”</i>
Klock et al. (2020)	GM	tailoring	x	3	x	<i>“...there were no suggestions for users who are more than 30 years old.”</i>
Koivisto and Hamari (2019)	GM	miscellaneous	x	x	x	<i>“Targeting specific questions relevant to e.g. certain demographic groups could yield new interesting veins of research”</i>
Wildeboer et al. (2016)	PSD	health	0	5	0	<i>“...another issue in interpreting the results is the difficulty to detect confounders, which can have a moderated effect, such as participants’ characteristics like age and gender...”</i>
Dolhalit and Salam (2014)	BC	miscellaneous	5	2	2	x
Almutari and Orji (2019)	PT	health	15%	74%	9%	<i>“Regarding the demographics of the target audience, most existing PTs for promoting PA are targeted at adults, making it difficult to establish their effectiveness in other demographics”</i>
Orji and Moffatt (2018)	PT	health	16%	66%	13%	<i>“Finally, there is a need for more PT to target diverse demographics such as older adults and children”</i>
Perski et al. (2017)	DBCI	miscellaneous	x	x	x	<i>Demographic characteristics, age, gender, education, employment and ethnicity were found to be significantly associated with engagement. There was a trend towards a positive association between engagement and older age, higher educational attainment and being a woman; however, as no meta-analysis was conducted, a conclusion about the size and direction of influence cannot be drawn</i>

largely neglected is also supported by the following review papers (Johnson et al., 2016, Almutari and Orji, 2019, Orji and Moffatt, 2018, Seaborn and Fels, 2015), which looked at the topic but not in any detail. Only Almutari and Orji (2019) reported outcomes separately, stating that one of the two studies was partially positive and the other one was positive in using social influence strategies on elderly users. Though interestingly, the results according to them were somewhat negative: “*social influence strategies targeted elderly appear to be the least successful with respect to the effectiveness of social influence strategies at promoting the desirable change in PA*” (physical activity). No clear reason for this was however given.

## 3.4 Discussion

We have thoroughly examined three approaches focused on increasing the engagement and motivation of digital-technology users: gamification, persuasive technology, and nudging. Research on gamification and persuasive technology appear to share a number of similar shortcomings: lack of evaluation of individual elements, impact of novelty factor, and varied quality of overall evaluations. These shortcomings were highlighted in the previous section. Digital applications of nudging require an in-depth systematic review to understand the current state of the approach.

In this section, we will look at elements of the three approaches from three different angles, i.e., which elements are mostly used or not used and how are they defined, the effectiveness of elements, and the overlap of elements between the different approaches. Next, we discuss the limitations of our work and possible future work in this context.

### 3.4.1 On the Elements

Interestingly, all three approaches appear to have “favorite” elements. Despite listing over a dozen variations, most of the gamification studies relied on *points*, *badges* and *leaderboards*. Persuasive technology studies often implemented *tunneling*, *tailoring*, *reminders*, *self-monitoring* and *feedback*, whereas nudges were typically provided as *default options* and *warnings/graphics*. Social elements were often regarded as important, and were utilized by a small but consistent number of studies across all approaches. However, some elements with relevance to a specific approach were almost completely ignored. Neglected gamification elements were *narrative*, *stories*, *exploration*, *creativity*, and *control*. In persuasive technology, PSD’s *system credibility support* and *rehearsal* were largely ignored in implementations. Outside the *default options* of nudging, very little overlap appeared between the two review papers, implying that a number of nudges are either unpopular, they have not been collected and reviewed comprehensively, or they often are labeled as persuasive technology elements (recall that the authors’ Hummel and Maedche

(2019) definition of nudging was limited to user interface design elements).

The review papers did not thoroughly speculate or discuss why certain elements are more popular than others. In gamification, this omission might be related to the difficulty of drawing a line between a full-fledged game and a gamified system, as suggested elsewhere (Seaborn and Fels, 2015). In persuasive technology, it likely relates to viewing non-PSD implementations through a PSD lens. Moreover, elements such as system credibility support are likely more important for commercial products than for academic studies.

Furthermore, the terminologies and definitions of elements used in gamification and persuasive technology (and possibly those of nudges) seem inconsistent and confusing. Understandably, the denomination of terms such as *points* will vary with context, but terminology referring to the elements themselves was sometimes confusing, as was also noted by Hervas et al. (2017). Especially, the terminologies and definitions of persuasive technology are confounded by the apparent splintering of the approach into various sub groups, which might even encompass nudging. PSD, BCT and non-PSD studies overlap to a certain extent and their elements are often unclearly defined, as remarked in some of the review papers (Orji and Moffatt, 2018, Asbjørnsen et al., 2019, Klock et al., 2020). Lastly, a number of persuasive technology implementations were not based on any known theory or concept, but simply attempted to persuade the user by using elements that fit the approach.

### 3.4.2 On Effectiveness of Elements

Our goal of determining the effectiveness of individual techniques was not met. Gamification and persuasive technology are apparently effective because most studies reported positive results for various outcomes. However, the effectiveness of nudging was found mixed because the statements of the two review papers diverged (Caraban et al., 2019, Hummel and Maedche, 2019). Among the gamification reviews, only one paper (Falkner and Falkner, 2014) focused on a single element Badges. The authors found no clear evidence that badges were effective, but the results were not entirely negative. In other reviews, Wen et al. (2015) and Dicheva et al. (2015) stated that the empirical evidence is insufficient for judging the usefulness of gamification. Similarly, only one review on persuasive technology (Kelders et al., 2011) (the oldest of the reviewed papers in our meta-review) reported that website intervention strategies achieve moderate adherence at best. Three reviews (Paraschivoiu et al., 2019, Hervas et al., 2017, Win et al., 2017) did not report any effectiveness results.

Most of the reviewed works on gamification and persuasive technology implemented several elements together, without evaluating the effectiveness of the independent elements. Therefore, it was difficult to ascertain which elements enable positive (or negative) outcomes. This problem was mentioned in several of the analyzed reviews (Rincón-Flores et al., 2019, Koivisto and Hamari, 2019, Hassan and Hamari, 2020, Orji and Moffatt, 2018, Berry et al., 2018, Sardi et al., 2017), and is likely partly due to interdependencies among

certain elements. For example, Points and Leaderboards, and Tailoring and Tunneling, are effective only when combined. In nudging, most of the studies implemented only a singular element, so the level of effectiveness should be more easily determined. Unfortunately, the two review papers presented disparate results, with one paper (Caraban et al., 2019) declaring that 66% of the 74 empirically studied nudges produced significant effects, and the other (Hummel and Maedche, 2019) claiming that nudging (including non-digital nudges) is less effective than generally supposed. This discrepancy might be attributable to the different objectives and scopes of the reviews.

### 3.4.3 On Overlap of Elements

Furthermore, our meta-review revealed overlaps among the three approaches. This is clear not only from the elements identified in the different approaches, but also from the reviewed papers. Some persuasive technology reviews (Agnisarman et al., 2018, Paraschivoiu et al., 2019) listed gamification as an element, and Alahäivälä and Oinas-Kukkonen (2016) investigated persuasion in gamified systems. Caraban et al. (2019) discussed how nudges could work in Fogg’s Behavior Model (the basis of PSD), and Asbjørnsen et al. (2019) marked PSD elements in gamified platforms. Some of the overlaps between the elements are clear, such as *goals* from the gamification approach and *goals and planning* from Persuasive Technology. Another example is the widely used *feedback* element. Other overlaps are less obvious; for example, some nudging elements are feedback-oriented, including most elements in the *confront* category, but have a deeper meaning than just providing feedback.

In summary, the philosophical foundations of the three approaches might vary, but their techniques in digital intervention implementations and goals are often aligned. We created Table 3.9 to highlight the more evident overlaps between the elements used in the three approaches. The rows of the table show elements that are alike based on their definitions that we presented in this dissertation (in Table 3.1 for gamification, in Section 3.1 for PSD, for BCT we refer to the taxonomy given by Michie et al. (2013), and Table 3.7 for nudging). For example, *social play* of Gamification (third row) and *social support* from PSD are identified as similar elements. A majority of the nudging elements defined by Caraban et al. (2019) rely on varied forms of feedback. Facilitate, Confront, Fear, Reinforce and Warnings/Graphics often affect the shape and content of a notification directed at a user, or lack thereof. Though certainly they can also be implemented in a more complex manner. Hence, a more in-depth look at these similarities is needed.

### 3.4.4 Limitations

To our knowledge, this meta-review is the first systematic meta-review of gamification, persuasive technology, and nudging. Although our results are expected to be of interest for researchers and practitioners, we acknowledge a number of limitations. First, such research is always subjective. To mitigate

bias, we ensured that the grouping of elements, etc. performed were also reviewed by other researchers from the field. However, some subjectivity may still be present in the findings. Second, because a standardized terminology is lacking, the same terms (i.e., elements) could be differently defined in different papers and approaches. This inconsistency may likely affected the comparison of the results reported from different works and approaches. Third, due to our meta-review approach, we did not identify the aims and goals of the individual studies, how they implemented the chosen techniques, as well as what their detailed outcomes were. In this way, we may have missed some possibly important information.

### 3.4.5 Directions for Future Work

Based on our findings and discussion, we formulated the following recommendations for future research in this domain (irrespective of the specific approach):

1. **Evaluation of individual elements:** Instead of implementing and evaluating several elements together, the elements should be introduced separately. If this is infeasible, the elements should be individually assessed by a robust evaluation method.
2. **Provide empirical data:** Although the lack of empirical data is of lesser concern in more recent studies than in earlier studies, a notable number of studies did not provide or gather clear empirical data of their evaluations. We therefore recommend that all future studies in all three areas conduct empirical evaluations based on sound research designs.
3. **Apply standardized terminology and definitions:** the different terminologies used in previous studies will likely confound discussions. Applying a clear terminology and definitions that have been vetted in advance would mitigate this issue. Researchers in each approach could gather and formulate a glossary of relevant terms and definitions that can be uniformly adopted in future research.
4. **Combat the novelty effect:** Short-term empirical evaluations may be affected by the novelty effect of digital technology. Longer studies and revisiting the same study after a certain time period are necessary to exclude the novelty effect from the results.
5. **Apply proper design guidelines:** Some elements are easier to adapt than others; for instance, Points and Leaderboard systems are relatively easy to implement, which undoubtedly contributes to their popularity. Other elements, such as Tunneling, Reduction, Positioning, and Feedback, are inherently more complex, and hence more difficult to implement. Proper use of a nudge element such as Positioning demands at least minimal understanding of good user interface design practices. We therefore recommend the formulation of appropriate design guidelines for gamification, persuasive technology, and nudging.

6. **Publish both positive and negative results:** While knowing what techniques are successful is important, to know what doesn't work is equally important.
7. **Consider diverse age groups:** Currently, the influence of age on the effectiveness of digital technologies is largely unknown. For instance, some of the more aggressive nudge elements might not be effective for elderly users. Future research should therefore target diverse age groups, from children to older adults, and possibly mix them in an inter-generational study (Havukainen et al., 2020).

Table 3.9: Overlaps between the three reviewed approaches. Persuasive Technology is split into three groups (PSD, Miscellaneous and BCT-cluster) for clarity

Gamification	Persuasive Technology			Nudging
	PSD	Misc.	BCT-clusters	
Resource & Economy	Reward	Point	Reward and Threat	x
		Credit		x
		Conditioning		x
Goals	Tunneling	Goals	Goals and Planning	Facilitate
Social play	Social support	Social Dynamics	Social Support	Social Influence
		Multi user	Comparison of behavior Comparison of outcomes	
Control	Personalization	Customization	x	x
Profile & Ownership	Self-monitor	Progress	Goals and Planning	x
Feedback	Praise	Feedback	Feedback and Monitoring	Confront
	Suggestions		Natural consequences	Fear Facilitate
	Reminders		Scheduled consequences	Reinforce
Fairness	Tunneling		x	Facilitate
	Reduction	Advice		
	Suggestion			
x	Liking	Attractiveness	x	Deceive

### 3.5 Summary

In this chapter, we investigated three important potential approaches to improve long-term engagement, i.e., gamification, persuasive technology, and nudging. To understand the state of the art of the approaches and their effectiveness, we performed a meta-review investigating review papers in the three areas.

The number of recent review papers suggests that all three approaches are yet vibrant (Asbjørnsen et al., 2019, Koivisto and Hamari, 2019, Hassan and Hamari, 2020, Almutari and Orji, 2019, Hummel and Maedche, 2019, Caraban et al., 2019, Rincón-Flores et al., 2019, Klock et al., 2020). Techniques in each approach were explored, as well as their effectiveness. Especially in the context of their effectiveness, various shortcomings were discovered in the studies

performed. In general, all three approaches could appear to produce positive outcomes. However, there appears to be lack of focus on evaluating these techniques with elderly users, while such results would be important knowledge for our work. Furthermore, there is also a lack of evaluation methods that attempt to detect effectiveness of individual elements and specific combinations more systematically.

In Section 1.1, we formulated three research questions derived from RQ2. Table 3.10 revisits these questions and summarizes the answers emerging from our findings.

Table 3.10: Revisit to our research questions and short summaries of our answers

(RQ2.1) What persuasive technology, gamification and nudging techniques are commonly used in digital applications?	Gamification: Numerous elements have been proposed, but points, badges and leaderboards remain the most popular approaches. Persuasive technology: Automatically personalized content (personalization and tailoring), feedback, self-monitoring, suggestions, and reminders Nudging: Warnings/graphics and reminders
(RQ2.2) What kind of long-term engagement techniques are available and how effective are they for different user age groups?	Our findings suggest that outcomes for long-term engagement, as well as which techniques are effective coaxing them are difficult to determine. The effectiveness of specific techniques remains largely unclear. A large body of evidence has been accumulated on positive outcomes in all three approaches, but the effectiveness of individual gamification, persuasion or nudging elements cannot be concluded at this stage.
(RQ2.3) Do studies focusing on these techniques consider users' age? Were elderly or younger users explicitly targeted?	Most of the studies focused on specific use cases, such as weight loss (Asbjørnsen et al., 2019), and sustainable living (Johnson et al., 2017). Only a handful of studies targeted specific age groups, such as youngster or elderly users, but the results in terms of age groups were largely unclear. None of the existing approaches or their techniques have been sufficiently tested on specific age groups.

## Chapter 4

# Existing Social Engagement Platforms: An Evaluation

### 4.1 Introduction

Various terms are used to refer to the form of community interaction provided by the platforms we target. The more common term would be “social networking”, which Facebook has made both famous and infamous (Sadowski, 2021, Ghaffary, 2021). The majority of the existing platforms do not give a clear definition as to what kind of platform they are, but rather use vague descriptions like “connecting the neighborhood”<sup>1</sup>. Hoplr defines itself as a “closed off social network”<sup>2</sup>. We have chosen to use the term “Social Engagement (SE)” platform. Our definition for social engagement is: “Social engagement is the commitment of a member to stay in the group and interact with other members. Interaction is enabled by a digital platform”. This definition is based on a definition given by Zhang et al. (2011).

SE platforms have been around for a while, but they garnered an increased attention over the year 2020 with the outbreak of the COVID-19 pandemic that forced people in many countries to stay indoors and only go outside when absolutely necessary. The adverse effects of this isolation have been discussed in the media and literature ever since (Nguyen and Nguyen, 2020, Sauer, 2021, Baddeley, 2020, Villius Zetterholm et al., 2021), also from a more practical view. The lockdown put a number of vulnerable people, especially the elderly, in a precarious situation. Being especially susceptible to the virus, the elderly were largely forced to stay at home and ordinary shopping trips were turned into nervous ordeals. This effect did not go unnoticed however, and a number of already active and new SE platforms, among other outreach programs have attempted to provide a solution.

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<sup>1</sup><https://about.nextdoor.com/>

<sup>2</sup><https://help.hoplr.com/hc/en-us/articles/115001045272-What-is-Hoplr->

We introduced a number of SE platforms already in Chapter 1. Some of these are platforms that are active in more than one country, such as NextDoor, Nebenan and Hoplr (see Table 4.1 for an overview). Also localized platforms, such as the Finnish Nappi Naapuri and Commu, and the German Nachbarschaft. Though all of the listed platforms more or less share a lot of functionality, the more commercial NextDoor, Nebenan, and Hoplr are intended more for interaction within closed neighborhoods to which outsiders are unable to easily access.

In terms of how successful these platforms have been in activating their users in the desired manner requires a long term analysis of the user behavior; only limited predictions can be made from examining the traffic or activity visible on these platforms.

In this chapter, we present and analyze existing social engagement platforms and present our findings. Lee's factors that were introduced in Chapter 2 were used as a starting point for our analysis. The analysis is partly done by examining these platforms ourselves, partly by means of interviews conducted with representatives of the platforms, and partly by user surveys. We interviewed representatives of five platforms. Because a platform representative preferred that the name of the platform was not related to the interview, we decided to anonymize all interviews and user survey results. We simply refer to them as platform 1 to 5. Additionally, a user survey on the platforms P1, P4, and P3 was conducted. Note that the interviews as well as the user surveys served two purposes. The first purpose was to evaluate the current state of the platform; the second purpose was to evaluate some of the recommendations that we formulated based on inspecting the current social engagement platforms (and given in Section 5.1). The two purposes were combined in a single interview and a single survey to avoid having to take peoples' time twice. In this chapter, we focus on the first purpose. The questions and results concerning the second purpose are presented in Chapter 6.

The chapter is organized as follows: Section 4.2 covers the methodology of how the platforms were evaluated. Section 4.3 presents the platforms we discovered and which ones were selected for further evaluations. Section 4.4 covers the relevant findings from our survey conducted on three of the platforms (P1, P3, and P4). In Section 4.5, we then present the findings of the evaluations performed on the platforms based on Lee's factors (Lee, 2015) as well as the results of the interview. We conclude the chapter in Section 4.8. This chapter aims to answer the research question RQ3.

## 4.2 Methodology

In this section, we explain the methodology used for the evaluation of existing SE platforms. We first describe how the platforms were discovered after which we describe the different methods used to analyse them, by means of interviews and user surveys. The SE platforms discovered were first checked for their

suitability; the main two criteria were: 1) the platform should be explicitly support volunteerism, i.e. is the user able to create and respond to a help requests? and 2) to ensure that Lee’s “Affordability” factor is not a concern, the service should be free. After this initial check, requests for interviews were sent out to the platforms deemed suitable. Parallel to the interviews, a more in-depth evaluation, especially using our design guideline list, was performed for some of the selected platforms. In a third step, user surveys were conducted on a three SE platforms. More details are given below.

#### 4.2.1 Finding and Selecting Social Engagement Platforms

Our focus in searching for SE platforms was on active platforms, meaning that platforms that are no longer active were ignored. The main method of discovering platforms was by a query on Google using the keywords: *neighborhood, community, social engagement, neighbor, local*. These were amended with additional help words, such as *app, application, technology, platform*.

We also utilized services the following services: comparably, craft and owler to also search for other potential SE platforms. These services are intended for querying the competition of for-profit companies. Nextdoor, P2 and P4 were used as points of comparison.

Because some platforms are in collaboration with local municipalities or non-profit organizations, we also searched on local government websites with community activities in Finland, Belgium, The Netherlands, and UK.

Using these techniques we discovered a total of 14 platforms (presented in Table 4.1). However, we could not perform a full evaluation of all of the discovered platforms, as some were country locked and require a local address or phone number. Also, some platforms became inactive during the evaluation process, or had become inactive already before we could evaluate them. We have left these in our list, as it highlights the issue of long-term engagement that some of these platforms might struggle with. Lastly, as we managed to organize interviews for five of the platforms, and three allowed us to send a survey to their users, we decided to focus on these following platforms. We have anonymized all interviews and survey results, i.e., no names of platforms or participants are given. The platforms will simply be referred by a number: P1 to P5. We also gained limited access to the following platforms: Allo Voisin, Facebook Community, Nextdoor, Help Your Neighbour, and Nachbarchaft. For these platforms we considered their usability experience briefly.

#### 4.2.2 The Interviews

As already indicated, the interviews, like the surveys had a mixed purpose: on the one hand, they were intended to enquire about the current use of a platform and how it was developed, and on the other hand, we used them to evaluate some of our recommendations formulated to improve SE platforms. Figure 4.1 shows how the interview and survey results are used in this dissertation.

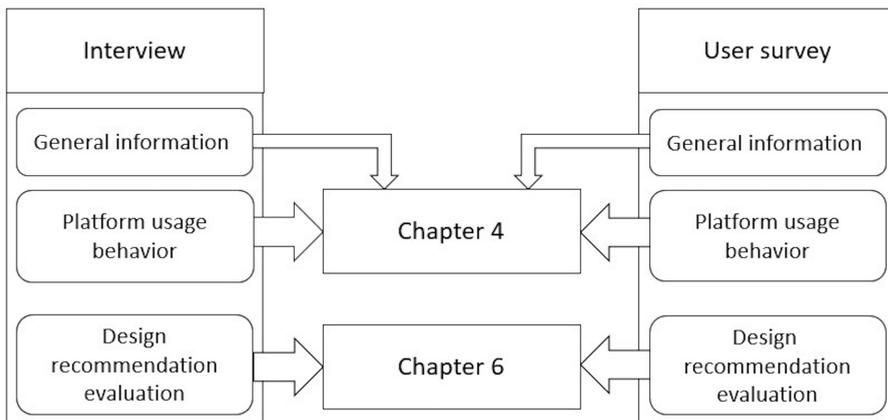


Figure 4.1: Simple depiction of how the interview and user surveys are utilized in this dissertation and which Chapter focuses on which area

We reached out to the contacts given for all platforms that we discovered to request for an interview. The interview had the intention to collect more information on the use of the platform and the development process, more in particular on the technology adoption steps that they might have taken when developing their platform or might even currently be undertaking. Representatives from P1, P2, P3, and P4 did get back to us and were very helpful in giving a bigger picture their respective platform’s inner workings.

Representatives from the platforms had mixed expertise and were different in terms of how they were involved with the platform. Except for P3 where two people were present, only one person from the platform was interviewed. It should be noted that only the people from P3 had technical expertise in term of actual development work. The representative from P4 had a background in anthropology and was focused on increasing engagement between the users and their local communities. Only the person representing P5 had hands on experience with providing assistance and recruiting volunteers to aid and working with elderly people. Also, as P5 is not intended for similar use as the other platforms, the interview was mostly refocused on discussing practicalities of helping elderly as well as validating some of our technical solutions. These are discussed in more detail in Chapter 6.

The interviews were largely conducted in a semi-structured manner where we started with a number of fixed questions but conversations were allowed to diverge from the original questions. The transcripts are available online<sup>3</sup>; the original audio records are available but for privacy reasons not disclosed.

The interviews were processed by dividing them into categories focusing on Lee’s factors and our recommendations. The interviews were intended as

<sup>3</sup>[10.6084/m9.figshare.19165283](https://doi.org/10.6084/m9.figshare.19165283)

both supporting and deepening our evaluation of the platforms and to check the representatives' opinion about some of our recommendations.

### 4.2.3 User Surveys

We also conducted surveys with users of three platforms: P1, P3, and P4. All surveys were roughly of identical length and took around 20 minutes to fill in. The tool used for handling the surveys was Qualtrics<sup>4</sup>. The complete survey results and questions used can be found via this link<sup>5</sup>. The questions in the surveys were divided into three categories: 1) about help requests; 2) about existing platform features; and 3) about the evaluation of our recommendations, which is considered in Chapter 6. Although our surveys were long (over 50 questions), many questions were dependant on how the participant responded, making the actual shown number of question much lower. We decided to keep most questions “optional”, meaning that the participants were able to skip them.

#### Distribution and Number of Responses

The survey was distributed with an email to the users of P1 and P3. The P1 survey garnered a total of 266 responses. P1 had roughly 40.000 registered users, of whom roughly 2.000 active users during the time the interview was done (August, 2021). In P3's case, a much newer service, our survey yielded 94 responses from about 2.800 registered users. The P3 survey was conducted two times, first in October and then in November 2021, the later one being slightly modified with a new question attempting to find volunteers for a followup study. P4 has a much larger user base. According to their official website, they have at the time of writing this dissertation (2022) about 500.000 registered users. P4 wanted to avoid sending unnecessary emails to their users, hence the survey was deployed directly on the platform, meaning that responses would come only from active users. Because P4 has closed neighborhoods there was much more control to whom the survey would be sent. In our case, it was sent to 25 municipalities in Flanders and also some districts in Brussels (unknown which ones). All municipalities were chosen by P4. The survey yielded in total 455 responses. All surveys were active for a period of just over two weeks during the months of September (P1), October & November (P3), and November (P4), in 2021. With all three surveys together, we accumulated responses from 813 individuals, in total.

The surveys were distributed by email in the case of P1 and P3. In the case of P4 the survey was provided on the platform itself, meaning that users who use the platform very irregularly or might have become completely inactive would miss the survey. These are factors that must be considered when looking at results.

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<sup>4</sup>qualtrics.com

<sup>5</sup>10.6084/m9.figshare.19165283

Qualtrics tracks “completion” of a survey, both in percentages and also with a simple Boolean true/false “finished” statement, which is marked if a participant reached the very end of a survey. When looking at these results, the number of individuals who completed the full questionnaire is substantially lower: P1 = 149 , P3 = 56 , P4 = 319.

## Handling of Survey Results

Basic statistical calculations, such as mean, standard deviation and margin of error<sup>6</sup> are provided along with some results. For the population sizes, the known figures were used: 40.000 for P1, 2.800 for P3, and 12.500 for P4; the figure which was provided by P4 does not include Brussels, meaning that the actual population size is in fact slightly higher. The Z score<sup>7</sup> was set with the confidence level of 90% in P3’s case due to lower response rates. For P4 and P1, a confidence level of 95% was set. When looking at the results of individual questions, where relevant we provide margin of error along with other results. Some follow-up questions are excluded from the calculation because they had a very low number of responses making calculating these figures moot. In general terms, the results were moderate. The margin of error for P1, P3, and P4 were 8%, 11%, and 5%, respectively when we calculated it by using the sample sizes that Qualtrics indicated as “finished” participants.

### 4.2.4 Hands-on Evaluation of the Platforms

We had two core points of focus when evaluating the platforms: (1) What kind of features are offered to the users and how; and (2) How do the platforms perform when evaluated from the perspective of Lee’s factors?

Note that some platforms also offer a mobile app for their service, and in the case of P3, this is the only version they offer. In terms of our evaluation, findings about the applications are considered as a whole, unless specified otherwise.

Concerning the evaluation with respect to the adoption of Lee’s factors (presented in Chapter 2), it should be noted that there was no concrete list of requirements that an application or technology should satisfy to address the different factors, and which could be used to evaluate applications or technologies from this perspective. The adoption factors are described by Lee at a high level. Therefore, creating a checklist that we could use to ascertain whether the adoption factors were considered, was necessary. The checks created for the individual factors are presented along with the findings in Section 4.5. The checklist was created by going through Lee’s factors, our findings, and attempting to condense them to points of interests. These were then evaluated and commented upon by other researchers.

<sup>6</sup><https://psy311.wichita.edu/wp-content/uploads/2020/07/Margin-of-error-made-simple.pdf>

<sup>7</sup><https://www.surveymonkey.com/mp/margin-of-error-calculator/>

Table 4.1: List of all SE platforms we have discovered for this evaluation. \*The account creation could only be partially evaluated

Name	Type of Platform	(A)ccount (I)nterview (S)urvey
Allo Voisin	web, mobile	A*
Commu	mobile	A, I, S
Facebook Com- munity Help	web, mobile	A
Help Your Neighbor	web	A
Helper	web	-
Nappi Naapuri	web	A, I, S
Nachbarschaft	web	A
Nextdoor	web, mobile	A*
¿Tienes Sal?	web, mobile	A, I
Hoplr	web, mobile	A, I, S
Solidare-it!	web	A, I
Inactive plat- forms	Meetey, Streetlife, Impact Days	

### 4.3 Selected Platforms

In this section, we present the SE platforms that do fall in our originally defined category. However, we only managed to inspect a handful in more detail. Also, we have listed some platforms that belong to the original category but are not free to use, or have features aimed for allowing people to make profit from offering their services. These platforms, Allo Voisin and Helper, are listed in our table, but were not considered into more detail. Table 4.1 also mentions the types of investigation done for the platforms: checking account creation and some of the basic features (A); interviewing a representative from the platform (I); and performing a survey with the users of the platform (S).

#### Platform Descriptions

**Allo Voisin**<sup>8</sup> is a French platform for provision of services and rental of equipment between neighbors. Allo Voisin has limited restrictions to register, user needs to be located in France and has a French phone number and address. Therefore, we were unable to create an account on the platform, but the platform allows viewing the main forum despite this. It is unclear how large the number of Allo Voisin users is that use the platform for simply helping each other, as it is more driven towards small business and earning money on the

<sup>8</sup><https://www.allovoisins.com/>

side. However, because it can also be used for helping each other, we have included it in our list. In terms of functionality, the platform offers relatively simple messaging functionality of posting requests for specific tasks.

**Commu**<sup>9</sup> is a Finnish startup, launched in May 2021. They are currently focusing on two cities in Finland —Tampere and Helsinki— but are aiming to expand. Unlike the other platforms we considered, Commu only provides a mobile application. Commu also does not have “closed neighbourhood forums”, but allows making help and requests and offers on the go. Commu also had a feature where users could ask for a small compensation for helping. It was intended for covering the costs that the help might incur, such as transportation costs. However, this feature has since been removed.

**Helper**<sup>10</sup> is a Belgian service where one can either register as a helper or look for help. The service is fully for profit where helpers expect to make some income. Both parties register for the service and the two parties is handled by the service provider, meaning that there is no visible platform for the users.

**Facebook**<sup>11</sup> with nearly two billion active users in 2021 needs very little introduction. It is a web platform that has shaped how a group of people sees and interacts with each other, in both good and bad ways. Although very popular, Facebook appeared quite often negatively in the spotlight (Sadowski, 2021, Ghaffary, 2021, Wells et al., 2021). A less well known feature is Facebook’s “community help” that was quietly launched during the pandemic outbreak in 2020. It is unclear how Facebook intends to extend this service but currently it provides simple help and offer request functionalities as a slightly modified version of the regular posting functionality. Facebook does not limit member access in any specific way; in theory anyone has access to the platform, with only GPS location and distance being limiting factors to visibility of notifications on the community page.

**Help your neighbour**<sup>12</sup> is an US-based website focusing on neighbourhood level community building and help finding services. It divides its communication platform into four tiers: individual, groups, neighbourhood, and city. The platform appears to have either very limited activity, or has already become inactive. Level of activity remained unclear as HYN is up and running but we did not manage to find very active communities. The platform does require a US zip code as part of the registration process, but this is not checked in any way, as we easily managed to create an account on the platform.

**Nachbarschaft**<sup>13</sup> is a German website launched during the COVID-19 outbreak as a service to offer help to people affected by the quarantine procedures. It is unclear how active the website is, but it appears to have some level of activity and being under constant development. To our knowledge, the platform is being developed independently, though some collaboration with a local

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<sup>9</sup><https://commuapp.fi/>

<sup>10</sup><https://www.helper.be/nl/>

<sup>11</sup><https://www.facebook.com>

<sup>12</sup><http://www.helpyourneighbor.com/>

<sup>13</sup><https://nachbarschaft.care/>

NGO service is happening. The service is limited to Germany.

**Nappi Naapuri**<sup>14</sup> is a Finnish web platform that, like Commu, provides an open access to users. The user must only provide an address, which dictates the general point of focus when logging in. Users may also give multiple addresses. The platform is still up and running, but currently not under active development apart from basic maintenance.

**Nextdoor**<sup>15</sup> is a US-based service that has rather aggressively entered the European market<sup>16</sup>. The platform is currently active in 11 countries and is by far the most successful neighbourhood application we have looked at. This is also likely why ND has had several issues brought up in the media. The majority of these problems are focused on US societal issues, such as racism<sup>17</sup>, but some interesting issues were related to Nextdoor’s approach of neighbourhood moderators — moderators are users with extra privileges— having too much influence within their own neighbourhoods. These moderators, or “leads” as they are named in Nextdoor, can also suggest new map borders for the neighbourhood. The leads status is permanent and can only be removed by the lead themselves or by ND, upon complaints.

**¿Tienes Sal?**<sup>18</sup> is a German-based company, under the name *Nebenan*, of which ¿Tienes Sal? is a branch of, located in Spain. Nebenan has another branch in France under the name *Mesvoisins*. The service appears to be quite similar to that of Nextdoor with a relatively rigorous registration process and where the location of a user is verified by letter, image of a document, or gps location. To our knowledge no admin feature is utilized.

**Hoplr**<sup>19</sup> is a Belgian-based platform that is rather similar to Nextdoor and Nebenan, also in how they verify their users’ domiciles upon registration. The platform is also currently active in the Netherlands.

**Solidare-it!**<sup>20</sup> is a Belgian platform, currently mainly utilized by a volunteer organization located in Brussels as an internal database to keep track of their volunteers and people needing help. The platform was originally devised and is still partly marketed as a platform for looking for and offering help. Note that another platform operates also in Belgium and is named SolidarIT, but it is not affiliated with the Solidare-it! and was launched specifically to assist with disaster victims of the floods that affected some areas of Belgium quite heavily in the summer of 2021. Note that despite we refer to solidare-it! in our interview snippets, the representative was actually from the volunteer group being the main utilizers of the platform at this time.

**Others:** We also came across a number of platforms that are either inactive or completely closed: **Streetlife**, which was absorbed by Nextdoor, operated

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<sup>14</sup><https://www.nappinaapuri.fi/info>

<sup>15</sup><https://nextdoor.nl/>

<sup>16</sup><https://techcrunch.com/2017/02/05/streetlife-knocks-nextdoor/>

<sup>17</sup><https://www.youtube.com/watch?v=mvL5HKyw0zs>

<sup>18</sup><https://tienes-sal.es/>

<sup>19</sup><https://www.hoplr.com/>

<sup>20</sup><https://solidare-it.org/home>

in the UK. **Meetey** was an Israel-based service<sup>21</sup> that also appears to be closed down. Similarly, an Antwerp-based volunteer recruiting service did operate a web page to recruit helpers to aid elderly during the COVID-19 pandemic but the registration page has become inaccessible.

## 4.4 Survey Results

In this section, we present the results from all conducted surveys. Note that in the case of P3 where two separate surveys were conducted, when discussing results, these are treated as a single survey. The results are presented in the order the surveys were conducted. In this chapter, as stated in the introduction in Section 4.1, we focus on the questions related to the evaluation of the platform and thus also only provide the results from the surveys that are relevant for this purpose.

The total number of responses reported by the survey tool (i.e., Qualtrics) do differ from question to question. Due to the varying response rates, they are reported separately with each individual result. In the case of age distribution, if worth mentioning, we show or explain differences between the total result and the results for age groups. Lastly, note that we have chosen to round the quantitative results to the closest number for easier reading.

### 4.4.1 Response Rate

Both for P1 and P4 there are circumstances affecting the number of responses. In the case of P1, the platform has in the neighborhood 40.000 registered users. However, the number of active users has declined over the years, which is also evident when looking at the number of responses P1 received to their own survey conducted in 2019 (they received over 1.000 responses). According to the organization, the current active user base is around 2.000 users. The figure is based on Google Analytics results stated by the representative from P1. In the case of P4, the platform is very much alive and actively growing. However, the survey was distributed within the platform itself, which means that our survey does not include users that have either ceased to use P4 or use it very sporadically.

### 4.4.2 Age & Gender Distribution

In Figure 4.2, the age distribution of all participants is shown in percentages. With the exception of P3, the majority of people who responded to our surveys were 46 years or older, with the highest group being in the 56–65 age category. Table 4.2 lists the participants' genders. On P1 and P3, the majority of the

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<sup>21</sup><https://techcrunch.com/2013/12/13/nextdoor-competitor-meetey-launches-its-local-social-network-internationally/>

responses came from females. In the case of P4, genders were nearly divided equally.

Table 4.2: Summaries of responders' genders

	<b>P1</b> (September)	<b>P3</b> (October & November)	<b>P4</b> (November)
<b>Total</b>	249	78	440
<b>Female</b>	197	49	235
<b>Male</b>	45	22	202
<b>Other</b>	7	7	3

Age distribution of participants

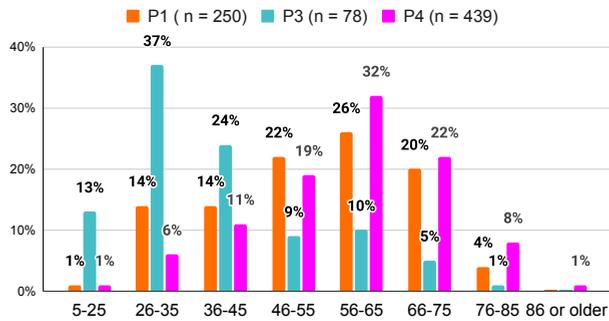


Figure 4.2: Age distribution of the survey results for all three platforms.

### 4.4.3 Frequency of Use

In the first survey that was for P1, we forgot to ask when the participant last logged in to the platform, but this question was added to the latter two surveys (P3 and P4); the results can be seen in Table 4.3.

For P4, the question had to be rephrased as we could assume that the majority of the participants already use P4 with some regularity, as the survey was distributed via the platform.

### 4.4.4 Device Used (P4)

Only P4 had both a web and a mobile application available for its users. Thus a question focusing on the main device used to access the platform was asked. When looking at the results we were also interested in the devices used by elderly users. Figure 4.3 shows the results for what type of device

Table 4.3: Results on how often respondent access P3 and P4

P3 (n=78)		P4 (n = 438)	
When was the last time you used P3?		How often did you use P4 in the last 3 months?	
this week	36%	monthly	10%
this month	32%	weekly	47%
I have not logged in to the app after creating my account	15%	daily	18%
can't remember	12%	it varies	25%

participants normally use to consult P4. A subtle drop in smartphone usage can be seen when moving to older age groups. At the time of the survey, we did not think of checking whether tablet device users were using the mobile application provided or the web version.

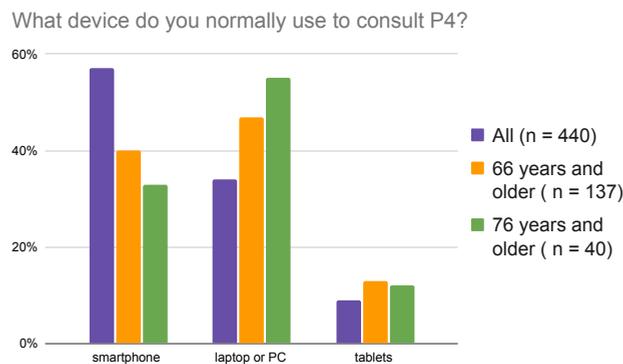


Figure 4.3: Distribution of devices used to access P4, by different age groups.

#### 4.4.5 Help Requests

A major point of focus in the surveys was to get to know how much the users of a platform actually use the platform to request or offer help. In the case of P1 and P3 we simply asked whether they had: a) offered to help, b) asked for help, c) both, or d) neither. Figure 4.4 shows the results for P1 and P3.

In the case of P4, this question had to be divided due to how offering to help and requests works on the platform. Firstly, P4 offers an option for their users to join a “pool of helpers”, wherein they state on what they are willing to help in their neighbourhood. Making a help request is a specific message type amongst other messaging types. All message types are color coded; help request is colored pink. We asked the users of P4 a series of questions on help requests: 1) “Have you filled in the “How can you help your neighbours?” part in your profile?” (Figure 4.5); 2) “Were you aware of the “Neighbourhood care” feature on P4, where people offer different types of help” (Figure 4.6); and 3) “Have you ever posted a “Help request” message on P4?” (Figure 4.7).

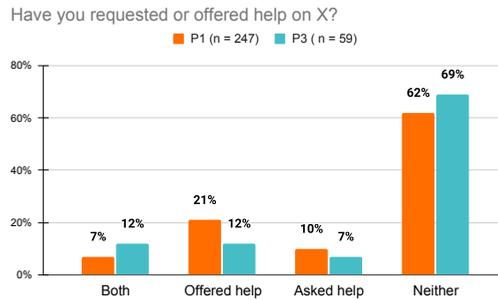


Figure 4.4: Help Results and offering help on P1 and P3. Margin of error: P1 6%, P3 11%

In all three cases, example images of the relevant fields were provided to the participants. We will focus more on questions 1) and 2) in Section 4.4.9.

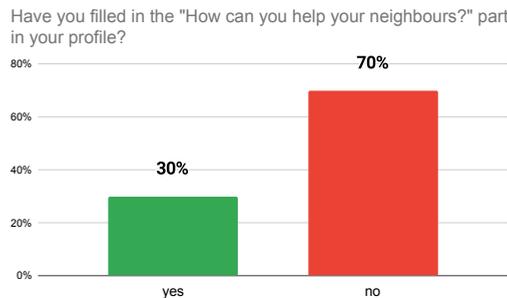


Figure 4.5: Results for P4 question on offering to help by means of joining the "pool of helpers". Margin of error: 5% (n = 395)

#### 4.4.6 Help Request Success Rate

Participants who had answered positively on the question whether they already asked for help on the platform were asked if they received help to their requests. Figure 4.8 shows the results. The results for P4, which had most responses out of the three, suggest that for this platform asking for help has a somewhat good chance of being responded to.

#### 4.4.7 Number and Types of Help Requests

Participants were also asked to list the type(s) of request they had made, in general terms as well as to give a number on how many requests they had done

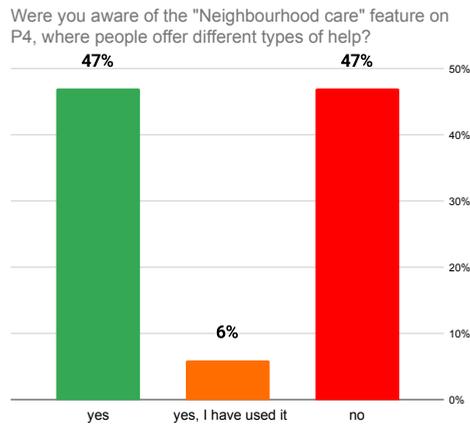


Figure 4.6: Results for P4 on how many were aware of the “pool of helpers”. Margin of error: 5% ( $n = 371$ )

overall.

For **P1**, respondents had mostly asked help once, with the mean value being 1.63 and highest number of request done being 4. This was derived from 35 responses. No unusual requests were mentioned; the majority being small tasks, such as, shopping, small repairs, and household help.

**P3** had a mean value of 4, out of 10 responses; the highest number of requests being 15 and the lowest 1.

**P4** showed more distribution, but the mean value leaned towards 4, from 64 responses. However, due to a mistake in the survey, participants were able to write text instead of simply giving a number. From this we could derive that some users were helping multiple times, with a handful of statements on help requests done weekly, or even nearly daily, but these appeared to be repetitive help tasks, such as walking a dog.

A general trend on all platforms appears to be that the majority of respondents ask help only once, with a very small minority asking for help on a more regular basis, or at least more than once. The types of requests were very much related to small tasks in and outside of the households, such as walking dogs, shopping, and other minor tasks.

#### 4.4.8 Ease of Help Request Process

We also wanted to know how easy the help process was and what types of challenges they might have encountered, if any.

The **P1** survey had this as an open question: “*How has the overall experience on requesting for help been?*” With the request to give a couple of words explaining what was easy and/or difficult. Only 20 participants left a

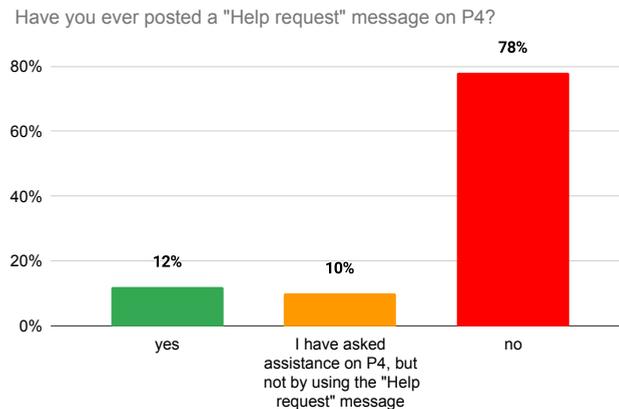


Figure 4.7: Results for P4 question on whether participant has asked for help. Margin of error: 5% ( $n = 370$ )

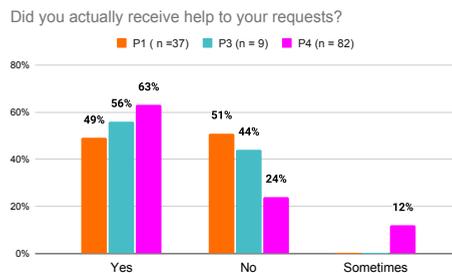


Figure 4.8: Results on how many had received responses to their help requests. Note that “sometimes” was only asked on P4

remark. Most remarks were rather evenly divided amongst age groups: 26–35 (2), 36–45 (3), 46–55(5), 56–65 (5), 66–75(3), 76–85 (2). In terms of easiness, most respondents simply remarked it as being “easy” or “fine”. A core complaint was on lack of responses, with one stating that after the *“third miss it was enough for one person”*, which implies that they had stopped using the platform. Other remarks on difficulty were about last minute cancellations, the lack of replies to messages, or simply a lack of people in the user’s vicinity. Two more specific complaints were 1) about the help requests being public and the wish to have an option to send private messages to notification makers. However, this, to our knowledge, is already possible on P1; and 2) after helping an individual that had assumed that the helper would be also available in the future.

For **P3**, seven participants responded to this question with one stating that

making requests was easy, but receiving responses was not. Another mentioned the lack of users. The remaining five gave only positive feedback on the process, i.e., that it was easy.

For **P4**, we reworked this question somewhat by replacing the single open question with statements to select from, as shown in Figure 4.9.

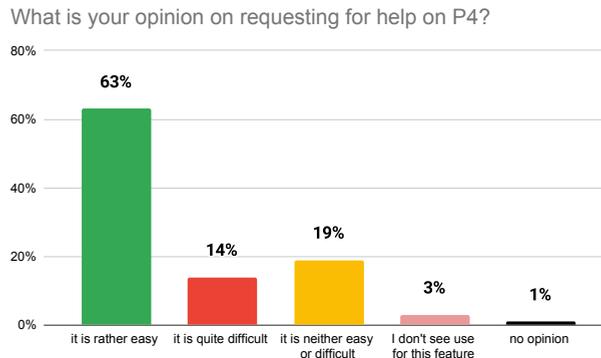


Figure 4.9: The five answers to the question: “Overall what is your opinion on requesting for help on P4?”. Margin of error 6% (N = 237)

The three participants who selected “quite difficult” all had a different justifications: 1) no people to engage with; 2) focuses on only practical problems; and 3) I don’t want to be a burden. The last response could imply that it is difficult for the participant to ask for help, in a fear of becoming a burden.

Seven people responded that they were not seeing use for the feature; their justifications were somewhat mixed: 1) doubting about the qualifications of potential helpers; 2) digital platforms are too large of a barrier; 3) lack of responses in own neighbourhood; and 4) stating that a lot of help is offered but was not sure if there was lot of responses. Most statements are only opinions about the feature as only two participant from this group had actually marked themselves as using the help request.

#### 4.4.9 Response Rates to Help Requests & Offering Help

In Section 4.4.6, we provide the results on the success rate of help requests, but we also wanted to estimate how successful the platform was in actually connecting people to help each other. We did this by looking at the number of replies from the volunteers who either responded to help requests or actively offered to help. In the case of P1 and P3, the user could leave a notification that would be visible on the map with a specific offer or help request. In the case of P4, users are encouraged to fill in a form in which they state the areas they would be willing to help others in. The form consist of general categories, such as chores, care and assistance.

The results of participants either asking or offering help, or neither for **P1** and **P3** was already given in Figure 4.4. For **P4** we were curious to know whether offering help by filling in a form had been successful, and thus we firstly asked users whether they had filled in this “How can you help your neighbors?” form. Results were given in Figure 4.5. For the participants who had selected “yes”, the follow-up question was whether they had been contacted through P4 by another user to ask for help. 116 out of the 120 responded to this question, with 36% stating that they had been contacted with a help request.

All participants were asked an estimate on how many users they had helped through help requests. The results are shown in Table 4.4. P1 and P3 has much lower rates of helping, with the mean value hovering between one and two, whereas P4 has managed to achieve more repetitive helping. By the mistake in the survey in P4 allowing text responses, some users stated helping on daily or weekly basis; these were not included in the results.

Table 4.4: Results on how many times participants estimated themselves to have responded to help requests

	Min	Max	Mean	Std Dev.	Total
P1	1	10	1.52	1.98	56
P3	1	5	1.55	1.50	11
P4	1	30	4.44	5.42	27

When looking at responses by age groups, in the case of P1 and P4 most activity was in the age groups between 45 to 75, peaking in the age group 55–65. This is not surprising as these are also the main demographic of both platforms as we showed in Figure 4.2. No noticeable trends emerged between age groups. In P3’s case, the trend was the same but the age group was younger: 15 to 45, with 26–35 being most active.

#### 4.4.10 Ease of Offering Help

Similarly to making help requests we also asked the participants to give remarks on how easy or difficult offering help had been.

For **P1**, a total of 52 participants gave remarks. Six participants said that the process was easy, where as the majority complained about a lack of people, responses, or help requests in their areas. One individual mentioned that on the single encounter it has been “a nightmare”, but otherwise no negative encounters were mentioned.

For **P3**, 11 participants answer this question with most stating the current method being easy. One user requested easier tools for cropping images and another gave an improvement suggestion on usability.

For **P4**, this specific question was dropped due to the uninteresting results received from P1 and P3. Instead we asked general feedback results which we already showed in Section 4.4.8.

#### 4.4.11 Barriers to Asking & Offering Help

We realised that it could be useful to look for potential barriers for asking and offering help after our first P1 survey. Therefore, we added some questions focusing on possible reasons why help was not offered or requested. Separate questions were created for participants who replied negatively to “asking” and/or “offering” help questions.

##### Reasons for not asking for help

Participants who replied negatively on whether they had requested for help were given a list of options as to why they had not done so. The options and results are shown in Figure 4.10. Note that in the case of P3 participants could only choose one option, whereas P4’s case this was a multiple choices were allowed.

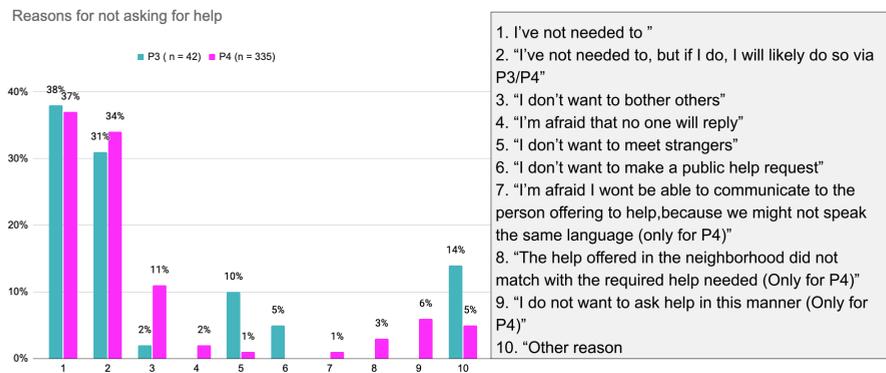


Figure 4.10: P3 and P4 results to followup question on why participants have not asked for help

In the case of P3, For participants who selected “other reason”, the largest obstacles for asking for help appeared to be: *“lack of users nearby”*, *“afraid or reluctant to meet strangers”*, *“not wanting to trouble others”*, and one individual complained about the *“language barrier being too high”*. And for participants from P4 the reasons listed were mostly a mix of the previously ready given options: *“not being aware of this option”*, *“had not thought to asked help in this manner”*, and *“already knowing people who could help them”*.

##### Reasons for not offering to help

Similarly to reasons for not asking for help, we provided possible reasons for not offering help to the participants that chosen negatively on whether they currently had offered to help anyone on the platform. The options and results

are shown in Figure 4.11 Note that in the case of P3 participants could only choose one option, whereas P4's case multiple choices were allowed.

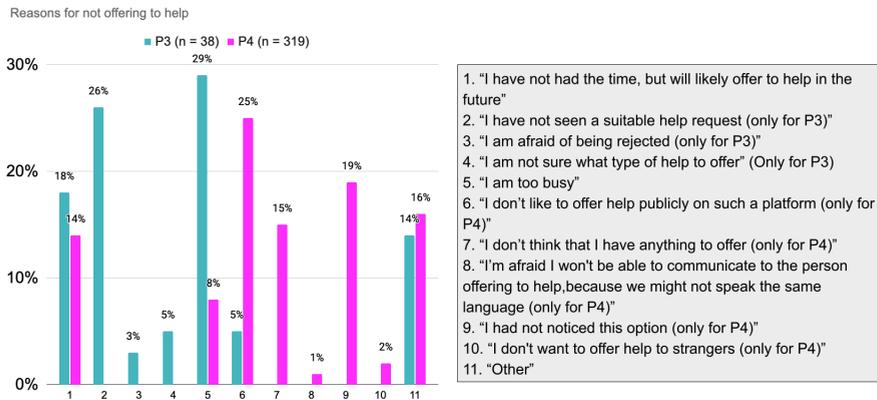


Figure 4.11: P3 and P4 results to followup question on why participants have not offered to help

Participants from P3 who had selected “Other” mainly gave variations of the already given options, with the exception of two responses that stated lack of users as the reason. As for participants from P4 similarly most answers were largely variations of the given options, such as “*being too busy*”. Some stated health, age, or lack of interest as their main reasons

### Alleviating reasons

In the questionnaire conducted on P4 we also asked participants who had not offered help what factors do they think could motivate them to do so? Provided options along with their results (n = 198) are:

1. “Ability to help anonymously” 28%
2. “If the whole process would be fast” 13%
3. “If I don’t have to meet in person” 13%
4. “Small compensation” 3%
5. “Recognition on the platform, such as: a badge, notifications, announcements, etc.” 5%
6. “Digital rewards such as badges that I could collect” 4%
7. “Other” 35%

The large percentage going for “Other” options is mainly due to some respondents using it as “none of the above” answer to the question. Some reasons were also given why they are unable to help, such as health, age or time. Additionally, a handful of suggestions were given, such as “directly asking” which was given by five participants, three referred to safety and another three on

lessening the obligation, one participant specifically stated that they do not want to help the same person continuously. Two participants also stated clarity of requests as a factor.

When we broke up the responses on age groups, answers such as “not meeting in person” and “fast process” were somewhat more popular in the older age groups (46–75), but there were too few responses to draw proper conclusions.

#### 4.4.12 Motivation to Help

We also asked the people offering to help (only on P4), what they saw as their main motivation to offer help and gave ready made options. The statements along with results are listed below (n=357; multiple options could be selected):

1. “I want to contribute something to my neighborhood” 69%
2. “I like to meet new people” 33%
3. “It’s easy to offer help on P4” 29%
4. “I want to keep Busy” 13%
5. “Other” 10%

For other reasons, two respondents mentioned own pleasure as their main motivation. The others mainly used the option for “none of the above”.

When divided by age groups, option 1 remained the main reason, but it did drop by 10% with the older age groups (66–85). It was not directly overtaken by any other motivation, but a large portion of users that selected “Other” was from these age groups.

#### 4.4.13 Feature-specific Results

In this section, we cover the results of the questions that targeted specific features that already exist on the SE platforms. The goal was to get an idea of how users perceive these features.

##### Messaging habits

One point of interest to us was to find out if users move away from the platform after making friends there. In the first survey this was simply asked in combination with their messaging behaviour, i.e., whether the user used private messaging continuously, or only in the beginning and then moved to some other applications.

In Figure 4.12 we show the results for all three platforms. The majority had not used the provided message service of the respective platforms, but of the respondents who did use them only a small percentage appears to migrate their conversations to outside the platform.

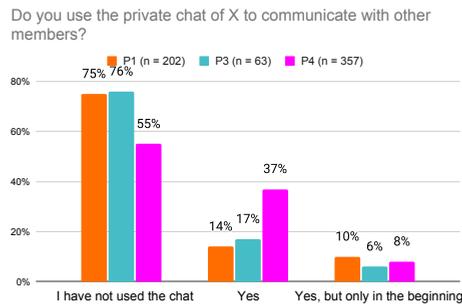


Figure 4.12: Results to internal chat use on all three platforms. Margin of error: P1 7%, P3 12%, & P4 5%

## Meeting people

Another topic we were interested in was to find out how often the participants met other users from the platform, how easy organising the meeting was, and whether any steps were taken to make the meeting more safe.

We started by asking “Have you met other users of the platform in person?” yes/no. Results were:

- **P1**: Out of the 202 responses, 21 had met other users in person.
- **P3**: Out of the 63 responses, 7 had met other users in person.
- **P4**: Out of the 359 responses, 140 had met other users in person.

Note that in the case of P1 and P3 the platforms only provide help requests, whereas P4 offers numerous other services, which also likely translates into a higher rate of meetings.

A follow-up question was given to participants that had replied positively to the first question. The question was whether any steps were taken to make the meeting more safe. In the case of **P1** and **P3** this question was an open question. Most participants replied that no specific extra steps were taken and a handful mentioned organizing meetings at a public place. For **P4**, this question was refined by giving possible options (shown below, along with the results in percentages). We received 144 responses:

- “Yes, I told a friend” (5%)
- “Yes, we met at a public place” (9%)
- “Yes, I brought a friend or relative” (1%)
- “No, I felt fine without taking any precautions” (78 %)
- “Other” (6%)

None of the participants who selected “Other” provided more information.

An additional follow-up question on the question about meeting people was asking whether it was easy or difficult to organize the meetings. The question was: “Was organizing the meeting easy?” yes/no. Results were as follows:

- **P1:** Out of the 118 responses, 38 found it easy.
- **P3:** Out of the 22 responses, 6 found it easy.
- **P4:** Out of the 135 responses, 127 found it easy.

In the case of P1, this question was accidentally shown to all participants instead of only to participants who had given a positive answer on meeting other users. This makes the numerical results somewhat unreliable as 38 stated that making meetings was easy, while only 21 had replied positively on meeting other users in person.

An open text field was provided to further ask what was easy or difficult. In the case of P4, we dropped the question for what was easy due to mediocre results from P1 and P3. In the end, all open text results on what was difficult or easy did not vary too much between all three surveys. The number of responses were limited on the first two surveys, with only a handful responding, but not giving any distinct answers on what they deemed difficult or easy. For P4, we had two individual responses: one commented on the difficulty of organizing the actual meeting via the private chat; the second one mentioned missing the messages they had received at first.

## 4.5 Results of Hands-On Evaluation and Interviews

In this section, we discuss the results of the hands-on evaluation of the selected platforms and the interviews performed. We discuss them together because for both we took the same evaluation perspective. We look at the platforms from two perspectives: from the viewpoint of Lee’s Factors (see section 2.2.5 for a description of these factors; for the factor usability we use our findings presented in Chapter 2.1) and when relevant for a factor also from the viewpoint of the use of engaging and persuasive techniques (presented in Chapter 3). For each factor, we will first re-look at the factor and then discuss (based on the evaluations) how each of the platforms selected for evaluation deals with the factor. We also discuss some additional factors that are not covered by Lee’s factors, but which, in our opinion, cover a substantial amount of aspects that might affect the willingness of elderly to use new technology, especially for the type of technology considered here, i.e., security & trust, and dormant users. Lee (2015) also briefly listed additional factors that might affect technology acceptance, such as service trust and lifestyle fit.

We might in some cases discuss platforms as a group, i.e., if no discernible differences between them could be identified. At the end of each subsection we will give a short conclusion. The depth of evaluation conducted on the evaluated platforms is shown on Table 4.1. The rest of this section is structured as follows. For each factor, we first briefly introduce the factor again and specify what features we considered to evaluate how well a platform deal with the aspect. In the subsequent section “Findings”, we discuss how well the

platforms support these features. We will use our own hands-on evaluation of the platforms, the performed interviews, and sometimes also results from the survey to evaluate a factor. Any quotation in this section focusing on specific platforms are from interviews conducted with a representative of said platform, unless stated otherwise. When a survey is referred, we provide a direct reference to the section where a more detailed description is given. We refer to findings from all evaluated platforms, but our focus is on the platforms for which we performed interviews and user surveys: P1, P3, P4, and P5.

### 4.5.1 Emotion

*Emotion* in Lee’s description (Lee, 2015) refers largely to the ability of a product to link the users to something they feel. Therefore, not only the technical benefits, but also the affecting benefits and values should be visible. This is especially important for elderly, as technology can be perceived to potentially decrease social contact and interpersonal interactions. Lee does also include emotional benefits as a whole in the factor:

*“Another aspect of the emotional factor is the degree to which a technology can offer enjoyment and entertainment to older adults”  
(Lee, 2015)*

While the platforms that we consider by definition focus on social aspects and attempt to provide means for contacting and communicating with people in the neighborhood, according to Lee due attention should also be paid to the emotional benefits that a platform can provide. However, some platforms do it better than others. For example, Allo Voisin, though being perfectly viable for this type of interaction is a more business oriented platform, meaning that it does not make the cut for this factor.

Despite Lee’s focus being mainly on socially-oriented emotion, with only some minor leeway towards more individual emotions of enjoyment or satisfaction, we have decided to consider enjoyment as a full fledged part of this factor. Essentially, any mechanics aimed at contributing to the user’s emotions, such as making the process of requesting and offering help more engaging and warm, for instance by means of gamification, will be considered. We inspected the platforms for the following features:

- Features showing that the platform is active and “alive”
- Gamification, persuasion or nudging features that contribute to the emotion factor
- Features that enable, or encourage connecting users with each other

### Findings

In Table 4.5 we show which features were found in the evaluated platforms. *Points* was the most common feature on the platforms. All platforms used

Table 4.5: Features noticed on evaluated platforms that fit the emotion factor.  
 \* Only limited access to platform. “-” means no relevant feature discovered.

	<b>Emotion</b>		
Commu	points	progress	feedback
Hoplr	points	badges	progress bar
Nappi Naapuri	-	-	-
Nextdoor*	-	-	-
Nachbarshaft	-	-	-
Help your Neighbor	points	-	-
¿Tienes Sal?	feedback	progress bar	user history
Hoplr	points	badges	progress bar
Commu	points	progress	feedback
Solidare-it!	points	progress	-

them largely to showcase and “reward” user activity by giving points for each new message created. Only Commu also provided additional points that a user can only gain by earning them from positive encounters; the more “recommendations” users have, the more trustworthy they will appear to other users.

From the interview and the user survey on P4, we found that points were a relatively new addition in this platform:

*“The neighborhoods that started before these features never really used it a lot. And neighborhoods that started afterwards with this functionalities, they use it a lot more than the neighborhoods before. Comparing percentages to neighborhoods that have been for example in Flanders for a 3 years already, it is very high”.*

We asked P4 users if they were aware of the points and whether they enjoyed collecting them. 92% of 365 participants stated that they were not aware of the point system. The 28 individuals who did know of the point system (54%) had no opinion on it; 11% agreed somewhat and 11% totally agreed on enjoying the process of collecting the points.

Other platforms also pay very limited attention to their point systems and leave it largely to the users to make up their own goals for collection points. Help Your Neighbor had no information on the points and none of the platforms utilized leaderboards or had additional uses for the points. Simply a sum of all gathered points was shown to users. Solidare-it!, even goes as far as stating so in their FAQ page:

*“Karma points show how active you are on the website. It’s a kind of currency for our gratitude. You can get Karma Points for as*

*well offers as requests, exchanges as positive evaluations. We hope that you are proud on your Karma points, but apart from that there is nothing that you can do with them”*

Use of points to show the level of activity, seems to be the main usage at the moment by most platforms. Hoplr has managed to give their score some added value, as their points are tied directly to help requests. According to their own help page, the methods of gathering points (named “score”) are: “by activating neighbour help”, “by adding help categories”, “by receiving applause when offering neighbour help”, “by receiving a thank-you when you’ve helped a neighbour”. This is an interesting mechanic of essentially using collected points to prove active volunteerism. Solidare-it! utilizes the karma points in a similar fashion as the points are visible to other users.

*Badges* were used by ¿Tienes Sal? and Hoplr. Hoplr uses badges to both tag message types and users, such as volunteers or helpers. In the interview on P2, it was mentioned that the badges were used to highlight the more active users or so-called “super users” in the platform. The main difference appears to be the messaging from the platform that offers more ideas for these users to engage with their neighborhood. The process is generally automated: the system has a built-in metric for when to give the badge. However, on some occasions, some users might be given the badge by the system admins. Interesting to know is that some users opted to remove the badge.

*“...some users remove it from their profile. Some people don’t want to feel enthusiastic, or responsible. But, some like it and for others nothing.”*

To our knowledge, none of the platforms utilize badges as collectible tokens (as they were originally envisioned (see Section 3.1.3)).

Solidare-it! tracks most actions done by users and these are showcased on their public profiles. These can be seen as a type of badges. Interestingly, Solidare-it! also appears to make both negative and positive interactions public knowledge (see Figure 4.13).

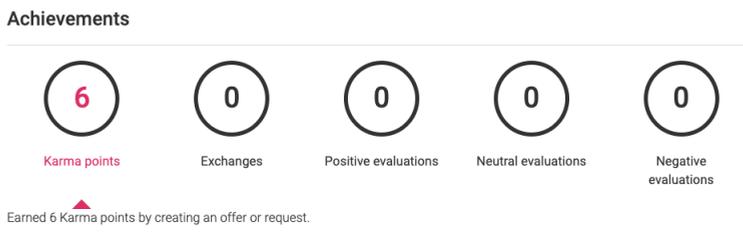


Figure 4.13: Point & badge system wrapped into one, in the Solidare-it! achievements

*Progress bars* were utilized by ¿Tienes Sal? and Hoplr in a very similar fashion to show how fully users had filled in their personal profiles. Also in the case of Hoplr, a progress bar is visible on the main landing page that indicates the current percentage of users that have joined from the neighborhood. This percentage bar is coupled with suggestions on how users can attract others to join.

*Feedback* was used on two of the platforms. Commu appears to be the only platform that allowed users to also leave written feedback about their encounters on other users' personal profiles. Solidare-it! allows leaving positive or negative feedback, but the extent visible to target user is less clear. The comment option is given when the user has decided to recommend someone, meaning that negative feedback is not possible. ¿Tienes Sal? uses a thumb up icon as a "thank you"; the number of which is made visible on the user's personal profile. Of course, on platforms such as ¿Tienes Sal? and Hoplr this sort of feedback can also simply be made directly in the open discussion, but the two features mentioned are more discreet.

*User history* is available on ¿Tienes Sal? and Solidare-it!, both showing how many times a user had performed one of the platforms core features, such as creating a messages, or replying to one.

In the interview, the representative of P4 mentioned that they also considered features that could support the emotion factor through more communal nostalgia:

*"We would also like to have a small Wikipedia page for the community, or maybe also a photo album collecting photos<sup>22</sup>."*

¿Tienes Sal? also provides an info button embedded into messages that give some general meta information about the message, such as: where is it visible, date of creation, status, and last reaction.

Other than that, Hoplr and ¿Tienes Sal? offer basic reaction and messaging options very similar to Facebook, whereas Commu offers only direct messaging and Nappi Naapuri a private chat and open replies to a request that everyone can see.

## 4.5.2 Independence

*Independence* refers to the elderly user's feeling of independence and actively enabling it (Lee, 2015). In the case of SE platforms, and from a technological point of view, a platform should ensure that the elderly can use it without the need to ask for help from somebody else. This means that the level of the measure "ease of use" should be very high and that the terminology used in the platform should be easy to understand. Also, any communication done, specifically with the elderly users, should not come across as "belittling" or "condescending". The main features we looked out for for this factor were:

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<sup>22</sup>A photo feature seems to have been implemented since the interview. As it was implemented after our survey it is unclear how users have perceived it.

- Clear jargon-free language that makes no assumptions on the level of the knowledge by the user
- Guides on how users should use the platform and form their messages

## Findings

Independence is not an easy factor to investigate by means of interviews with representatives, or even by hands-on evaluating, but rather requires a long-term user study. When asked for in the interviews, it was a topic that had not been considered, but was generally considered as an important question to ask.

*“We should look into that. Because maybe we need to look at terminology in terms of elderly people and different backgrounds. . . my colleague is working on communication and writes as inclusive as she can. We should look more into it and user experiences and other audiences that we have not looked into yet.” - P4*

In the case of P3, also the conversations between users were discussed, for instance whether age differences could cause dichotomy between the language used in the chat.

*“We have instructions that try to encourage writing, but also say what is a good title or description. How to place location, or if you want something in return what it should be. But on the conversation side, but that is a good idea that there could be something. . .” - P3*

In the case of P1, some remarks in the surveys suggest that users had understood the language used, but rather struggled to understand the behaviour of other users and could at times draw rather harsh opinions because of this, as in the case of one user of P1 stating in an open text question that *“after they learned of my age, they ceased to communicate. Clear age racism”*. This was an individual comment and no conclusions can be derived from it, but a number of other comments did hint to a potential problem lying within the user-to-user communication where one of the parties simply stops responding to messages.

In terms of complexity, *iTienes Sal?*, Hoplr, and Nextdoor are inherently more complex platforms as they offer a number of additional features. Images of the landing pages are shown in Figures 4.14 (Hoplr) and 4.15 (*iTienes Sal?*).

Most of the platforms also give small cues, instructions or suggestions in the message creation process, as shown in Figure 4.16. Help Your Neighbour gives explanations for all the buttons the first time a user navigates to a new part of the site, but after this we were not able to find a way to activate this tutorial again.

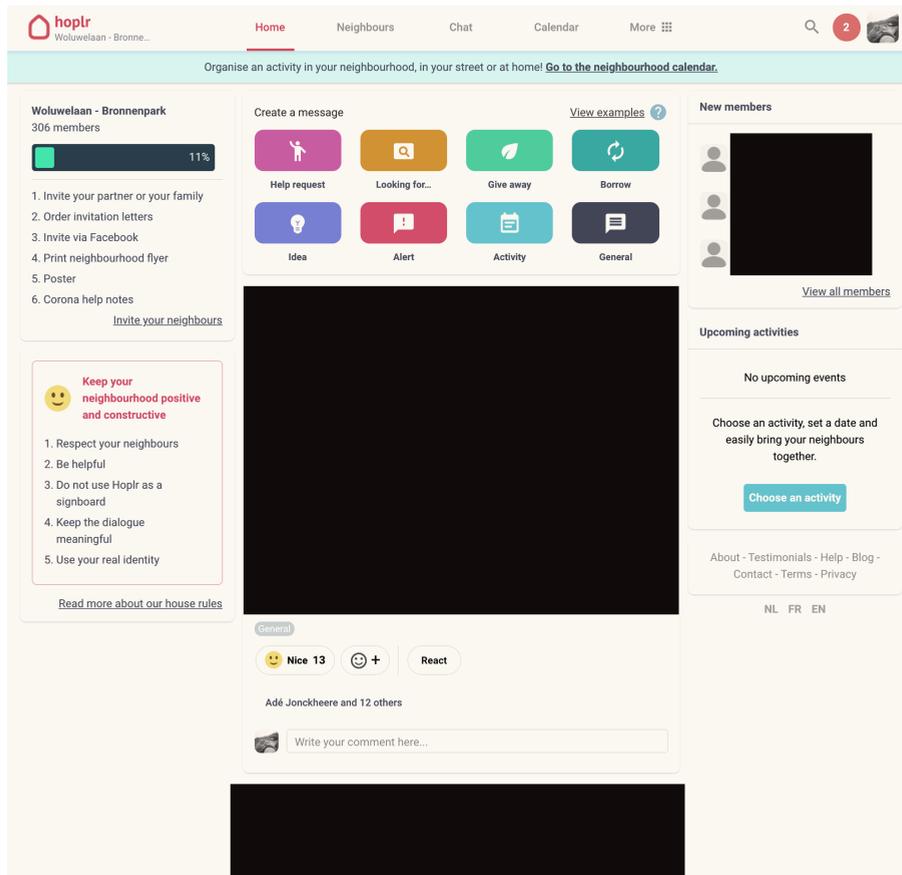


Figure 4.14: Screenshot of Hoplr’s landing page

### 4.5.3 Usability

**Usability** refers to the general usability of the platform. In terms of evaluating this factor, we used our list of guidelines presented in Chapter 2 to see which of the guidelines we compiled (based on the ranking presented in Chapter 2.1) might have been overlooked by the platforms.

#### Findings

In Table 4.6 we show how well the platforms considered, covered the design guidelines (given in Chapter 2.1). Despite seemingly average results, most platforms covered all the main guidelines. The lower percentages were mostly coming from the lack of the more novel features such as multimedia messaging. However, some missing features did come as a minor surprise to us; for most

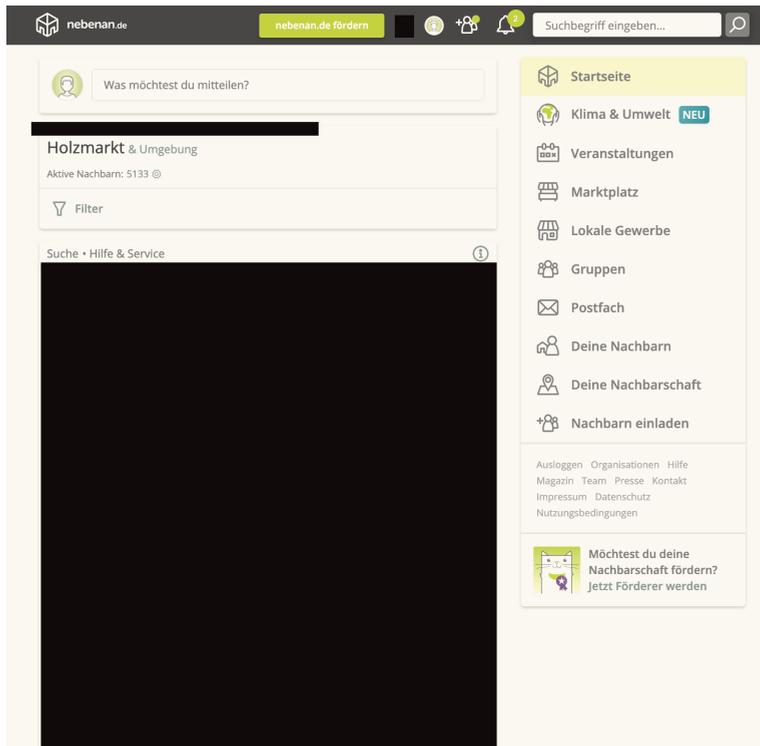


Figure 4.15: Screenshot of Tienes Sal? landing page. Note that this image is actually from the German version, but the platform is the same, except for language used

parts, no confirmations and summary views were given. Guidelines that were not relevant to these platforms, such as specific gesture usage on touchscreen devices and other more specialized guidelines, were not considered.

We suggest that Nachbarshaft, Solidare-it! and Help Your Neighbor should look into additional usability guidelines, despite hitting most of the general marks. Though, in the case of Solidare-it!, this is not a major concern, as the platform is currently not intended for larger audiences, which is why it is also not included in the table. All of these platforms function and also do not present any major issues, such as broken features, but current user experience is not optimal. Some of the more critical issues that were encountered, were: Help Your Neighbour failed to scale in a way that text stays legible; Nachbarshaft's error message presentation and closing the request view automatically is something that even an average user would find annoying. Otherwise, the number of guidelines not followed were all quite minimal, such as occasionally buttons without padding. In Hoplr, ¿Tienes Sal?, and Nextdoor, the large number of additional features inevitably requires a larger menu to ac-



Figure 4.16: Screenshot of message examples for Help request on Hoplr

Table 4.6: Results on how well some of the evaluated platforms cover our list of design guidelines. Note, we ignored the category “not important guidelines” as no platform covered these.

	Commu	Hoplr	Help Your Neighbour	Nachbarshaft	Nappi Naapuri	¿Tienes Sal?
very Important	81%	88%	70%	75%	76%	83%
important	80%	75%	63%	68%	73%	85%

cess them, which naturally impacts usability. Lastly, in more general usability terms, Nappi Naapuri shows that simple guideline adherence is not the only thing that is required. Though Nappi Naapuri appears to have equal results to Nachbarshaft and Help Your Neighbour in general usability and ease of use, it performed much better in our hands on testing than its’ two counterparts.

The look and feel of the platforms came in two forms: Facebook-type endless scrolling of notifications, and a map view where requests are shown on a map. In terms of look and feel, there was a clear disparity between smaller less well funded platforms and larger enterprises, but usability experience appeared generally decent.

In terms of information embedded in the help request and offering and in other messaging options, the information were quite common: title, typed message, optional image, and some meta data to narrow down the topic further. Video and audio options were not provided by any of the evaluated platforms, not even Facebook that has a video message feature in the main platform. When asked in the interviews whether they thought adding audio and video would be a good idea, the majority agreed. However, the representatives of P2, P4, and P5 did have some opinions on this:

*“I think having both options might be useful. Some users might, but typing is not the most easy thing. But some might feel more exposed from sending these types of messages”. - P2*

*“I think. Would be interesting to see if people would use it. Yes. Maybe, maybe. It is bit like calling, no? You just do the phone icon and maybe record a message. I think it would be interesting to see”. - P4*

*“I think yeah. Because that is one...for older people who do not exactly speak the language. for instance in the north African communities, they use whats app a lot, but the vocal thing. So that is one of the things we are considering. With video with step by step, how to use it”. - P5*

In general, based on the interviews we found that none of those platforms directly considered elderly users in the design process, but made adjustments along the way based on received feedback, mostly by means of direct phone calls and emails. Especially when the platform is still growing, garnering useful feedback by phone calls and direct emails is a feasible approach but can become harder to handle as the user base grows. Otherwise, platforms simply rely on the fact that their overall main features are simple enough for all users:

*“Accessibility in general is currently in the pipeline. The platform in general is very easy. It doesn’t have complex features”. - P2*

*“Some elderly users have given feedback and called to us that they don’t know how to use the platform. Mostly basic stuff, such as mixing up registry fields and when asking their password they think we’re asking their google password. What we have actually done is enlarging font and somehow tried to simplify the process”. - P1*

*“Well, the UI overall is really simple. So in that context there was no need to consider them separately as the UI is very intuitive”. - P3*

However, ‘simple or easy’ can be a very fluid concept. The number of features can in themselves be confusing to users even if by themselves they are simple to use. P4 and ¿Tienes Sal? both currently offer several side features, such as for ¿Tienes Sal?: Events Marketplace, Shops & Services, Groups, P.O Box, Your Neighbors, Your Neighborhood, and Invite Neighbors; and for P4: Neighbors, Chat, Calendar, and under the “More” button: Participation, Local directory, Neighborhood map, Invite your neighbor, and Neighborhood stories. When asked the representative of P4 whether (s)he thinks that elderly users use other features:

*“I don’t think they find their way to the other features.”*

## **Registration**

Creating an account or registering is a process that all of the evaluated platforms required. This increases complexity for elderly users immediately as some information (such as a password) is required. In terms of steps required, in the more streamlined platforms this was generally quite straightforward: email, password, and some basic details. Some common methods used to make the logging in easier, were the use of an existing account, such as a Google or Facebook account (Hoplr & Nappi Naapuri), or keeping the user logged in at all times (Commu). Also, Hoplr provided logging in by sending an access link to the user’s email.

It is unclear how difficult or cumbersome users find the actual login steps, but it would appear that after an account has been created accessing the platform might be feasible. The stumbling stone appears to be the more complex

account registration process on the closed-neighborhood platforms. The account making process for ¿Tienes Sal?, Nextdoor, and Hoplr are inherently more complex than the ones without closed-neighborhoods, as the user has also to provide a verification of his/her location on top of the regular account creations steps.

Below are some remarks given in the interviews regarding registration:

*“Majority of them have mobiles and internet already. Maybe not a laptop. But they don’t know how to use it. They might say that once their son or daughter helped them get started. Using, like whats app, is fine, but the installation steps: download the app, register in. These can be too much. When you are in, it is very intuitive. Because it is “write something here” and they write something. But the registration, they need to do a verification, they must use a GPS, these are bit complicated for them.”- P2*

*“What are some of the common issue on the platform for elderly users?” - Interviewer*

*“The logging method. The account making part, specifically, they changed it to be easier.” - P4*

#### 4.5.4 Value

*Value* is about the perceived value: “does the user see the added value of a technology from the outset?”. Whether a person perceives a platform as valuable is difficult to estimate without explicitly asking them and even then it might remain a vague concept. However, we can look at how platforms are advertised; this may give a first indication of how well a platform highlights its value. Therefore, to evaluate this aspect, we focused on:

- What steps does the platform take to show its value?

#### Findings

Interestingly, Facebook’s Community Help fails this outright as no direct references to the platform have been made available and even on the page itself there is only a very short sentence on what it is about.

In addition, some users who seem very active on the platform or want to see that it succeeds, might struggle to find suitable methods on how they could help the platform to get ahead, like in the case of P1:

*“There is this group who really want to help and that the platform (P1) is where everyone would join and it is a very interesting group of people. In some way, would it be possible to provide service to this group in a really quality manner would be damn great.”*

In the case of P4, the platform's approach is to gradually extend to new municipalities and neighbourhoods. When steps to open a new area are taken, establishing value is a core focus:

*“When we start in a new neighbourhood, we put out physical letters in the mailboxes.... We also do info sessions in person and then we have banners and these types of things. These are the steps when we open a neighbourhood within a municipality. We organize the letter and info session together.”*

Other platforms with less resources also aim for onboarding experience on startup to really drive in the core features and how to use them, as in the case of P3:

*“When we have a new user there is a very simple tutorial. On continuing from there, the tutorial should push the user to one of our pre-made requests and try out the chat. And there are reminders and example notifications set for the first 4 weeks. It is still very much on its early phases, but we have noticed that notifications and emails do activate users”.*

Lastly, something that can certainly cause that the perceived value drops in the eyes of the users are requests that go unnoticed or several messages with very few replies. For example in the case of P4, a message will either quickly gain traction or will be lost in the infinite scroll, as discussed with P4:

- *“Ensuring that help request is not going unnoticed. How does P4 actually handle this?” - Interviewer*
- *“We don't really have anything. But usually, if no one reacts in the first moments, no one will react. This type of feature would be important. We rely on the social workers to do this.” - P4*

This topic was also briefly discussed with the representatives of P3:

*“We have debated on this issue a bit. If you can recognise that there is a non active request, it is a good excuse to contact an user, assuming we can actually reach them. What we have debated, whether we should remove or try to get rid of these types of message. I don't think we have a need to remove these, but at the same time leaving inactive request can turn against us. For example generating a message “hey your request has been active for 3 months” and contact them like that. - P3-2*

*We have tested contacting people behind several inactive requests via email that has been disguised as an automated message. It has activated some people on log-in in and checking their requests.” - P3-1*

In terms of the hands on evaluations, before a user has logged in, the landing pages of most platforms do attempt to showcase the value of the platforms and give reasons for making an account, such as in the case of Hoplr, illustrated in Figure 4.17. ¿Tienes Sal? makes it clear that it is a neighborhood focused platform, but added value for the user is not directly clear, as shown in Figure 4.18. Out of the the more in depth evaluated platforms, Nappi Naapuri does the poorest job in conveying the purpose of the platform on the sign-in page as the user is not clearly informed other than that the platform is about neighborhoods, as shown in Figure 4.19.

### Why register on Hoplr?

The screenshot displays three value propositions in colored boxes:

- Positivity is central** (orange box): Accompanied by a smiley face icon. Text: "Hoplr is not Facebook. Problems may be discussed but keep it friendly, civilized and positive".
- Access to social capital** (pink box): Accompanied by a hand icon. Text: "You will have access to nearby resources such as material, knowledge, time, volunteers and infrastructure".
- Keep in touch with your neighbours** (light blue box): Accompanied by a hand icon. Text: "The corona virus and the corona measures are causing less social contact and more home isolation. Take care of your neighbourhood".

Below these boxes is a grid of logos for partner cities and towns:

- +100 cities and towns use Hoplr. Check out the possibilities for governments at [services.hoplr.com](https://services.hoplr.com)
- BRUGGE
- Vlaanderen (It wagt en verkiert)
- H. HASSELT HEEFT HET.
- MECHELEN
- Lier
- Dilbeek
- NOORDERLIJN
- Berchem A

Figure 4.17: Screenshot of value creation part of Hoplr landing page, when user has no account

## 4.5.5 Experience

*Experience* is something very personal, but it affects how the user react to new technology and how easy or challenging it is for him or her to learn to use a new technology. It also influence the expectations on what a website or application should look like, or how the user interface should work. This applies to all age groups, which is why changes to the user interface of popular tools is usually done gradually over time, instead of through large sudden changes. To evaluate the impact of experience, the main point of focus was on:

- No novel design choices in terms of how UI operates or for navigation logic

### Findings

Asides from Help Your Neighbour, Nachbarshaft and Solidare-it! utilize familiar design choices, for most parts. Also, these three platforms all work, but

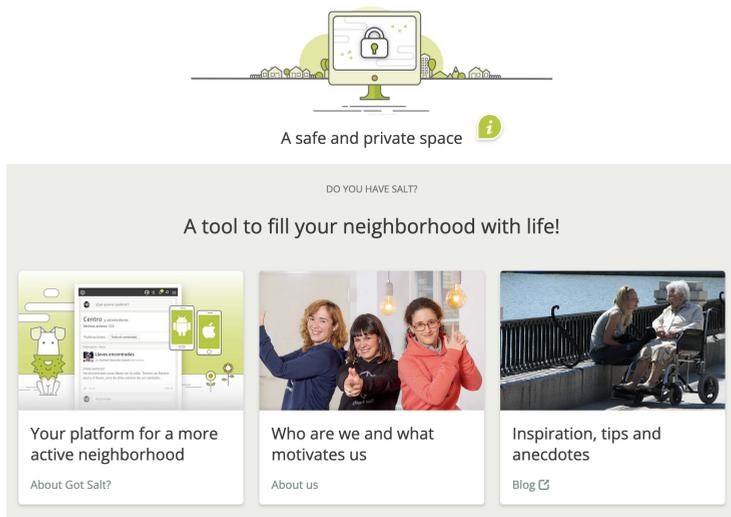


Figure 4.18: Screenshot of value creation part of ¿Tienes Sal? landing page, when user has no account (translated with Google Translate)

show a slightly burdensome experience to their users. Help Your Neighbour is divided into three parts, i.e., city, neighbourhood, and user, but the difference between these is somewhat vague, and the process of switching between them is something an elderly could likely easily be confused with. Nachbarshaft's handling of form filling at the time of the evaluation was not very user friendly with reloading the whole page if faulty information was given in the forms. Solidare-it! works mostly fine but its default page, being the user profile, and a slightly out of norm 'look and feel' could be problematic for some older users. These platforms were functioning properly at the time of the evaluation, but the user experience provided diverges somewhat of what could be argued as the established norm. Asides Solidare-it! where the platform is no longer intended for "regular" users, most platform representatives highlighted that their platforms focus on ease of use and the need for simple as possible use experience for the elderly.

#### 4.5.6 Social Support

*Social Support* is about the support and endorsement from family, peers, or social communities toward the use of a technology. Due to the nature of the platforms, the social support is at least partially covered by all the evaluated platforms. However, social support from family through the platform is more challenging, especially in the case of closed neighbourhood platforms, if family members live in different areas. In the interviews, the representative of P4 had already encountered this issue and had to give a user special rights to overcome

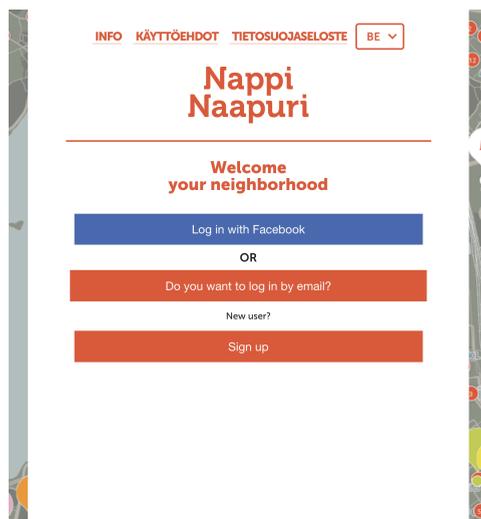


Figure 4.19: Screenshot of Nappi Naapuri landing page, when user has no account (translated with Google Translate)

the issue:

*“... we once gave one user social worker powers, but this was an exception. His sister was 70 or 80. He was taking care of her. We thought it was an interesting story, but generally no. It is difficult to screen what is the intent of the person.”*

To evaluate this aspect, we only consider social support *for using* the platform and not the type of social support provided by the platforms’ main functionality. We looked for:

- Activities to stimulate or support the use of the platform
- Available communication tools
- Features making communication easier
- Features encouraging communication

## Findings

From the interviews, we found that P2 works together with care taking groups who are responsible for bringing the elderly users on to the system, essentially to deal with the hard part of making accounts. P4 likewise has special accounts for social workers who can make announcements for other users, but these both fall more under technical support rather than social support.

In terms of trying to ensure that the level of discourse stays at a certain level, Hoplr does have a board with “house rules” (see Figure 4.20) permanently

visible on the entry page, covering some basic rules of conduct and a link to the full rule book.

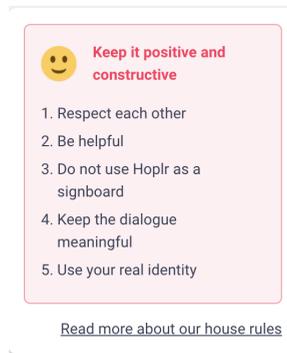


Figure 4.20: Screenshot of Hoplr’s house rules

Platforms that are in the initial growing phase, often do enjoy some additional freedom of movement in this area, as they can more easily handle requests from individual customers and more personally provide a more personalized customer service. Like, in the case of P3:

*“We have actively attempted to help users who ask for help. During last summer there was a mother looking for someone to offer a motorcycle ride to her child. We asked if we could also extend the request to other social media platforms. “Come to P3 if you have a motorcycle” We are still quite in an early phase so we can also try out these types of events.”*

However, giving more power to individual users with the hope of creating a self-regulating and perpetuating environment can also backfire, as indicated in the response given for P4 to the question on what was problematic about neighborhood admins:

*“It was before I was there, so I don’t know for sure, but I think these people used it to post too much and took up too much space – “This is my neighbourhood, bla bla blaa”– kinda taking over. What I heard it gave them too much power.”*

Similar comments have been given for the Nextdoor platform as we indicated in the Section 4.3. One thing that in particular Hoplr, Nextdoor, and ¿Tienes Sal? seem to focus on are email notifications that keep users up to date of what is on going in their areas. These seem to be concentrated on summaries of messages and announcements from the user’s neighborhood. In the case of P2 super users get more personalized content:

*“We send specific notifications to the more engaged users. More ideas, because we know that they are more active.”*

Nearly all platforms offered a very similar set of communication tools: internal chat and ability to create specific messages with images. Email notifications appear to be the main way of pushing users to create new content on the platforms. On platforms with points, the points were always associated with content creation, or posting messages.

### 4.5.7 Technical Support

This factor is about supporting a user in case of any technical problems, but also to help users to learn how to use the technology. Practically every platform that wants to be taken seriously, is expected to offer some level of technical support to their users and the evaluated platforms are not an exception in this regard. To evaluate this aspect, we looked for:

- Tools teaching the user the ropes
- Material available for users who like to know more about the platform

### Findings

All of the evaluated platforms provide some level of technical support to the users. The larger ones rely on the usual habit of having a separate “help” page with a dictionary type approach and a search function that worked moderately well on most platforms. However, as far as we could see, none of the platforms offer aid in audio or video format. It is unclear how the larger platforms handle direct help requests, but in the case of the smaller ones where the volume of help requests is still manageable, phone calls and emails were the major way of addressing requests from users. Especially, phone calls still seem to be an important medium for elderly to ask for help, as explained by the representative of P5:

*“...what we found out they do not know how to implement on their phone. They find it easier to talk on the phone and explain there. If they know they can call someone or complain, can also be email, but phone should really be one possibility for them.”*

P2 had also attempted recruiting tech ambassadors directly from the users, but the implementation was not thought out fully:

*“We also did try out an idea, but it did not work out so well. A banner, if you were willing to help out elderly with technology. It did not work out so well because the people were already in the platform.”*

P2 and P4 also work together with volunteering and other local services. In the case of P4, a verified account is provided to some volunteers who can organize events or post notifications to users of the platform through their own dashboard.

-“in Flanders there are lot of centers that depend on the municipality that are for the neighbourhood and their target is elderly people, they organize events or meal at noon and activities. Some municipalities connected these centers as social workers who can post messages.” - P4

-“Since it - (P4) is locked to neighborhoods, can social workers communicate with several of them - (elderly users) and in more detail?”

- Interviewer

-“They don’t see the municipality dashboard, but they can see the neighborhoods. If they see a problem they can try to find someone online who is not digitally active. They can create a help request for them. This is another thing we have.” - P4

-“So social workers do have a different access level?” - Interviewer

-“Yes, they don’t have a regular account, but they do have a badge that states "I am a social worker" and must have a introduction message. I’m here for this and this, so that their role is clear. They can switch between, but we try to restrain how many neighborhoods they can connect to.” - P4

P2 did not mention this level of integration, but rather that volunteer organizations help with the account creation phase and generally on making people aware of the platform.

- “they are bit out. We are working together with an NGO that works with elderly people. We have made two campaigns with them. We are aware of this gap existing (on getting elderly users to the platform). They might not succeed in the registration to the platform.”

-“Ok, so the NGO is actively helping them (elderly users) to come on to the platform and teaching them how to use it?”

-“In general. They are a NGO for helping elderly, who are alone and helping to dignify their age. We have a lot of people on the platform willing to help these (elderly users). But they are not on the platform. They (NGO) are trying to let them know that this platform exists and they can meet people. Like going for a walk is a major activity in our platform. Many elderly people don’t know about the platform.”

Commu offers a more novel form of communicating directly with the platform operators via the “Commu insiders chat group”, which at first operated on a Whatsapp group but recently switched to Telegram. A screenshot of the announcement is given in Figure 4.21. One of the researchers was a member of the group for three months, in which time the chat was used by Commu to ask opinions on minor UI tweaks (button color changes) and otherwise to communicate events and news related to the platform.

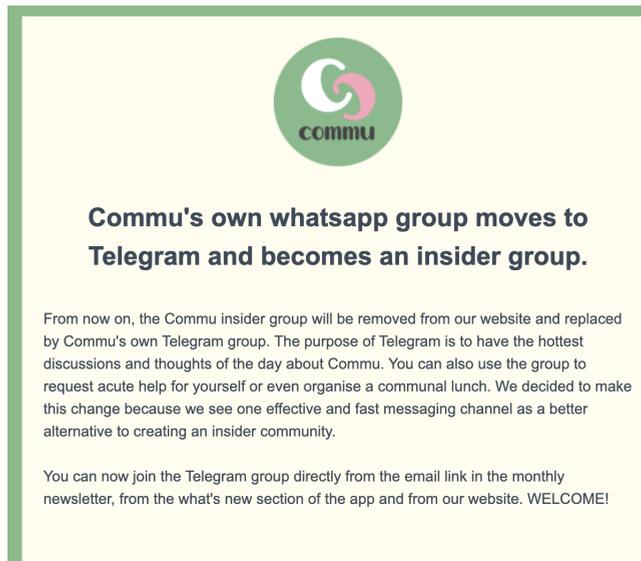


Figure 4.21: Commu insider announcement

#### 4.5.8 Confidence

As the name of this factor suggests, confidence is about how confident the user is about being able to use the technology. This is largely affected by how easy or intimidating the technology appears to be and how the user estimates the consequences of making mistakes. In principle, in the type of platforms we consider, the overall fear for making mistakes should be relatively low, as the major mistake a user can make is simply sending a notification or message that might not have been up to their standards. However, it is possible that a user perceives this as a serious danger. Note that in our case, we consider confidence from two perspectives: as confidence in own abilities, but also as confidence to contact other users in a safe way. We do so because contacting, or willingness to broadcast own needs to other users is a vital point of success for these type of platforms.

To evaluate the confidence aspect, we checked the platforms for:

- Do the platforms encourage making contacts?
- Non-intimidating design or language
- No “destructive buttons”, such that a user cannot (at least easily) cause irrevocable damage. For example, deleting the user’s own account should be possible, but not in a way that the user can easily do it by accident or without being able to cancel it.

## Findings

We did not notice any overly hostile or potentially intimidating design in the platforms. Also, none of the platforms seemed to have “destructive buttons”, but lack of confirmation messages before posting a request could be perceived as a minor version of this.

Generally most users appear to prefer volunteering to help on these platforms rather than asking for help, which is not very surprising in itself. This was also noted in most interviews:

*“That is a basic problem. In Dutch we call it “asking timidity” on asking for help. It is real and it is also for young people . . . That is actually why we have buttons for offering help as and not ask, you can ask, but it is not default. Because of this issue, the difficulty of asking.” - P4*

*“More people offering than asking. I think it is because people feel vulnerable for asking help. So it is easier to offer help than to ask for it.” - P2*

*“Yes at the moment. Its about 70/30 atm, with 30 percent asking for help. We are trying to use marketing to turn it...”- P3*

*“I think overall it (help) is offered more than requested. Which is quite interesting. The one’s who need help can’t find a way to take a hold on these types of (Trails off).” - P1*

These statements are also backed up by our findings in the surveys given in Section 4.4.5 and Section 4.4.9. It is also important to note that the majority of the participants chose not to help or offer help. Numerous reasons for this are possible: on the more focused platforms, emails are also sent to participants who had originally created an account out of curiosity. This was especially evident in the case of P1. P4 on the other turn provides a broader range of services, thus people willing to ask or offer help are just a “sub group”. However, it is possible that there are more people on the platform that could be successfully activated, mainly due to increase in especially volunteers due to COVID-19. As mentioned by P5:

*“During COVID we saw a surge of helpers who wanted to feel useful, but now that normal life is back, we will have people leaving. That is one of the questions on how to maintain this type of network...”*

A similar situation was noted in some of the interviews:

*“Did you see a spike in especially elderly users during the COVID-19 outbreak?” - Interviewer*

*“Not specifically elderly, as we don’t know the age. But yes there was a spike. As people could not meet it was difficult to focus the*

*platform on what to do in the neighborhood. We also sent out papers that people could put in buildings. A lot of people were offering help to older people to go to shopping.” - P2*

*“When the corona situation happened, it was very active for a short while. Everyone wanted to offer help.” - P1*

According to the interviews, the level of activity increased for a period, but then has slowly petered out as time passed. One possible explanation could be that it was difficult to keep the new helpers active due to the lower number of people asking for help, as well as the lack of other worthwhile activities on the platform.

#### 4.5.9 Affordability & Accessibility

*Affordability* is about the perception of the potential cost in relation to potential benefits, while *accessibility* is about the knowledge of the existence and availability in the market. Affordability of the technology itself is satisfied for the evaluated platforms as all were free to use. This excludes of course the fact that users might need to acquire a device and an Internet connection first, but that is outside our current focus.

It is of course also possible that users have to pay for receiving help, as in some survey results, participants stated that the helper had asked for a compensation. However, in general the platforms reviewed were not intended for profit. Therefore, accessibility in itself might not be much of an issue if the two prerequisites of device and Internet connection are covered. However, users will also need to be made aware of the existence of the platform. Especially P2 and P4 seem to be proactive in this perspective by mailing leaflets about their services and organizing info sessions, or having help organizations making the elderly aware of their existence, as showed in Section 4.5.4, focusing on value. The Finnish Nappi Naapuri probably gained some of its traction and especially credibility by being mentioned in the national media<sup>23</sup>, but not every platform can count on this type of publicity.

We can conclude that affordability, in general, is not an important adoption factor for these types of platforms, as long as the user has a computer or smartphone with Internet. In this way, we are of course ignoring cases where users do not have these at hand, but that would also require a whole other level of focus.

Accessibility as defined by Lee et al. is more of a marketing issue and outside our scope. However, some techniques have already been mentioned due to them being tied with other factors — value and technical support. For example, the use of volunteers by P2 and P4. We also show some relevant interview fragments on some techniques utilized by these platforms for this, as

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<sup>23</sup><https://areena.yle.fi/1-3717001>

they might be of interest to some readers. However, we will not look into the factor further as it is outside the scope of research.

P4 presented the most comprehensive and structured method for recruiting new users. Essentially, by avoiding uncontrolled access where the platform is accessible to everyone everywhere, they open new areas progressively and have a planned approach to get users to join:

*“When we start a neighbourhood. We put out physical letters in the mailboxes. And we always, well not always actually, with a municipality and they are also in the letter. We also do info session in person and then we have banners and these types of things. These are the steps when we open a neighbourhood with a municipality. We organize the letter and info session together.”*

P1 seems to have mainly spread due to successful “word of mouth” via social media; according to P1’s own survey 70% of 1246 respondents had heard about P1 through social media.

#### 4.5.10 Trust & Security

Lee et al. (Lee, 2015) present “service trust” as a potential additional factor, which they defined as:

*“The degree to which a user can depend and rely on a technology, as well the services and organizations related to its operations.”*

We have extended this factor to also include the trust in other users of the technology. We use the following definition for trust: *trust is the belief of someone in the reliability, truth, or ability of someone or something.* We coupled security with this as well but like for trust we focuses more on secure interaction than on the traditional data protection form of security. Our definitions for security is: *the user is given tools to make user interactions more safe.*

If people, and especially elderly, do not trust an application or service, they will not use it. Some studies consider trust building as the key technology adoption factor (Meng et al., 2019). It was necessary to consider trust as an independent factor because it is something that is required from users in a platform that connects them with strangers, online and in person. Trust in these types of platforms is essentially directed at 1) other users and 2) the platform.

To highlight the importance of trust in the context of SE platforms, we must briefly revisit the term social capital. Social capital has various definitions (Claridge, 2004) depending on the context. The definition we follow is “social capital is an integral part of positive connections between people”, used by Sherchan et al. (2013), who also highlighted that trust (or social trust as they call it) is an integral part, or rather is built on top of social capital.

While it is possible to deal with some user concerns about security and privacy by technological means and communicating these measures to them,

several challenges remain. Convincing users is not necessarily easy and more importantly evocation of trust amongst numerous users for offering and requesting help is much harder to achieve with technology alone, and most likely will require manual interventions.

In the case of the platforms we reviewed, we considered trust from two points of view:

- Trust in the technology (i.e., the platform)
- Trust in the people offering help or requesting help

## Findings

From looking at the platforms, there was no direct way for us to evaluate the level of security provided from a technical point of view to protect the information collected or to avoid misuse of the platform. However, we noticed that some platforms invested efforts in trust building by means of external initiatives, such as the earlier mentioned involvement of social workers and info sessions. In the case of P5, the staff, at time, meet the elderly in person, and it might take a while until they start to trust them:

*They learn to know us after a while; they know that they can come and slowly slowly be secure. We saw that after six months or a year I know you and am comfortable enough to ask for you myself. COVID time also accelerated that. Sometimes our colleague might have asked “don’t you need help with groceries?” and they go “oh yeah maybe I could need some help”.*

Similarly, when asked during the interviews, trust is generally considered to be covered by simple moderation methods. In case of users meeting each other, the platforms largely lean on instructions given and general safety guidelines. In terms of features none of the platforms at the time of our evaluation had implemented anything that would make in-person meetings more secure. In the case of P2:

*-“...are there guidelines or other steps taken to make the users trust the other users or neighborhood more?”- Interviewer*

*-“ We...don’t. For guidelines, during corona we did some guidelines, for shopping how to contact. But really, no. What we hope is to offer a platform where the ice is broken. What happens after is very difficult to control. We give rules on what you can do on the platform, but afterwards, it is out of our control. So far we have not had any major issues.”- P2*

It of course also good to mention that outside some occasional unpleasant meetings, none of the platforms had encountered (or were aware of) major issues with meetings going wrong. An example of negative behavior, as remembered by the representative of P1:

*“We have instructions, such as “meet outside”, but in my opinion we need more of it (security) in there. For us it was very important that the platform is very open, meaning that despite not having any friends, you can still join the neighborhood. We have had some problems like one particular case, where a male users sent private messages to number of women and wanted to participate in every event. We had one user requesting that she wants out from the platform, as turned out that this male individual had some mental problems. He was helping with a lamp but didn’t really know how to do it.”*

Also, the results of the surveys on meeting other users in Section 4.4.13, show no serious misuses. Most negative encounters appear to be that of “ghosting”, a popular term brought about by Tinder users, where one party suddenly simply ceases to communicate, or respond. Other cases were: some sporadic cases of miscommunication, not contacting, or no opening the door for the helper despite having agreed beforehand, to mention the most common ones.

The evaluated platforms clearly fell into two separate categories for distributing communications among users: 1) Completely open map with notifications visible to everyone and the main filter being the distance from those notifications (Commu, Facebook Community, Help Your Neighbour, Nachbarshaft, and Nappi Naapuri); and 2) Closed neighborhood forums where asking and offering help were just small features among many other features (Nextdoor, ¿Tienes Sal?, and Hoplr). As the later category utilizes additional verification steps and limit users to more controlled groups, they can bring about some additional sense of security, which can translate to trust. The borders between neighborhoods were managed with different levels of strictness. Hoplr appear to use the structurally most strict method of governing neighborhoods. As far as we know, users can only see content from other users in the same neighborhoods. No direct tools are provided to, for example, make an announcement that can be seen in neighborhoods adjacent to user’s own area. ¿Tienes Sal? is slightly less strict; users are still very much tied to their own neighborhood, but they can choose to have their messages shown to adjacent area, as explained by the platform itself (see Figure 4.22).

¿Tienes Sal? was the only platform that we noticed to proactively provide additional meta-data on the created messages. An example of such info is shown in Figure 4.23. This form of communication allows users to easily ensure to whom their notification is visible, which can be seen as a form of added security. Additionally, the added information on activity levels is useful to all parties.

#### 4.5.11 Dormant Users

Dormant users or inactive users are a phenomenon on any platform that requires a registration process. There can be numerous reasons for users becom-

## Public Posts. What is that?

For example, to reach people outside the neighborhood, the author can mark a post as "Public Post". This is then also visible on the neighborhood page when you are not logged in. Public posts only show the content of the post and the name of the neighborhood the post came from. Names, profile pictures and replies from other neighbors remain protected in the neighborhood and cannot be seen by outsiders. This is how we protect you and your neighborly privacy.

Conclude

Figure 4.22: Screenshot of message explaining public posts. Taken from Nebenan and translated with Google translate.

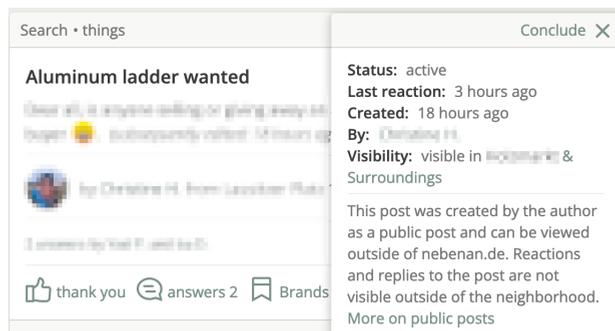


Figure 4.23: Screenshot of how ¿Tienes Sal? shows additional message meta-data. Taken from Nebenan and translated with Google translate.

ing inactive, such as: losing interest in the platform, accessing it only for a single task, or simply forgetting the account. However, there is also another type of dormant user, the type that still logs into a platform to see current content, but rarely interacts with anyone.

Help your Neighbour is a good example of a platform that does not hide the fact that its users have become dormant. When exploring the main discussion forums, last notification was more than a year old and no activity was detected during the evaluation. In other platforms, dormancy was hidden from direct observation.

Dormant users is not necessarily a factor applicable to the elderly user, but rather to the net of people surrounding them. This happens when this group is mostly inactive or unresponsive. Engagement is both easy and difficult to gauge. We explored this subject in Chapter 3. In commercial platforms it is often looked at from a purely statistical point of view. When asked for in the interviews, used metrics varied. For instance, in the case of P2:

*“We consider an active user the one who has been verified. So we don’t separate with engagement, so how engaged they are, I don’t*

*know exactly.”*

We also investigated user activity in our survey (see Section 4.4.3). In the case of P1 and P3 not making requests can be a disturbing pattern as this is currently the main focus of these platforms. For P4 and other similar platforms, requests are just one feature of many others. P3 had this to say about dormant users:

*“Activating is a big question. Our big challenge is to make the application from a passive to an active application. At the moment our approach is through messaging. Probably one big hook is through new content, or email notifications.”*

Here, passive means that as long as users are inactive the platform also remains inactive, where as an active platform has new content for the users irrelevant of user activity. New content can be different things. On Facebook for instance, these are posts from news or entertainment sources.

## 4.6 Other Studies

We also looked at other studies on the found platforms. We could only find studies focusing on Hoplr and Nappi Naapuri. It is likely that other platforms, like *iTienes Sal?* also have published studies, but likely only in their native languages. The two theses focusing on Nappi Naapuri were only available in Finnish. We will briefly cover some of their findings in this sub section.

### 4.6.1 Study on Hoplr

Waeterloos et al. (2021) conducted a very recent user study on Hoplr, looking at volunteerism of its users during COVID-19 pandemic. The study highlights the importance of platforms such as Hoplr in enabling “civic participation”. The authors also looked at civic participation from an analytical point of view and indicators of local social integration by means of a user study within Hoplr. Majority of the study is outside our scope, but one particularly finding was relevant; the importance of communities within the Hoplr: “. . . *online sense of community significantly predicted participation through an ONN*” (Online Neighborhood Network). The survey was participated by 8,585 individuals around Flanders.

### 4.6.2 Studies on Nappi Naapuri

The two relevant publications found were both theses published at applied universities in Finland, in Finnish (Rissanen, 2015, Montonen, 2017). They were published between 2015 and 2017 when the platform was still growing and under active development.

Both studies conducted their evaluations by means of interviews. Rissanen (2015) (study 1) interviewed representatives from a volunteer organization and Montonen (2017) (study 2) interviewed people that represented volunteers and users needing help. The very small size of both studies is a limiting factor in both cases.

List of the findings and suggestions from both studies:

1. (Study 1) Nappi Naapuri is not currently suited for organized volunteering due to the lack of centralized coordination or support structure.
2. (Study 1) The platform was found to be more trustworthy in dense population areas. Showing accurate location on the countryside was deemed “too accurate”.
3. (Study 1) Elderly users who are less familiar with use of technologies might require hands-on assistance.
4. (Study 1) Volunteer organizations can be an effective method for bringing in more elderly users.
5. (Study 2) Spontaneity enabled by the platform can be both a crux and boon, as a helper can’t guarantee 100% willingness to help at all times or being reachable.
6. (Study 2) A reward system might be beneficial for more long-term engagement.

## 4.7 Discussion

Looking at the results of the surveys in terms of help requests, the majority of the respondents has actually not used these platforms for this. Also, when looking at help requests by age groups, no observable patterns emerged. As reasons for not offering or asking for help, the majority simply selected that they needed no help or were too busy. A suitably large group of the respondents however did seem to be open for asking for help, by stating that if they did need help they would ask for it on the platform. This could also indicate that users see the help request as a last resort, or that one should only ask help for more “serious” cases given the fact that in case of P4, the third most popular option for not asking for help was “I don’t want to bother others”. This would hint that the users’ perceived barrier for when to make a help request is somewhat high.

P4’s approach of providing “pool of helpers” seems to provide an additional avenue for users to ask for help and connect within the platform, but users in general appeared to favor directly asking for helps, with only 6.50% out of 371 participants having utilized the “Neighborhood care” service. As we did not do more followup questions on this topic we can only speculate about the low usage rate. Some potential reasons could be 1) The pool itself might bring the barrier to ask for help down, but because the user has to send a direct chat message to the potential helper, this can in itself be a barrier; 2) Neighborhood helpers are asked to list activities they are willing to help

with, which is extremely useful, but the current list is very long and detailed (over 60 options), which can make a user think that they are only able or willing to help with those specific activities.

As we have highlighted that the reasons for helping and offering to help, as well as what brings versus what keeps users on these platforms, are a very complex set of factors. What we can conclude is that currently a rather large number of participants is neither asking for help nor offering help. It is possible that the users of P1 and P3 created accounts out of curiosity, or perhaps out of actual need for these services but simply never took the plunge of actual using the service. In P4's case, offering and asking for help is simply a feature among many other and very likely not the main reason to join the platform for the majority of the users.

## 4.8 Conclusions

In this chapter, we have discussed the social engagement platforms that we identified and the evaluation of a number of them. We evaluated these platforms by several means. We did interviews with representatives and have conducted surveys with the user bases of three platforms. We also did a hands-on evaluation of platforms. Lee (2015) also mentioned indications for additional factors, such as, system reliability; long-term reliability of a technology, interoperability; seamless working of technology with other technologies, lifestyle fit; how technology can fit user's life pattern and conceptual fit; how technology fits users mental model. Though, also important factors, they do go outside our current focus as these require a more in depth look at the users themselves or are aspects of the technology that need to be considered in the broader context of the environment in which the technology is used by the user.

**Limitations:** Two significant limitations exists in our evaluation. 1) The majority of Lee's factors requires a long term evaluation, monitoring user behavior and conducting interviews periodically. We have attempted to overcome this partly with interviews as the representatives are able to give an account on how things have evolved. 2) One part that we did not evaluate in detail were the weekly email notifications, news and reports sent out by the platforms. A number of factors, especially social support and emotion, could, at least partly, be affected with relevant mails.

In addition, the evaluated platforms are evolving rapidly. P4 made changes to their UI just days before our survey, requiring last minute modifications. P3 has also been actively developing their platform. If P1 decided to re-activate their efforts, numerous changes might also take place. Hence, it is important to realise that our aim is more in terms of which of the current features appear to be good design choices, what might be something to further investigate, rather than a critique of their current status.

In the next chapter, Chapter 5, based on our findings from the evaluations,

as well as the findings from Chapter 2 and Chapter 3, we will present our recommendations on how these platforms could be improved to better include elderly users, but also to stimulate long-term engagement.

Lastly, we revisit our research questions presented in Chapter 1 and investigated in this chapter; these are shown in Table 4.7.

Table 4.7: Revisit of research questions RQ3, RQ3.1 and RQ3.2 and our answers

<b>(RQ3) What is the current state of existing social engagement platforms?</b>
The current state of platforms is rather varied. The well funded and larger platforms, such as Nextdoor, ¿Tienes Sal? and Hoplr, appear to be on stable ground, but in general, the field appears unstable in the sense that a number of SE platforms have either become mostly inactive or even completely disappeared. Some platforms appeared and remained with the focus on asking and offering help. Larger platforms appear to have added help request option during COVID-19 pandemic. These platforms are essentially closed Facebook-like social media platforms with the majority having the same core features and functionalities.
<b>(RQ3.1) How well are existing social engagement platforms tailored towards elderly users?</b>
Despite none of the interviewed SE platforms set out explicitly towards elderly users, they have become popular especially with users at the cusp of retirement. Especially P2 and P4 have also targeted campaigns especially aimed at elderly users, in order to make the process of joining easier.
<b>(RQ3.2) Which long-term engagement techniques are used by existing SE platforms?</b>
In terms of long-term engagement techniques P1 appeared to struggle with this. P3 is still a new service, but no techniques in this context were used. P4 has managed to bring together users that do keep in touch with each other, but do not necessarily use the platform actively for this. Simple gamification techniques — points & badges — are among the more common engagement techniques used. Otherwise most platforms appear to rely largely on emails as a source of re-activation. There is a clear indication that COVID-19 caused a surge of new users, mainly people looking to volunteer as helpers. However, based on the interview results, many of these volunteers however did not stay active for a long period on these platforms

## Chapter 5

# Design Recommendations for Improving Social Engagement Platforms for Elderly

### 5.1 Introduction

In this chapter, we provide recommendations based on our findings. Some recommendations are derived from the survey results, others from the interviews and from seeing how the current systems behave. The aim of this section is not to criticize the evaluated platforms but rather a) to gather and highlight features that are not apparent necessarily on all platforms while being considered as important or useful and b) offer recommendations to improve identified weaknesses. This chapter aims to answer research question RQ4 ("What aspects could be improved in the evaluated SE platforms and which of these can we provide to developers as recommendations to take into consideration when developing SE platforms focusing on elderly users?"). A number of the given recommendations have been evaluated. This is described in Chapter 6.

### 5.2 Methodology

The recommendations are given a number (e.g., (R1)), a name, and to which adoption factor the recommendation relates to. The descriptions are structured in the following manner: 1) identified problem or area where there is "room for improvement" 2) an analysis of possible solutions, or otherwise supporting our claims, based on existing literature or existing commercial implementations

3) our recommendation presented as a general guideline. Note that the analysis based on literature or existing applications is not necessarily given for each recommendation, as there was not always such material available.

## 5.3 Recommendations

In this section we introduce our design recommendations. We also indicate to which Lee's factor our recommendation fits.

### 5.3.1 (R1) Points with purpose (Emotion)

Gamification features, such as points, do carry potential for a higher level of engagement. Points were utilized in a number of platforms evaluated, but overall do appear as a bit of an afterthought. Most commonly points are given for posting request or messages. Efficiency for engagement of simply collecting points is questionable based on our findings presented in Section 3.3.1. However, the usage of points in these platforms provides them with a simple means to have a simple representation of users' level of engagement.

In terms of giving value to points, P4 and P5 do attempt this, as P4 specifically states "The P2 score indicates a user's 'neighbourliness' and willingness to help", but at least, currently, there is no scale attached to their scores, e.g., is "70" a high score?, nor a way of knowing how valuable individual actions are, in terms of points. P5 simply allows users to see an user's previous activity (as shown in Figure 4.13).

Of course, in these types of platforms, where collective good is a key aspect, some gamification elements might result in negative reactions, e.g., leaderboards can be effective but should be utilized with care as we briefly discussed in Chapter 3. Lastly, though gamification might not be simply for the younger users, there is evidence that it can also elicit positive outcomes in elderly users (Martinho et al., 2020), such as: improved well being, positive engagement, social interaction, improved conditions. Though care is needed in not making the gamification too difficult to learn.

### Analysis of Gamification of Games

Games are a massive consumer market, with the gaming market being a multi billion dollar business (Wijman, 2019). Gamification for games, especially in multiplayer games has been a stable factor in this industry for a while now. By this gamification, we mean the gamified platforms that are used to launch the games, or otherwise detached from the game and not directly part of the games themselves. As the core design ideas of these platforms are generally to keep players engaged with the product and ideally spend money while doing so. Looking at some of the ways points have been utilized in these platforms might give some clues on what approaches, outside of leaderboards, might

be effective. We will also look at the Steam platform<sup>1</sup> despite not being a game, but a digital market front for where to buy PC games from. Steam has become famous for testing out varied forms of gamification techniques over the years (Wilde, 2019).

**League of Legends (LoL)** is a rather successful free to play game that has been active since 2009 and has a reported revenue of over 1 billion in 2020 (Field Level Media, 2021). The LoL platform relies on users using money within the platform for various enchantments for their heroes, which is done by buying “Riot Points”, essentially the currency of LoL. Interestingly, in term of revenue, according to at least one study (Swrve, 2014), only a very small group of players actively spend their money. There are also resources that players can gather by simply playing the game a certain number of times, while achieving certain goals, such as: leveling up, winning a match, participating events. The platform has numerous different forms of points for the players to collect: blue and orange essence, experience points for leveling up champions (playable characters), star shards, the champions (playable characters) themselves are also earned, mastery score and milestones.

**Fortnite** is yet another highly successful free to play form game from Epic Games. It is generally a game that can be played for free, but offers in-game purchases to players It was reported to brought in several billions of dollars in profit in 2018 and 2019 (Clark, 2021) and has reportedly over 300 million monthly active players (Mansoor, 2022) in 2021. Similarly to LoL, Fortnite also has an internal money system, called V-bucks. However, Fornite appears to have much fewer forms of collectible points, with the main one being simply XP to level up the players’ characters. Leveling up in turn allows the player to access a battle pass that essentially gives players access to different outfits, loading screens, etc.

**Star Wars: Battlefront2** is probably better known for their “lootbox fiasco” (Gilbert, 2018) where players could acquire an in-game crate of random rewards in exchange to real money. This type of reward system was also recently marked as gambling in Belgium, largely due to the outcry associated with Battlefront 2 (Gartenberg, 2018). The types of reward systems the game offers for players are very much tied to completing in-game milestones that reward players with XP as well as with the infamous lootboxes. The boxes can contain different cosmetic upgrades, new weapons and collectible cards that could improve player’s characters.

**Steam** is a digital market front owned by Valve<sup>2</sup>. As Valve is a privately owned company, the revenue income of Steam and its digital community market are not public knowledge, but some estimations have been done in the past with estimates of Valve’s annual revenue being over a billion U.S dollars over 10 years ago Chiang (2011). Steam has become rather famous for the numerous experimental gamification attempts especially during their famous

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<sup>1</sup><https://store.steampowered.com/>

<sup>2</sup><https://www.valvesoftware.com/en>

sales events (PC Gamer, 2022, Wilde, 2019). A somewhat successful form of gamification that the Steam store has come up with are the collectible cards given for playing a game<sup>3</sup>. These have created a small ecosystem of their own within the service (Hatfield, 2013). The cards do not have any other value outside being converted to badges once a whole set has been collected. Steam also introduced a “Point shop”<sup>4</sup>, which allows users to collect points by various means, though mainly by buying games. The points can be used to purchase items from the store. These items can be wallpapers, emojis and other similar content.

If a loose trend can be surmised from these examples, it is that the modern gamification appears to be a combination of periodical new content creation (Fortnite and LoL both have seasons that bring with them new content), as well as utilizing “hooking” techniques (Eyal, 2014) within and outside the game platforms. Playing a game creates rewards that users can manipulate outside the game that often make the game play more interesting in some way, or in the case of Battlefield and other lootbox systems where the randomness of rewards is stimulating in itself.

### Recommendation

By no means do we advocate that the level of implementation for gamification used for games and related systems should be applied to SE platforms. We rather suggest to look at the broader picture of how they use gamification to connect people to their services, i.e., their points have value. These platforms bring in users for various reasons, similar as the SE platforms. They reward continuous interaction with points or direct rewards. Some users might not care about these, but even if only a quarter of the user base sees this as added value, it can become a powerful new avenue of engaged users.

**Our recommendation is simply to attach (more) value to points that could stimulate people to collect the points.**

#### 5.3.2 (R2) Show activity (Emotion, Dormant Users)

An active community can stimulate users to be active as well. Currently, none of the platforms communicate about the status of help requests to users, nor utilize any clear methods of internal tracking of the status of help requests; whether they have been completed or are still active. Users of P4 have a general level of understanding on how many of their local neighbors are in the platform, but that is the extent of it. P1 clears some requests automatically, but it is unclear if this process is applied to all requests. Most platforms do showcase activity on individual message level, but currently it is not easy for users to grasp the current activity of their own neighborhood. In the case of platforms where a map is an integral part of the UI — P1 and P3 — this

<sup>3</sup><https://steamcommunity.com/tradingcards/>

<sup>4</sup><https://store.steampowered.com/points/shop/>

is slightly different as the notifications are clearly visible on the map. But even this has its own challenges: area with few users, but relatively high level of activity might appear more quiet than in reality, and in areas with more notifications it might be difficult to ascertain how active the user base is on weekly or monthly terms. Also, P1 suffers from the map easily cluttering up, lowering its usefulness on smaller screens. Hence, there is a risk that some users make wrong assumptions on the current activity in their area or neighborhood.

### Recommendation

**Our recommendation is to provide a easy to understand overview of activity in the users' neighborhood.** Depending on how this is done, it can also be utilized in more meaningful manner. Simple statistics showing a collection of past actions by users can be enough, but if this is done graphically and playful way, such as by a simplified graphical representation of the nearby area that chances overtime based on user activity, such an animated evolution of the users' area could be a reason for users to check in, even when they might not have any direct need at that moment. This in turn would help the user to stay connected with the platform.

P4 seems to be an interesting case where this has been turned into a recruiting motivation. P4 shows its users the overall percentage of users joined from the neighborhood and hands out numerous suggestions on how the user can try to get more people involved.

### 5.3.3 (R3) Guiding (Independence)

Appropriate guiding of users in how to perform tasks is essential for independence, especially for elderly. The evaluated platforms attempt to instruct their users in how to succeed in tasks in different manners. For simpler, more streamlined, tasks this is rather easy as they can simply label the required fields the user needs to fill in, or select the correct radio button. For less straightforward features, this however might not be enough. Hence, P4 does offer explanation on the different message types and P2 explains what "public post" means. However, these instructive snippets were somewhat intermittent when comparing the platforms. P4, for instance provides suggestions for message content, whereas P2 does not. Both offer more detailed instructions on their respective help pages.

It is likely safe to assume that the amount of information provided by both platforms is enough for most users. However, for instance in the case of P2 even for a help request, it is not instantaneously clear which message type the user needs to select, as this is under the "seek" message type, after which the "help & service" needs to be selected.

## Analysis of solutions

We have covered guidance in Chapter 3. We presented some of its manifestations in the context of gamification, persuasive design, and nudging (Goals (Table 3.1), Tunneling (Section 3.1.4), and Facilitate (Table 3.7) respectively. Some of these techniques only hold small aspects of guiding, such as goals, whereas out of the three mentioned techniques Tunneling is more closely related to guiding and Facilitate can be seen as the more directly controlling the narrative, such as button sizes and placement. Goals given to users in the early stages of using a technology can be considered as a form of guiding, such as “send a message” or “upload my profile picture”. Use of guiding were shown to have positive outcomes often when combined with other persuasive design elements (shown in Section 3.3.2).

## Recommendation

An unobtrusive guidance that clearly indicates fields that need to be filled is already mostly used by all the platforms. **Our recommendation is to cover all aspects of a task, such as also the uploading an image or file, and to provide a direct access to more information.** Currently, to access the help page, it usually needs to be done separately. Instead, providing a sniped of the help page where it is relevant, might be much more effective and less likely to cause the user to get lost.

### 5.3.4 (R4) Onboarding (Independence)

Onboarding is a well known term within the human resources sector, where it is essentially seen as “bringing new staff up to speed”. Within the domain of UI design for digital technology, onboarding can be seen as a combination of guiding and other design elements brought together (Cox, 2021). There are some indications on the importance of well done onboarding to ensuring that users stick with a platform (Cascaes Cardoso, 2017) and on improving engagement (Strahm et al., 2018). The generational gap is also something to consider as more technically savvy users might be more divided on the necessity for onboarding (Froehlich et al., 2021), but it can be effective in alleviating concerns that elderly users might have (Volkman et al., 2020).

All evaluated platforms approached the account creation in a different way. Commu, for instance, does offer a step of instructions upon making the account, whereas Nappi Naapuri has a very bare bones experience and simply asks the user to give an email and password without any added information. Hoplr the registration is divided to several steps, with information given out mostly on the location verification part. Hoplr also informs how many users area already registered at the selected neighborhood.

Out of the evaluated platforms, only Commu and Help Your Neighbor appear to provide a more hand-on onboarding session. Commu has the user

create a dummy help request at the end of account creation process. Help Your Neighbor highlights and explains all the buttons and most of the icons of each view when first accessing it, but we did not find a way to launch this again afterwards. A grain of salt is to be added at this point, as our results could also be due to ad-block services blocking some extra features, and access to ¿Tienes Sal? and Nextdoor were done via third parties. However, no clear way of activating any onboard-like feature was discovered.

### Recommendation

**Our recommendation is to have a step by step onboarding approach offered to users, which does have the potential of being much more effective form of teaching and supporting an elderly user over a large help page.** This is already very common practice on many web services. This approach is very much intended for a specific target audience, hence the ability to turn it on/off with relative ease is also strongly recommended. Lastly, there should be an easy way to start the onboarding at will, as sometimes, web services run the onboarding segment only once when first accessing a site, but then permanently hide it.

### 5.3.5 (R5) Usability guidelines (Usability)

The importance of following usability guidelines when developing a user interface is well known. No major usability guideline violations were detected when evaluating the platforms, but some minor points of improvement were detected here and there, such as a lack of confirmation or a summary before posting messages. Of course, the way a platform is built, in terms of user interface layout and navigation steps, can have an influence of the applicability of some usability guidelines.

### Analysis and Recommendations

Analysis of usability guidelines is provided in more extent in Chapter 2.1, where we present an up to date list of guidelines.

When interviewing the representatives, for most parts, no guidelines appeared to be directly used to ensure usability for elderly users, despite this, no major issues were detected. However, **usability guidelines can provide an important additional means for ensuring that all angles of usability are covered**, as we indicated in Section 4.5.3 focusing on our usability findings.

### 5.3.6 (R6) Handling user feedback (Usability, Trust & Security)

Based on the interviews, feedback handling does appear to be generally functioning well on most of the evaluated platforms. For most parts, this appears to be done via direct emails and phone. We can safely assume that some level of communication in terms of enhancing the service or informing about well known bugs is done by emailing users' en mass. However, to our knowledge, none of the platforms had an inbuilt news-page that covers bug fixes, or what is currently being worked on. Again, reasons as to why, is easy enough to understand. Maintaining a page on upcoming updates and ensuring the content is clearly written requires quite some resources. Additionally, giving individual feedback to users can become difficult when the user base grows. For instance, Commu's insider group can become difficult to control and monitor once the platform grows substantially, also ensuring that feedback is not only received from a handful of more engaged members is important.

#### Analysis

Feedback is regularly mentioned as an important element for usability, but also in gamification, persuasion, and nudging (see Chapter 3), and in many facets of learning (Orrell, 2006, Biggs and Tang, 2011). However, despite the fact that the importance of feedback is well accepted, its quality can vary (Orrell, 2006). The quality of feedback may be affected by a persons' own communication skills and the effectiveness may be affected by the receiver's personality. Therefore, giving good feedback can be challenging in a digital environment, as it is composed of several interconnected elements (Steur and Seiter, 2021). Some studies have however shown that, for example, certain feedback mechanics can have a positive influence on building trust towards a platform (Resnick and Zeckhauser, 2002, Bolton et al., 2004).

#### Recommendation

It is evident that users are willing to contact the platform about some of their issues. This is clearly a positive thing, since a user feels strongly enough about a service to want it become better.

**Our recommendation is to 1) provide easy means of giving feedback, 2) keeping track of it and 3) showing this to users.** One such example can be seen from the very successful Star Citizens project that has an open access roadmap<sup>5</sup>. This can also easily become resource heavy from the perspective of the platform, meaning that in the beginning step 3) can simply be acknowledging the received feedback to the person who sent it. Showcasing that the platform is open for feedback and actively working on it can not

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<sup>5</sup><https://robertsspaceindustries.com/roadmap/progress-tracker/teams>

only help improve usability in the right direction, but also increase users' trust towards it.

### 5.3.7 (R7) Audio & video messages (Usability)

Typing a message can become difficult for elderly. Typing text, especially on smartphone devices is tedious and error prone even for younger users. For elderly users, larger devices, such as tablets, laptops and desktop computers might mitigate this, but elderly can also develop writing problems. An alternative could be to allow them to record a message (audio or video). None of the evaluated platforms offer this functionality. The same applies to reading messages, which could be useful to more visually impaired users.

#### Analysis

The use of multimedia has been recommended in several usability guidelines (Nurgalieva et al., 2019, Zaphiris et al., 2007). However, only audio messaging might also be enough: a study supported elderly users' preference for audio messages over video, due to the latter requiring additional motor skills (pointing to the camera) as well as they did not like to see themselves on the screen, however they did enjoy receiving video messages from their family members (Judges et al., 2017).

Speech-to-text is a fascinating technology that is already widely used in certain domains, e.g., in the medical world to dictate prescriptions, and to automate subtitle creation for platforms like YouTube. It is, however, still also very prone to errors, especially when we move outside the core languages that most of the speech-to-text technologies focus on, not to mention dialects (Fukuda et al., 2019). Speech-to-text also require the user to know additional command words to utilize special symbols, such as question marks and full stops correctly. Hence despite it clearly having its uses, it is still somewhat far from being user-friendly and hassle free utility for more demanding user groups. Lastly, training data is generally done with speech of average adults, whereas characteristics of elderly speech degrade speech recognition (Winkler et al., 2003, Vipperla et al., 2008).

But on the flip side, text-to-speech can be very useful in reading typed messages. It has for example shown to be an effective tool to help with learning difficulties (Oumaima and Abdelouafi, 2018). Similarly, voice activated assistants offer services to read, for example, news out loud<sup>6</sup>.

#### Recommendation

**Our recommendation is to provide additional forms of content creation to users, namely, audio and video messages.** Audio and video

<sup>6</sup><https://support.google.com/news/publisher-center/answer/9822868?hl=en>  
<https://support.apple.com/guide/iphone/spoken-content-iph96b214f0/ios>

messages could be a potential way to make the request creation process easier for some of the elderly users. Furthermore, adding text-to-speech functionality can be very useful for reading out typed messages.

### 5.3.8 (R8) Customization (Usability, Experience)

Customization is an important tool in many digital applications, where the power of choosing how elements might look or behave is given to the user. In terms of positive outcomes, Customization was tied with motivation (See Section 3.3.2). This recommendation is mostly focused at the more feature rich platforms, like P2, P4, and Nextdoor that offer a myriad of options for their users. It is unclear how popular some of the added features are on these platforms, but at least in the case of P4 it appears that at least older users might not use them much. Nonetheless, access to these features does clutter the home page and make it more difficult for a user to find what they might be looking for.

#### Analysis

We introduced Customization in Chapter 3 as an element in Gamification and as a persuasive technique (See Table 3.9). In terms of positive outcomes, Customization was tied with motivation (See Section 3.3.2). Additionally two independent studies (Deaker et al., 2012, Turkey and Adinolf, 2010) that looked to benefits of customization in World of Warcraft (a very popular online video game) reported also positive effects on motivation. Additionally, Deaker et al. (2012) list a number of causes for motivation, among others enjoying the process of customization.

#### Recommendation

**Our recommendation is to allow user to customize how their main entry page.** The customization does not need to be very complex, simply allowing the user to hide certain buttons would suffice. Ideally, the customization option could be coupled with the onboarding (R4), where users are shown all or most of the features and asked which they would like to keep or hide out of direct sight. Of course, by hiding features there is the risk that some features are used less. If many users are hiding a specific feature, this can also be seen as an indicator that there is a need to improve said feature or consider removing it completely.

### 5.3.9 (R9) Clear value (Value)

Most platforms do take a number of steps to broadcast their value to potential users. P2 and P4 take active steps in using volunteers and advertising in new municipalities; P1 and P3 rely on grassroots as well as news services among

other non-digital methods. Despite this, some users appear to still struggle to understand the concept fully, like in the case of P1, though, generally this appears to be a rather small minority and we want to avoid generalization. However, if people don't have a clear idea of what the platform can do for them, such as assuming that help request should only be made for more "serious" tasks or that asking for help can be bothersome to others, this might impact the success of the platform. Controlling assumptions can be challenging, as users might also make assumptions from the type of requests they see on the platform at the time of joining it.

## Recommendation

**Our recommendation is to showcase some clear example scenarios of the different types of requests.** What kind of request can be created (or have been created) and how they could be (or have been) handled.

Currently, some of the platforms do offer simple example requests and do offer pointers, but showing some successful requests, or even having a video of the process of making a request and showing how the request could be handled can be an effective way of clarifying and cementing the value of a platform.

### 5.3.10 (R10) Transparency (Trust & Security)

In our interview with P5, it became clear that some elderly users are starting to become more aware of data privacy and want to know how their data is protected and how it is used. All of the platforms that were evaluated are located within the EU and thus declare to follow the European GDPR (General Data Protection Regulation)<sup>7</sup>. GDPR lists a set of requirements aimed to protect users' rights in terms of data privacy. Because of this, the platforms do provide a generic data protection statement and Hoplr also mention collaboration with ethical hackers, as well as providing some slightly more in-depth information on how data is used on their help page.

The raising awareness of users' need for data privacy could be in part be due to a number of scandals about online social networking platforms, especially Facebook, such as the Cambridge papers (Cadwalladr and Graham-Harrison, 2018). The COVID-19 situation also brought users' data privacy in the forefront with the release of contact tracing applications and the handling of the user's data (Fahey and Hino, 2020).

## Analysis

Data privacy concerns of users and the importance on mitigating these by being transparent have emerged (Villius Zetterholm et al., 2021). Of course, despite several scandals (Cadwalladr and Graham-Harrison, 2018, Fuller, 2019, Kozłowska, 2018), Facebook is still among the largest Social Media giants,

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<sup>7</sup><https://gdpr.eu/what-is-gdpr/>

though they did recently enact a re-branding campaign<sup>8</sup> shortly after their latest scandal<sup>9</sup>. These are of course more general data privacy issues. In a more narrow field, such as use of social media in previous studies, elderly users had shown concern about their data privacy and can find personalized technologies “creepy” as well as sometimes being uncertain on who would see their posts (Hope et al., 2014).

### Recommendation

A simple GDPR statement might not be enough to alleviate all concerns; instead *open and honest communication* on who is able to access or see the user’s data is needed. **Our recommendation is that platforms inform users clearly how any information provided by the user is used by the platform.** This could be coupled with recommendation (R3) Guiding, by embedding this relevant information in the guidance process.

#### 5.3.11 (R11) Support & encourage communication (Social support, Confidence)

The majority of the platforms leave it to the users on how to handle the interpersonal communication once somebody responded to a message. Usually this is done by means of public or private chat messages. It is likely safe to assume that for a majority of users this is perfectly sufficient. However, adding support for other common forms of communication, such as phone, email, and popular external communication services, could be useful especially for elderly users.

We also noted a rather low level of using the internal chat on all three platforms (P1,P3,P4) surveyed. Some reasons for these are easy enough to devise. For instance, in the case of P1 and P3 both surveys had nearly identical level of inactive users (who had not used the main feature of the platform). In P4’s case, the results did vary somewhat depending if participant had offered or asked for help, but on most occasions around half of the participants responded negatively to using private messages. Similarly more older users had used the feature distinctly less.

Additionally, having a possibility of keeping a family member updated on the activities of an elderly user could be a beneficial feature in the context of social support. Of course, this does bring additional privacy concerns to the table, but this could be a feature that can only be activated separately as likely, it would not be needed by a large group of users.

<sup>8</sup><https://www.theguardian.com/technology/2021/oct/29/mark-zuckerbergs-role-in-facebook-rebrand-may-backfire-experts-say>

<sup>9</sup><https://www.reuters.com/technology/facebook-whistleblower-says-transparency-needed-fix-social-media-ills-2021-12-03/>

## Analysis

Despite elderly users slowly embracing new technologies, there are indications that they prefer traditional forms of communication, such as telephone, emails, and even written letters (Hope et al., 2014, Dickinson and Hill, 2007). Though, it should be noted that these studies are already aged. Also, it is important to note that elderly users are in fact willing to learn how to use new technology if they see the value of it. There is no direct evidence on elderly users being reluctant to use internal chats.

A study by Judges et al. (2017) looking at elderly users' adoption of communication technologies stated that receiving messages is a key requirement to get elderly users to adopt communication. Having users sending noncommittal greetings to each other could be an effective way to do this, as well as creating connections between the users that can develop into extrinsic motivators (Leone et al., 2018) for using the platform, Akin to P4's greeting new neighbours feature.

## Recommendation

We have several recommendations for communication that we have split to two distinct sub facets: *support and encourage communication*.

**Our recommendations for supporting communication are: To provide more familiar means of communication (email, phone) and coupling them with the recommendations (R3) Guiding and (R4) Onboarding, as it is equally important to make them aware of these possibilities.** Coupling support for email and phone, in terms of technical challenge, is rather small for the platforms.

**Our recommendations for encouraging communication: 1) Sending an automatic message via the chat to introduce the users to it. 2) Akin to P3's onboarding upon account activation, suggest sending a greeting message to other users. 3) Allow certain people to keep track of activities of their family members;** making family members aware of a user's activity in the platform (e.g., via email, or an other messaging tool) could be meaningful and increase feeling of social support and security.

Lastly, one form could be by coupling gamification elements to the process, by giving specifically communication focused goals or tasks, like: "say hello to a user".

### 5.3.12 (R12) Help manuals (Technical Support)

The platform should provide technical support to their users and overall all of the platforms do accomplish this. At least, in so much that they do provide instructions for users. What we can conclude from the interviews, is that for most parts, elderly users seem to rely on direct in person connections when they get stuck. How easy an online help service is for the elderly is unclear.

## Analysis and Recommendation

A paper manual was already noted as a potentially useful medium to help elderly users by Lee (2015), as elderly often refer to printed directions for support with new technologies.

**Our recommendation is providing a leaflet that contains clear instructions of all the core features and how to use them, as well as a brief explanation about the platform itself.**

### 5.3.13 (R13) User roles (Technical support, Emotion, Dormant users)

Recruiting users by giving the different level of roles, has been used by online forums and social networks to lessen the need for expensive hired personnel. In the case of larger social networks this is likely the only feasible way for them to perform. Outside this, giving user a distinct purpose within the platform can itself be a source of added motivation to be more engaged with the platform and its community.

Currently, out of the evaluated platforms, Nextdoor, P2, and P4 do utilize user roles: Moderators (Nextdoor), Super user (P2), Volunteers & City Representative (P4). To our knowledge, Commu nor Nappi Naapuri currently utilize any user roles.

## Analysis

Probably among the most common user roles are the moderators. These usually manifest as forum admins who control the content and the users allowed within certain groups or discussion boards. More specialized user roles can be found in Wikipedia where the majority of content and data management relies on volunteers who have varied access rights to modify content. Another example is Google Maps that actively monitors its users movements to show general business of locations, but also actively gathers information about different locations by prompting users to comment on visited locations. Whenever users give Google Maps information, they are rewarded with points and very active users can also get different level of badges<sup>10</sup>.

Of course, these examples all show user roles that have been devised to deal with the specific of the platform.

Lastly, users curating their own content also carries its own risks as highlighted in the case of Nextdoor (Section 4.3) and in the discussion on P4 in Section 4.5.6.

<sup>10</sup><https://support.google.com/local-guides/answer/6225851?hl=en#zippy=%2Clearn-more-about-rewards%2Cearn-the-local-guides-badge>

## Recommendation

Adding user roles can be useful to 1) have a better control over created content once platform reaches a certain size, 2) keep certain users more engaged with the platform, 3) activate otherwise potentially dormant users.

**Our recommendation is to investigate from what types of user roles a platform can take advantage of.** P1 and P3 might benefit from local representative that broadcast area-relevant information or requests. More closed neighborhood platforms might not benefit from nigh all powerful admins, but rather from users that check the content of notifications and can highlight them if necessary. P2 and P4 could benefit from roles like event organizer or users who indicate points of interest in the area, or adding a more dynamic discussion angle between a neighborhood and the local municipality. In short, we have identified the following potential user roles:

- local city/area/neighborhood representative
- moderators
- verified users
- event organizer
- special content creator

### 5.3.14 (R14) Safety features (Trust & Security)

In terms of current safety features, the platforms largely rely on providing guidelines, such as meet outside in a public area. No inbuilt features otherwise are provided. Reporting of profiles was the most common safety feature.

It appears that for most parts the encounters on the evaluated platforms have been without any major incidents so far. This could partly be due to their limited size, lack of actively meeting other users, or they are simply not being reported. Security when meeting unknown people is an important factor for most users but even more so for for elderly who might feel vulnerable, especially if the helper is expected to visit their home.

## Analysis

How the help request currently works, practically on all of the platforms is by making a public request for help to which other users can give either public or private responses. Volunteers can either respond to existing requests or make a public announcement on willingness to help. Hoplr is currently the only service that also offers the searching of potential help via a pool of active helpers. There is currently no filtering of unwanted contacts anyone can respond and send a direct response to any visible request or offer.

## Recommendation

In terms of security features, what we recommend are simple and relatively easy to implement, technically, however they would require more volunteers.

**One such feature could be to announce an upcoming meeting to a third party.** This could even be coupled with (R12) where a selected family member or even simply the platform is informed of the upcoming meeting. If both users are aware of this it could work in making participants feel more safe. **Another option could be to invite a third party to join the meeting,** this would require available volunteers willing to join meetings and might require some added calendar options to ensure that everyone is available.

**Another simpler safety feature would be to track encounters.** A soft barriers in the help request process, by attaching some form of feedback system for encounters and ideally adding steps to the help request flow, such as allowing both volunteer and requesting person to view more information on each other before sending or receiving a message.

Being able to review encounters, is a rather obvious recommendation. However, this does raise additional questions, for instance: who may see those reviews?; how to control against false bad reviews?; how easily could person receiving the review guess who gave it?. Nonetheless, it could be a valuable avenue to help users assess for themselves whether meeting another user for the first time is a good idea, or not.

### 5.3.15 (R15) Area of visibility (Trust & Security)

This issue is more focused on the platforms with closed neighborhoods (e.g., P2, P4, and Nextdoor). Tying the platform to a single neighborhood can improve safety and security and should definitely be kept as such but it has the disadvantage that people outside the neighborhood cannot help, while in terms of travelling, a person from further away might be perfectly willing to help with a task, for instance because it is on his way to work. P2 already allows publishing some notifications outside the users' own district to be seen in the neighboring ones.

#### Recommendation

**Our recommendation is : allowing some notifications, such as help requests, to be seen outside the users' neighborhood.** Any feature of this type would require additional instructions for the users, to mark the message as visible outside the neighborhood, for instance by means of a color code.

### 5.3.16 (R16) Provide activities (Dormant Users)

Especially P1 and P3 appeared to have a rather large number of dormant users. Reasons for these can vary. Users can, in general terms, be grouped into four distinct categories 1) visitors, 2) passive members, 3) socializers, and 4) content generators (Akar and Mardikyan, 2018). P3 stated that they

had seen some success in re-activating users at least briefly with emails, but whether long-term engagement could be achieved was less certain.

### Analysis

It is unlikely that visitors or passive members will create new content on a platform, but there are techniques that could elicit some of the users to become more active, such as, communication between groups, rewards and playfulness (Akar and Mardikyan, 2018), essentially with the aim of converting a passive user into a dynamic one. An example is how Google asks people to add content about their visits to various places.

### Recommendation

**Our recommendation is to provide simple, easy to do tasks or activities within the platform.** Ideally, the user should be rewarded for performing the task or activity in some manner. Example tasks could be clearing old requests or reviewing new requests. Of course, giving users any rights over moderating messages is something to be considered carefully (as Nextdoor’s and P4’s experiences with moderators showed). This could be coupled with the recommendation (R13) user roles, by providing roles that might be useful for platform and interesting enough for the user to do, but might not necessarily require social interaction. This type of engagement could turn dormant users into active ones, or keep some users who might not otherwise use the platform, suitably engaged.

#### 5.3.17 (R17) Account creation (Usability)

Creating an account, i.e., registration, varies in difficulty from simply typing some basic information to a multi-step verification process. This was clearly indicated as a stumbling stone for elderly users. The reason for having this feature is clear, it aims to increase trust in the members within the community, as they’re all from the same neighborhood.

### Analysis

In the context of e-commerce, early registration is something that can cost e-commerce sites millions in lost revenue (Nielsen, Jakob, Budi, 2012). As the authors put it:

*“In our testing we saw countless apps that asked users to register before the apps had proven their worth in the slightest. This is wrong. Remember that users start out with fairly low level of commitment to your app. Unless yours is truly great app that offers immense value, people won’t use it enough to make registration worth their while.”*

Out of the evaluated SE platforms Nextdoor and Allo Voisin platforms follow this philosophy by allowing users to access the platform without registration and even before verifying their home address. However, they cannot create messages and access to many parts is restricted until verification is done. Another great real life example is the Europe-pass<sup>11</sup> that allows users to use the service without making an account, but will only store the data for a limited time. though arguably their use case is rather different.

Making registration easier is not easy without sacrificing security. The added security of requiring users to verify their location is a strong marketing point for some of these services. However, allowing an easier access for both parties might allow for more “on-off” users that do not plan on using the platform weekly, but simply when the will or need arises. This could also be an effective way “to rope users” into the platform as it can contribute to the value factor; allowing the user to see what the platform is about and to judge whether it would be useful going through the added trouble of doing the full verification.

## Recommendation

We have three intertwined recommendations for this purpose:

**Firstly, the registration process should be as easy as possible with very clear fields and ideally minimal input required.**

**Secondly, a two step registration could ease the likelihood for elderly and other users to join the platform or by allowing access to basic functionalities without a location verification.** To alleviate registered users’ security concerns, content created by non-registered or verified users’ could be color coded, or categorized separately. Naturally, this does open up an avenue to possible problems, such as spamming, or bots. Meaning that some features might need to be restricted, but this is more a matter of mostly fine tuning and discovering the optimal balance.

**Thirdly, circumventing the use of classic passwords could also be a strong booster for elderly users.** Either by using third party login services, such as Google’s, by email, sms authentication codes, or authentication services such as itsMe<sup>12</sup> or bankingID<sup>13</sup>. It is important to consider the trade-off between safety and easiness, and there is plenty of evidence that traditional passwords might not be very safe, mainly because of the users themselves (Florencio and Herley, 2007)

### 5.3.18 Summary of the Recommendations

In Table 5.1 we provide an overview of the recommendations presented. They were gathered from both functionalities already implemented in some of the

<sup>11</sup><https://europa.eu/europass/en/create-europass-cv>

<sup>12</sup><https://www.itsme.be/en>

<sup>13</sup><https://www.nordea.fi/en/personal/our-services/online-mobile-services/code-app.html>

platforms, as well as based on our own hypotheses derived from the hands-on evaluation, interviews and questionnaires.

Table 5.1: Table of recommendations, their corresponding Lee’s factors and short description

No.	Factor	Name	Description
1	emotion	points with purpose	Points should have a purpose other than just accumulating them.
2	emotion, dormant users	show activity	Features showing that the platform is active and “alive”.
3	independence	guiding	Provide guidance in forms of info snippets on all core features of the platform.
4	independence	onboarding	Provide a clear introduction of the application’s core functions when starting to use it for the first time.
5	usability	guidelines	Ensure that at least the more important guidelines for technology in question are followed.
6	usability, security & trust	handling user feedback	Allow users to give feedback and provide means for them to follow and see how these suggestions might be implemented
7	usability, security & trust	audio & video messages	Allow users to also make audio and video messages
8	usability, experience	customization	Allow users to choose what they see in the main view. This can be done by providing filters
9	value	clear value	The technology should clearly state its value to users by means of allowing users to see most of the functionality before creating an account as well as by showcase examples of using the technology
10	value, security & trust	transparency	Apart from following GDPR, the platform should also openly communicate on how user data is utilized even when not directly asked by the user
11	social support, confidence	support & encourage communication	Ensure multiple forms of communication is supported, as elderly users might not want to use a chat, but call instead. Encourage the communication by providing tiny cues and opportunities for users to do so can be effective in boosting users’ confidence in themselves and others
12	technical support	help manuals	Provide numerous ways of support, including online and offline manuals
13	technical support, emotion, dormant users	user roles	By involving the users more with the platform by giving them roles can help especially with: <i>engaging users and usability</i>
14	security & trust	safety features	Users Features designed to protect the safety of the users that in turn can increase their trust towards the platform: <i>review encounters, blocking users, announce meetings, control who is able to contact the users</i>
15	security & trust	area of visibility	A hybrid openness approach between the more closed approach of Hoplr and Nebenan vs the full openness of Commu and Nappi Naapuri might provide the flexibility some users would likely have
16	dormant users	provide activities	Provide reasons to check back in. Reasons can be small tasks, such as tiny moderator tasks or clearing old requests from the platform (without actually affecting the platform, of course)
17	usability	account creation	Keep the registration, i.e. account creation process, as simple as possible. Allow user access to platform even without proper verification, but limit access to some features until after they finish the full registration

### 5.3.19 Possible Other Recommendations

We also gathered a number of points that platforms might find interesting to consider in their future implementations. These do not constitute a full fledged recommendation yet at this stage, as they are largely thoughts that emerged from discussions between colleagues during the process of writing this dissertation. Some of these can be technically more challenging to implement with uncertain benefits.

#### Evaluate language use

This kind of platforms rely heavily on communication between users. If younger audiences participate in any significant number, they are very likely to bring their own form of writing and slang to the platform. The use of language within social communities is an interesting topic in itself as it is very much a world on its own (Eckert, 1988, Tsur and Rappoport, 2012, Danescu-Niculescu-Mizil et al., 2013). Formation of internet communities is a natural part of the majority of online services that have groups of regular users communicating amongst themselves. This can also affect how the language used within these communities evolves. This is more of concern to platforms such as Hoplr where open discourse is allowed and encouraged, where as for instance on Nappi Naapuri and Commu it could be less of concern as the communication methods are much more controlled. However, even in that case, active monitoring the platform is necessary to ensure that the language used remains accessible also to new users.

The simplest way to do this is to have rules on what an average user's message should achieve, such as shown to users in Hoplr. For example, an offer to help should not use unfamiliar slang words, acronyms or expressions. And as for the monitoring, this is an area where machine learning could prove useful. Upon noticing a slang word an unimpeded suggestion or replacement word could be offered, or translated for the recipients. Tools for this type of content creation where enhanced version of a written text is offered by a bot, do already exist<sup>14</sup>.

#### Monitor help requests & offers

One common complaint from a number of respondents was the abrupt end to the help request flow, where one of the parties stopped communicating. There can be several reasons for this and depending on the stage of the help flow, not much can be done. However, another important point to focus on are the requests and offers that have not received any attention. Again, a rather simple explanation for this can be that the request or offer is made in an area that is not very active, or nobody is able to deal with the request or needs the help offer. However, simply letting a message die, will likely lead to

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<sup>14</sup><https://www.grammarly.com/>

disillusioned users making less active areas even more inactive. Intervention from the platform level might be necessary to avoid such situations. In any case, steps could be taken to indicate that the requests and offers have not gone unnoticed.

### **Uphold the communicated rules**

As we stated earlier, practically all evaluated platforms present a number of guidelines on how users are expected to behave and communicate. No concrete bad or recommended examples of violating these guidelines are directly shown. However in terms of requests another thing to consider is how they might be perceived. A perceived high barrier for requesting help can be as much, or even more of a hindrance, than technical usability issues. One such example for this can be found in Stackoverflow<sup>15</sup>, a popular platform for asking help in solving especially programming focused challenges. The perceived quality of questions required by existing users of Stackoverflow has become a butt of a joke in some corners of the internet<sup>16</sup>. This phenomenon does not necessarily mean that Stackoverflow is in fact overly strict, but if enough users perceive this to be the case, it can become an actual problem. This is also something that requires active moderation from the side of the platform as runaway community culture can be difficult to correct afterwards. Reddit was forced to ban hundreds of their forums as they had developed into very toxic communities<sup>17</sup>.

### **Recurring requests**

Generally, users can guess from the title what the help request is about. In some cases the request is recurring, such as walking daily, or during certain days of the week. Usually, these types of request likely turn into simply finding a person to do the task once and then the request for repeating the task happens outside the platform. However, it could be in the advantage of the platform to try to keep these events visible within the platform, as it will result in more activity in the platform. This can be done by simply allowing users to create an recurring request that could have one or more assigned helpers. Firstly, in this way, a level of non-commitment can be kept, as one individual did state that they “dislike being always expected to help”. Secondly, this allows for showing these interaction to other users. Also, using a timetable for requests, such as start and end date, can be an effective way for a platform to find help requests that might have otherwise gone unnoticed, or are about to expire. This could also potentially be coupled with (R14) safety features, namely to handle the logistics of a third party joining a meeting.

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<sup>15</sup><https://stackoverflow.com/>

<sup>16</sup><https://devhumor.com/media/marked-as-duplicate>

<sup>17</sup><https://www.nbcnews.com/tech/tech-news/reddit-bans-hundreds-subreddits-hate-speech-including-trump-community-n1232408>

## 5.4 Conclusions

In this chapter we have presented our design recommendations based on findings from the previous evaluation chapter and findings from literature. The recommendations are tied to Lee's factors, with the aim of improving such platforms both in terms of adoption and usability, but also in terms of motivating and engaging users. An overview of our recommendations is given in Table 5.1.

The type of recommendations given are the result of focusing on Lee's factors as our main starting point. Using another design or adoption framework might have resulted into a different set of recommendations. On the other hand, the 'Security & Trust' focused recommendations (R14, R15) are only partially connected with Lee's factors (discussed more in Section 4.5.10). These recommendations were more the result of our initial interviews.

Naturally, to cover all of our recommendations in a single survey was not going to be possible. The recommendations focused on in our survey were deemed as having a higher priority in terms of requiring validation. Additionally, several of the recommendations not included in the evaluation, such as, guiding (R3), onboarding (R4), clear value (R9), customization (R8), and account creation (R17) would require their own surveys and also preferably giving concrete use case examples to the participants. For instance, the benefit of onboarding or guiding is something that user might not readily grasp if only presented briefly in a survey.

Lastly, we revisit the relevant research question (presented in Chapter 1). Table 5.2 presents with a summary of our answer.

Table 5.2: Research question RQ4 and our answer

(RQ4) What aspects could be improved in the evaluated SE platforms and which of these can we provide to developers as recommendations to take into consideration when developing SE platforms focusing on elderly users?	We identified a number of potential areas for improvements and formulated recommendations for them (see Table 5.1 ). It is not the intention to suggest that all of the evaluated platforms are missing these features.
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# Chapter 6

## Evaluation of Selected Number of Recommendations

### 6.1 Introduction

In Chapter 4, we introduced and evaluated several social engagement (SE) platforms and in Chapter 5 we presented recommendations based on our evaluations for improving such platforms. In this chapter, we show and discuss the results of our evaluation of some of these recommendations. Evaluation is based on our survey and interview question results focusing on the recommendations. An overview of the list of all of our recommendations was given in the previous chapter, in Table 5.1.

We start the chapter with explaining the methodology used for the evaluation, next the results of the surveys are presented, followed by the results from the interviews. The chapter ends with conclusions. This chapter contributes to the answer on research question RQ4.

### 6.2 Methodology

In this section, we present the methodology used to come to a first evaluation of a select number of our recommendations. An empirical approach has been used.

The empirical evaluation of the recommendations was done by means of user surveys and interviews with representatives of existing platforms. The evaluation of the recommendations were integrated with the surveys and interviews presented in Chapter 4.

## Surveys

The surveys were divided into three parts: questions on requests habits, on general issues about the platform, and questions to evaluate recommendations. For the basic details, such as age groups and gender distributions, see Section 4.2.3.

The goal of the evaluation part was to evaluate some of our recommendations. Evaluating the whole list of recommendations would have made the survey too long, thus we focused on key factors: emotion, usability, security & trust, and engagement. The following questions were asked for all three platforms:

- Emotion:
  - Would you want more information on how active the neighborhood is?
  - Would you enjoy collecting points that have value?
  - Would you enjoy spending points that are useful on other platforms?
  - Would you enjoy sharing points?
  - Would you like to have more responsibility for the neighborhood?
  - Would you want to be more aware of how many people have been helped in their neighborhood overall?
- Usability:
  - Would you like to have a paper manual?
  - Would you like to have a confirmation window before your post is published?
  - Would you like to have the ability to post Audio or Video messages?
  - Is the current UI useful?
  - Clearing of old messages from the feed would be useful?
  - Which method for navigating within posts do you prefer: Infinite scrolling, pagination, or partial infinite scroll?
- Security & Trust:
  - Would you like to have more control over who sees your help requests?
  - (Follow up) Who would you like to see these requests?
  - Would you like to rate how the encounters with other users went?
  - Would you want a third party to join when meeting a stranger for the first time?
  - Would you want a third party, selected by you, to be also aware of a meeting?

The majority of feedback was collected with the first two surveys, the ones for P1 and P3. In terms of analysis and depending on the context, we mostly simply list most prevalent forms of comments. In some cases, a simple “tone”

evaluation was conducted, based on wording and use of exclamation marks. For example, results for asking whether participants saw points as motivating was categorized as:

- *strong yes/no*. Example response: *“Ew! Nothing like that!”*
- *“yes/no”*. Example response: *“Not part of helping”*
- *“light yes/no”*. Example response: *“No junk. But maybe a gift voucher for a coffee . . .”*

In these cases, we also calculate mean, median and standard deviation by giving the responses numerical values from -3 (strong no) to +3 (strong yes).

The questions were, for most parts, similar in all three surveys; however, especially in the survey conducted on P4, some changes were made, such as open questions being converted into closed questions with a Likert scale and in other cases questions were formulated differently. Differences between questions are always highlighted when showing the results for a specific question. It is also important to know that the questions were delivered in four different languages: English (P3, P4), Dutch (P4), Finnish (P1, P3), and French (P4). Lastly, in order to have the figures fit better, when discussing the results some questions have been shortened in the respective description box. For example, in Figure 6.4 “My neighborhood for some general purpose” has been converted to “My neighborhood”.

After running the first survey on P1, we also created some new questions, especially for the last survey conducted on P4. Here is the list of additional questions and on which platforms they were used:

- I was aware of being able to collect points by being active on P4? (Usability; P4)
- I enjoy collecting points (Engagement; P4)
- I would like to easily challenge people from my neighborhood to a simple digital game (Engagement; P4)
- A friendly digital competition between neighborhoods or towns could be fun (Engagement; P4)
- I would like to be able to offer help to people outside my own neighborhood (Usability & Engagement; P4)
- Which of the following types of user do you think could be useful on the platform? (Engagement; P4/ P3)
- Which of the following features you think might improve the P4 platform? (Engagement; P4 / P3)
- What do you like/don’t like about P3’s map? (Usability; P3)
- I am unlikely to ask or offer help, but I like to follow the types of notifications there are in my neighborhood (Engagement; P3)
- I would be willing to perform small tasks within P3, such as checking notification content if I get points or other recognition out of doing so (Engagement; P3)
- Creating my account on P3 was easy (Usability; P3)
- Choose your preferred method of logging in (Usability; P3)

## Interviews

During the interviews with the five SE platform representatives (see Chapter 4) we also asked their opinions on some of our recommendations, especially those that might make the platform more engaging.

## 6.3 Results of the Survey-based Evaluation

In this section, we go through the results of the relevant part of our surveys. Note that percentages are always rounded to the nearest full number, and the text of questions and results are at times simplified in the provided bar chart figures. The survey results are grouped by recommendation. We considered the following recommendations: (R1) *points with purpose*, (R2) *show activity*, (R5) *usability guidelines*, (R7) *multimedia messages*, (R13) *help manuals*, (R14) *recruit users*, (R15) *soft barriers*, (R16) *safety features*, (R17) *area of visibility*, and (R18) *provide activities*. The following subsections present these results by adoption factor, except for the last sub section, Section 6.3.5, that covers results about missing features.

### 6.3.1 Adoption Factor: Emotion

#### (R1) Points with purpose

##### Interest

A question asked in each survey was whether the participants think they would be more motivated if the SE platform had collectible points that could be interchanged for small rewards. In the first two survey, this was a simple yes/no question. In the version conducted on P4, it was converted into a Likert scale question and more examples for the potential rewards were given: cup of coffee, discounts, digital rewards. The results for all three surveys are given in Figures 6.1 and 6.2.

When we look at P1 and P3's results filtered by age, not very surprisingly the number of people seeing points as a potentially motivating factor was higher for the younger user groups. A similar trend could be noted for P4 where against and indifference (neutral option) to points overtook the agreeing results starting from age 66 and older.

Participants from P1 and P3 were given the option to comment freely on their choices. 56 participants commented in the P1 survey and 22 in the P3 survey. In both cases, the comments were rather evenly divided between for and against. For P1, 33 comments were against and 20 for. From the feedback it is clear that the question did evoke rather strong emotions with some participants, as one comment illustrates: "Very disgusting" (Female, age 56–65). The majority of the against comments stated in different terms that this would go against the altruistic spirit of the platform:

- "Helping is rewarding in itself" (Female, age 46–55)

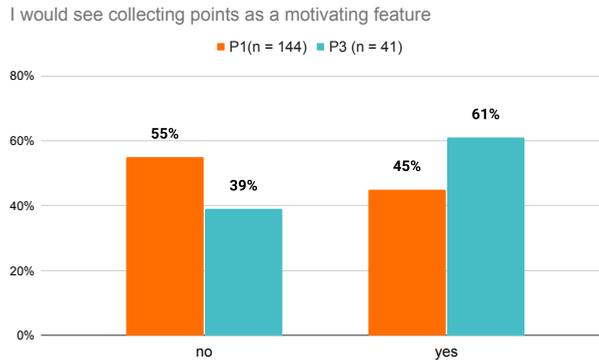


Figure 6.1: P1 and P3 results on whether participants saw points as motivating. Margin of error: P1 8%, P3 13%.

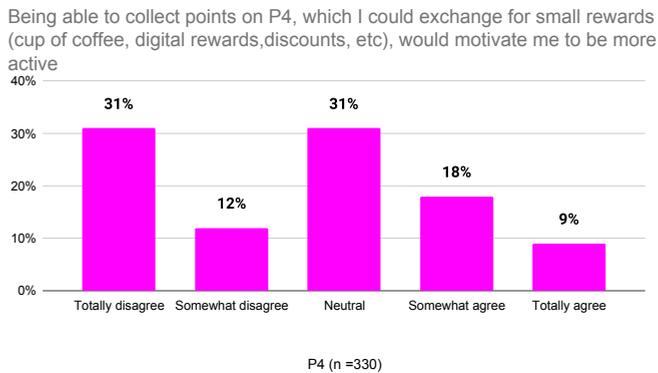


Figure 6.2: P4 results on whether participants saw points as motivating. Margin of error 5%

- “It might motivate, but in my opinion does not fit the spirit of the platform” (Female, age 26–35)
- “Helping should be altruistic” (Female, age 56–65)
- “Essential part of volunteering is to expect nothing in return” (Female, age 66–75)

Other negative comments that gave a reason were often about rewards feeling as “commercial”. Interestingly two users stated that it might be too motivating and make users focus solely on collecting points. The pro group mostly simply stated agreeing with the statement:

- “Gamification is refreshing” (Female, age 46–55)

Table 6.1: Results for the perceived “tone” of open comments on question on whether points could be motivating.

	<b>P1</b>	mean	<b>P3</b>	mean
strong yes (3)	2	-0.58	4	0.09
yes (2)	10	median	5	median
light yes (1)	8	-2	2	0
light no (-1)	5	st. dev	2	st. dev
no (-2)	26	1.79	7	2.24
strong no (-3)	2		2	

- “Having an incentive could motivate many :)” (Female, age 46–55)
- “Having a ‘carrot’ is a good incentive” (Female, age 66–75)

In P3’s case, 22 participants left written feedback, 11 against and 11 in favor. The majority of the against statements gave the same reasons as in the case of P1, i.e., about points being against the spirit of the application. In Table 6.1 an overview of the answer by “the tone of responses” is given.

## Value

As a follow-up to the previous question about collection exchangeable points we wanted to know whether there would be a difference in motivation if the participants could also use the points on other platforms. The question was formulated as follows: “*If the points that I would collect on the platform could be used on another platform, such as a game that me, my friends, my children or grandchildren play, this would motivate me to be more active*”. The results for all three surveys can be seen in Figure 6.3.

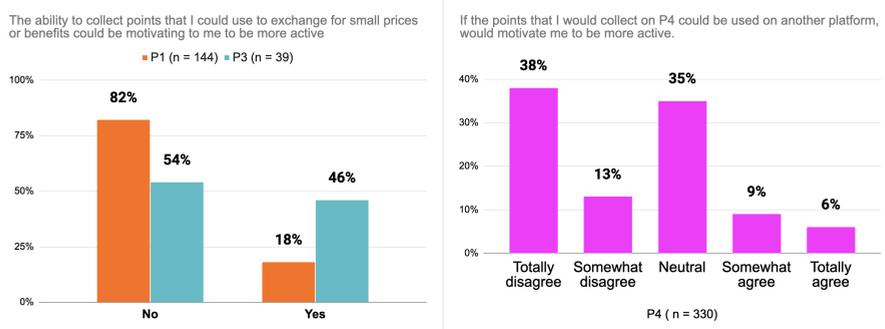


Figure 6.3: P1, P3 and P4 results on whether points that have added value (outside the platform), were of interest to the participants. Margin of error: P1 8%, P3 13%, P4 5%.

When looking at the results by filtering out different age groups, the results did not change much. For age groups of 45 and below ( $n=62$ ), P4 showed a small increase in agreeing towards the concept (totally agree: 10%, Somewhat Agree: 18%). When looking only at the age groups above 45 ( $n=264$ ) the results were quite close to the general results (totally agree : 5%, Somewhat agree: 7%), as this group represents the majority of the respondents.

When analysing open comments on the question, less surprisingly, most comments were against (shown in Table 6.2). Like in the previous survey P3's comments were divided directly in half between pro and contra. One common reason given by the against group was "not playing games", otherwise the reasons given mirrored largely those of the previous question only focusing on points.

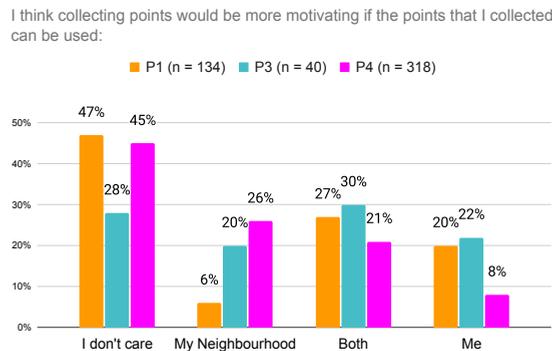


Figure 6.4: Results for the question on who the points should be rewarded to

Table 6.2: Results for the perceived “tone” of open comments on whether collecting points that could be used on another platform might motivate users to be more active

	<b>P1</b>	mean	<b>P3</b>	mean	<b>P4</b>	mean
strong yes (3)	0	-1.60	2	0.11	0	-1.49
yes (2)	4	median	6	median	5	median
light yes (1)	0	-2	1	0	1	-2
light no (-1)	3	st. dev	2	st. dev	2	st. dev
no (-2)	30	1.28	6	2.14	52	1.24
strong no (-3)	3		1		5	

## Cooperation

The results on the question to who the points could use can be seen in Figure 6.4. Note that the question phrasing did change somewhat between P1 and P3 where the question “*Would you find collecting points to be more motivating*

if they were accumulated to...” was changed for the P4 survey into “I think collecting points would be more motivating if the points that I collected can be used: ...”.

No notable differences between the answers could be seen when filtered by age. Seeing the trend of the two previous questions, the fact that “I don’t care” was the most selected option was not very surprising.

### Competition

Questions on introducing some kind of competition were added only to the last survey on P4. As we noted in the previous surveys that points were a rather divisive topic, we also wanted to investigate whether users of a platform would be interested in simple friendly competitions between neighborhoods or towns, or with their own neighborhood members. Results for both questions can be seen in Figure 6.5.

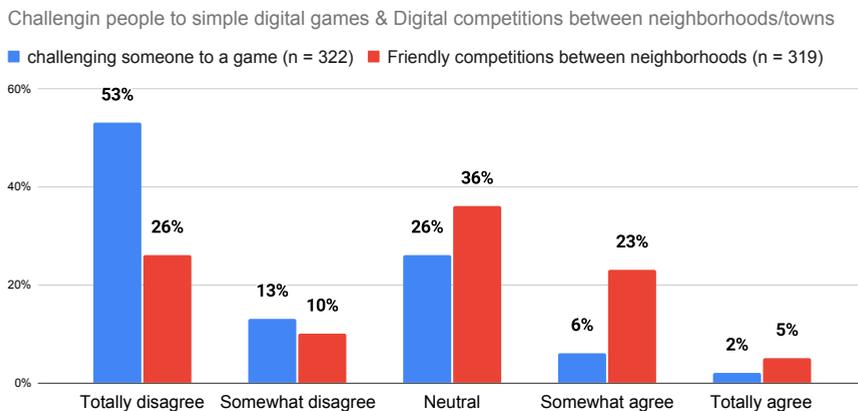


Figure 6.5: Results for the two questions on simple digital games between users and competitions between neighborhoods. Margin of error: 5%

### (R2) Show activity

We divided the question on the interest to see the activity level on the platform into two parts. The first part was focusing on helpers asking for their interest in seeing more information on the platform’s activity and if so, what kind. The second part was aimed at all participants and focusing on wanting to see the activity level of the platform.

For P1, we formulated the question to people offering help as follows: “Would you like to see to how many people you have offered help” and as a follow-up we asked for choices on how that information could be shown, in an open question with some examples mentioned, such as a leaderboard or a list of help given/received. The first part was a yes/no question to which 64

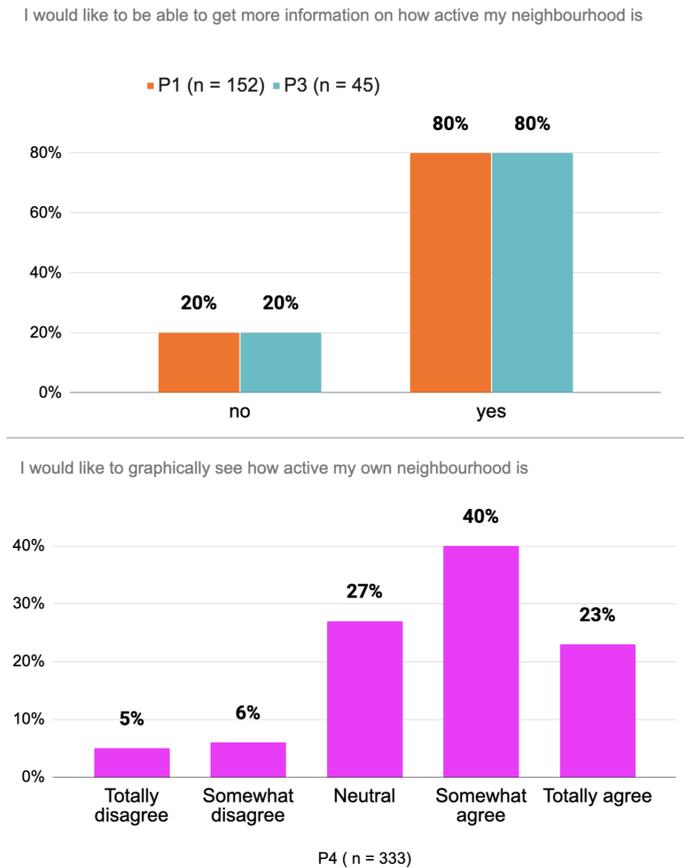


Figure 6.6: P1, P3 and P4 results on participants wanting to see more information about their neighborhoods. Margin of error: P1 8%, P3 13%, P4 5%.

in total gave a response, with 56% selecting yes. In terms of open responses, the suggested features were a leaderboard, a list of encounters, and an activity diary. Also some criticism towards this question was noted. Two participants stated that a leaderboard would go against what the platform was about and make it feel cheap.

The **P3** survey had the same questions as the P1 survey. Only 15 people responded with 93% selecting yes. Suggestions included: a list, a leaderboard, and a single person mentioned that these lists should be private and not elicit competition.

For **P4**, the question was rephrased as follows: “*Would you like to easily see how many people have completed a help request in your neighborhood?*” with the same yes/no option. 372 responses were given with 70% selecting

yes. There was no noticeable generational difference in the responses when looking at different age groups. The lowest result was 65% when looking at participants of ages 36–55. In the case of P4, we did not collect suggestions via an open question.

The second question on seeing the level of activity, was intended for all participants. This question evolved slightly after running the surveys on P1 and P3, where the question was a simple yes/no question: *“Would you like to have more information on how active your neighborhood is?”* The question was provided with a followup question asking what type of information and how they would like to see this information presented. In the case of P4, a more specific question was presented on whether participants would like to see the information presented graphically. A simple concept image was provided as an example of a graphical representation and the question was converted into a Likert scale question. Results for all three surveys can be seen in Figure 6.6.

On P1, 54 comments were given by the participants. The most (n=17) commonly mentioned type of information was simply seeing how many active users were in the neighborhood. The second most (n=16) popular suggestion was to see how many completed requests were in their area. The third most popular request (n=13) was to see more information of past activities, feedback on those activities, and other usage history related information. P3 had a total of 14 responses to this question with the results corroborating the P1’s results. The most frequently wished information was the number of active users, completed requests, list of current requests, and user history.

### 6.3.2 Adoption Factor: Usability

As we discussed in Chapter 4, some features marked as essential in our design guidelines were not included in the evaluated platforms. We wanted to find the opinion of users on these features.

#### (R5) Usability guidelines: Confirmation window

The confirmation window was one feature that was lacking on all evaluated SE platforms, especially before posting a message or for most other actions for that matter. Some platforms used a confirmation window but only for logging out. In the survey, we decided to focus on message creation as this is a core function in all platforms and it could give elderly more confidence if they know that they still can change their mind before sending a message. We added an example image of a confirmation window to the question *“Would you like to see a confirmation before your message is made visible to other users?”*. The options for answering were: ‘yes’; ‘no’; and ‘yes, but I also want to see a summary of my message’. This question was modified slightly for the P4 survey with the example image showing also a summary of the message directly and giving only yes/no options to the participants. The collected results from all three questionnaires are given in Figure 6.7.

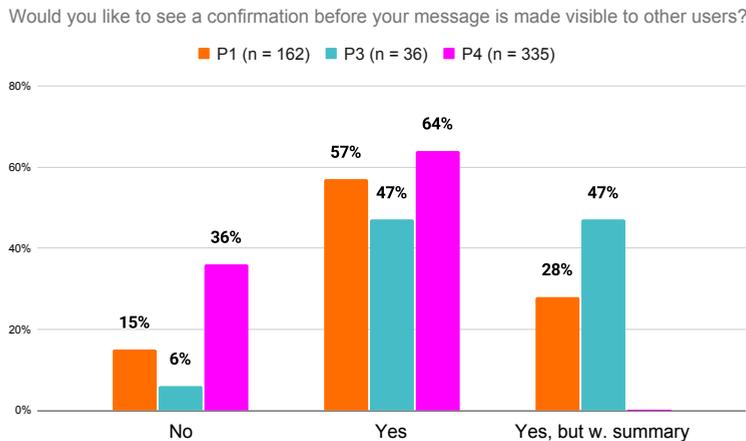


Figure 6.7: Results of the question on confirmation windows. Note that in the case of P4 a summary was embedded in the given example

### (R5) Usability guidelines: Scrolling vs. pagination

Because we had the feeling that the guideline to prefer the use of pagination over scrolling is a somewhat outdated guideline, we wanted to see how the users of the SE platforms perceived this. Thus, we provides different popular navigation techniques: 1) infinite scrolling, 2) partial scrolling and 3) pagination (no scrolling), and asked the participants indicate their preference. The different methods were illustrated with simple example images. They could also choose option 4) “I don’t care”. Results are shown in Figure 6.8

Pagination was chosen over infinite scrolling in the case of P1 and P3, though all platforms utilise infinite scrolling. When comparing age groups, a slight trend of preferring pagination could also be seen in the older age groups in all three surveys, though in the case of P4, the “I don’t care” group essentially became the winner when looking at the age group from 66 onward.

### (R5) Usability guidelines: User interface layout

The layout of the user interfaces of the three platforms could roughly be divided into two approaches: 1) pins on a map (P1 and P3); 2) Infinite scrolling of user-created content (P4). We were curious to know whether the participants found their respective main page layout usable. For the participants of P1 and P3 a simple statement was provided: “*The Map of the platform allows me to easily choose from messages near me*” with options to agree or disagree with the statement. The results to this question are given in Figure 6.9. Filtering answers by different age groups did not yield noticeable differences. We also asked the users of P4 if they think that “*Seeing the location of a request on a*

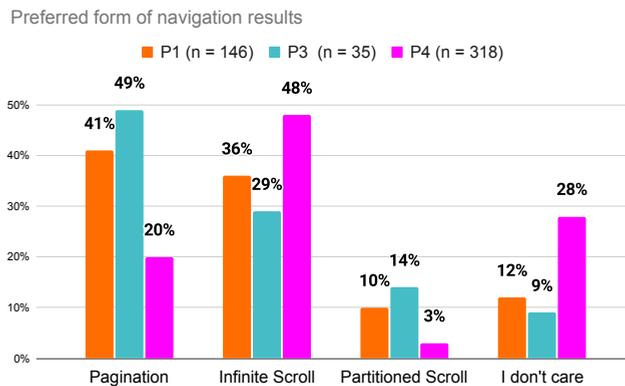


Figure 6.8: Preference for the way of navigating through posts

*map would be helpful*”; the Likert scale results of these questions are shown in Figure 6.9

We also devised additional questions focusing specifically on the more complex layout of P4, which has several buttons and options spread on either side of the core content, as shown in Figure 6.11. Additionally, users are directly given eighth different message options, as shown in Figure 6.11 (buttons below the “Create Request” text; note that figure is obfuscated to make identifying P4 harder). Two questions were made: 1) a question to get the overall user impression of the home page: “*The current homepage of P4 is clear and easy to use*”, and 2) a question focusing on the multiple message options given: “*The options for the different types of messages and the current way of presenting them are clear to me*”. A screenshot was provided with the second question. The results to these questions are given in Figure 6.10.

As we assumed that users might struggle to directly criticise anything on the P4 main page in a survey provide on P4, our last question asked the participant to indicate which parts of the main page were less important to him or her. The participants were presented with an image of the main page and asked to click up to ten areas in the image that they had no interest in. Qualtrics allows dividing an image to sectors that are not visible to the respondents, for an easier grouping of results. Figure 6.11 shows an abstract version of the heat map. The original heat map image is not shown to ensure the anonymity of P4. The figure also shows the results of the heat map generated from the clicks. In total 101 participants completed this task.

### (R5) Usability guidelines: Message feed

As far as we know, only P1 clears old user-created content automatically. We wanted to investigate whether participants would find a feature to “remove” some of the older messages or content useful. The question was presented as

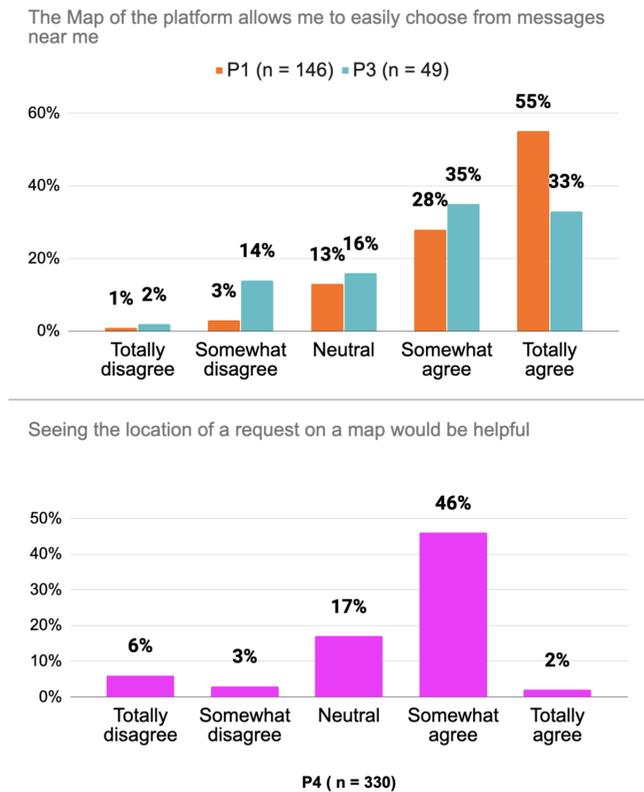


Figure 6.9: Results for how the map view is perceived by P1 and P3 users and would users from P4 want to see similar feature on their platform

a statement: *“It would be useful to easily remove my old requests or notifications”*, with the options to “agree” or “disagree”. The results for the questions are shown in Figure 6.12.

### (R7) Audio & video messages

We were curious to know whether especially elderly users would like the option to be able to create and send an audio or a video message. In all three surveys we asked the participants: *“Would you like to be able to create video and/or audio messages in addition to text messages?”* (see Figure 6.13).

Due to the varied use cases for P4 participants to utilise the platform, we also divided the responses by age groups and filtered users that had either offered or requested for help. The results of which are visible in Table 6.3. However, note that the number of answers drops significantly in that case, to a total number of 127.

Results to opinion on: A) Current landingpage (web) B) Message types and presentation being clear

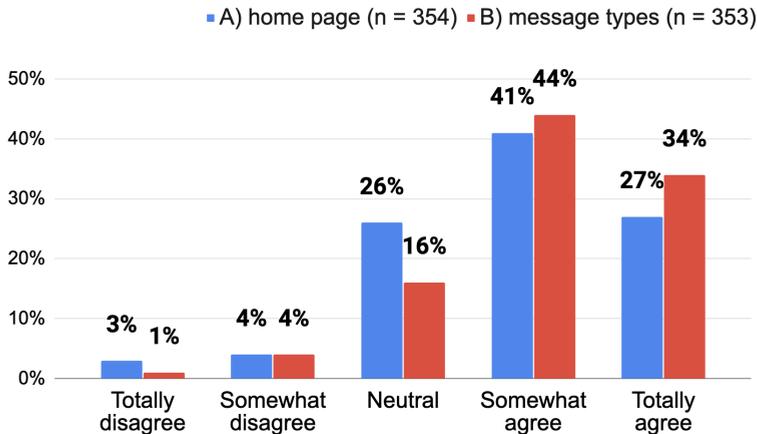


Figure 6.10: Results on whether participants found P4's message types and presentation clear

Table 6.3: Audio and Video messages divided by age groups and showing only participants that had either offered to help or created a help request

Field	15-25	26-35	36-45	46-55	56-65	66-75	76-85	86 or older	Total								
Yes, also audio messages	0%	0	0%	0	100%	1	0%	0	0%	0	1						
Yes, also video messages	25%	1	0%	0	0%	0	50%	2	25%	1	0%	0	0%	0	4		
Yes, both	3%	1	10%	3	3%	1	16%	5	45%	14	13%	4	10%	3	0%	0	31
No, text messages work fine	0%	0	8%	7	11%	10	19%	17	32%	29	20%	18	10%	9	1%	1	91

In the case of the P1 survey, participants were asked to comment on their selection. When we filter responses based on who had replied positively on audio and/or video messages (n=23), the responses could be divided between seeing audio more easy to make and video as adding security, and being useful to people needing sign language. Interestingly, a number of participants who had selected both (audio and video), stated that they personally did not need this feature but did see it as a beneficial option for other users.

In the case of the P4 survey, we also supplemented the multimedia question with the followup statement *“Being able to hear messages out loud would be. . .”* with options: “useful to me”, “useful to some users”, “I have no opinion”. Out of the 335 responses, the majority (65%) selected the option stating that it could be useful to some users and only 2% stated it could be useful for themselves.

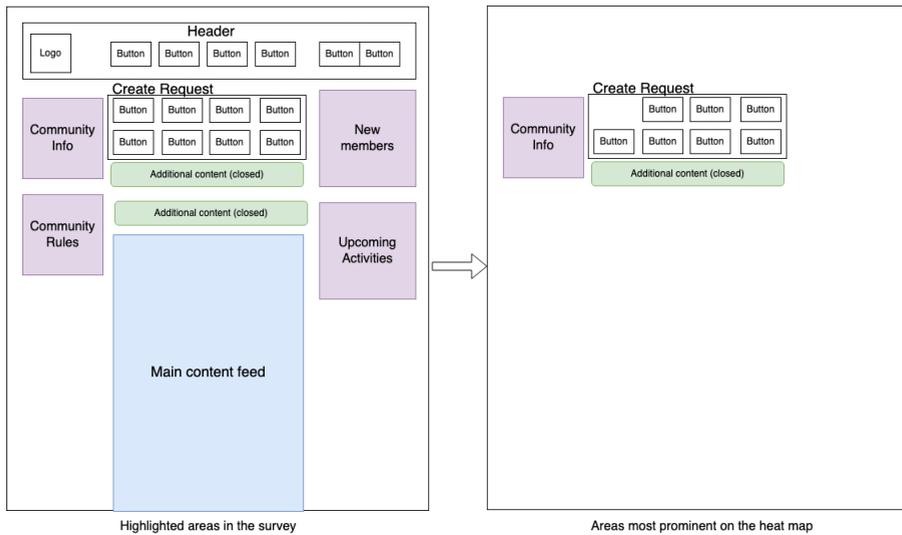


Figure 6.11: Heat map survey results. The left image shows the prominent marked areas (different areas are highlighted with different colors) as not very important on P4's main view and the image on the right shows which areas received most clicks from the participants and thus indicated as "less important".

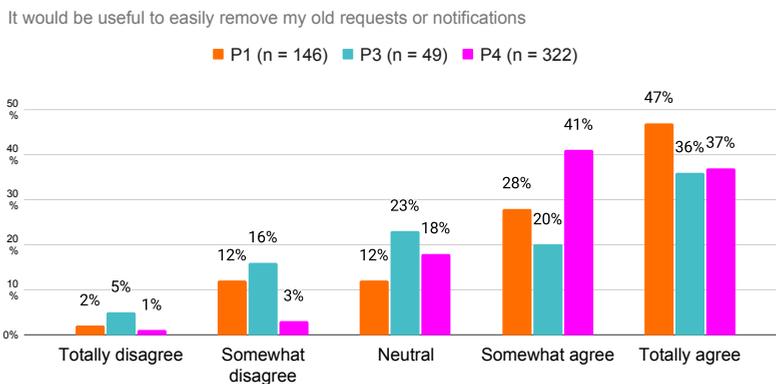


Figure 6.12: Results on whether participants see a need for removing old messages

## (R12) Help manuals

One point of interest was to investigate the need for a non-digital tool for aiding with the use of a SE platform. Paper manuals were already tentatively

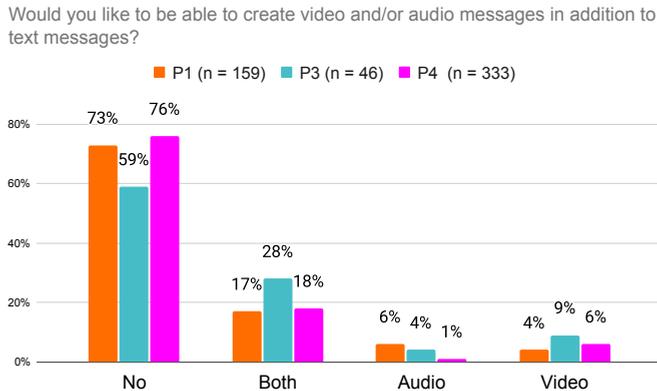


Figure 6.13: Results on whether participants prefer multimedia messages and which kind of media

suggested by Lee (2015), alongside her technology adoption factors (presented in Section 2.2.1). We also suggested a paper manual as part of our recommendations. Therefore, the following statement was present in all three surveys: *“It would be useful to also have a paper manual for the platform”*; results are shown in Figure 6.14.

In all three surveys the majority chose “Totally disagree” with “Somewhat disagree” as a close second. However, in the case of P1, the results were more towards supporting the concept when we filtered out younger participants. When looking at replies by age, the older age groups were largely behind the “Agree” statements.

In the first P1 survey, we also asked the participants to further explain their choice with an open question. The comments (n=100) were mostly (49) of the participants who saw no need for a paper manual, either in personally as in “I have no need for this”, or in more general terms. The group that was positive about paper manuals was roughly divided into two subgroups of which ten stated that they enjoy reading from paper or that it might be easier, and another group of ten stating that they personally had no need for it but that they saw it potentially useful to others. Lastly, four stated that it might be useful and in total nine specifically mentioned elderly as a potential target user.

### 6.3.3 Adoption Factor: Security & Trust

Here we take a look at the results of the surveys that cover topics focusing on improving security and building trust.

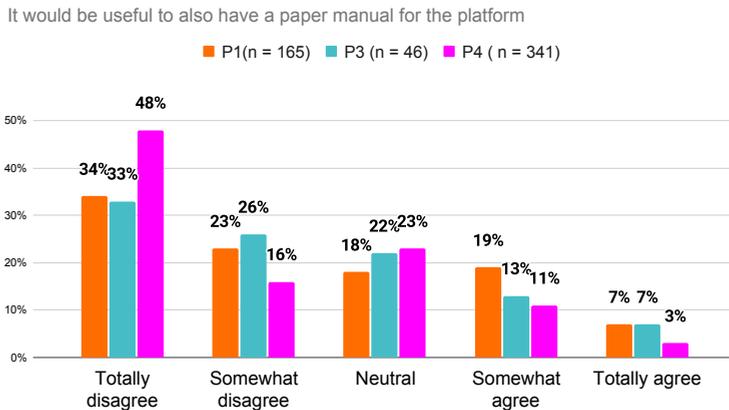


Figure 6.14: Likert results on questions regarding paper manual

## (R14) Safety features: Soft barriers

### Restrict who can see messages

One of our hypotheses was that the general lack of control over who can see help request messages and notifications can influence the users' perceived security, which in turn can affect the trust of both the service and other users. For this reason, we asked: *“Would you like control over who sees your help requests or notifications?”*. In the P1 and P3 surveys, four options were presented: “no, all members may see them”; “yes, but only for help requests”; “yes, but only for offers to help”; and “yes for both”. The question for P4 was slightly modified to ensure that users were aware of the context being the help requests and offers. The results for all three platforms is shown in Figure 6.15.

When we looked at results for P4 by filtering on different age groups, the results did not drastically change. However, when we looked at users who were aged 55 years or higher and had made a help request, the number rose slightly ( $n = 22$ ); the majority did still select “No”, but the total number of participants in favour of some form of control rose to 41%.

A followup question was also presented to the participants who agreed: *“Who would you prefer to see your requests & offers?”*. Four options were given with the possibility of selecting more than one option: “My family”; “People selected by me”; “People verified by a third party”; and “Other”. In all three surveys, user's own control was the most popular option, with a third party verification coming as the second highest preferred option. In the comments, some participants mentioned that instead of selecting a group to show messages to, having an option to exclude certain users or areas might be more useful.

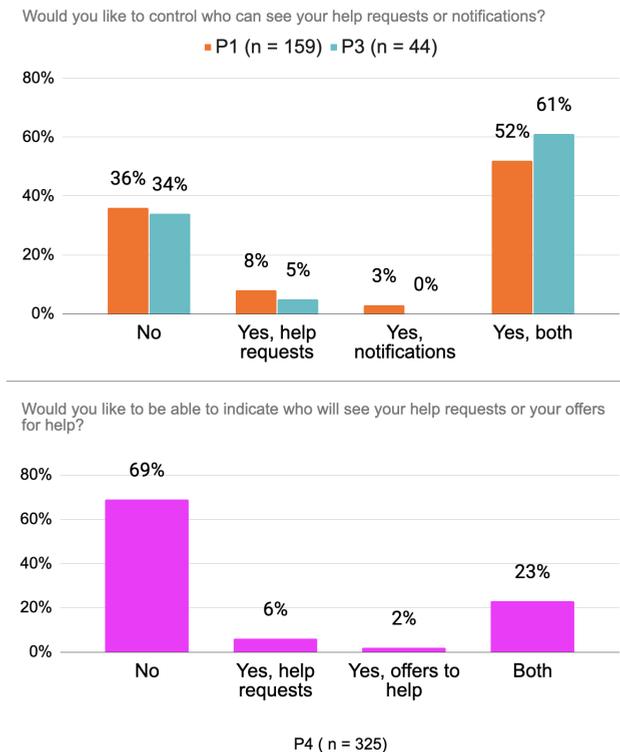


Figure 6.15: Results on whether participants want more control over who can see their requests. Margin of error: P1 8%, P3 12%, P4 5%

### Feedback system

Another approach increase safety and improve trust towards users could be a feedback system, akin to what Commu already utilises (user recommendations). The participants were asked whether they see the possibility to review or comment on encounters as a positive thing, or not. In the first two surveys (P1, P3), three options were given to participants: “no”; “yes”; and “yes, but anonymously”. In the third survey (P4), an additional fourth option “yes, but only visible to P4” was added. Results of the surveys can be seen in Figure 6.16.

It is noteworthy that the vocabulary used for formulating the question differed somewhat between the first two surveys and the third one. In the P1 and P3 survey, participants were asked whether they would like “to review” how an encounter had gone, where as in the P4 survey the term “leave a comment” was used instead. This change was done in part due to handful comments left in the P1 survey, where participants felt negatively about reviewing each other.

When filtering answers based on age, in the case of P1 younger participants

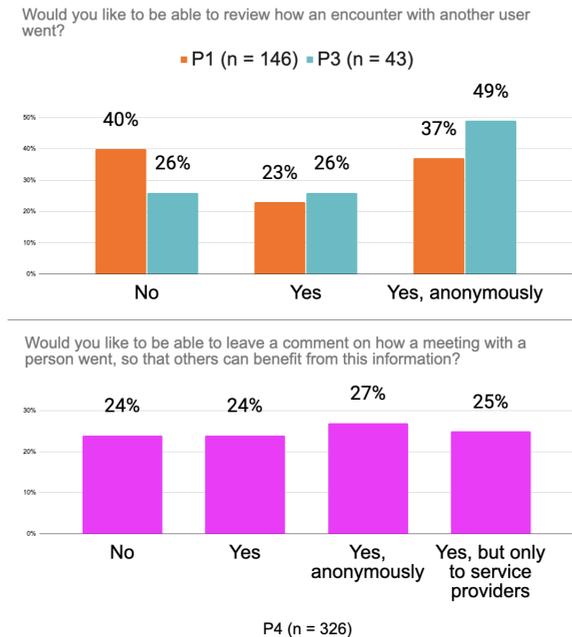


Figure 6.16: Results on whether participants want to be able to leave feedback on how their encounters with other users went. Margin of error: P1 8%, P3 12%, P4 5%

(age group 15–35; n=19) appeared to be more in favour of an anonymous review system (53%) with 32% being against it. When looking at older age groups (66 and up; n=40), 50% were against reviewing others users. P3 showed similar patterns, but the number of filtered responses was too low for any proper conclusion. P4 did not show as much no-answers as in the cases of P1.

P1 and P3 participants were also asked to elaborate on their choice by means of a text field. Especially the participants who had selected “no” differed in the reasons given:

1. Being afraid of receiving publicly negative feedback
2. Reviewing others is not preferable
3. Unnecessary
4. Unreliable
5. Dislike the concept of scoring
6. Comments are enough
7. Only positive feedback; negative feedback directly to service provider
8. “Vote with your feet” (Avoid that person in the future)

With the exception of 2), which was stated by three individuals, these were all individual comments. Positive comments varied mostly between four reasons:

trust, safety, quality of service, and feedback to the other party. Less surprisingly, the majority gave trust and/or safety as the main perceived benefit.

### **Control who can send you messages**

A third way of handling barriers that does go rather well hand in hand with the previous “feedback” solution, is to give users control over who can send them a message. P1 and P3 participants were presented with one potential way of handling this: “*Would you like to see more information about users before they can message you?*” and given a simple yes/no option, with the possibility to comment on their choice; results are shown in Figure 6.17.

Interestingly, comments on P1 (n=22) and P3 (n=7) were only from participants that had selected “no”. Most stated that as long as it is possible to block a message afterwards that is enough, or if the platform has several negative interactions. Lastly, on P1 remarks on already low level of activity were made, assuming that this would likely lead to making them also inactive.

P4 participants were presented with a slightly modified Likert statement: “*I would like to see more details about a person before she or he can contact me*”. The results can be seen in Figure 6.17.

### **(R15) Area of visibility**

This question was only applicable to P4 as it, like *¿Tienes Sal?* and Nextdoor, has a closed neighborhood, where users for most parts only see content from that area (though in the case of *¿Tienes Sal*, some content can be seen outside the user’s own “area”). The questions were deliberately framed only to cover help requests. Two separate questions were used: 1) “*I would like to be able to offer help to people outside my own neighborhood*” and 2) “*Seeing the location of a request on a map would be helpful*”. Results to these questions are shown in Figure 6.18.

### **(R16) Safety features: Meetings**

Participants were asked whether they would feel safer when meeting strangers if the meeting was announced to a third party. Participants were presented with a Likert statement: “*I would feel more safe meeting strangers if a third party that I had chosen was also made aware of the meeting*”. The responses from the three questionnaires can be seen in Figure 6.19. Another variation to this suggestion was to have a third party joining the meeting. In a similar fashion to the previous question, a Likert scale was used for the level of agreeing with this statement: “*I would feel more safe when meeting strangers if a third party joined the meeting*”. The results can be seen in Figure 6.20.

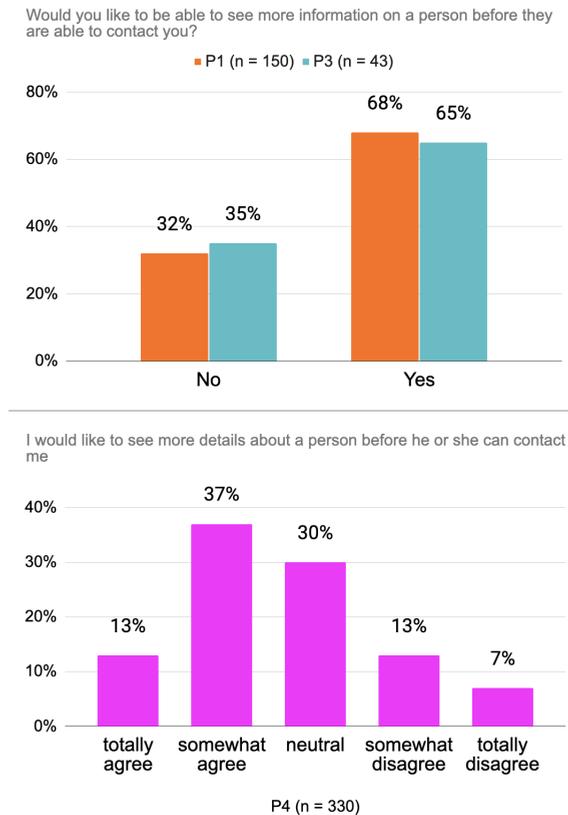


Figure 6.17: Results on whether users prefer to see more information on other user before they can contact. Margin of error: P1: 8%, P3: 12%, P4: 5%

### 6.3.4 Adoption factor: Dormant Users

#### (R13) User roles

A set of questions focusing on what roles participants might be interested in, outside the usual admin roles was presented. Like our other questions, these one also took a more clear shape by the third survey; on P1 and P3 the question was framed rather openly: *“I would gladly take up more responsibility on activating my own neighborhood. For example: helping elderly users to get to know the platform and use it, organizing events, etc.”*. Results are shown in Figure 6.21.

In the P4 survey, a question about additional user roles was presented; the following user roles were suggested, of which more than one option could be selected:

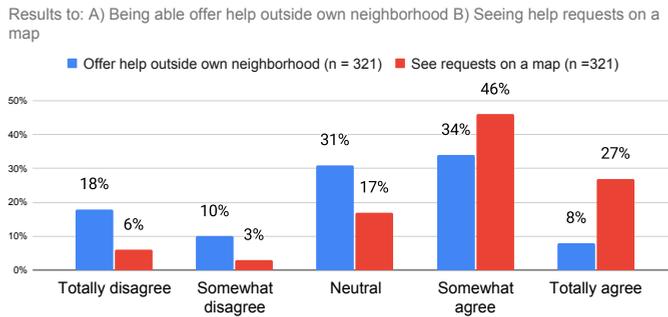


Figure 6.18: P4 results on help request related content being visible outside users' own neighborhood and showing them on a map. Margin of error:5%

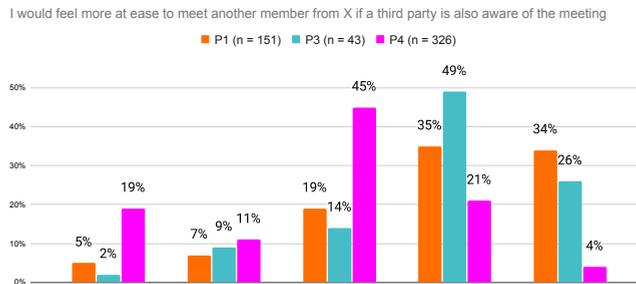


Figure 6.19: Results on perceived importance on notifying a third party about meeting. Margins of error: P1 8%, P3 12%, P4 5%

1. "Map manager"; 61%
2. "Event organiser"; 59%
3. "Municipality representative"; 51%
4. "Other?"; 7%

Note that the result percentages are calculated from the total number of participants ( $n = 284$ ). Individual suggestions given were: district inspector, local delegate, content moderator, police, neighborhood workers, and local news reporters.

#### (R16) Provide activities

In the second survey we added a more task focused question focusing on user roles: "I would be willing to complete small tasks in P3, such as checking and confirming content of notifications if I would received points or other recogni-

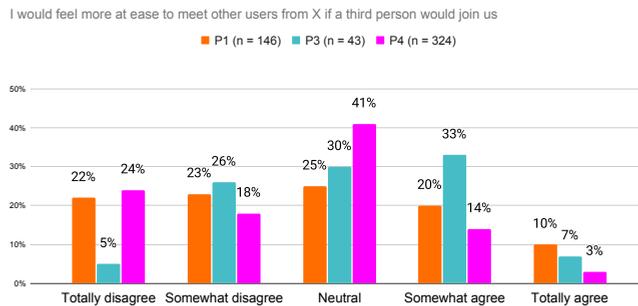


Figure 6.20: Results on perceived importance on a third party joining a meeting. Margins of error: P1 8%, P3 12%, P4 5%

*tion for doing so*". We decided to further modify the question for P4 and to drop the gamification remark and simply focus on overall willingness: *"I would be keen on doing small tasks for P4, such as checking whether old messages are still valid or helping people with learning to use the platform"*. Results for both are visible in Figure 6.21.

### 6.3.5 Missing Features

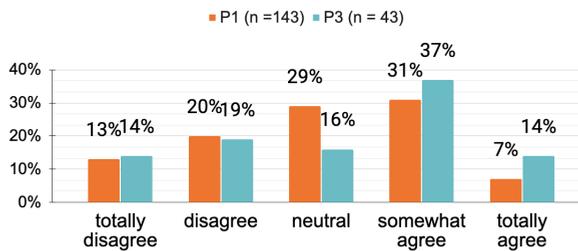
On P3 and P4, as last question before asking for open free form feedback, we showed some features and asked them to choose the ones they thought would fit the platform best; they could select multiple options. The list of features differed between the two surveys as it was improved for the P4 survey. Results are shown in Table 6.4.

P3 had only one written response in the "other" section, asking for a list of all open requests and grouped by categories. P4 had 22 responses, of which most did not add anything to the given list. However, these are worth mentioning: have end dates in request; and an integration with Cubigo (a service focused on elderly users); two mentioned wanting a moderator for messages, though with different use cases: the first suggestion was for deleting old messages and the second one to filter messages that are not acceptable.

## 6.4 Results of the Interview-based Evaluation

During the interviews with the five SE platform representatives (see Chapter 4) we also asked their opinions on some of our recommendations. In this section, we go through these parts of the interviews. As with the surveys, we deal with a specific recommendation at a time. Note that in the case of the P3 interview, two people were present, they have been added a number (e.g., P3-1) when quotes from both are given.

I would gladly take up more responsibility on activating my own neighbourhood.  
For example: helping elderly users to get to know the platform and use it,  
organizing events, etc.



Willingness to take on small tasks within the platform

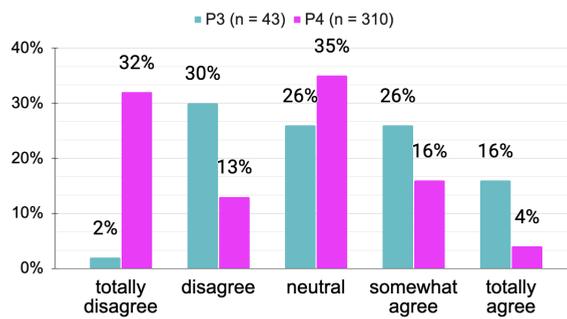


Figure 6.21: P1 and P3 results to question on taking on more responsibility and P3 and P4 results to questions on willingness to take on small tasks. Margins of error: P1 8%, P3 12%, P4 5%

#### 6.4.1 (R1) Points with a purpose (Emotion, Dormant Users)

The interviewees were given a very specific dummy scenario on how gamification could be used, largely based on how Steam's card rewards work as introduced in the previous Chapter 5, Section 5.3.1. A more thorough explanation about our proposed gamification approach will be given in Chapter 7. Here, we only give the scenario as it was explained to the interviewees: "As rewards for responding to help request, collectible cards would be given to every user of the platform. The card shows who (username) collected it and in turn, the collector of card can see how many times it has been used in a gameplay". The question given to the interviewees was whether they would see this as a useful and effective approach for engaging or motivating users in the platform and attract new users.

**P1:** "Yes. Especially if the more the platform is used it generates content and not necessarily rewards the individuals. I think it's a good idea of rewarding activity in the platform. Especially noticing good feedback from other users."

Table 6.4: Participants’ selections to a suggested list of features to improve the platform. The information is represented by the number of respondents, which is defined as follows by qualtrics: “Base data on the number of respondents. This will only ever add up to the number of respondents who answered the question.”

P4		
“Which of the following features you think might improve the P4 platform (you can select multiple features)?”		
options	choice count	
“Being able to see what is happening in neighboring areas”	68%	168
“Communicate with users outside your own neighbourhood (family, friends, etc)”	38%	94
“Ability to compare the activity of your neighbourhood with others”	26%	64
“Hiding messages from certain users”	19%	46
“Something else?”	10%	26
	participants	248
P3		
“Which of the following features would, in your opinion, suit P3?”		
options	choice count	
“Having a representative from the country or municipality”	56%	24
“Restricted groups (For example, users in the same city)”	37%	16
“Ability to compare own level of activity with other users”	9%	4
“Ability to compare the activity level of my own neighborhood with other neighborhoods”	5%	2
“Hiding notifications from certain users”	2%	1
“Other?”	2%	1
	participants	43

*And we would need more feedback... I think that is really good idea... It is difficult to know for sure (validation) but creating a digital community that remains active for a long time is challenging. The community should be large.”*

**P2:** *“So cool! I think it is very interesting and very different approach. And might create a way that the people carry on and not only in the beginning. I think it could work. Engagement is very difficult. People usually join for a specific need. Wanting to help, or being alone. After achieving this, they might not carry on, since the need is fulfilled. Which makes sense and is good. We keep engagement through a new generation of users...It think it is a very good idea.”*

**P3:** *“Yes. Adding points is easy and creating a leaderboard is also rather easy. In the game world meta gaming is the name as in ‘what can you do with these points’. In some cases you collect karma without value. But to have some focus on collecting is a really good feature in my opinion”*

**P4:** *“Ok. I think this example is very interesting since it is inter-generational. I think it is very interesting. Since everyone is struggling to get this inter-generational contact.”*

**P5:** *“...Maybe that could be one way to do it, I don’t know.”*

## 6.4.2 (R2) Show activity (Emotion)

We asked the interviewees whether (visually) showing how the user community is growing could be a source of motivation for the users. Note that this question was not asked to the representative of P1, P2, and P5, as this was a

recommendation that was emerged from the P1 survey result, which was after these interviews.

The answers were as follows:

**P3-2:** *“Definitely. My dream is to have competitions between towns on which one is doing more good, or areas within cites, using postcodes for example. Having a common mission on doing good. On Facebook, for example, people are asking what kind of place is this. Is it a friendly neighbourhood? We could somehow show it via the application that we are the best area in this town.”*

**P3-1:** *“I also like this idea and you can discuss on how to actually implement it. I think it’s also a meta game, like you do something and the progress is shown somewhere. I absolutely like this idea.”*

**P3-2:** *“If you want to push the platform outside of just being for an individual, but also for the community. Sharpening the “common goal”.”*

**P4:** *“It might cause comparison that oh, our neighbourhood is not doing well. I think the growth chart is very interesting. A very good idea... ”*

### 6.4.3 (R5) Usability guidelines: Message Feed (Usability)

We asked the interviewees whether they were seeing any value in removing non-active or old help requests from the system.

**P3-1:** *“We have debated on this issue a bit. If you can recognise that there is a non active request, it is a good excuse to contact a user, assuming we can actually reach them. What we have debated, whether we should remove or try to get rid of these types of message. I don’t think we have a need to remove these, but at the same time leaving inactive request can turn against us. For example generating a message “hey, your request has been active for 3 months” and contact them like that.”*

**P3-2:** *“We have tested contacting people behind several inactive requests via email that has been disguised as an automated message. It has activated some people to login in to check their requests.”*

### 6.4.4 (R7) Audio & video messages (Usability)

Responses to the question on whether especially elderly users would benefit from adding audio and video message capabilities to these platforms were as follows:

**P1:** *“Yes. Really a good idea.”*

**P2:** *“I think having both options might be useful. Some users might, but typing is not the most easy thing. But some might feel more exposed from sending these types of messages.”*

**P3-1:** *“Yes”*; **P3-2:** *“Yes, absolutely. yes”*

**P4:** *“I think. Would be interesting to see if people would use it. Yes. Maybe, maybe. It is bit like calling, no? You just do the phone icon and maybe record a message. I think it would be interesting to see.”*

**P5:** *“I think yeah. Because that is one...for older people who do not exactly speak the language. For instance in the north African communities, they use Whatsapp a lot, but the vocal thing. So that is one of the things we are considering. With video with step by step, how to use it.”*

#### 6.4.5 (R15) Safety features (Security & Trust)

To explain our approach for soft barriers, we explained our own approach to this to the interviewees (a more detailed explanation of this is given in Chapter 7) and asked their opinion on it. Here, we only cover the brief scenario given to interviewees: “Before a volunteer can contact the elderly users, they (the elderly) sees the details of the volunteer and is given the option to accept or reject the offer. Only after accepting are contact details given to the volunteer. Volunteer is also asked to mark when the task is done, after which this is still confirmed with the elderly user.”

**P1:** *“...that is a good idea that the elderly person gets to decide after seeing info about the helper. I think it is a really good idea. Especially on making refusal easy, instead of not answering at all in an open chat. We don't have a method to say anyone “no”. I think that is really important, because elderly often are afraid of someone becoming a burden. Also people are afraid of being rejected.”*

**P2:** *“I think it is a very good idea. One thing is to go for a coffee, but for actual help request, to make the elderly person feel comfortable. We don't really have this on our platform.”*

**P3-2:** *“Yes, I would especially see the benefit if the case is bit more sensitive. Talking about suicide or rape. I would not place a notification like that openly to P3. It would be better to have a case to justify why this person in particular would be a good person to talk about it with. In this case your system would be better.”*

**P3-1:** *“In P3's case the justification could in the chat. You open the chat and over there have the conversation. How can you have knowledge before hand that this person is correct for the conversation.”*

**P3-2:** *“... In the case of elderly yours (context: talking about cons of open chat vs. confirmation) is better that you can confirm. Of course you can also discuss in the chat if you have common values and if the chat does not go you can leave it that. But there might not be a ‘soft’ message. Its completely in the hands of the users”*

**P4:** *“It is really interesting.... I think the acceptance step is very important.”*

**P5:** *“I guess yes... if they know there is control and I can give feedback if things do not go well. AND easy feedback, not necessarily online, but maybe a phone number.”*

**I:**

*Do you see benefit in offering the user's a possibility to review their interactions?*

**P2:** *"I think that would be useful. It would give you a better idea of the other person."*

**P1:** *"...I do feel that it would increase user satisfaction if we had some solution to this. We should have some sort of user review type features, or maybe not a review, but "thank you it went fine!". Some sort of trustworthiness badges..."*

**P4:** *"Yes"*

**P5:** *"I guess, yes."*

#### 6.4.6 (R13) User roles (Dormant Users)

**I:**

*Activating passive users through small objectives that might also help the platform. Maybe in similar fashion to google. Message moderation, or something like that?*

**P3-1:** *"Yes. This is something we have discussed probably most. We have a lot of passive users, since this is also a passive platform. We have notification once a day. It is really neat, but then again if a user does not get a notification they know that there is nothing new to see on the platform... How to activating is a big question. Our big challenge is to make the application from passive to an active application. At the moment our approach is through messaging. Probably one big hook is through new content, or email notifications. "*

**P4:** *"It is very interesting. I never thought of this. We also have this problem. If people have something active to do, they appreciate it. We do ask some questions on how do they like their local neighbourhood via a small questionnaire. We would also like to have a small Wikipedia page for the community, or maybe also a photo album collecting photos."*

## 6.5 Discussion

The previous sections have presented the results from our survey and interviews that aimed to validate a selection of our recommendations. We now discuss these results to draw conclusions.

### 6.5.1 (R1) Points with purpose

Overall, the reactions in the surveys on the proposal to introduce points were mixed and rather inclined toward being negative or neutral (no strong feeling about the topic in one way or a the other). However, as no clear examples

about how the points would be used were given, participants may have based their opinion on their knowledge about the use of points in other systems. Seeing that the majority of the respondents on P1 and P4 were 55 and older, the reactions to our questions on points with purpose, were not surprising as older adults are in general less familiar with gamification. However, we should note that this form of gamification would not be intended for elderly users, but rather for the volunteers who would in general be in younger age groups. The results of the surveys suggest that younger age groups reacted more positively to many of the points related questions. However, what we did not expect was how the suggestions for pointification apparently elicited emotional responses from some users, in both positive and negative sense. The reactions can in part be explained by the fact that we didn't explain in detail how the points would be used (as this would have resulted in a quite long explanation). However, it is something to bear in mind that a small minority of users might react strongly against it, meaning that especially more competitive point systems such as leaderboards, need to be well thought out if implemented.

On the other hand, the reactions of nearly all the representatives in the interview were optimistic reactions. However to them, a more detailed method of how to apply this point system was given.

We can conclude that points with a purpose is a useful recommendation, but it is also clear that great care on how this would be implemented and communicated is needed in order to avoid negative reactions and the risk that it backfires.

### 6.5.2 (R2) Show activity

Overall, most platforms show how active they are by means of the amount of created content that a user can see when logging in. In the case of P1 and P3, this are pins visible on a map; the more pins, the higher the level of activity can be assumed. In the case of P4, this is based on the amount of messages that were created on the day the user logs in. If the last message is several days old or older, users may conclude that the platform is not very active.

In all three platforms, a majority of the respondents wanted more information on how active their neighborhood is. A visual representation that changes over time based on users' activity, could be a source of motivation on itself to more frequently consult the platform and even if not, it still will serve the main purpose of informing users better on the current level of activity.

Additionally, representatives from P3 and P4 were quite positive when we suggested this type of feature, with the thought that this could also work as an incentive to have a benign competition between different communities. The results of the P4 survey also indicated that around a quarter of P4's users were tentatively open to "friendly competitions between neighborhoods".

In terms of what information specifically users were interested in seeing, most request were on seeing lists of completed help requests, past requests, and especially the number of currently active users (P1 and P3 survey).

### 6.5.3 (R5) Usability guidelines

**Confirmation Window:** For this feature, the reactions were as expected. The majority of respondents were in favor of confirmation windows coupled with summaries. Therefore, we do recommend having this feature, as it might positively affect the user’s confidence (i.e., being in control). Of course, offering a way to disable the feature, or implement it in such a way that it does no slow down the process, is advised (for example P3’s approach to request creation).

**Scrolling vs. Pagination:** Results suggest that this a personal preference; some prefer scrolling, others pagination. Although, usability guidelines suggest that scrolling should be avoided, it looks like scrolling appears to be a perfectly fine approach, as long as it is implemented in a manner that users always know when they are expected to scroll for more information.

**User Interface Layout:** As already stated, none of the platforms surveyed had any major user interface issues. P4’s landing page however is currently rather busy. Based on the heat map showing the areas that respondents had no interest in (see Figure 6.11 in Section 6.3.2), some minor tweaking might be in order, such as, condensing the eight message types into fewer, or using only one button. A number of users also marked the new “Trending messages” feature, but this was at the time of the survey a brand new feature, only implemented a week before, meaning that user were probably not familiar with it and therefore no conclusion can be drawn for this feature. Also, the banner that shows the percentage of joined neighbors and offers guidance on how to recruit might work better by simply displaying the percentage bar, as the clicks were largely focused on this area and not on the bar itself. This type of UI tweaking could ideally bring an ideal way to realize the recommendation (R8) “*Customization*” that could allows users to, for example, hide some of the features.

**Message Feeds:** Removing old messages was posed as a question, not out of concern towards the platforms’ pages becoming cluttered, but rather from its suitability to be a task for a potential role for a user. The high number of participants indicating that clearing out old messages could be a good feature does give weight for both a) needing this feature and b) assigning it as a task to some users.

### 6.5.4 (R7) Audio & video messages

Somewhat surprisingly, the suggestion for audio and video messages was something that was received less enthusiastically in the surveys. Though even in this case, over a quarter of the respondents on all surveys were in favor of it. Something that could have affected the lower positive results for this feature in

the P4 survey is that we did not focus specifically on help request and offers. However, respondents did often mention that they see this as a useful feature for elderly users. This was also backed up by the fact that, in the P4 survey, 65% of the responses found that being able to hear messages was a good feature for “some users”.

Interviewees did react positively on the suggestion to have audio and video messages. In terms of elderly users, it appears that audio messages should take precedence over video as making a video might be more difficult to do.

### 6.5.5 (R12) Help manuals

Not surprisingly, younger participants were not in favor of having paper manuals. However, a small minority in three surveys would like to have them. Based on some of open comments, most see it beneficial to other users, but a handful did mention that they prefer reading from a paper. The most practical approach to provide a paper manual would likely to have a small pamphlet that showcases the platform, gives some detailed step-by-step instructions for essential features, and has instructions on how to access and use the on-site help. In this manner, such a pamphlet could also contribute to the *Value* factor. Note that the development of such a paper manual could best be done in a user centered way to properly fit the target audiences’ needs.

### 6.5.6 (R14) Safety features: Soft barriers

**Restrict who can see messages:** The results for the questions related to this recommendation (Section 6.3.3) were somewhat interesting in how they differed between the two Finnish platforms (P1 and P3) and P4. Participants from P4 were much more against this form of control, with 69% stating that they did not want to restrict a help request’s visibility, whereas on P1 and P3 the results were practically the exact opposite. Some reason for this might be cultural, but could also be the differences between how these platforms operate. Also note that the majority of P4’s participants who chose the negative option, had actually not created help requests. About how the restriction should be done, giving the power to the users was the most popular option. Second most popular option was “third-party validated” people.

**Feedback system:** Originally, when we were looking at potential methods for leaving feedback, a simple star-based review system was considered. However, perhaps less surprisingly, when asked about this in the P1 survey, some of the responses reacted very negatively to the concept of reviewing one another. However, the majority were in favor of being able to give feedback on their encounters as a whole. Anonymous reviewing was the most popular method on all three platforms. Both parties should also be able to give feedback, the person requesting the help but also the volunteer. Something akin to P3’s approach (where only positive comments are shown and negative feedback goes

directly to the platform) is likely, in terms of avoiding conflicts, rather effective. However, this does not directly protect users from people who have caused negative experiences but not so badly that they have been removed from the platform.

**Control who can send you messages:** Leaving the moderation to individual users in terms of accepting or rejecting incoming messages was perceived as a positive feature in the surveys. What kind of information about a person would be needed, was not specified. This will require another investigation.

### 6.5.7 (R14) Safety features: Meetings

Based on our findings given in Section 6.3.3, if a user is willing to meet, they rarely take up any precautions, except perhaps to organise the meeting outside. We wanted to explore users' opinion towards some proposed safety features: A) a third party was informed about a meeting, or B) a third party was invited to join a meeting. P1's and P3's respondents were very much in favor of A), whereas P4's respondents were not, which could potentially be again either due to cultural differences, or simply because a lot of the respondents on P4 were not planning on meeting anyone anyway. Less surprisingly, the suggestion B) gained less support, but enough to warrant further investigation.

Of course, option B) would complicate the organisation of a meeting. One way to mitigate this is by having predetermined dates when, for instance a volunteer would be available to join. There are certainly other unforeseen challenges in this approach, but it could be essential for some users that otherwise would feel vulnerable.

### 6.5.8 (R15) Area of Visibility

Overall, the results on whether users were interested in seeing help requests from outside their own neighborhood (as already possible in P2) were mixed and between agreeing and neutral. If implemented, care should be taken to ensure that users who just want to see their neighborhoods feed can do so and vice versa, e.g., by means of customization (recommendation (R8)).

### 6.5.9 (R13) User roles and (R16) Provide activities

Recruiting users for performing simple tasks withing large online platforms is a proven method and a small minority of the respondents was in all three platforms open for taking more responsibility in the platform, e.g., in the form of assigning roles to users. The roles suggested were all relatively popular, such as, event organizing, managing points of interest on a map, and municipality representative. A number of suggestions given on P4 were focused on increasing direct contact with the local municipality.

Looking at willingness on “taking up responsibility” (P1, P3) and “taking up small tasks” (P3, P4), a small minority do seem to be open to this avenue of activation.

### 6.5.10 General Remark

Based on comments, certain respondents have a strong opinion about how these platforms should work. For instance, in the comments focusing on points, a number of individual comments referred to the altruistic nature of these platforms and that one should not expect anything in return for helping, but rather help from the sheer joy of helping. Questions that they believed to insinuate that other means of motivation might be needed, were rated rather negatively. Our main takeaway from this is, that there is a need for clearly communicate the purpose of certain features.

## 6.6 Conclusions

In this chapter, we have reported on the evaluation of eight of our recommendations by means of the users survey responses and/or the responses of interviewees. For most parts, these recommendations have been validated, i.e., meaning that the potential of a recommendation for its designated factor, such as emotion, is supported to a relatively high degree by either interviews, user surveys or both.

**Limitations.** This evaluation has two major limitations. Being a survey, the questions were fixed and no further in depth inquiry could be made about the answers. Additionally, the survey evolving slightly between the three applications (mainly based on the answers received). This makes it more difficult to draw conclusions in terms of the number of participants agreeing or not with a statement.

Furthermore, we note that a majority of the participants for P1 and P3 who completed the surveys fully were female, in the case of P1 this was 81% and for P3 62%. This could have had an impact on the results, although it may also be the case that it is a reflection of the number of female users on these platforms. P1 and P4 had distinctly different age groups in terms of participants when compared with P3, but unfortunately the response rate of P3 was substantially lower and therefore it is not possible to generalize the results in terms of age groups, the higher level of agreeableness towards some of our gamification questions in P3.

We are aware that all of our recommendations require a more stringent evaluation process and will require fine-tuning before they can actually be implemented. In addition, their implementation may require to be specific and dependent on the platform on which they will be used on. For instance, what works on P4 might not work on P1 or P3. Cultural differences may play a role in this.

More focused studies might also help to fix the current leaning for “neutral” options, especially in the case of P4. Out of various reasons why a participants might choose the neutral option, two are important to consider in any future studies: A) The participant has no strong opinion on the question. To deal with this, it is necessary to investigate which methods can elicit opinions; B) The respondent did not understand the question. This could be solved by running more pilot surveys with individuals from the target audience before actual conducting the survey. Such pilot studies might reveal this.

## Chapter 7

# Nosville: Proof of Concept Social Engagement Platform

### 7.1 Introduction

In the previous chapters, we have introduced, surveyed, and discussed several topics: technology adoption, design guidelines for elderly users, digital engagement and motivation approaches (i.e., gamification, persuasive technology, and nudging). We also did extensive evaluations of SE platforms. Based on the finding, we formulated recommendations to improve these kind of platforms, especially from the viewpoint of providing better adoption by elderly and to improve long-term engagement.

A selected number of recommendations were evaluated by means of surveys with end users of existing SE platforms and interviews performed with responsible persons from a number of SE platforms. Because the proof of the pudding is in the eating, we also develop software for our research objective, i.e., to digitally connect elderly with other members of their community and nurture a long-term engagement between the two groups. The software has been named Nosville. In a normal situation, we would have developed Nosville using a user centered approach, which would have made it possible to evaluate design ideas directly with the target audience. However, COVID-19 made it practically impossible to develop a software solution using this type of approach and to perform an experiment with the target audience over a longer time period. Long term experimentation would have been necessary for evaluating the recommendations concerning long-term effectiveness. Therefore, a SE platform was developed based on the findings discussed in the previous chapters and a small online (i.e., pilot) user study, including working software fragments for a number of features of our software solution, was performed to evaluate them. To deal with the long-term engagement, a gamification solution including a card game was elaborated and implemented. For the game

itself, an expert evaluation was performed. However, as already indicated, the evaluation of whether the proposed gamification approach is able to achieve long-term engagement could require an experiment with the target audiences over a longer period which could not be performed.

In this chapter, we present Nosville our proof of concept platform to meet our research objective. We will cover how it was developed, as well as the results of the evaluations. Nosville is partly based on an existing research framework developed in our research group, but adapted and extended to deal with the functionality of a SE platform and to implement our recommendations.

This chapter is structured as follows: First, we present Nosville (Section 7.2). Next, in Section 7.3, we discuss the evaluation performed for the SE platform part of Nosville. In Section 7.3.4, we present the evaluation of the Nosville game. The chapter ends with the conclusion (Section 7.4) and a summary (Section 7.5).

## 7.2 Nosville

Nosville is the name given to the platform developed with the intention to test our recommendations. It is a fully functioning web application built partly on top of the TICKLE framework (De Troyer et al., 2019, 2020), which is a web platform intended for engaging youngsters for learning. TICKLE utilizes collectible location-based cards as one of its main features. In Nosville, these cards were converted to help requests.

We first provide some background information on the TICKLE framework on which Nosville is partly based (Section 7.2.1). Next, we provide a short description of Nosville (Section 7.2.2). Then, we elaborate on the solution implemented regarding help requests, on the language use, guidance, and the map view (Sections 7.2.3, 7.2.4, 7.2.5, 7.2.6) and in Section 7.2.7 we present our gamification solution.

### 7.2.1 TICKLE Framework

TICKLE<sup>1</sup> was a research project aimed at tackling school burnout of pupils within the Brussels Region. As part of the project, a web application was developed that utilised several concepts (also discussed in this dissertation), such as gamification and persuasive techniques, to increase the engagement and motivation of youngsters for learning.

The application was developed in an iterative approach. It allows content creators (school, teachers, or others) to easily create learning content. The learning content is offered to the youngsters in the form of collectible digital cards attached (and related) to locations in a neighborhood. Youngsters can collect these cards by visiting these locations and solving small assignments.

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<sup>1</sup><https://wise.vub.ac.be/tickle>

By using such a playful way of informal learning, the aim is to show young people that learning can also be fun and in this way motivate them to go back to learning (De Troyer et al., 2019, 2020).

TICKLE is a full-stack platform, with the web application behaving as the front-end and a back-end handling background functionality, such as sending notifications, giving recommendations, and maintaining data, and running on a Firebase<sup>2</sup> server.

### 7.2.2 Overview of Nosville

The Nosville project was originally envisioned to study the potential of a game for indirectly stimulating long-term engagement in SE platforms by the means of loosely coupled platforms (Lindberg et al., 2019). The project consisted of two platforms: 1) a web application built on top of TICKLE with the intent to allow creating and responding to help requests, and 2) a digital card game built from scratch using the Unity3D game engine<sup>3</sup>. The Game is a mix of 2D and 3D game play, with cards being simple 2D objects, but as they are played 3D buildings and roads appear in the play area, traffic is generated and eventually also pedestrians emerge. Most buildings are generic, selected randomly, but some location cards generate unique buildings, such as the fire station.

The main goal of complementing the SE platform with a game was to add more direct and indirect value for the volunteers to remain active on the SE platform. This was done a) by allowing volunteers to collect cards in the SE platform (for completing help requests) and b) by converting these cards into playable game cards within a game. By doing so, we hoped to create a self feeding community of two groups of users: the volunteers using the SE platform and the users playing the game. The hypothesis is that the gamers will stimulate the volunteers to collect more cards as they need these as resources to play the game. Note that the volunteers and the gamers can be two different groups of people, for instance the gamers could be relatives or friends of the volunteers.

A simplified picture of how the two platforms were intended to affect each other is given in Figure 7.1. Though the actual process is slightly more complex, it can be summarized in three steps: 1) a volunteer completes a help request, 2) a digital card is (randomly) generated and made playable within the game platform to all users. The volunteer is marked as the “collector” of the card. 3) The volunteer is given statistics of how many cards he/she has collected, and are being used in the game platform.

To develop the SE platform with respect to our recommendations, We added some new features to TICKLE, such as an embedded guidance tool that allows users to check available features on the current page, and info

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<sup>2</sup><https://firebase.google.com/>

<sup>3</sup><https://unity.com/>

buttons to provide info on expected user input. The platform's user interface was also retouched using our design guidelines (introduced in Chapter 2.1) to ensure that the platform would also be suitable for elderly. Other similar steps were taken to make the platform simpler to use with the intent of being usable by elderly users. Additionally, language support for Finnish, Dutch, French, and English was added due to a potential collaboration in Finland and the main research group being located in Brussels.

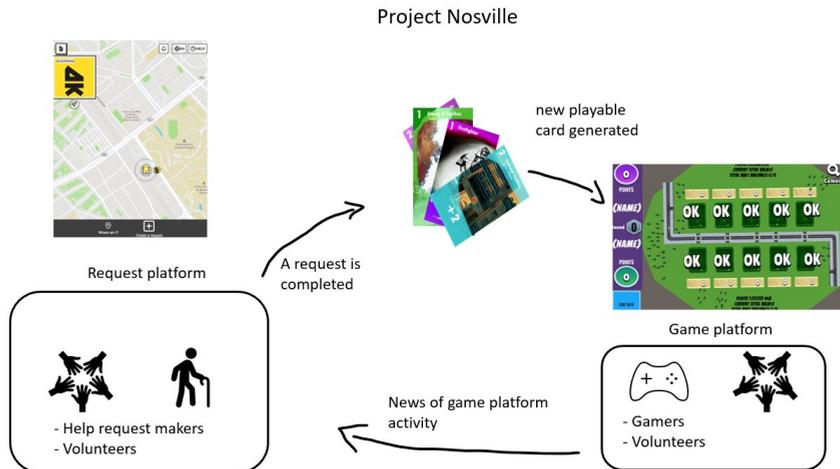


Figure 7.1: Simple illustration of the ideal feedback between the game and web application

In terms of developing the features of the web application, before COVID-19 a user centered approach was envisioned, involving elderly testers. At that time, a collaboration with a local volunteering organization was in the making. However, it soon became evident that this approach was not feasible anymore due to the COVID-19 measures. Hence, we continued the development based on the aforementioned design guidelines and formulated recommendations to ensure a good accessibility and usability for elderly users.

### 7.2.3 Help Requests

Creating and dealing with help requests is a core functionality of a SE platform. Such a flow was not available in the TICKLE application and therefore, it has been added. In the following, we describe this help request flow into more detail.

**Making a request:** The help request flow starts with the request maker (called beneficiary) creating a request (for help). This creation process is sim-

plified as much as possible by dividing a request into four parts (also illustrated in Figure 7.2):

- **What:** Entering the request's content. This is done by creating a message. The user (beneficiary) can enter text content, or record an audio message or a video message.
- **When:** Indicating when the request is needed. Three options are given: today, tomorrow, or this week.
- **How:** Indicating how somebody can contact the user. The user's phone and email address are automatically provided, but can easily be removed. An "other" field is provided to give another form of communication (e.g., a chat application).
- **Summary & Title:** A summary of the previous fields is shown. The user may edit them directly in the summary, if needed. At this point, a title for the request is asked; if none is given an automatic placeholder title will be used.

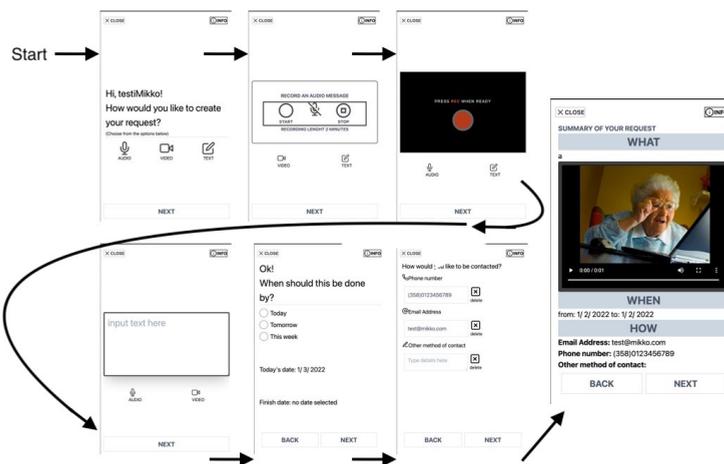


Figure 7.2: Screenshots of the request making steps: message type (text, video, or audio), ending time for the request, contact method, and summary

**Request process flow:** After the request has been created, a process flow that covers our recommendation (R14) *soft barrier* is started. A number of checks are embedded within the current request flow process, which are:

1. Beneficiary is shown the details of a helper and can choose to accept or reject an offer.
2. Only upon accepting the helper, the volunteer is shown the contact details of the beneficiary. If the offer from the volunteer is rejected by the

- beneficiary, the request is hidden for the volunteer and the volunteer receives a message stating that the request is no longer active (to avoid telling him that the beneficiary did not accept his/her offer).
3. A helper (volunteer) can indicate that according to him the help request has been fulfilled.
  4. When a help request is marked as fulfilled, a confirmation message coupled with a reward is sent to the volunteer and the beneficiary is asked to review how the help went. In the case that the beneficiary indicated that the request was not fulfilled, it is re-activated but hidden from the initial volunteer who gets a completion message and a smaller reward, in form of points.

The request flow is shown by means of an activity diagram in Figure 7.3.

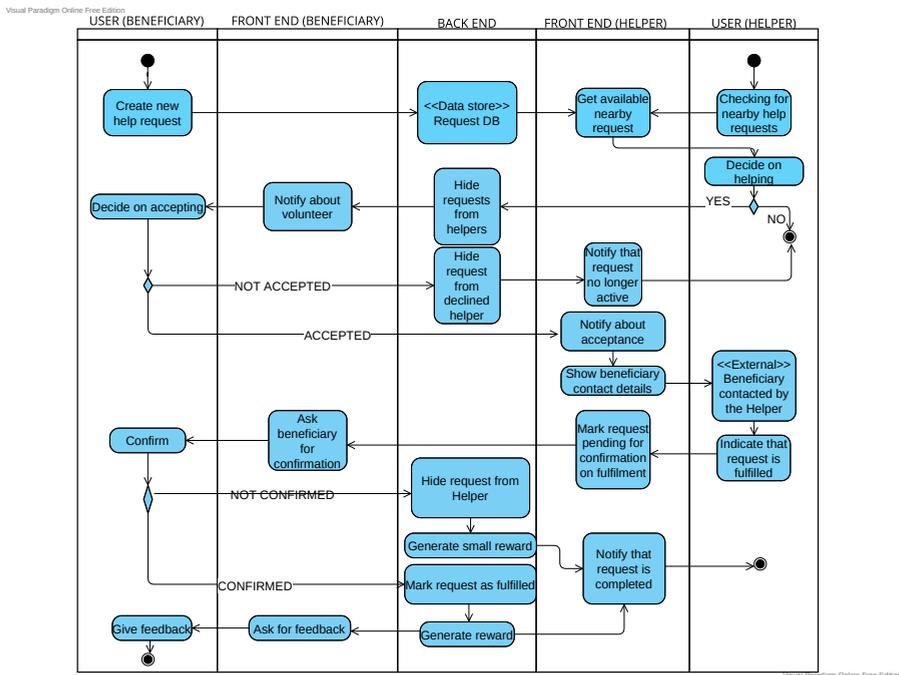


Figure 7.3: An activity diagram of the request flow

In case a beneficiary does not accept the help offer from a particular helper, the request is made visible again, but hidden for that particular helper. The same happens in the case that a beneficiary does not confirm a help as finished. Also, the beneficiary is asked to leave feedback on how the help process went after confirming that it has been finished. The process involves several steps, but in general these will be performed within the span of one or few days. As a result, the individual steps are not expected to be overwhelming.

**Note:** It should be noted that the process was devised before the interviews and user surveys were performed. In the initial version, our focus was solely on ensuring that the beneficiary was safe, but as pointed out during our interview with *solidare-it!*, some beneficiaries can also be difficult to handle and volunteers should have equal right to be warned.

### 7.2.4 Language Use

Additional focus on language use within the web application was taken. As we highlighted already in Chapter 2.1, any written information needs to be clearly presented. In our case, written language is present in: 1) the user interface as text and labels that are often used in combination with icons, 2) error messages; it is important that any error message clearly describes the problem and how to solve it, 3) info pages and the embedded guidance tool. In the current version, these deliver information to the user about the current page (s)he is using. The current guidance tool is the most text-intensive part of the web application. To support elderly, a spoken audio version of the same information is also made available.

The language use of the platform has been checked by three experts and the translation to Dutch and to French were done by native speakers. Most attention on the language use was given to the areas that would be subject to our pilot study (see Section 7.3, i.e., account creations steps, and audio & video request making steps).

Note that in the platform we use the term “requests” (and not help request) to avoid stigmatization. In a similar fashion, all users are allowed to both respond to and create requests, and although internally a user might be recorded as a *beneficiary* or a *helper* as their starting roles, this is not shown to them directly.

### Supported Languages

Language support for Finnish, Dutch, French, and English were added due to a potential collaborative contact in Finland and the main research group being located within Brussels. A translation plugin for messages was considered at one point, but was dropped mainly to ensure a higher level of control over the used terminology thorough the platform as sentences might translate correctly, but not to the preferred words.

### 7.2.5 Guidance

An embedded guidance tool (see Figure 7.4) was added to every page of the web application, with the goal of informing the user on how to use the page and how any given data will be used. This covers our requirements (R3) Guiding

and (R10) Transparency.

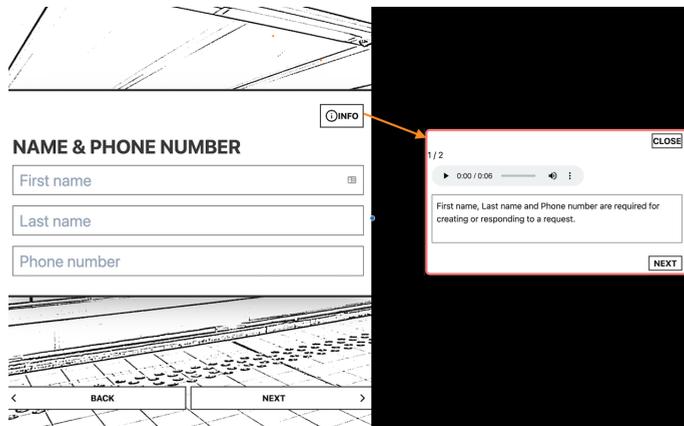


Figure 7.4: Example of embedded guidance

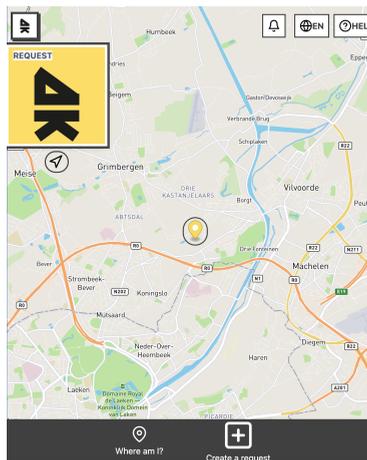


Figure 7.5: Screenshot showing the basic map view with a help request (shown as a yellow card at the top) of the Web application

## 7.2.6 Map View

Like in TICKLE, the map view is the main page in Nosville. Requests are placed on the location of the beneficiary and shown as a pin on the map. All nearby requests are also shown on top of the view (see Figure 7.5).

### 7.2.7 The Game

The designed game is a simple city building card game, loosely based on games such as hearthstone. The game is set around three types of digital cards: “location”, “character”, and “event” cards. These in turn are divided into five categories that all represent different aspects of a small community:

- *Environment*: These cards are colored green and represent nature, such as parks and park keepers.
- *Business*: These are blue cards that represent commercial manifestations within a community, such as stores and store clerks.
- *Culture*: Purple cards are used for cultural, such as museums and artists.
- *Civic service*: These are orange cards and cover public services of a community, such as garbage collectors, police stations, and firefighters.
- *Neutral*: These are black cards and both cover goods and less appreciated aspects of a community, such as regular buildings, bicycle thieves, and abandoned buildings.

Using these categories, the game could also have some pedagogical function and be useful in education, e.g., for raising awareness for different aspects of a city or for urban planning.

Remember that the cards are actually collected by volunteers in the SE platform as rewards for completing request and made playable in the game. Some cards are more rare than others, for instance, there could be a 70% chance to get a common card, 25% chance to get a rare card, and a 5% chance for an unique card.

The cards are played in a preset game area of ten slots (see the right side of Figure 7.1 and Figure 7.6 ), five slots for each player. All placed cards affect the value of the side they are played on, i.e., the community, negatively or positively, and they might also have other effects within the game area, such as removing other cards. The game ends as soon as one side has a location card on all of the five slots. The player that has made their side more valuable wins . A player can “attack” the opponent by placing negative cards on the open slots of the opponent or by replacing already filled slots.

The game was designed around a simple design principle: “easy to learn, hard to master” (Desurvire and Wiberg, 2009). By using the easy to learn principle, the game is open for a wider audience, but in order to keep the game interesting and challenging it must be able to provide challenges for the experienced players.

To lower the barrier to play the game, we decided to go for a short game. A single game play should last only around 15 minutes. This way, it can be easily done in spare time, and does not require that a player “commits” to play the game for a longer time.

The game employs a number of features (introduced in Chapter 3.1.4, Section 3.1.3) intended to enhance its engagement:

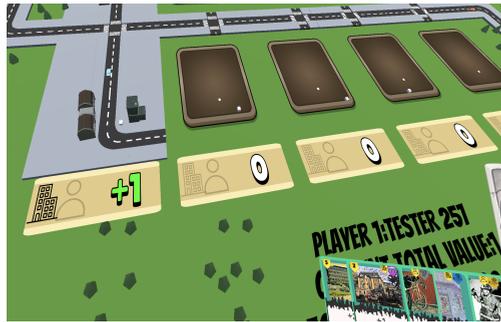


Figure 7.6: Screenshot of player view of the Nosville game platform

- *Profile & Ownership*: Though the cards are earned communally, mainly by performing activities within the SE platform, the players do have a personal account and assemble their own deck of cards. This means that the players do have a sense of ownership and can create and design their own playing strategies
- *Social Play*: Though single-player is possible, this game was designed as a two player game and in this way allow for social play.
- *Creativity*: Players can explore different card combinations at will, which can yield powerful new strategies that even we might not have foreseen.
- *Goals*: The goal of the game is rather easy for players to understand and the means to reach it
- *Learning*: The cards are tied to real locations (Brussels in our proof of concept implementation). Though not intended as an educational tool, this might allow users to learn new locations about their local town and the parts that make a community tick, such as, different civic services that a municipality offers.
- *Relevance & Relatedness*: The real life locations can be an incentive in itself, even if the player might not learn anything new.
- *Exploration*: Playing cards has different effects on the play area also visually, such as different 3D buildings, traffic and pedestrians. These were designed with exploration in mind, to keep the player curious of what might happen next.

Additionally, design elements were taken from other similar games: 1) Regularly new content, mainly cards being periodically added; 2) Keeping players up to date with embedded notifications to inform them about new cards and who (user in the SE platform) collected them. Note that the players cannot earn points or cards by continuous playing of the game, a classic method of nudging that freemium game use instead of or next to paying for new content.

In terms of long-term engagement, regularly providing new content is a good strategy. Hearthstone, one of our sources of inspiration, pushes out three

expansion packs per year<sup>4</sup>. They also have added new game play styles over the years. One relatively easy way of creating new content in our case, is to cover new real-life locations and provide cards for them.

## Implementation

The game was developed with the Unity3D game engine<sup>5</sup>, which allows for an easy way of supporting several different operating systems and devices without the need of maintaining different code branches. The game was realized to a point where both multiplayer and single-player game-play were possible. However, the graphical design of the game was rather basic. Before spending time (and money) on this, we decided to perform a formative evaluation with the aim of gathering initial opinions on this type of game, in particular whether the game on itself could be engaging, because to be usable as a long-term engagement mechanism for SE platform, the game on itself should be engaging.

## 7.3 Nosville Evaluation

As stated before, organizing face-to-face evaluations of our platform proved extremely challenging due to the COVID-19 pandemic, especially given the fact that elderly people were a higher risk group. In theory, an online approach would have been feasible. However, this also would come with its own caveats:

1. **Technological adeptness:** Elderly willing to participate in an online evaluation would likely be more technologically “savvy” than the average elderly we might otherwise meet.
2. **Setup:** An online evaluation would ideally require sharing of a screen, or installing some form of screen capturing tool to clearly identify more challenging points. Of course, simply having the participant speak out loud could circumvent this, but would run other risks, such as the participant navigating outside given areas.
3. **Finding people** is always challenging, but finding elderly users online is especially challenging, as to reach them, in general one cannot rely on online forums. Usually a contact person will be needed.

In the next section, we will explain the methodology used for the evaluation of Nosville. Next, the results are presented and discussed.

### 7.3.1 Methodology

Because Nosville consists of two loosely coupled platforms, we decided to start by evaluating both platforms independently. Later on, an evaluation of the

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<sup>4</sup><https://playhearthstone.com/en-us/news/20475356>

<sup>5</sup><https://unity.com/>

combination would be done, but due to the COVID-19 situation this was not possible anymore. For the same reason, a full evaluation of the Nosville SE platform was also not possible. Therefore, we opted for a pilot user study for the SE platform. For the game, an expert evaluation was performed with an early proof of concept.

## 1. Pilot User Study for the SE platform

Because the platform is rather comprehensive, evaluating the whole platform would be too extensive. Instead we opted to focus on the following:

- Showing activity
- Info buttons
- Usability aspects
- Audio request
- Video request
- Communicating how data is used
- Creating an account

A survey was created using Qualtrics. In some of the questions, parts of the SE platform were embedded in the question using iframe tags<sup>6</sup>. To avoid confusion between the test of the question and the information given in the iframe, special attention was given to how the questions were formulated.

### Survey structure

The survey had in total three hands on tasks, where users were asked to directly utilize Nosville features: 1) Creating a (dummy) account; 2) Creating an audio request; and 3) Creating a video request. In order to make these as easy as possible, six custom versions of Nosville were prepared (English and Finnish versions), where the platform only provided the relevant feature. This was done mainly due to the fact that the participants would need to perform the tasks without supervision. Later on, it was decided to perform the survey also in the form of an interview.

For each hands-on task, detailed background information was given, such as what the application is about and what is the task about. Two questions were given at end of each hands on task: 1) Did you succeed with the task and 2) How easy was it.

Another part of the questionnaire focused on the use of INFO buttons that currently are used for two reasons: to clarify how data is used and to provide guidance. The questions related to the INFO buttons focused on:

- Look & feel of the button, whether another placement would be more preferable?
- Was INFO button needed at any stage, and where?
- Was navigating in the INFO content easy?

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<sup>6</sup>[https://www.w3schools.com/tags/tag\\_iframe.asp](https://www.w3schools.com/tags/tag_iframe.asp)

- Was the INFO content easy to understand?
- Was the audio or the text version of INFO used?
- Was the audio version helpful?

Questions focusing on “how easy was task x” utilized a 5-point Likert scale: “extremely easy”, “somewhat easy”, “neither easy nor difficult”, “somewhat difficult”, “extremely difficult”. The next part of the survey focused on the recommendation (R2): show activity (see Figure 7.7). A graphic designer had created three separate concept illustrations that were intended to show how the general level of activity could be presented to the users of the platform.

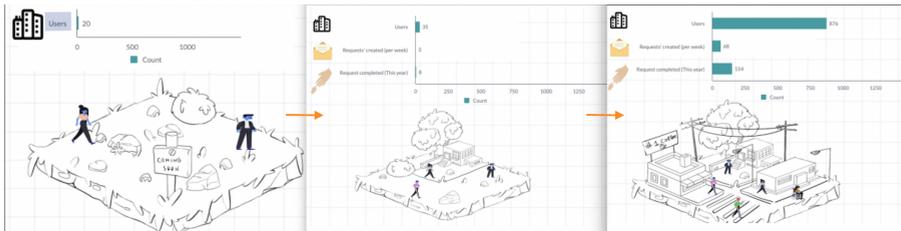


Figure 7.7: Illustrations created by the graphic designer as a simple example scenario for R2 “show activity”

A last group of questions focused on the preferred method of communication with potential helpers, and how important they felt on being aware of how their data was used in the platform.

## Interviews

The interviews were conducted by using Zoom, as it allows connecting directly via a browser. The interview was structured around the survey, by going through the same questions one at a time, but allowing for open feedback and any thoughts that came to mind for the topic area. The platform was shown by sharing the interviewer’s screen with the participant, meaning that a participant would only be able to observe and comment.

## Finding participants

Discovering participants turned out to be one of the more challenging tasks. Numerous methods were utilized: (1) the Commu survey had a notification about this study where participants could leave their email address. Only two participants did so but never replied to our call for joining this study; (2) Friends and family members were asked, outside the author’s own circle as these people would likely be less biased. The target age was originally 65 or older, but we could not afford to be too strict with this as the majority of available participants were slightly younger (60–63).

All announcements were given in a similar fashion, containing a direct link

to the questionnaire<sup>7</sup>, with a notice that an interview would be preferred but if they wanted, they could just perform the tasks and fill out the questions by their own.

### **Languages**

Despite the difficulty in finding participants that could do the survey in English or Finnish, we decided not to translate the questionnaire to Dutch and French as in the most likely scenario this would only result in one or two extra participants. Instead, it was assumed that the time would be better spent on finding more participants and hope that when COVID-19 (hopefully) eventually fades, opportunities for in-person evaluations would begin to present themselves again.

## **2. Expert Evaluation of the Game**

For the game, we performed a formative evaluation of an early proof of concept to investigate whether the current design choices and game concept itself had potential and was worth future development. The proof of concept was fully playable, in multiplayer mode and as a simple single-player game where the AI of the game makes only simple moves and plays the location cards in a sequence. A set of starter cards had been created and a deck of cards had been assembled. The game was hosted on itch.io<sup>8</sup> in a format playable directly via a web browser.

The goal of the evaluation was simple: to have experts, namely individuals who have game design experience, judge the potential of the game and give general feedback.

### **Finding participants**

Finding experts willing to evaluate the game proved to be very challenging. A number of steps were taken to find volunteers, such as contacting colleagues, posting a call on several social platforms focused on game design and on reddit and discord. It quickly became apparent that the active communities where game development is actively discussed, are rather saturated, making visibility of a notification a challenge. Finally, most of the participants were found via direct contact by email.

### **Setup of the evaluation**

A questionnaire<sup>9</sup>, mainly focusing on general opinions on different aspects of the game, was created with Qualtrics. All core question, except for the last two questions that asked for general feedback and suggestions, were given as 4-point Likert scale statements: “strongly agree”, “agree”, “disagree” and

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<sup>7</sup>[10.6084/m9.figshare.19165283](https://10.6084/m9.figshare.19165283)

<sup>8</sup><https://reizka.itch.io/nosville>

<sup>9</sup>see footnote <sup>7</sup>

“strongly disagree”. Each question was followed by a comment field where the participant could leave text responses.

The participant was given a brief explanation about the game and link to the questionnaire. The rules of the game were not explained, though the website for accessing the game provided a simple explanation. It was emphasized that the game was by no means a final product. The site that hosted the game had a direct link to the Qualtrics questionnaire.

### 7.3.2 Results of Pilot User Study

Nine participants were found. Seven did the survey unsupervised and two did the survey in the form of an interview. The youngest participant was 59 and the oldest 69, with a average age of 64.7 years. Though, as with the previous qualtrics surveys, not every participant completed the full survey.

The two interview participants were both 63 years old. It was a couple from the U.S. but the interviews were conducted separately over a period of two days in January 2022. Each interview lasted roughly an hour as open comments on the current design of the platform, the questionnaire topics, and relevant topics such as data security were encouraged. The interviewees also performed the tasks from the questionnaire. The results are discussed according to the topics covered by the survey (see Section 7.3.1)

#### Account Creation

The focus of this part of the survey was to investigate whether we met the recommendations (R17) about an easy registration process. Additionally, as the INFO buttons were available at each step of the account making process, we also wanted to evaluate whether the recommendations (R3) Guiding and (R10) Transparency were met.

For the first question “*Did you manage to complete the task?*”, all nine participants answered “yes”. Out of the nine participants, seven marked the task as “extremely easy”, one as “neither easy nor difficult”, and one as “somewhat difficult”.

For the surveys performed without supervision, no major remarks were given, but one individual found the black and white design “refreshing”.

In the interviews, the following questions and remarks where made:

Interviewee 1 (female, age 63 years) and Interviewee 2 (male, age 63 years) both found the account creation as a whole very clear and easy. Both appreciated the focus on data security. Interviewee 1 made minor remarks on the order of input fields of asking username before actual name. Interviewee 2 found some text slightly too small though he was able to read it, but not with ease. He also suggested a more central placement of the buttons currently placed at the bottom of the screen.

Lastly a question was asked on delivering the info also in audio format. Interviewee 1 stated that she prefers to read, but could see that audio messages

could be nice for some people. Both found the language used for the info clear, though Interviewee 2 did give some suggestions on how the text could be made shorter.

### Audio & Video Messages

Task 2 was comprised of two separate sub tasks, creating an audio and creating a video message. As somewhat expected, this part was more challenging for the participants. It has to be noted that 100% functionality of the features could only be guaranteed when using a Chrome browser. For this reason, participants were asked to indicate which browser they had used to complete the task.

Audio recording was marked as completed by seven participants. Four marked the task as “somewhat difficult”, one as “somewhat easy”, and three as “extremely easy”. One participant did not tick the task completed part. One comment made recommended to automatically check whether the computer has a microphone.

Video recording was marked as completed by five participants and by one as not completed. This participant used Firefox as browser where the video recording currently does not work. The responses on how easy the task was were again divided: three “somewhat difficult”, one “neither easy nor difficult”, one “somewhat easy”, and two “extremely easy”. The comments given for the surveys performed without supervision mentioned problems on viewing the recording and on not working in Firefox.

Both interviewees found the audio and video request option interesting and for most parts very clear. They found using them somewhat easy. Interviewee 2 suggested to use a stepped approach. Interviewee 1 mentioned that she personally would not like to use video due to privacy concerns, but did find audio message a nice option. Also suggestions for button placement and appearance were given by both interviewees.

### INFO part: Buttons and Content

Information and help about the functionality offered on a page or the information requested can be obtained by means of an INFO button. We wanted to investigate whether this type of guidance was noticed and whether the information provided was relevant and clearly explained (Recommendation (R3) Guiding and (R10)).

The first question regarding the INFO buttons concerned whether they had been used at all. Eight participants replied to the question “*Did you use the INFO button?*” with the following results:

- “No, I did not need it”: 2
- “No, I did not notice it”: 1
- “Yes, several times”: 1
- “Yes”: 4

Our followup question was to know which sections of the INFO were used. We used images of each segment to make recalling easier. Generally, all segments had been checked out by two participants. Only the INFO for audio and video had been checked by three participants.

We also asked how easy navigating inside the INFO content was. Results on the question “*Was navigating through the information provide in the INFO pages easy?*” were: three stating “somewhat difficult”, one “somewhat easy”, and one “extremely easy”.

Also, we wanted to know how clear the content provided within the INFO was. Three participants replied “somewhat clear” and two “extremely clear”. No comments were given whether some content in the INFO was unclear. As also an audio version was provided for the INFO content, we wanted to know whether anyone actually used it, but all five participants marked that they had only read the text.

Lastly, we wanted to find the participants’ opinion on the placement of the INFO button. Images of different INFO button placement were given, including how it actually was placed within the application. Six participants selected the current placement as their preferred option and two chose the option “they all look the same to me”.

Both interviewees found the written content clear. They also preferred the current positioning of the given ones. Navigating the info content was also clear for both. Interviewee 2 suggested providing data privacy notice at the very beginning of the process, instead of at the end.

### **Showing Activity**

We wanted to investigate whether showing activity, i.e., how active the user’s neighborhood is, by more visual means would be of interest to the users. Three concept images with an explanation were shown for conveying the current state of the neighborhood.

In terms of remarks to the concept images, one participant recommended using pictographs to convey the data and simply giving numerical specifications instead of more detailed images. On the question “*How interested would you be in following the progress of your area through these kind of images?*”, four replied “not interested”, two “somewhat interested” and two “very interested”.

Also, the participants were asked “*How easy or difficult was it for you to understand what the images were telling you?*”. Three stated “somewhat difficult” and “somewhat easy” and two “neither easy nor difficult”.

Neither interviewee found the graphical info view very interesting. Though Interviewee 1 did mostly use Nextdoor as her point of reference. When a smaller platform “Buynothing” was discussed as an example, she did state it might be interesting to see how many neighbors were using the application and having success with it. The images used in the evaluation were clear to both interviewees. Two points of concern were brought up by them: scale, how

Table 7.1: Preferred method of communicating with a helper.

Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
By phone	1.00	6.00	3.40	1.74	3.04	5
By email	1.00	5.00	3.80	1.60	2.56	5
By using a chat service in the application	1.00	4.00	2.80	1.17	1.36	5
By means of another (external) chat service, such as: whats app, Telegram, etc	1.00	5.00	3.20	1.60	2.56	5
By using sms text messages	2.00	6.00	3.80	1.83	3.36	5
By meeting in person	1.00	7.00	4.60	2.24	5.04	5
Other	4.00	7.00	6.40	1.20	1.44	5

large of an area is represented and would the evolution stop at some point and result in a static image?

### Data Security Awareness

The participants were asked how important it was for them to know how their data would be used, with the question “*When using an application that requires me to register, I want to know how my data will be used*”. Six participants selected “strongly agree” and two “somewhat agree”.

Both interviewees were very concerned about their data security. Both made several remarks about data privacy being a very important factor. For instance, Interviewee 1 stated as one of her main concerns was the handling of data and having control over own privacy and knowing exactly where any data goes and how it is handled. According to this interviewee, the platform should also protect the users from themselves, in terms of not allowing the user to give out data that “really shouldn’t be given”. Interviewee 2 also discussed data security from various viewpoints, among them were topics such as how the data was stored, would it would be encrypted, and whether the information would be retained when you cancel an account. This interviewee stated about data privacy:

*“I worry about it a lot”*

### Communication Methods

A question for the preferred method of communication in the imaginary case where the participant has asked for help and someone has volunteered to help, was asked. A list of communication methods were provided and the participants were asked to drag them into their order of preference. The results are shown in a Table 7.1

When asked in the interviews what method of communication the interviewees would prefer to deal with in a help request or offering scenario: Interviewee 1 preferred a video call type of service, because that would allow to talk and see each other at the same time, or a simple phone call, or text. Interviewee 2 could not directly name preferred methods of communicating, but mention the ones that he didn't like: meeting in person and phone. For email he mentioned that it would be slow as communication mechanism.

### Other Interviewee Comments

Additional comments made by the interviewees worth noting are:

Interviewee 1 found the black and white look fine in itself, but suggested the use of colors and highlights to make the more important fields stand out more clearly. Interviewee 1 also was curious whether any competitive features would be included, such a feature allow helpers comparing each other's rates.

Interviewee 2 briefly discussed voice operated devices, using "Hey Google!" smart speaker as an example. Additionally, the interviewee mentioned what he would see as an attractive app:

*"I think, I would find it much more attractive if the app continued (after finding a helper). So that I hire somebody they do it and like in AirBnB you rate it from both sides. . . . and if I was the service provider (helper) I would like to know if it was a dirty old man grabbing (laughs)... or someone who is extremely difficult"*

### 7.3.3 Discussion Pilot User Study

In this section we discuss the results of our pilot study and findings regarding the Nosville. We start with discussing the limitations.

#### Limitations

First, it should be noted that despite great care was taken in preparing the evaluation in terms of clarity of written content and ease of use of the survey, conducting the evaluation online posed some issues. This was mainly due to the fact that the participants were essentially given a two layer interface to interact with: the questionnaire and (parts of the) the web application embedded in the questionnaire. Additionally, despite informative text was provided at each segment of the questionnaire, supervision by a person during the evaluation could have yielded much more informative feedback. The offer of supervision was always made and highlighted as the most preferred option from our end, but we did not want to directly force participants to do so as we were afraid that this would have resulted in even fewer participants.

We also had no control over the medium participants used to perform the survey, though the recommendation to use a laptop or desktop was given. The use of a mobile device did not break anything per-se, but the frames

with the web application features for instance did become smaller since they were already wrapped inside the boundaries created by Qualtrics. One solution would have been to offer a separate link for performing the evaluation with the web application, but this would have increased the complexity of the evaluation even more.

## Conclusion

It can be derived from the results that relatively good results has been reached in terms of usability of the platform. However, at the same time it is clear that there is some room for improvement for the audio and video messages.

Results on the INFO button and content are less informative. Some of the users simply did not use them. This can be seen as a good thing in terms of the overall design being clear enough for them to not need any additional information. However, one user did not see the INFO button, which may indicate that the placement was not optimal. The results suggest that information provided in itself was for most parts clear, but hiding more information behind a single button, though provided at each page, might need to be reconsidered. An approach where the information is directly visible on the page, for instance when the user click on a field might be a better solution for delivering this type of information, but more in depth evaluations and usability evaluations would be needed to confirm this.

The interviewees found the audio message option a potential useful option and the use of an onboarding procedure was suggested. Also, both interviewees were extremely worried about data privacy.

In terms of more disappointing results, there was the lack of interest towards the visual representation of activity. Perhaps this speaks not so much about the level of interest towards information about the platforms' level of activity, but rather about the need for additional fine-tuning the design.

## 7.3.4 Results Game Evaluation

### Background of Participants

Six experts participated in the evaluation. The first set of questions were aimed at checking the level of self perceived knowledge in game development and design, user experience engineering, and general programming. This was important to know as the evaluation was relying very much on the participants' ability to see the potential of the game, rather than evaluating its current status (for instance, no graphic designer was yet involved, making the look & feel of the game slightly "rough around the edges"). It should be noted that one participants was already slightly familiar with the game concept before participating in the evaluation. The evaluation was conducted in spring 2021.

All three questions used a Likert scale. The results are shown in Table 7.2. One participant did not provide an answer, the remaining participants marked

Table 7.2: Results of participants background. “strongly disagree” is omitted as no-one selected it.

I have experience in...				
	Game development	Game design	Programming	User experience engineering
Strongly agree	4	3	5	1
Somewhat agree	0	1	0	4
Neutral	1	0	0	0
Somewhat disagree	0	1	0	0

themselves as having experience in all the fields, exception for game design, where one participant marked “somewhat disagree”.

### Game Concept

The first statement: *“The theme of the game is interesting”* received three times the score “Strongly agree” and two times the score “agree”. The participants were encouraged to leave comments for their choice. Four participants left comments with two seeing potential for impact depending on an active user base. One comment criticized the lack of a proper introduction at the beginning of the game, and another commented that the game cards could include more in-depth explanations on the places they were representing. Overall the tone was positive.

The second statement: *“The current location cards are graphically altered images of real places around Brussels’ region. Providing cards from my own area in similar fashion makes the game more interesting”* receive a slightly more divided response, with three participants selecting “Strongly agree”, one “agree”, and one “Disagree”. The comments were partly suggestions, such as adding more customization for their own locations. The participant who had given the score "Disagree", stated that players could be more interested in cards depicting locations they had yet personally visited, where as another participant stated that adding references to own location could be beneficial:

*“Adding references to the user’s own surroundings not only makes the game more familiar to them from the beginning but can also increase the feeling of ownership in some way, as in: "This is \*my\* neighbourhood”*

### Engagement and Fun

The following statements focused on whether the participants saw long-term engagement possible with the game. A first statement was: *“Introducing weekly new cards set around the player’s region will be an effective way to keep players engaged”*, which received two times “Strongly agree”, two times “Agree” and one times “Disagree”. The participant that gave the score "Disagree" stated the following:

*“This is what many current games are doing, constant minor updates and novelty, but I dislike the approach in general as often-times it ends up being shallow content. I would choose a different route in maintaining players’ interest.”*

One participant noted that weekly updates might be difficult to maintain in terms of required design and development work. Another more in depth response mentioned both the need to consider the amount of work required, but also provided a suggestion on how to overcome it:

*“This is an important method of making the game-play interesting in long-term. New content makes people come back to the game (but obviously they must be attracted to the game in the first place by other means). This is cleverly used in many location-based games and would be beneficial in web applications too. Of course, one must consider the tradeoff between the effort in making many new cards and the benefits of them. There must be a cutoff point after which the effort of adding new weekly cards is greater than the benefit of adding them to the game. Crowdsourcing new cards, with an appropriate reward and moderation scheme, could be usable here.”*

The next statement focused on the current form of game-play: *“Seeing the town “growing” during game-play will make the game-play more enjoyable”*. Two participants selected “Strongly agree” and three “Agree”. One participant did not fully understand how the card system behaved:

*“I honestly did not understand the concept of the cards points and how they relate with one another. A tutorial would be really appreciated and beneficial before the real game-play.”*

Note that a short tutorial text was provided for the game, on the website, but not in the actual platform.

Another participant suggested adding mini challenges to the game-play:

*“It would be even more enjoyable if there would be ways to interact with the town in some way. Perhaps some mini-stories / mini-games included in the town so you could choose a district and a new scene would open whereby you could complete certain tasks related to the card(s) involved.”*

Another participant appreciated the building mechanics, of different types of buildings and locations:

*“Progression and advancing have been identified as major drivers of user engagement in online games. This is progression at its finest.”*

The third statement focused on the length of the game-play: *“Game length is suitable for this type of game”*. One participant selected “Strongly agree”,

four “Agree”, and one “Disagree”. The participant who selected “Disagree”, unfortunately did not motivate the choice. Note that due to the AI being a very weak opponent, the participants could only give estimates on the game-play length, as was noted by one of the participants. This participant also suggest letting the player choose the length of the game:

*“This is not a fully informed answer because I only played for a short time against the computer (which was pretty weak opponent by the way). Perhaps the users could choose the length of the game (i.e the size of the town to be built) so that those who want to play longer matches could do so.”*

The fourth statement focused on how easy the game is to learn. The answers were slightly more divided, with four selecting “Agree” and two “Disagree”. Generally, because of the lack of a tutorial, most players stated that it took some time to understand the core game-play concept. One participant did not understand all the rules, but managed to play the cards irrelevant of this:

*“I could not understand the game’s rules, besides knowing I was in need to find a card that would be inserted in a green spot.”*

The fifth statement focused on whether the game supported different game play strategies: *“The game has potential for varied player strategies”*. The responses were somewhat divided: one “Strongly agree”, two “Agree”, and two “Disagree”. One reason for disagreeing was the currently low number of varied cards, but otherwise seeing the potential:

*“Not yet, I would say there is not enough types of cards for elaborated game strategies”*

The other disagreeing participant referred to the lack of understanding the rules properly. Another looked at strategies from different angles:

*“It depends on what "player strategies" mean here. If you refer to player types as in Bartle’s taxonomy then this game does not support all of them well. If you refer to strategic decision regarding where to place the card (or whether to place at all), then there are some options for the player.”*

The sixth statement focused on the potential for long-term engagement: *“This game has potential for longevity (Long term playing)”*. The overall response was cautiously optimistic: one “Strongly agree” and four “Agree”. The comments focused on the need for active updates to maintain engagement and having an active player community (in terms of finding players whom to play the game with). Some suggestions that were given focused on having special events, or cards functioning differently on certain days. Also, a suggestion for added social interaction was given to better support community building.

Questions seven to eleven focused on general feedback from different angles and though they were very interesting in terms of potential future game development paths, such what type of cards to add, how to better handle the 3D view, etc. These bear less importance outside future development planning.

### 7.3.5 Discussion Game Evaluation

The results of the evaluation, as stated, can by no means be generalized because of the small amount of participants. However, the results do support the current game concept. They indicated what was hoped: the current game, though still a very rough version showed potential in terms of design and current game-play method. Also in terms of long-term engagement for the game itself, most participants leaned towards seeing potential for this.

These results were attained despite the lack of an in-game tutorial (the rules and goals are explained on the web site where the game was accessed from), and most players managed to grasp the core game-play mechanics quickly.

Potential pitfalls were clearly indicated by the participants: the need for the constant content updating can become taxing, as well as ensuring that new cards would be interesting enough. At the moment, a simple card making tool that allows making new playable cards relatively easily, has already been implemented. As indicated by one participant, this could also open another potential avenue for engagement by making a version of the tool public and having people create their own cards. However, this would require security tools or measures to curb any trolls.

In this section, we have shown the results of our pilot evaluation for a game intended to function alongside a web application. The game was never intended as anything more than to show how a social engagement platform could potentially be coupled with a game to both increase the general level of engagement and make the platform more interesting to a larger group of users.

## 7.4 Conclusions

The evaluated features from our web application, i.e., the SE platform, were rather well accepted from a usability point of view. The results of the user study (including the interviews) also confirmed our assumption that elderly users, in general, find data privacy an important topic. In the case of the two interviewees, as they were from the U.S., the lack of a uniform governmental regulation<sup>10</sup> for data privacy added to their concerns.

On the topic of showing activity, our concept images received mixed feedback, but in terms of the questionnaire results, the majority were somewhat interested in a visual depiction of how the neighborhood evolves. The mixed results are likely due to our concept images being somewhat rough. Because

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<sup>10</sup><https://www.nytimes.com/wirecutter/blog/state-of-privacy-laws-in-us/>

we are still convinced that an attractive visual representation of how active a neighborhood is, could provide added value in terms of keeping user engaged, we recommend to redesign the feature involving users along with a good graphic designer.

The evaluation also confirmed that adding info on all relevant pages can be helpful. While the provided info pages did answer all the users' questions, they were unlikely to use them, except if absolutely necessary. Therefore, a more embedded approach, where info is attached to the different field or text segments (e.g., by means of "?"-buttons) might yield better results as was also stated in the interviews.

### Limitations

A number of limitations are present in both studies, the main one being the low number of participants. Next, the conducted user study for the SE platform was mainly done through an online survey. As the participants also had to perform some tasks with the software, which were embedded in the questionnaire, this embedding has made the user experience inherently more cumbersome and distracting. Linking to the SE platform from within the questionnaire would have had the disadvantage that the context of the questionnaire would be lost once the participant was using the software and with the risk that the participant would not return to the questionnaire anymore or would get lost in the platform.

The low number of participants in the web application evaluation could have potentially been mitigated with a long-term evaluation. However due to the COVID-19 situation that didn't allowed for physical contacts and meetings, motivating participants to perform an evaluation over a longer period only using online communication would be hard. Attempting this form of approach would have likely dropped our already low number of participants next to zero. As number of willing participants to engage in a one time survey of 15 minutes already struggled to find any willing partakers.

Lastly, due to limited scope of the user study, we could only evaluated a handful of the recommendations we presented in Chapter 5. Also, in terms of design guidelines, our Nosville web application does adhere to the majority of the guidelines presented in Section 2.1: 92% of the guidelines listed as "very important" and 96% of the guidelines marked as "important". However, no thorough evaluation of these guidelines were done in our survey. The full list of guidelines covered by Nosville can be found online<sup>11</sup>.

## 7.5 Summary

In this chapter, we have presented Nosville, a project originally intended to study indirect gamification by means of coupling, in a loosely way, a game

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<sup>11</sup>[10.6084/m9.figshare.19165283](https://doi.org/10.6084/m9.figshare.19165283)

platform to some other platform (e.g., a SE platform). Due to the COVID-19 situation, our focus shifted more towards SE platforms and how they could be further improved in terms of adoption and long-term engagement by especially elderly users. Nosville was developed with these goals in mind as a proof of concept consisting of a SE and a game platform. The SE platform was developed based on our recommendations formulated in Chapter 5 and the design guidelines presented in Section 2.1.

For the evaluation of Nosville, a pilot user study was conducted in 2021 (for the game) and early 2022 (for the web application). The game, for which a proof of concept was developed, would be used to stimulate the long-term engagement for the SE platform. A small formative expert-based evaluation was performed for the game to investigate whether the game on itself could be engaging. For the web application an online survey was conducted where participants could try out core features of the application and leave feedback on them. For both platforms the results were positive and resulted in some good suggestions for improving the application and game.

This chapter ties directly to our research objective, which was **to digitally connect elderly users with other members of their community and nurture a long-term engagement between the two groups**. This was done by implementing our findings given in the previous chapters and by means of two digital platforms: a web application for the SE platform and a game. Though neither is far from complete, the preliminary results were promising.

Future work on Nosville firstly needs to focus on improving the current highlighted problems as well as implementing remaining recommendations within the application. Although, a number of SE platforms already exist, the created SE platform can be used as a context to test out other recommendations and new ideas relatively easily due to its versatility and ease of customisation.

## Chapter 8

# Conclusions and Future Work

In this chapter, we summarize the work presented in this dissertation and discuss how the findings contribute to our research objective and research questions formulated in the introduction. We also mention the limitation of our work and discuss directions for future work.

### 8.1 Summary & Findings

To achieve our research objective, i.e., *to digitally connect elderly users with other members of their community and nurture a long-term engagement between the two groups*, we conducted the following research:

1. We started by investigating the current state of the art regarding the use of digital technology by elderly. For this purpose, we first collected existing user interface design guidelines for elderly users and combined them into a single list by removing duplicates, combining similar guidelines, and adding some guidelines that we identified as missing. Next, we asked experts in usability and user interface design to provide feedback on each guideline, especially on how important the guideline is for the current types of mobile user interfaces. Based on this evaluation, we divided the guidelines into three lists: a list of guidelines which are very important (44 guidelines), a list with important guidelines (51), and a list of guidelines which were rated as less important (15 guidelines).
2. Next, we investigated how these design guidelines could contribute to the adoption of technology by elderly. For this purpose, we first reviewed existing technology adoption factors. Next, we proposed a reference model for design guidelines for elderly based on the technology adoption factors proposed by Lee (2015). This reference model allows to link design guidelines to technology adoption factors and can also guide researchers in discovering new guidelines.

The work mentioned in these two points is described in Chapter 2. It deals with research question **RQ1** How to ensure that the digital technology will be adopted by elderly? The answers to RQ1 are given in sub-questions **RQ1.1**, **RQ1.2**, and **RQ1.3**, see Table 8.1.

Table 8.1: Research questions 1.1–1.3 and their answers

<b>(RQ1.1)</b> What aspects have already been identified as important to take into consideration when designing a digital application for elderly users?
An in depth look to both technology adaptation models was taken, especially that of Lee. Additionally, design guidelines focusing specifically on web and touchscreen devices were surveyed and merged together into a up to date list of 111 guidelines. The list of guidelines was evaluated by experts and modified over a period of several months.
<b>(RQ1.2)</b> What tools (e.g., guidelines, theories) currently exist for designing technology for elderly users, and do they cover all aspects identified in RQ1.1?
We identified a large number of user design guidelines but we concluded that most of them were focusing on usability and that for instance security was not covered. Furthermore, different technology adoption models were discussed. Especially, the 10 factors identified by Lee (2015) are important for elderly users, but additional factors may be useful.
<b>(RQ1.3)</b> How can we provide more guidance to developers when developing software for elderly users?
Our list of merged guidelines provides a useful tool for developers of digital technology for elderly and identifies the needs of modern elderly users. The current version of website with all the results, as well as the evaluation page, with an up-to-date version of our guidelines are both accessible <sup>1</sup> . Additionally, our reference model based on Lee’s factors provides a high level view on how technology adoption factors and user design guidelines relate, and which factors can be covered by means of design guidelines.

- To achieve our research objective, it was also important to investigate how to nurture long-term engagement. For this purpose, **RQ2** and its sub-questions were formulated, see Table 8.2. To answer this research question and its sub-questions, we performed a meta-review of important approaches known for their potential to improve engagement and motivation: gamification, persuasive strategies, nudging, and (digital) behavioral change intervention. The aim of the meta-review was to collect a list of engagement techniques and their effectiveness as reported in the literature. We also wanted to know whether their effectiveness was researched especially with elderly users. Our meta-review concluded by mapping out several individual engagement techniques and despite hundreds of studies being done in this field, their focus was rarely on elderly users. In general, software using engagement techniques appear to have

<sup>1</sup><https://elderly-ui.web.app/> ,<https://elderly-stats.web.app/>

several positive outcomes, but the effectiveness of individual techniques remains vague. This work is described in Chapter 3.

Table 8.2: Research question 2 and our answer to it

<b>(RQ2.1)</b> What persuasive technology, gamification and nudging techniques are commonly used in digital applications?
Gamification: Numerous elements have been proposed, but points, badges and leaderboards remain the most popular approaches.
Persuasive technology: Automatically personalized content (personalization and tailoring), feedback, self-monitoring, suggestions, and reminders
Nudging: Warnings/graphics and reminders
<b>(RQ2.2)</b> What kind of long-term engagement techniques are available and how effective are they for different user age groups?
Our findings suggest that outcomes for long-term engagement, as well as which techniques are effective coaxing them are difficult to determine. The effectiveness of specific techniques remains largely unclear. A large body of evidence has been accumulated on positive outcomes in all three approaches, but the effectiveness of individual gamification, persuasion or nudging elements cannot be concluded at this stage.
<b>(RQ2.3)</b> Do studies focusing on these techniques consider users' age? Were elderly or younger users explicitly targeted?
Most of the studies focused on specific use cases, such as weight loss (Asbjørnsen et al., 2019), and sustainable living (Johnson et al., 2017). Only a handful of studies targeted specific age groups, such as youngster or elderly users, but the results in terms of age groups were largely unclear. None of the existing approaches or their techniques have been sufficiently tested on specific age groups.

4. With this background work done, we could focus on starting to design a solution for our research objective. Before devising a solution, we first investigated the current state of the field, as formulated in the third research question and its sub-questions, see Table 8.3.

For this purpose, a multi-method evaluation of existing SE platforms was undertaken, based on the results from both research questions RQ1 and RQ2. We examined 11 platforms. A more in-depth study was done for five platforms (P1–P5). The in-depth study consisted of interviews with representatives from these platforms and a survey conducted with users of P3, P1, and P4. These platforms, for large part, have become popular among users who are very close to or just reached the retirement age (around 65 years). The results are reported in Chapter 4.

5. Despite the fact that the platforms were in general well evaluated, points to improve were detected and features that appeared to work rather well on some of the platforms were gathered and compiled into a list of 19 recommendations that could contribute to Lee's technology adoption factors. These recommendations are presented in Chapter 5 and provides an answer to research question **RQ4**, see Table 8.4.

Table 8.3: Research question 3 its sub questions and our answers

<b>(RQ3)</b> What is the current state of existing social engagement platforms?
The current state of platforms is rather varied. The well funded and larger platforms, such as Nextdoor, ¿Tienes Sal? and Hoplr, appear to be on stable ground, but in general, the field appears unstable in the sense that a number of SE platforms have either become mostly inactive or even completely disappeared. Some platforms appeared and remained with the focus on asking and offering help. Larger platforms appear to have added help request option during COVID-19 pandemic. These platforms are essentially closed Facebook-like social media platforms with the majority having the same core features and functionalities.
<b>(RQ3.1)</b> How well are existing social engagement platforms tailored towards elderly users?
Despite none of the interviewed SE platforms set out explicitly towards elderly users, they have become popular especially with users at the cusp of retirement. Especially P2 and P4 have also targeted campaigns especially aimed at elderly users, in order to make the process of joining easier.
<b>(RQ3.2)</b> Which long-term engagement techniques are used by existing SE platforms?
In terms of long-term engagement techniques P1 appeared to struggle with this. P3 is still a new service, but no techniques in this context were used. P4 has managed to bring together users that do keep in touch with each other, but do not necessarily use the platform actively for this. Simple gamification techniques — points & badges — are among the more common engagement techniques used. Otherwise most platforms appear to rely largely on emails as a source of re-activation
There is a clear indication that COVID-19 caused a surge of new users, mainly people looking to volunteer as helpers. However, based on the interview results, many of these volunteers however did not stay active for a long period on these platforms

6. We also evaluated a number of the recommendations. This was done in the user survey (conducted on P1, P3, and P4) and in the interviews (conducted on P1–P5). The results are reported in Chapter 6.
7. Finally, we designed a solution for our research objective and implemented a proof of concept. The solution consists of two components: a SE platform and a game. The SE platform provides features implementing a number of our recommendations, while the game is intended to stimulate the long-term engagement of the users of the SE platform. This is a novel approach for indirectly stimulating people to continue to be active on a SE platform. The main goal of complementing the SE platform with a game was to add more value for the volunteers to remain active by allowing volunteers to collect cards in the SE platform (e.g., for completing help requests) which can be used as resources by gamers in the game. By doing this, we hoped to create a self feeding community of two groups of users: the volunteers using the SE platform and the users

Table 8.4: Research question 4 and our answer to it

<b>(RQ4)</b> What aspects could be improved in the evaluated SE platforms and which of these can we provide to developers as recommendations to take into consideration when developing SE platforms focusing on elderly users?
We identified a number of potential areas for improvements and formulated 17 recommendations for them (see Table 5.1 ). It is not our intention to suggest that all of the evaluated platforms are missing these features.

playing the game. The hypothesis is that the gamers will stimulate the volunteers to collect more cards as they need these as resources to play the game. Although pilot evaluations were performed for the SE platform and the game, no experiments could be done to test this hypothesis. This solution and the evaluations are presented in Chapter 7. Work presented there is also directly connected with our research objective, see Table 8.5.

Table 8.5: Research objective and our answer to it

<b>Research objective:</b> to digitally connect elderly users with other members of their community and nurture a long-term engagement between the two groups
An implementation based on our findings was showcased in Chapter 7 in form of two digital platforms; a web application, representing a SE platform and a novel gamification approach for long term engagement of volunteers. Based on our results, though neither is far from complete the preliminary results were promising.

## 8.2 Contributions

The core contributions of this dissertation can be summarized as follows:

- an up-to-date overview of the research field on the adoption and use of digital technology by elderly.
- an up-to-date list of usability design guidelines for elderly users, evaluated by experts.
- An overview of gamification, persuasive technology, and nudging, and their effectiveness as reported in the literature.
- A thorough evaluation of existing social engagement platforms.
- A list of recommendations on how social engagement platforms might become more accessible to elderly as well as on how they could better stimulate the long-term engagement of their users. The current level of evaluation of these recommendations is given in Table 8.6.
- A new approach for using gamification in these types of platforms to

stimulate long-term engagement and with the potential to bridge inter-generational divides.

Table 8.6: Table of how our recommendations has been evaluated. \* = partly evaluated. Explanation of the columns: Survey = results shown in Chapter 6; Interview from Chapter 6; Analytical refers to literature presented in Chapter 5 that backs up our recommendations; and Nosville pilot tests to the evaluations done in Chapter 7.

No.	Factor	Name	Survey	Interview	Analytical	Nosville pilot tests
1	emotion	points with purpose	x*	x	x	x*
2	emotion, dormant users	show activity	x	x	-	x*
3	independence	guiding	-	x	x	x*
4	independence	onboarding	-	x*	x	x*
5	usability	guidelines	x	-	x	x
6	usability, security & trust	user feedback	-	x	x	-
7	usability, security & trust	audio & video messages	x	x	x	x
8	usability, experience	customization	-	-	x	-
9	value	clear value	x*	x	x	-
10	value, security & trust	transparency	-	-	x	x
11	social support	support & encourage communication	x*	-	x	x*
12	technical support	help manuals	x*	-	x	-
13	technical support, emotion, dormant users	user roles	x*	x*	x*	-
14	security & trust	safety features	x	x	-	x*
15	security & trust	area of visibility	x*	-	-	-
16	dormant users	provide activities	x*	-	-	-
17	usability	account creation	-	x*	x*	x*

## 8.3 Limitations

A number of limitations were met during the process of this dissertation. These were already discussed in their respective chapter. Below we give an overview of these limitations with a brief explanation, grouped by chapter.

### Chapter 2

- Our current list of user design guidelines is very large and thus cumbersome to properly evaluate.

### Chapter 3

- Despite best attempts, some bias might still be present in the meta-review performed for the fields gamification, persuasive technology, and nudging.
- Inconsistent terminology used in the three fields might have affected some of our comparisons.

- The aims and goals of individual studies were not identified in the meta-review, nor their detailed outcomes.

#### Chapter 4

- Lee’s factors are best evaluated with a long-term approach. In the evaluation of the existing SE platforms, this was not feasible, which directly affects the strength of our findings.
- The existing SE platforms emailing habits were not investigated. In this way, we could likely have missed the use of some persuasive techniques and of some of Lee’s factors.

#### Chapter 5

- The list of recommendations provided is by no means exhaustive. Other recommendations are possible.

#### Chapter 6

- Only a selection of the recommendations were evaluated.
- Due to evaluation approach, we could not focus to any specific recommendation in great detail in our surveys.
- Changes made to the surveys in between evaluations (though improving the surveys) make comparing results and drawing conclusion difficult.
- The majority of responses from the first two surveys came from female participants. If the number of female users does not correspond with the numbers in the surveys then this limits the value of the results.
- Most of the participants were older users. The low number of younger participants limits any conclusions to be drawn from the results for their age group.
- Participants from third survey of P4 were all relatively active users, as the survey was distributed through the platform itself. In this way, the opinions of inactive or less active users were missed.

#### Chapter 7

- A low number of participants in the evaluation of the web application was major limitation.

## 8.4 Future Work

We have identified several avenues for future research for ourselves and for researchers active in the domains considered. First, we list all future works identified in previous chapters, listed in similar manner as the limitations in the section above.

#### Chapter 2

- The current list of user design guidelines can be evaluated further by focusing on the parts that were highlighted as more important by the experts.

- Furthermore, usability requirements are likely to change, as the oncoming generation of elderly users are going to be more and more familiar with the use of technology throughout a larger part of their life. It could be investigated how this will impact the user design guidelines.

#### Chapter 3

- Currently, different gamification, persuasive and/or nudging elements are often coupled in software systems, making direct cause and effect harder to ascertain. Investigating the effectiveness of especially some of the more prominent elements individually would be useful.
- Investigating the overlap between gamification, persuasive technology and nudging and unifying the terminology used in the different fields would be useful to draw overall conclusions.

#### Chapter 4–6

- More detailed evaluations of the recommendations and investigating possible implementation for each of them are needed.
- There is a need for a long-term evaluation of some of the recommendations, particularly for those aimed at increasing long-term engagement.

#### Chapter 7

- Nosville should be improved based on received feedback.
- Additional recommendations could be implemented and evaluated.
- The game could be further developed and an integration with the SE platform could be devised.

Further, there are also interesting possible avenues for future work in a broader context, in the context of the SE platforms and our design recommendations. We will briefly discuss them here.

#### **Multilingualism:**

Another direction for future work that has not yet been mentioned is the language aspect. While in some countries only one language could be used for a SE platform, there are different countries where people speaks different languages, even in a single city. A good example is Brussels that has a quite international population. Official languages are French and Dutch, but many people do not master them enough to communicate in one of the two languages. While it is possible to offer the interface in different languages (as we already did in Nosville), it is a different issue to deal with the language differences in the communication between people. Creating different versions of the platform for people speaking the same language could be an easy solution, but that will not allow the integration of newcomers speaking a different language and would further segregate the community based on the language.

### **Cultural Differences:**

In our interviews, though not being a direct topic, a representative stated:

*“I think it is also a cultural thing. The older women, especially, are super open minded. Why, I don’t know. Men are generally more introverted, but the ladies love to meet people. In our case, the older they are, the more open they are to meeting people. But I think it is a cultural thing.”*

These kinds of cultural differences could affect the applicability of some of our recommendation, for instance the proposed safety features. Therefore, it could be useful to investigate how cultural differences can impact the recommendations. A number of studies exist on cultural differences and how they might affect the adoption of technology. An example of such a study is (Lee et al., 2013), where the adoption of mobile phones in culturally different countries are compared. One study also suggest that a country’s culture (including technological and economical characteristics) can impact decisions on the types of technology used on a company level (Qu et al., 2011). Some cultural differences can be addressed by adapting the technology to the culture, but similar as for the language issue, such a solution is not optimal for regions with people of different cultures, as it will not help in bringing different cultures together. In addition to the current recommendations, we could search for incentives and features that can contribute to bridging cultures, as otherwise, a neighborhood might simply be split into sub neighborhoods, each with their own culture.

### **Inter-generational Divide:**

Lastly, as the number of elderly around the globe rises, SE platforms can become even more useful for connecting people from all age groups in a beneficial manner. A study by Righi et al. (2017) that presents a 5-year research study that explores the design and use of technologies aiming to enhance the social life of elderly people, posited as one of the main arguments that: *“... technologies designed ‘for older people’ should be designed to meet situated and dynamic needs/interests of the communities (and not only of care) to which they belong.”* SE platforms are well placed to realise this.

## **8.5 Conclusion**

In this chapter, we summarized the work performed and the findings. We also presented an overview of our contributions, as well as of the limitations of the work and different direction for future work.

In addition to the contributions to the research domain and in terms of valorization, the findings could directly be useful for SE platform developers. Also the proposed loosely coupling of a game with an SE platform, could also be applied in other domains, such as, e-commerce or educational platforms.

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# Appendix A

## Tables and Figures

Table A.1: Guidelines from the expert evaluation listed as “important” and “nice to have”

<b>1</b>	Are all audio content, sound/speech feedback/instructions clear?
<b>2</b>	Is slower speech for users with cognitive disabilities possible?
<b>3</b>	If a user submits something, a review page is provided?
<b>4</b>	Summaries of larger information sets are provided?
<b>5</b>	For vocal feedback, human voice is used?
<b>6</b>	On touchscreen devices, are the gestures used taking users with disabilities into account?
<b>7</b>	Secondary functions (such as customization, settings, etc) are easy to find?
<b>8</b>	Any numerical data is presented clearly?
<b>9</b>	On touchscreen devices, if gestures are used, is it possible to practice using them?
<b>10</b>	High level feedback messages are presented at the center of the application window
<b>11</b>	All video content has a resolution that is high enough?
<b>12</b>	Feedback messages use an encouraging tone?
<b>13</b>	On touchscreen devices with a custom launcher, normal supplementary device information (time, date, signal type/strength) is always visible?
<b>14</b>	If required, the application recognizes and caters for disabilities?
<b>15</b>	On touchscreen devices clickable items are easy to recognize and operate?
<b>16</b>	One element only supports one form of interaction?
Continued on next page	

Table A.1: Guidelines from the expert evaluation listed as “important” and “nice to have”

17	No distracting sounds are used ?
18	Returning to default system state is easy?
19	Is it easy to access a screenreader?
20	Errors not caused by the user are not reported as a regular error?
21	Search field is placed in either of the upper corners of the view?
22	Physical button is provided when needed?
23	Interactable elements give a sufficient feedback, when activated?
24	Overall good colorscheme used?
25	Video content has audio description version?
26	On touchscreen devices, when dragging gesture is used, is preference given to vertical movement?
27	Inputting data by typing is avoided?
28	Large information chunks are divided and made easy to navigate via familiar means?
29	No uncommon symbols or special characters are used?
30	On touchscreen devices, interactable elements are not clipped directly to edges?
31	Information that is only meant for screen readers or other assistive technology is not generally visible?
32	Keypad on touchscreen devices is split between text & numbers?
33	If required, assistive tools are supported?
34	In case of a service providing system, the user can contact the service provider for assistance?
35	Videos, images & icons have text alternatives?
36	No overly decorative fonts are used?
37	Link placement and presentation is clear?
38	On touchscreen devices, gestures can be turned on/off or adjusted?
39	System allows multimodal interaction (e.g. voice commands), when necessary?
40	Website conforms to HTML standards?
41	Buttons are more wide than high?
<b>nice to have</b>	
1	Scrolling for information is avoided?
2	Interface can be provided vocally to user?
3	User can customize how (sound/text/audio only, or specific combination) or when feedback is given?
Continued on next page	

Table A.1: Guidelines from the expert evaluation listed as “important” and “nice to have”

<b>4</b>	On touchscreen devices with small screens, do simple gestures replace buttons?
<b>5</b>	Limit interaction when user is physically moving (walking)?
<b>6</b>	If applicable, is user aware of different navigation opportunities?
<b>7</b>	Can the system be controlled with a keyboard?
<b>8</b>	Questionnaires are easy to use?

Table A.2: List of Feedback, Challenge and Creativity &amp; Control elements. The latter two are together as the elements discovered are essentially interchangeable.

Authors	Total Reviews	Feedback				Challenge		Creativity/Control	
		on performance immediate Frequent avatar-based Performance notifications Dashboard		suggestions, tips, signposting, assistance, virtual helpers, making suggestions, onboarding, informational		Challenge, timer, quiz		Roleplay, choice, Customization	
Alahäivälä and Oinas-Kukkonen (2016)	15	0	0%	1	7%	1	7%	0	0%
Wen et al. (2015)	23	0	0%	0	0%	0	0%	0	0%
Hamari et al. (2014)	24	6	25%	0	0%	7	29%	0	0%
Nah et al. (2014)	15	4	27%	1	0%	1	7%	2	0%
Falkner and Falkner (2014)	10	0	0%	0	0%	0	0%	0	0%
Dicheva et al. (2015)	34	0	0%	0	0%	0	0%	0	0%
Seaborn and Fels (2015)	31	1	3%	0	0%	7	23%	0	0%
Pedreira et al. (2015)	29	1	3%	0	0%	0	0%	0	0%
Johnson et al. (2016)	19	1	5%	0	0%	2	11%	0	0%
Morschheuser et al. (2016)	28	4	14%	0	0%	0	0%	0	0%
Sardi et al. (2017)	27	25	93%	0	0%	7	26%	0	0%
Hervas et al. (2017)	14	4	29%	0	0%	5	36%	0	0%
Rincón-Flores et al. (2019)	22	0	0%	0	0%	8	36%	0	0%
Alhammad and Moreno (2018)	6	0	0%	1	17%	4	67%	0	0%
de Jesus et al. (2018)	15	0	0%	0	0%	0	0%	0	0%
Johnson et al. (2017)	26	17	65%	6	23%	15	58%	0	0%
Klock et al. (2018)	20	5	25%	0	0%	0	0%	0	0%
Klock et al. (2020)	40	22	55%	7	18%	18	45%	29	15%
Koivisto and Hamari (2019)	273	57	21%	26	7%	146	53%	13	2%
Hassan and Hamari (2020)	66	7	11%	0	0%	34	52%	0	0%

Table A.3: List of Profile &amp; Ownership, Fairness and Storytelling &amp; Fantasy elements

Authors	Total reviews	Profile & Ownership				Fairness		Storytelling	
		Avatars		Competence		Suggestions		& Fantasy	
		avatar, user profiles, character, virtual identity, Customization, personalization, Character Upgrades		Ranking Leaderboards Scoreboard, User Rankings, likes, social status, reputation system, social reputation, progress, progression, progress bar, status bar, skill trees, self monitoring		suggestions, tips, signposting, assistance, virtual helpers, making suggestions, onboarding, informational, replay or do over, retries, health, health points			
Alahäivälä and Oinas-Kukkonen (2016)	15	0	0%	1	7%	1	7%	0	0%
Wen et al. (2015)	23	0	0%	2	9%	0	0%	0	0%
Hamari et al. (2014)	24	0	0%	14	58%	0	0%	6	25%
Nah et al. (2014)	15	3	20%	6	40%	1	7%	2	13%
Falkner and Falkner (2014)	10	0	0%	0	0%	0	0%	0	0%
Dicheva et al. (2015)	34	1	3%	24	71%	0	0%	0	0%
Seaborn and Fels (2015)	31	3	10%	19	61%	0	0%	1	3%
Pedreira et al. (2015)	29	0	0%	8	28%	0	0%	0	0%
Johnson et al. (2016)	19	0	0%	9	47%	0	0%	3	16%
Morschheuser et al. (2016)	28	0	0%	25	89%	0	0%	3	11%
Sardi et al. (2017)	27	0	0%	8	30%	0	0%	0	0%
Hervas et al. (2017)	14	2	14%	11	79%	0	0%	2	14%
Rincón-Flores et al. (2019)	22	2	9%	10	45%	0	0%	2	9%
Alhammad and Moreno (2018)	6	3	50%	5	83%	1	17%	1	17%
de Jesus et al. (2018)	15	3	20%	10	67%	0	0%	0	0%
Johnson et al. (2017)	26	4	15%	16	50%	6	23%	0	0%
Klock et al. (2018)	20	1	5%	14	70%	0	0%	2	10%
Klock et al. (2020)	40	23	58%	28	70%	7	18%	7	18%
Koivisto and Hamari (2019)	273	36	13%	114	42%	26	10%	22	8%
Hassan and Hamari (2020)	66	16	24%	46	70%	0	0%	5	8%

Table A.4: List of Resources & Economy elements, namely the most popular Gamification elements Points and Badges

Authors	Total Reviews	Resources & Economy					
		Points		Achievements		Resources	
		Points, experience points, point system, scores, xp		Badges, Achievements, medals, trophies, Rewards, in-game rewards, Prizes, awards, incentives, trophies levels(wen2016)		virtual currency, virtual economy, coins, collecting, virtual goods, collection	
Alahäivälä and Oinas-Kukkonen (2016)	15	0	0%	1	7%	0	0%
Wen et al. (2015)	23	23	100%	16	70%	0	0%
Hamari et al. (2014)	24	9	38%	13	54%	0	0%
Nah et al. (2014)	15	10	67%	12	80%	0	0%
Falkner and Falkner (2014)	10	0	0%	10	100%	0	0%
Dicheva et al. (2015)	34	20	59%	22	65%	2	6%
Seaborn and Fels (2015)	31	18	58%	26	84%	0	0%
Pedreira et al. (2015)	29	15	52%	8	28%	0	0%
Johnson et al. (2016)	19	11	0%	4	21%	2	0%
Morschheuser et al. (2016)	28	22	79%	13	46%	0	0%
Sardi et al. (2017)	27	0	0%	25	93%	0	0%
Hervas et al. (2017)	14	6	43%	10	71%	0	0%
Rincón-Flores et al. (2019)	22	11	50%	14	64%	2	9%
Alhammad and Moreno (2018)	6	5	83%	6	100%	0	0%
de Jesus et al. (2018)	15	14	93%	9	60%	1	7%
Johnson et al. (2017)	26	8	31%	2	8%	0	0%
Klock et al. (2018)	20	11	55%	16	80%	1	5%
Klock et al. (2020)	40	15	38%	37	93%	17	43%
Koivisto and Hamari (2019)	273	138	51%	98	36%	10	4%
Hassan and Hamari (2020)	66	32	48%	26	39%	0	0%

Table A.5: List of Social Play elements

Authors	Total reviews	Rating/Voting		Interaction		Collaboration		Competition	
		peer rating, votes, voting, a downvoting, collective voting		s-Interaction, s-connection, connectivity, relationships, s-networking features, s-sharing, s-network, s-media integration, posting, sharing, commenting, forum chatting, user generated content, news feed (user actions), emoticons, memes, s-features		teammates, cooperation, teams, player communities, Peer interaction & collaboration, guild		competition, duel, betting, battles	
Alahäivälä and Oinas-Kukkonen (2016)	15	0	0%	4	27%	1	7%	0	0%
Wen et al. (2015)	23	1	4%	0	0%	0	0%	1	4%
Hamari et al. (2014)	24	0	0%	0	0%	0	0%	0	0%
Nah et al. (2014)	15	0	0%	0	0%	1	7%	0	0%
Falkner and Falkner (2014)	10	0	0%	0	0%	0	0%	0	0%
Dicheva et al. (2015)	34	0	0%	0	0%	0	0%	0	0%
Seaborn and Fels (2015)	31	0	0%	0	0%	0	0%	0	0%
Pedreira et al. (2015)	29	4	14%	0	0%	0	0%	0	0%
Johnson et al. (2016)	19	0	0%	5	26%	0	0%	0	0%
Morschheuser et al. (2016)	28	0	0%	0	0%	0	0%	0	0%
Sardi et al. (2017)	27	0	0%	16	59%	0	0%	0	0%
Hervas et al. (2017)	14	0	0%	3	21%	0	0%	0	0%
Rincón-Flores et al. (2019)	22	0	0%	0	0%	2	9%	4	18%
Alhammad and Moreno (2018)	6	0	0%	1	17%	0	0%	2	33%
de Jesus et al. (2018)	15	0	0%	0	0%	5	33%	6	40%
Johnson et al. (2017)	26	0	0%	13	50%	0	0%	0	0%
Klock et al. (2018)	20	0	0%	0	0%	0	0%	0	0%
Klock et al. (2020)	40	0	0%	10	25%	13	33%	17	43%
Koivisto and Hamari (2019)	273	18	7%	49	18%	47	17%	25	9%
Hassan and Hamari (2020)	66	1	2%	24	36%	7	11%	14	21%

Table A.6: List of Goals, Exploration and Relevance &amp; Relatedness elements

Authors	Total Reviews	Goals				Exploration		Relevance & Relatedness	
		Levels		Challenge & Goal					
			Levels, Stages		Challenges, Quests, Missions, tasks, clear goals, rules, meaning, goals		virtual territories, virtual world, 3D world, game world, unlockable content		Real world, Financial Reward, learning, Physical Cards, Gameboard, Real World interactive objects, physical objects as resource, physical dice Motion Tracking, extortion based spirometer controlled location tagging, Check-ins, location data
Alahäivälä and Oinas-Kukkonen (2016)	15	0	0%	0	0%	0	0%	4	27%
Wen et al. (2015)	23	0	0%	3	13%	0	0%	0	0%
Hamari et al. (2014)	24	6	25%	11	46%	0	0%	0	0%
Nah et al. (2014)	15	5	33%	2	13%	1	7%	0	0%
Falkner and Falkner (2014)	10	0	0%	0	0%	0	0%	0	0%
Dicheva et al. (2015)	34	17	50%	8	24%	0	0%	0	0%
Seaborn and Fels (2015)	31	5	16%	6	19%	0	0%	0	0%
Pedreira et al. (2015)	29	1	3%	1	3%	0	0%	0	0%
Johnson et al. (2016)	19	4	21%	2	11%	0	0%	0	0%
Morschheuser et al. (2016)	28	7	25%	2	7%	2	7%	0	0%
Sardi et al. (2017)	27	0	0%	14	52%	0	0%	0	0%
Hervas et al. (2017)	14	6	43%	14	100%	0	0%	0	0%
Rincón-Flores et al. (2019)	22	0	0%	8	36%	0	0%	0	0%
Alhammad and Moreno (2018)	6	2	33%	1	17%	0	0%	0	0%
de Jesus et al. (2018)	15	10	67%	5	33%	0	0%	0	0%
Johnson et al. (2017)	26	5	19%	15	58%	0	0%	0	0%
Klock et al. (2018)	20	5	25%	0	0	0	0%	0	0%
Klock et al. (2020)	40	18	45%	27	68%	6	15%	13	33%
Koivisto and Hamari (2019)	273	59	22%	91	33%	13	5%	51	19%
Hassan and Hamari (2020)	66	0	0%	25	38%	0	0%	12	18%

Table A.7: More information on the gamification review papers, summarizing their general areas and foci, as well as what kind of results were discovered. Lastly included are the main remarks made by each review paper. b = behavior, c = cognitive

<b>Authors</b>	<b>Total re-views</b>	<b>Area</b>	<b>Focus</b>	<b>Results</b>	<b>Remarks</b>
Alahäivälä and Oinas-Kukkonen (2016)	<b>15</b>	health	behavior change systems	Gamification appears to yield neutral or positive effects.	Gamification should pay more attention to user context.
Wen et al. (2015)	<b>23</b>	health	literature findings on gamification	Not enough empirical evidence to judge usefulness	(1) Potential publication bias (2) Only 39% studies published in quality forums. (3) Points & Badges integrated regardless of context.
Hamari et al. (2014)	<b>24</b>	misc.	empirical results	2 positive 13 partly positive	(1) Overall positive. (2) Poor methodologies. (3) Context is important. (4) Short evaluation times
Nah et al. (2014)	<b>15</b>	education	learner outcomes	13 positive 2 not reported	Encourage practitioners and researchers to use proper design approaches

Table A.7 continued from previous page

Falkner and Falkner (2014)	<b>10</b>	CS education	use of Badges	No evidence that Badges make any contribution to student engagement.	(1) No clear evidence on badge efficiency. (2) Concerns of potential publication bias. (3) Small group sizes. (4) Short evaluation times.(5) Virtual rewards can have negative influence on behavior.
Dicheva et al. (2015)	<b>34</b>	education	effectiveness	18 positive 7 partly positive 1 negative	Lack of proper evaluations
Seaborn and Fels (2015)	<b>31</b>	misc.	theory vs. practice	Overall positive results reported by studies	(1) Lack of isolated studies for effect. (2) Potential for novelty effect. (3) Lack of statistical treatment of empirical data.
Pedreira et al. (2015)	<b>29</b>	software engineering	effectiveness	Majority of the reviewed studies did not provide evidence of effectiveness.	(1) Lack of sound evidence of impact. (2) Only 7% of the studies were journal publications. (3) Lack of empirical data. (4) Over half implemented only Points & Badges with unclear impact results.

Table A.7 continued from previous page

Johnson et al. (2016)	19	health	effectiveness	24 positive (16 b, 8 c) 15 partly positive (6 b, 9 c)	(1) The evidence of 42% of the studies were ranked as weak. (2) 18 / 19 studies used mixed methods. (3) Difficult to identify a single element's effectiveness.
Morschheuser et al. (2016)	28	crowd-sourcing	effectiveness	Psychological outcomes: 8 motivation, 3 attitude, 5 fun, 23 behavioral outcomes. No mention of negative results	(1) 7 studies used monetary incentives. (2) Nearly all studies used Points. (3) No validated psychometric studies.
Sardi et al. (2017)	27	health	effectiveness	Overall positive results; increased motivation and engagement	(1) 35% of the 46 studies (including serious games) were not empirically valid. (2) Potential for novelty effect. (3) Lack of tools to assess potency of gamification. (4) Poor design is also a factor.
Hervas et al. (2017)	14	misc.	behavioral change	proposed taxonomy of gamification	Terminology sometimes confusing
Rincón-Flores et al. (2019)	22	MOOC	effectiveness	Increased course completion rates, 9 studies mentioned increase engagement & motivation.	(1) Studies lean towards "positivism". (2) Still unclear how effective gamification is, despite positive results.

Table A.7 continued from previous page

Alhammad and Moreno (2018)	<b>6</b>	software development	effectiveness	4 positive 2 not reported	Points and Badges were the most common approach.
de Jesus et al. (2018)	<b>15</b>	software testing	effectiveness	Mostly positive, some were not evaluated.	Points and Leaderboards were most common.
Johnson et al. (2017)	<b>26</b>	energy consumption	effectiveness	(1) Mostly positive. (2) Mixed results in 6 studies	(1) Potential for novelty effect. (2) Small sample sizes. (3) Poorly described methodologies. (4) Lack of control groups. (5) Narrow data collection time-frames.
Klock et al. (2018)	<b>20</b>	education	effectiveness	Most results were either indifferent or positive	Badges, Leaderboards and Points were most common

**Table A.7 continued from previous page**

Klock et al. (2020)	40	misc.	tailored gamification	Most common focus of tailoring was the user profile	<p>(1) Lack of research on automating tailoring in Gamification, (2) Researchers should focus more on other types of Tailoring, other than just User profile, (3) Lack of evaluations on the effectiveness of application domain, (4) when tailoring considering dynamic modelling, while ensuring that data is trustworthy, (4) Lack of balance when considering game elements for existing player type models, (5) Evaluations should also consider user characteristics, (6) Should consider gender and other characteristics simultaneously, (7) Lack of evaluations focusing on neutral and negative results</p>
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Koivisto and Hamari (2019)	<b>273</b>	misc.	effectiveness	Of the 66 analyzed experimental quantitative studies, 28.7% reported positive outcomes and a majority reported "somewhat mixed" results.	The research approach is scattered. Models and variables lack published negative outcomes.
Hassan and Hamari (2020)	<b>66</b>	e-participation	effectiveness	mostly positive	(1) Lack of published negative outcomes. (2) Gamification research methodologies are somewhat sporadic. (3) Poor design guidelines a possible reason for low elderly participation.

Table A.8: More information on the persuasive technology review papers, summarizing their general areas and foci, as well as what kind of results were discovered. Lastly included are the main remarks made by each review paper. PT = Persuasive Technology

<b>Authors</b>	<b>Total re-views</b>	<b>Area</b>	<b>Focus</b>	<b>Results</b>	<b>Remarks</b>
<b>Persuasive System Design Reviews</b>					
Wiafe and Nakata (2012)	<b>44</b>	Misc.	Persuasive Systems techniques, methods, domains and applications	23 successful 2 unsuccessful 19 not specified	(1) Terms and vocabulary lack understanding. (2) Ad-Hoc adoption can be counterproductive.
Kelders et al. (2011)	<b>9</b>	Health	PSD in web based interventions for weight control	Only moderate adherence (33%-77%). More elaborate intervention showed better results.	(1) Number of PSD features used varied from 3 to 12. (2) Need for more a all-encompassing system. (3) Most systems neglected dialogue and support systems.
Wildeboer et al. (2016)	<b>33</b>	Health	Web-based interventions and Persuasive Technology Principles	Overall high effect size	Some evidence of publication bias

Table A.8 continued from previous page

Win et al. (2017)	13	Health	use of persuasive features	x	No clear effectiveness, but mentions eight of the studies reported improved adherence and effectiveness
Asbjørnsen et al. (2019)	45	Health	PSD and BTCs motivation adherence in weight loss maintenance	18 did not provide results Seven reported increased adherence Six reported significant effects	(1) More focus on long term effects is needed. (2) Evidence related to motivation is sparse. (3) Concept and reporting of adherence needs to be streamlined. (3) Poor reporting of social support and credibility support made listing them challenging. (4) Some combinations of PSD and BTC appear to be more effective. (5) Lack of user involvement in design processes.
<b>Persuasive Technology Reviews (non specific)</b>					
Dolhalit and Salam (2014)	10	education	Persuasive Multimedia Techniques	Studies showed increased engagement	PT principles should be outlined. Optimistic on the use of PT in changing attitudes and behavior in a fun manner.

Table A.8 continued from previous page

Almutari and Orji (2019)	Health	social influence strategies	56% positive, 41% partially positive, 3% negative x	74 % of the studies focused on adults
Paraschivoiu et al. (2019)	Driving habits	Persuasion Interface Design	x	Counts gamification as a persuasive element
Orji and Mofatt (2018)	Health	Persuasive technology in health	75% positive 17 % partially positive 8% negative or others	There still exist many inconsistencies in both naming and operationalizing strategies in persuasive systems: " <i>...due to this methodological plurality and the heterogeneity of sample sizes and data, we are not able to draw strong conclusions about which persuasion contexts provided the most positive effects</i> "
Agnisarman et al. (2018)	Sustainable living	Persuasive technology in sustainable living	Reported outcomes: 6 behavior change 7 behavior change and awareness 1 behavior & attitude change 1 behavior & attitude change and awareness 2 attitude change 9 Awareness	(1) Small sample sizes. (2) Short test periods

**Table A.8 continued from previous page**  
**Behavior Change Technique Review**

Berry et al. (2018)	9	Health	Results on the use of DBCI to facilitate physical activity	Overall most studies showed positive results but long-term effectiveness remains unclear	(1) A clear picture of how many participants completed each online session was not often provided. (2) Three studies showed a risk of bias. (3) It was difficult to compare studies due to design and population heterogeneity.
Perski et al. (2017)	117	Misc.	Conceptualizing engagement	Lists DBCI techniques that were shown to have positive effect on: engagement and motivation	Provide an elaborate DBCI conceptual framework that also has gamification elements narration and challenge in it

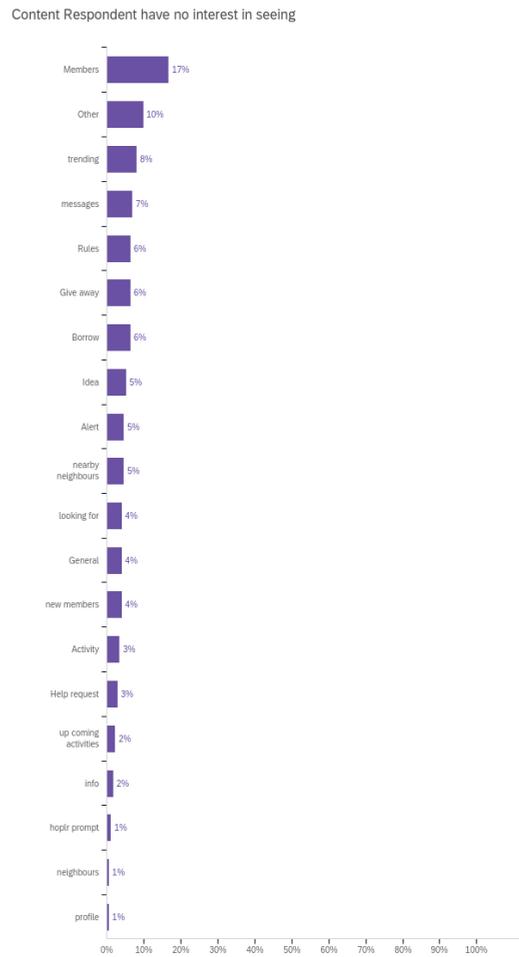


Figure A.1: Results based on clicks that fell inside designated sectors; areas that received no clicks have been removed.

Table A.9: Table of all reported theoretical foundations used by the studies

<b>Gamification</b>	Custom Theory (Alhammad and Moreno, 2018, de Jesus et al., 2018), Fogg FBM (de Jesus et al., 2018), Behaviourism (de Jesus et al., 2018), 6D (Alhammad and Moreno, 2018), Empowerment (Johnson et al., 2016), Extrinsic and Intrinsic Motivation (Johnson et al., 2016, Seaborn and Fels, 2015), Transtheoretical Model (Johnson et al., 2016), Goal Setting Theory (Hervas et al., 2017, Hassan and Hamari, 2020), Self Determination Theory (Hervas et al., 2017, Johnson et al., 2016, Seaborn and Fels, 2015)
<b>Persuasive Technology</b>	Self Efficacy (Berry et al., 2018), Self Management (Win et al., 2017), Fogg FBM (Wiafe and Nakata, 2012), Transtheoretical Model (Wiafe and Nakata, 2012, Orji and Moffatt, 2018) Reported only by Orji and Moffatt (2018): Goal Setting Theory, Social Conformity Theory, Theory of Reasoned Action, Self Determination Theory, Unified Theory of Acceptance and Use of Technology, Reinforcement Theory, Social Cognitive Theory, Premack's Principle. Parallel Process Model, Theory of Meaning Behavior, Sexual Health Model, Social Learning Theory, Health Belief Model, Theory of Planned Behavior, Big Five Personality Theory, Knowledge, Attitude, Behavior Model, Cognitive Theory Model, Technology Acceptance Model

Table A.10: Clusters of behavior-change techniques in the studies reported by two review papers

<b>Cluster Labels</b>	Berry et al. (2018)	Asbjørnsen et al. (2019)
<b>Scheduled Consequences</b>	0	3
<b>Reward and Threat</b>	1	7
<b>Repetition and Substitution</b>	1	32
<b>Antecedents</b>	3	12
<b>Associations</b>	1	23
<b>Covert Learning</b>	1	0
<b>Natural Consequences</b>	2	10
<b>Feedback and Monitoring</b>	5	45
<b>Goals and Planning</b>	6	44
<b>Social support</b>	4	33
<b>Comparison of behavior</b>	2	9
<b>Self-belief</b>	2	8
<b>Comparison of outcomes</b>	2	6
<b>Identity</b>	3	5
<b>Shaping Knowledge</b>	2	37
<b>Regulations</b>	4	6