An Interactive Suicide Ideation Self-Test Service for Helping People Resolve Barriers towards Contacting a Suicide Prevention Helpline

by

Siyu Chen

to obtain the degree of Master of Science
at the Delft University of Technology,
to be defended publicly on Tuesday September 14, 2021 at 13:00.

Student number:	4587456	
Thesis committee:	Dr. ir. Willem-Paul Brinkman,	Associate Professor, TU Delft, Supervisor
	Dr. Saskia Mérelle,	Senior Researcher, 113 Zelfmoord Preventie, Supervisor
	Dr. Myrthe L. Tielman,	Assistant Professor, TU Delft
	Dr. Huijuan Wang,	Associate Professor, TU Delft

An electronic version of this thesis is available at `http://repository.tudelft.nl/`.

TUDelft

Abstract

Suicide prevention is an important global topic, since suicide is being a worldwide serious health issue for decades. In the meantime, people start to pay more attention to mental health issues and Artificial Intelligence is developed and applied in many different fields. Recently, there are many studies been done on using Conversational Agents for mental illness. There are also applications of preventing suicide with Conversational Agents. In the Netherlands, 10.4 suicides happened per 100 thousand inhabitants in 2019. 113 Suicide Prevention is a Dutch national organization with a mission of pursing zero suicides. They are providing multiple services to help people with suicidal thoughts, including a self-test for evaluating suicidal risks anonymously. Even though, people who have taken the self-test receive some suggestions from the 113 websites, they might not contact the 113 helpline for further help. However, it is significant for people with suicide ideation to disclose their thoughts in order to reduce their intention of committing suicide. Therefore, a conversational agent was designed and developed to upgrade the suicide self-test service, which was aiming to resolve test-takers barriers towards contacting the helpline for human help. With the service, the conversational agent interacts with users to help them take the self-test and persuade them to reach for further help by relieving their worriers. A double-blind mixed designed experiment was conducted with 147 healthy general participants and two conditions (traditional questionnaire and interactive service) to verify the hypotheses and evaluate the service. It was hypothesised that participants would have more motivation to contact a helpline for further professional help after taking the self-test in an interactive way than taking the self-test in a traditional questionnaire way. The results showed a significant increase in the traditional questionnaire condition comparing to the interactive service condition. For participants' satisfaction and perceived usefulness, these are higher in the traditional questionnaire condition than the ones in the interactive service condition. In conclusion, the proposed interactive self-test service did not show an expected potential of increasing people's motivation to contact a helpline for professional help. However, the traditional self-test with a textual barrier intervention section showed the potential to motivate people's help-seeking behavior comparing to the proposed interactive self-test service based on the experiment.

Preface

This graduation thesis was completed as part of the fulfilment for my Master's programme in Computer Science at TU Delft.

Studying at TU Delft has been such a journey for me. Before I came to the Netherlands for the study, I was excited and looking forward to a different student life abroad. However, the reality hit me hard. Besides all the new experiences and the new friends I have, the study was quite challenging for me. I started to fall off track and then I hit the lowest bottom in my life. With my last bit of strength and self-esteem, as well as the support from my boyfriend, I managed to find my way to get back on track. Nevertheless, it was just the beginning, there was still a long way to go. I spent much more time on this journey than most other students, but I do not regret my choice. I have learnt who I am and what I expect myself to be on my way to finishing the study.

I would like to thank my supervisor, Willem-Paul Brinkman, for his guidance, inspiration and support on this research. I also would like to thank Saskia Mérelle, my supervisor at 113 Zelfmoord Prenventie, for her great assistance and feedback. They were both being very supportive and understanding all this time, which helped me enormously come this far with the research. Furthermore, I appreciate having the weekly research group meetings with all the other master's students (Zilla, Salim, Jeffery, Mohammed, Zhang, Mitchell, David, Pascal, Sharon, Robert, Ramya, Beyza and Alkis), the PhD candidates (Ding, Fran and Nele) and the postdocs (Merijn), where we listened to each other and shared our opinions. Also, the academic counsellor Michel and the Thesis Support Group were helpful for me going through the research period.

It was a valuable experience for me to work on the thesis project collaborating with 113 Zelfmoord Prenventie. I would like to thank the colleagues from our research department (Renske, Diana, Milou, Elke, Margot, Kim, Elias, Guus, Marijn, Jeroen, Mandy, Kelly, Christina, Pommeline, Laura, Karlijn, Emil), it was a pleasure to work together. I also would like to thank the psychologists (Wilco, Ellen and Sander), the helpline counsellors (Xenia, Jasmien, Bruno and other counsellors), other colleagues (Anouk, Stefanie, Eva, Femma) and the colleagues from the research department for their support, opinions and feedback on my research work.

Last but not least, I would like to thank my family and friends for always being there for me and believing in me. I truly appreciate my mom and my sister's continuous support from my heart, especially my sister, Maomao, for keeping each other's company via calls during the coronavirus pandemic. Thank you, my boyfriend, Jason, for being at my side through this whole journey, I cannot express how grateful I am to be together with you. I also would like to thank Jason's family (Simone, Marie, Kayleigh, Beau-Dean, Louise, Sander, Jan, Louise, Marcel, Eline, Florian and Cruizer), who let me have another family in the Netherlands.

Siyu Chen
Delft, September 2021

Contents

1

Introduction

1.1. Background and Motivation

According to the suicide data from World Health Organization (WHO) in 2019[1], almost 700,000 people die by suicide every year globally. Suicides deaths occur not only among adults of all ages, but also in adolescents[2]. In [1], it is indicated that suicide is the forth leading cause of death among 15 to 29-year-old, and it is also the third leading cause of death for 15 to 19-year-old female. In the meantime, for every actual suicide, more than 20 other people may have had suicide attempts. There are even more people suffering from suicidal ideation as the estimates of the 12 month prevalence rate of suicidal ideation are 2% and 2.1% respectively in developed and developing countries[3]. The annual suicide number in the Netherlands has been stable since 2013 based on the data from Statistic Netherlands (CBS). While most of the suicides happen in the middle-age group, there is an increase among young people[4]. Besides, the suicide rate is almost three times higher than the number of road casualties [5]. Since suicides are preventable with appropriate effort and it is one of the major public health issues for all the countries, it is necessary to develop national suicide prevention strategies[6].

In the Netherlands, 113 Zelfmoord Preventie (which is shortened as 113) is the Dutch national suicide prevention organization, with the mission of zero suicides, which is rational to pursue zero suicides as an aspirational goal with a systematic and sustained approach[7]. In 10 years, they have developed a mature eHealth platform to help people with suicidal ideation via anonymous 24/7 free online service[8][9], including crisis helplines, self-assessment tests[10], an online self-help course[11] and brief online psychotherapy[12]. Based on the 2018 annual report of 113, there were 70,000 crisis calls and chats happening in total, which had increased from 50,000 calls and chats in 2017. 780,000 individuals visited the 113 websites for help or information [13].

Even though 113 is providing multiple kinds of anonymous services for potential audience and spreading knowledge and information of suicidal ideation online and offline, the people who are suffering from suicidal thoughts have to approach them actively. To make matters worse, a troubling phenomenon has been found that a sizable group of people with suicidal ideation did not seek help. Based on the research of Luoma et al.[14], among all the suicide victims, only 45% had contact with primary care providers in the month before committing suicide and 32% had contact with mental health services within 1 year of suicide. Elzinga et al.[15] reported that even in the case of patients with depression, who contacted general practitioners, GPs only assessed and discussed suicidal thoughts with 44% of the depressive patients during the consultation. Moreover, people with suicidal ideation tend to not disclose their suicidal thoughts to anyone in general. It has been found that almost 50% of people when suffering from suicidal ideation did not reveal their suicidal thoughts at all [16] [17] and they may even deny that they ever had suicidal ideation[18]. However, Dazzi, Gribble, Wessely, & Fear's findings[19] suggested that, for both adolescent and adults, acknowledging and talking about suicide may reduce suicidal ideation and repeated questioning may benefit long-term mental health. The study of Calear and Batterham [20] revealed that the responses of psychologists and counsellors were perceived to be the most helpful by people with suicide ideation in Australia.

Every month, around 6,000 people fill in the online self-test [13], the Suicidal Ideation Attributes Scale(SIDAS)[10], on 113's website[8] to be informed about the severity of their suicidal thoughts. However, because of privacy and the anonymity of the help, 113 does not know if the participants follow any of the advice, if they are

1

already in the procedure of solving their problems, receiving adequate help, or discuss their problems with important others. It is urgent to search for solutions to address this issue, since preliminary results of the self-test data from 113 showed that the majority (71%) of the participants who have filled in the online self-test fell into the high suicidal risk group. Moreover, only 10% of the participants visited the helpline page after receiving the textual results and suggestions of seeking help. Seward et al.[21] found that, people with the highest risk of suicidality, who tend to avoid seeking help, are likely to seek for online support, especially for emerging adults. Therefore, one potential solution towards the issue, that the test-takers who have filled the online self-test are with suicidal risk may not seek help from anyone, is that an anonymous conversational agent interacts with the participants to motivate them to reach for human help, such as calling or chatting with 113 Helpine, when they have completed an online self-test of suicidal ideation. The reasons of choosing to develop such a self-test to a chatbot were that a chatbot could give personalized suggestions based on users' profiles and it had the potentials to apply the design of behavior change support systems to change user's behavior of seeking professional help. In this way, a conversational agent might be able to encourage not only young people with suicidal risk, but also middle aged men and all other kinds of help-seekers who incline to the idea of solving their health related problem by themselves[22], to contact 113, such a health service provider. Nonetheless, people with suicidal thoughts might not appreciate an online self-test in the format of a chatbot because of its widely commercial usage, and a chatbot might not be able to impact one's behavior as much as other behavior change support systems, since it provided a one-time self-test with limited interactions.

1.2. Research Questions

The main research question of this study is:

- Is it possible and in what way can a conversational agent motivate people to reach for human help, when they have completed an online self-test?

To answer the main question, we break it up to three sub-questions:

- What kind of persuasive mechanisms could a conversational agent use to persuade people for seeking human help after completing the online self-test of suicidal ideation?
- How could such mechanisms be effectively encapsulated in the conversational agent?
- Do people feel more motivated to enter the 113 Crisis Line after they interacted with the conversational agent?

By answering the three sub-questions, the main research question was discussed in the following way. Not only motivations, but also specifications and requirements were needed to design and develop such a project. It was necessary to figure out what the obstacles and concerns that prevented people to contact with counselors from 113 were. Two focus groups from 113 had the discussions of the above topic from both experts' and clients' perspectives. After that, the specifications and requirements for the conversational agent were defined according to those potential barriers. The fundamental elements mentioned above led to the design of the system. A prototype based on the design was reviewed and refined by 113 psychologists and counsellors and a pilot study for the later evaluation. In the evaluation part, an experiment using the prototype was organized to study the third sub-question.

1.3. Research Approach

To answer the research questions mentioned above, the research approach applied in this study followed the four stage of designing Behavior Change Support Systems (which is shortened as BCSS) [23]. In the first stage, the literature of help-seeking behavior, theories and strategies of BCSS were studied and discussed to understand the barriers of people with suicidal thoughts towards seeking help and to find possible persuasive mechanisms for the proposed system. The second stage was to discover and discuss the most common barriers and appropriate strategies in different scenarios with a focus group of 113 counsellors and researchers, which resulted in a target goal, a target audience and a list of requirements for the conversational agent. A design of the agent was proposed based on the requirements and the goal of users contacting 113 for professional help targeting people with suicide ideation who took the self-test of suicidal thoughts on the 113 websites. Before conducting an experiment with the proposed prototype of the agent, professional input of

113 psychologists and counsellors and a pilot study feedback were taken into account to refine the final prototype. The experiment was conducted with the final prototype to evaluate if people with suicide ideation felt more motivated to contact 113 for professional help after taking the self-test by interacting with the chatbot. In the end, the results were interpreted and the conclusion was drawn to complete this research.

2

Related Work

2.1. Help-seeking Behaviour and Strategies

2.1.1. The Factors and Barriers towards Seeking Help

Chapter 1 discussed the concerning situation that a sizable group of people with suicidal thoughts usually tend not to seek help. Therefore, it is essential to understand the help-seeking behaviour among people with suicidal ideation to figure out their barriers towards seeking help. Based on such understanding, we can identify appropriate strategies to apply in order to develop a personalized solution for the situation. According to previous research on help-seeking behaviour among the general population with suicidal ideations, several factors may be related to people's willingness to seek help.

Suicide ideation   Severity of suicidal ideation is one of the factors that has influenced help-seeking behaviour of people with suicidal ideation. Both studies of Calear et al. [24] and Seward and Harris [21] found that a higher level of suicidal ideation was negatively associated with positive attitudes towards online help-seeking. These findings are in line with the concept of help-negation, which means that individuals with severe suicidal thoughts refuse or reject available support or solutions. Help-negation was also mentioned by Clark and Fawcett [25] theoretically and possibly related with pessimism, cynicism, hopelessness and maladaptive coping, which are common characteristics of people with suicidal ideation[26]. Further research indicated that help-negation was a sign of overall maladaptive coping, consistently associated with prominent avoidant, negativistic, and passive-aggressive personality traits [27].

Stigma   Only 7% of the individuals who experienced suicidal ideation reported stigma as a barrier to help-seeking according to the WHO's global survey [28]. However, stigma consists of perceived public stigma and personal or self-stigma [29] [30]. In contrast to perceived public stigma, self-stigma is still considered as one existing barrier towards help-seeking. The study of Calear et al. [24] indicated that a higher level of stigma has a significant and negative impact on the attitudes and intentions towards help-seeking. Reynders et al. (2014) found that people in the low suicide rate regions had more positive attitudes, less self-stigma and shame compared to people in the high suicide rate. Reynders et al. [31] found that self-stigma was negatively related to the intention of seeking help from a general practitioner, psychiatrist, psychotherapist and family. Especially, men, younger adults, higher educated people and people with lower ratings of mental health experienced self-stigma more often regarding suicidality.

Self-stigma is the reduction of an individual's self-esteem or self-worth caused by the individual self-labelling herself or himself as someone who is socially unacceptable [30]. For example, some people with suicidal ideation may negatively believe that it is a sign of weakness to get help from other people.

Mental health literacy   It has been found that a higher literacy level was significantly associated with positive attitudes towards help-seeking [24]. Lack of literacy in terms of mental health could lead to the result that people with suicidal ideation are not able to realize the need of professional help for their problems. One of the most crucial reasons why people did not seek treatment, was low perceived need based on the WHO's global survey of adults [28]. Individuals may deny that they have suicidal thoughts or suicidal ideation is

a mental health problem. They may also have the beliefs that the treatments are not effective, they would rather manage the problems by themselves.

Other barriers   There are several other possible barriers concerning the help-seeking behaviour of people with suicidal ideation according to Hom et al.'s review [32], including fear of hospitalization or mistrust of health providers. In addition, some structural factors had also been discussed in the review, for example, lack of time or availability for care. Besides, age, gender and suicidal history are also the factors related to the help-seeking behaviour of people with suicidal ideation [24][21][31]. Yet, these are specific facts of each person, which are not possible to be influenced or resolved.

Reasons for completing self-test   Since this study is targeting the help-seeking behaviour of the help seekers who fill in an online self-test, a step back is needed to find out the reasons that people choose to do an online self-test for their mental problems. First of all, in terms of the availability, affordability and accessibility of the Internet, people can easily get access to the online self-tests, especially some of them are free of charge, and it is convenient and flexible for people to take the tests no matter when and where. This kind of assessment also provides efficient results via the latest self-tests with textual feedbacks and web links for more details. Because the Internet can accept people who tend to be anonymized and tend to have no human interactions and keep their activities privately, this type of people prefers taking the self-tests online. In this case, such individuals can obtain results in a more effective manner by not having interactions with other people. Other reasons for filling in such tests can be self-exploration and self-awareness, to know more about themselves, to figure out answers to personal problems, to help them make decisions or to satisfy their curiosity [33].

There are quite a few works of literature studying the reasons that people taking online self-test for mental concerns. However, these studies often focus on people taking general medical self-tests [34][35][36]. Kue-cuekbalaban' research [36] studied the personal reasons of using a self-test, for example, people may take self-tests to monitor and reassure about their health statues based on perceived risks, or to look for confirmation or explanation for the existing problems. There are several perceived benefits of self-tests mentioned by the participants in Ryan et al.'s study [34], for example, to preserve their anonymity or not to speak about 'embarrassing' complaints, or they serve as a pre-check to assure the problem before talking with doctors about a possibly awkward complaint, or they want to pre-check their condition to not waste their doctors' time or save their own time from the difficulties to schedule and visit doctors. The review of Ryan et al. [34] revealed that some individuals taking self-tests were driven by negative feelings of seeing a doctor or negative experience with the GPs who were being uninterested or dismissive. It was also possible that people accessed such tests opportunistically without expecting any benefits or for any purposes. Self-testing could be seen as an empowering process for some people, which means they are in control of and responsible for their own health according to Ryan et al [34].

While there are barriers for people with suicidal ideation to seek help, there are also motivators inspiring people to reach for help. Not much research has been done to study the facilitators for help-seeking towards suicidality or mental health problems. However, there is some work addressing such facilitators among young people. According to Rickwood et al. [37] and Gulliver et al. [38], several reasons contributed to young people's help-seeking behavior for their mental health. If young people have knowledge on mental health issues and professional sources of help, if they are willing to express their feelings, or if they trust potential help providers, it is more likely that they would seek help for mental health problems. In addition, they found that emerging adults also seek help because they are supported or encouraged by families or friends and aware of the severity of their mental problems.

2.1.2. Theories and Strategies for Behaviour Change

After discussing the literature on help-seeking behaviour, the theories behind behaviour change are briefly introduced in this section. Behaviour change is an intentional process involving progress through six stages of change based on The Transtheoretical Model (TTM) from Prochaska et al [39]: precontemplation, contemplation, preparation, action, maintenance, and termination. Since the audience targeted in the research are the test takers of the self-test for suicide ideation, it is likely that they might not have taken any actions, or they had received treatment because of their history of suicidal ideation and they might experience a new episode of suicidal ideation and they plan to check their condition. Therefore, they are in one of the stages of precontemplation, contemplation or preparation. People in the stage of precontemplation do not intend to take actions in the next 6 months. People in the stage of contemplation intend to change in the next 6 months. People in the stage of preparation intend to take action in the next month. The research of Prochaska et al.

[39] demonstrated that applying stage matched interventions contributed to considerable improvements in recruitment, retention and progress, especially with computer-based individualized and interactive interventions. Therefore, it can be beneficial to figure out which stages people are in and use appropriate interventions based on the stages to attain the optimal outcome.

Since the purpose of this research is to study the possibility and the potential methods of intervening the help-seeking behaviour of people with suicidal ideation, we start with two well-known theories of behaviour change theories respectively from Fogg and Michie et al. Fogg Behaviour Model [40] demonstrates that a target behaviour requires sufficient motivation, sufficient ability and an effective trigger for a person to perform. Motivation and ability in the model can trade off, which means that people may perform a simple task even with low motivation, or people with high motivation may put effort on difficult actions. However, an appropriate trigger plays a significant role in all kinds of scenario. In the COM-B system from Michie et al.'s work [41], behaviour not only depends on three components, including capability, opportunity and motivation, but also influences all these components as well. Capability and opportunity interact with motivation separately. In both theories, one or more components should be changed in order to generate the target behaviour.

The ability or capability is the fundamental requirement for people with suicidal ideation to perform help-seeking behaviour. Increasing ability by requiring extra effort to learn new skills creates another barrier for the target audience. Instead, simplifying the target behaviour is the proper mean to increase the ability [40]. For example, defaulting some settings or reducing some steps in the help-seeking process to avoid the target audience overthinking, convincing the potential clients that seeking help for their suicidal thoughts is a normal social behaviour and other people with suicidal ideation also take such actions, or solving the concerns of people with suicidal ideation towards the consumption of time or physical effort for seeking help from 113. Jaroszewski et al.'s study [42] has demonstrated that reducing barriers of people in risk by providing related information could increase the use of crisis services.

A trigger or an opportunity is always needed for people taking actions. An essential part of the experimental system to consider for the design is to create appropriate triggers that help people with suicidal ideation to overcome the barriers and take the opportunities. A trigger can be designed to affect motivation or ability, or it can serve as a reminder. Since the outcome of behaviour change in this research is a one-time action, which is that the test takers contact 113 for professional help after finishing the self-test, a trigger functioning as a facilitator is what is supposed to be focused on in the system. Facilitating contacts to professional help is the last step of the whole process, increasing the ability with a simplified step can increase the chances of people taking actions.

Motivation plays an important role for the performance of the target behaviour. Motivational Interviewing (MI) is a collaborative conversation style, which can be applied to strengthen a person's own motivation and commitment to change' [43].It is a client-centred method that attempts to explore and resolve their ambivalence, allowing them to decide for themselves whether to change. The practice of MI implicates applies four core counselling skills: OARS (asking Open-ended questions, Affirming, Reflecting and Summarizing) [43]. In terms of methods, MI practises can be aligned with supporting each of the three basic psychological needs specified by self-determination theory, namely autonomy, competence and relatedness.

Self-Determination Theory is a broad-based theory of human motivation [44].According to Markland et al. [45], SDT can offer a theoretical framework for deepening our understanding of the efficacy of MI. More precisely, it is argued that the specific strategies in MI may fulfil the clients' basic psychological needs for competence (e.g. by using techniques to explore and build confidence), autonomy (e.g. by allowing clients to discover their own reasons for change) and relatedness (e.g. by being compassionate). Further, people's motivation towards the target behaviour, which is contacting 113 for further help, may be positively influenced.

Principles of Influence includes six principles which could influence human behaviour strongly [46]. The six principles are reciprocity, consistency, social validation, liking, authority and scarcity. Among these principles, social validation, consistency, liking and authority are the ones that can be applied in this research. Social validation implies that people tend to be 'more willing to comply with a request for behavior if it is consistent with what similar others are thinking or doing'. Based on this principle, the possibility of people perform help-seeking behaviour can be raised by showing the fact that other test-takers do contact 113 after self-testing and other people with suicidal thoughts also contact 113 for further help. Consistency means that people tend to be 'more willing to comply with requests for behaviors that are consistent with that position after committing themselves to a position'. To apply the consistency principle, people who take the self-test for suicide ideation should be committed to the role of help-seekers. The test takers can be called as help-seekers or can be told that self-testing is the first step they take to receive help during the process. The liking

rule is stated as people have the tendency to be 'more willing to comply with the requests of friends or other liked individuals. The strategy of role model can be applied to follow the liking rule. The story of several liking and well-known individuals performing help-seeking behaviour may encourage the test takers to seek for help. The rule of authority can be explained as that people tend to be 'more willing to follow the suggestions of someone who is a legitimate authority'. As a national suicide prevention organization, the authority of 113 could be stressed with its legitimate background and by presenting suggestions with support from the psychologists and the research which have been done in 113.

Overall, all these theories and strategies are aimed to motivate potential help-seekers to perform help-seeking behaviour. Table 2.1 lists the theories and strategies with requirements which are derived from them.

Theories & Strategies	Requirements
The Transtheoretical Model	To figure out which stages people are in and use appropriate interventions based on the stages
Fogg Behaviour Model	To perform a target behaviour requires sufficient motivation, sufficient ability and an effective trigger
COM-B System	To perform a target behaviour requires capability, opportunity and motivation
Motivational interviewing	To explore and resolve people's ambivalence, allowing them to decide for themselves whether to change
Self-Determination Theory	To fulfil the clients' basic psychological needs for competence, autonomy and relatedness
Principles of Influence	To influence human behaviour based on the principles of social validation, consistency, liking and authority

Table 2.1: Theories & Strategies with Requirements

2.2. Conversational Agents & BCSS

The development of conversational agent technology in recent years resulted in many studies on applying such technology to mental health care. Conversational agent interventions were studied for suicide prevention [47] and cognitive-behavioural therapy [48]. Both meta-analytical reviews from Vaidyam et al. [49] [50], which covered chatbots and conversational agents in mental health from 2010 to 2020, revealed the high potential for conversational agents being used in mental health field in psychiatric use and benefiting in psychoeducation and self-adherence, generally positive outcomes on diagnostic quality, therapeutic efficacy and acceptability of such agents. The conversational agents interventions for mental health regarding practicability, feasibility, efficacy and acceptability are promising, according to the reviews of Gaffney et al. [51] and Bendig et al. [52]. However, all of the reviews suggested that further research should explore the efficacy and efficiency of these Internet- and mobile-based psychological interventions with a more robust experiment design including target populations.

Martinez-Miranda's paper [47] on especially reviewing embodied conversational agents (ECA) for the detection and prevention of suicidal behavior shared the same conclusion with the reviews above. Half of the included studies [53] [54] [55] were using ECAs as virtual counsellors, which are related to the topic of developing conversational agents to intervene help-seeking behavior with suicidal thoughts. Unfortunately, none of these studies were mainly focused on suicide detection and prevention. The same method to detect suicidal behavior were applied, which were performed through validated surveys (e.g., PHQ-9 [56]). These applications [53] [54] [55] offered the basic function of preventing suicidal behavior by suggesting users to seek help and altering the researchers and specialists to facilitate help. Furthermore, since the systems were focusing on preventing, intervening and treating depression, this function was only served for the extreme situation when users reflected suicide ideation on their questionnaires. Thus, none of the studies reported detailed evaluation specifically on the effectiveness of the suicide detection and prevention in those applications.

There are three other studies providing a better insight of conversational agent intervention for risk detection and suicide prevention. HelPath is a mobile-based embodied conversational agent to remotely monitor and collect relevant individuals' data for detecting suicidal behaviors [57]. It is aimed at combining self-reported information of mood state, negative thoughts, the execution of recommended activities and related data collected from user's electronic health record to provide suggestions and CBT-based exercises for preventing the relapse of suicidal behaviors. The ECA would alter to relatives or specialists for direct contact support via SMS if any risks were detected. Another application, which was developed and evaluated by

Jaroszewski [42], is a brief automated risk assessment and intervention platform aiming at increasing the use of crisis resources among individuals in crisis. A chatbot is applied in the system to message and assess potential users in crisis. Once a user is assigned as 'high-risk', the assessment will stop and crisis resources will be presented to the user immediately. When individuals show unwillingness of trying the crisis resources in the follow-up question, they will be presented with an interactive Barrier Reduction Intervention (BRI) via the chatbot. This BRI provides a brief psychoeducation to help users in crisis to overcome concerns and barriers of using crisis resources. Tielman et al.'s paper [58] presented three protocols covering risk detection and management in autonomous e-mental health (AEMH) systems. Each of the models represented a step, the first one for detecting and evaluating risk level, the second one for auto-referral and user's expectation and autonomy, and the third one for motivating user's help-seeking behavior. These models were proposed to provide a design base for AEMH systems focusing on risk detection. In conclusion, previous programs on risk detection and prevention ask for initial users of the applications and their high involvement with personal mental health data, which results in limited population meeting the high standard. For further research, it is justified to study a suicide detection and prevention chatbot which combines reducing barriers and motivating people to seek help based on an existing online self-test for suicide ideation to reach common individuals with suicidal thoughts.

2.3. Focus Group

Several factors and barriers of people with suicidal ideation toward help-seeking behaviour had been found through literature research in Section 2.1, as well as theories of behaviour change and potential strategies had been discussed. In order to attain insight of the difficulties among people with suicidal ideation and opinions on methods for behaviour change, the experience and knowledge of the employees and volunteers from 113 were valuable for this research. Focus group is described by J. Smithson as a controlled group discussion, where a specific topic is selected for discussion with participants selected from a target population [59]. Therefore, focus group meetings within 113 were organized to discuss the topics mentioned above.

2.3.1. Focus Group Set-up

The focus group for this study consists of employees and volunteers from 113. There were 20 participants in total, including 4 from the Communication Department, 8 from the Research Department, and the rest of them were 3 psychologists and 5 counsellors from the Crisis Line. Both of the Research Department and the Communication department shared their opinions from their professional perspectives, since they had done research on suicide topics and surveys with clients via social media. The psychologists and counsellors from the Crisis Line were invited because of their practical experience of communicating with help-seekers directly. In order to have high-quality and in-depth discussions with the participants, only 5 to 8 people attended in each meeting. In total, three meetings were arranged for the focus group.

The described focus groups were approved by TU Delft Human Research Ethics Committee on 11-06-2019, with the application ID number 814.

The purpose of the focus group meetings was to explore the potential barriers, concerns and obstacles that the help seekers were facing with when they are completing the online self-test. To serve this purpose, two questions and three scenarios were created for the meetings. These questions and scenarios were asked and presented in the way to trigger and generate discussions within the group. For the questions, several choices were made available, and the participants were requested to first rank the choices according to their opinions on a questionnaire. In this way, the participants were able to answer questions based on their own knowledge and experience without bias from others' remarks. After that, each of them informed the group of their top choices from their rankings. Since they already stated their stances, this led to discussions to exchange the reasons behind their choices. For the scenarios, the same idea was applied to have group discussions. Each scenario illustrated two ideas for a specific issue that would happen in the proposed system. The participants chose one of the methods that they preferred on the questionnaire, and then informed the others of their stances, which also led to a group discussion. Notes on the opinions and arguments of the participants were taken during the meetings. The questions and scenarios for the meetings are discussed in the following section.

2.3.2. Questions and Scenarios

Questions Based on the literature concerning the purposes of taking mental health or medical self-tests in Section 2.1.1, the first question (Question A) aimed to find out what purposes test takers have for filling in a

self-test. This question served as a pre-question for the second question (Question B) by guiding the focus group to think of the reasons behind taking self-tests before having the discussion of barriers towards seeking help. Question B contained two sub-questions. The first sub-question focused on exploring the barriers of the help-seekers based on Section 2.1.1. The second sub-question focused on figuring out which motivators people might have for seeking help. This question served as a post-question for Question B-1.

Scenario 1   This scenario was inspired by the original procedure, where visitors approached the self-test for suicide ideation by filling in an answer for each question. Afterwards, they would receive a textual feedback according to the severity of their suicidal thoughts. The textual feedback depended on the severity of their suicidal ideation, which was accorded to the results of the self-test for suicidal ideation (SIDAS) [10]. When the score was equal or higher than 20, test takers were considered as high-risk. Otherwise, they were considered as low-risk. Based on their severity score, several methods were suggested for them, from talking with families or friends, contacting 113 to making an appointment with GPs or psychologists. New in this scenario was the trigger to motivate people for help. As research showed that half of the suicidal population had no plans for disclosure [16] [17], we expected that a substantial part of the visitors might hardly be motivated or urged by plain text. Therefore, the solution for this scenario should work on encouraging the test takers to seek help at one hand, on the other hand, this scenario took into account the barriers for these people to motivate them in a suitable way. Consequently, a barrier survey would be applied in both solutions to promote the next stage. The barrier survey explored the reasons that stop the test takers to seek help from others. Therefore, this scenario proposed two solutions with different strategies to help people move forward.
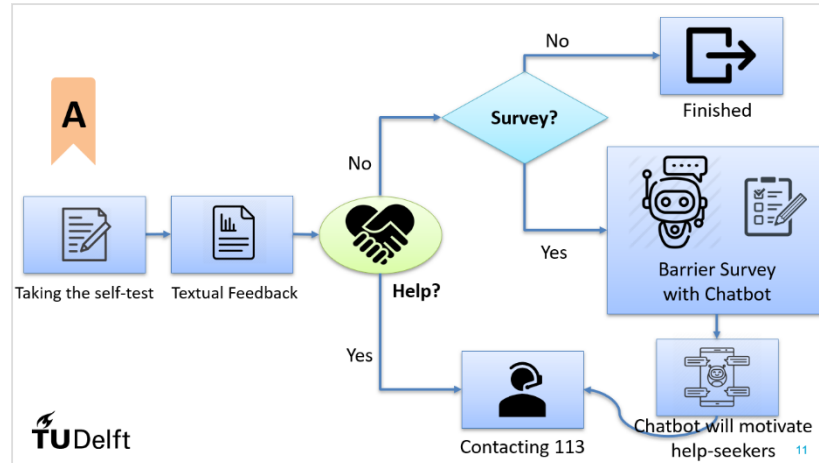

Figure 2.1: The solution A in Scenario 1

The overall idea of solution A was to respect the choices of the users and let them be in control, which referred to an important part of motivation to change, which was previously mentioned as self-autonomy. If the test takers were willing to receive more help from 113, they would be directly connected to a chat with 113 Crisis Line. If they were not ready for further help, they would be requested to fill in a barrier survey in order to let the chatbot interact with them by applying appropriate strategies based on their specific barriers. However, they could still choose not to follow the process and finish the test only with a textual feedback.
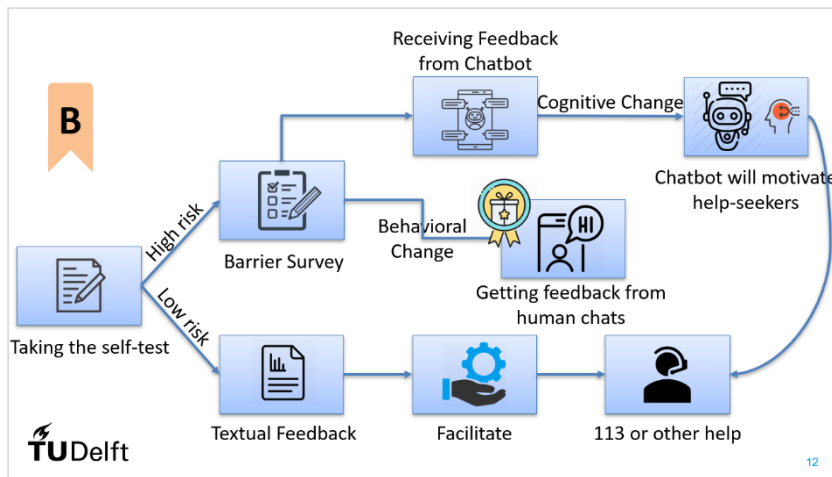
Figure 2.2: The solution B in Scenario 1

The strategy in solution B was that more attention was being paid to test takers who score high on suicidal ideation. Since this kind of users have probably an urgent need for help, they will be directly taken to the next step of answering a barrier survey without being informed. In order to raise their intention to finish the survey, they would be promised with feedback reporting their results of the test as a reward. Two different flows were designed based on what type of barriers they have. Either they would be targeted with a cognitive change method, where they would receive feedback from the chatbot and interact with the chatbot, or they would be targeted with a behavioral change method, where they receive feedback from human chats.

Scenario 2   The original self-test for suicidal ideation was like all other online tests, a simple questionnaire with options to select on a webpage. Since a chatbot solution was proposed to improve the whole self-test service, it was also possible to combine the self-test with the chatbot to enhance the experience of taking the self-test.
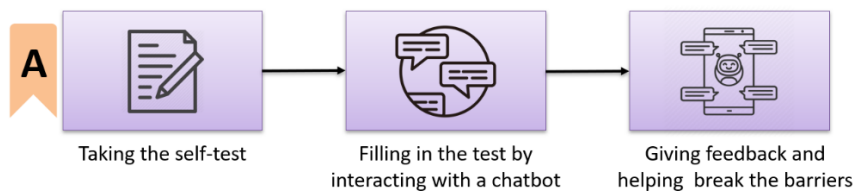
Figure 2.3: The solution A in Scenario 2
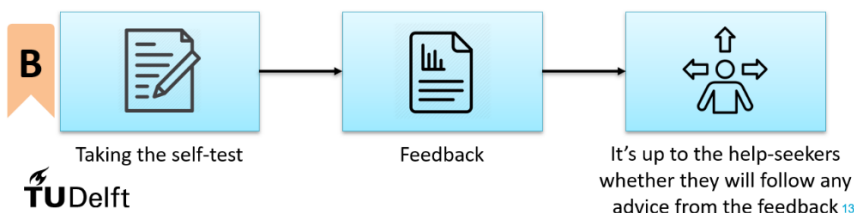
Figure 2.4: The solution B in Scenario 2

In solution A, the test takers would be able to fill in the test by interacting with the chatbot. With such set-up, they receive their feedback from the chatbot and then the chatbot smoothly offer further help in the chat. By skipping the step of asking users' permission to interact with the chatbot, it increases the probability that their barriers get addressed and the chances of seeking further help. Solution B, which was the original self-test process, illustrates that it will depend on the test takers to decide their next step. In this case, the

choices of the test takers were fully respected, and their decisions were not intervened. The test takers might feel comfortable with the self-test and they might come back to 113 for further help.

Scenario 3 In both solutions of scenario 1, a barrier survey was used to identify what kind of barriers the test takers could have against seeking help after filling in the self-test for suicidal ideation. Once the barriers of the test takers were clear, it would be essential to apply a matching strategy to facilitate help-seeking behavior. Two strategies were demonstrated. The idea of the first one was presenting a role model to change the belief of people with self-stigma who believed seeking help was the behavior of weak people. The second one with the method of reframing that aimed at changing the view of seeking help from professional. An example of reframing was to reframe the help-seeking behavior as asking for advice to solve the problems causing the suicidal ideation.
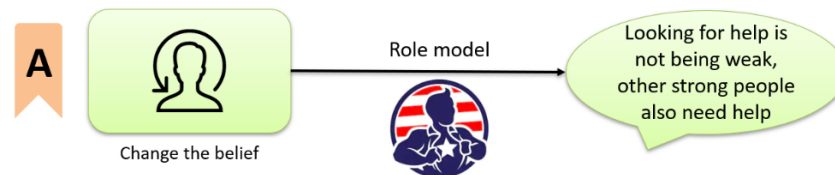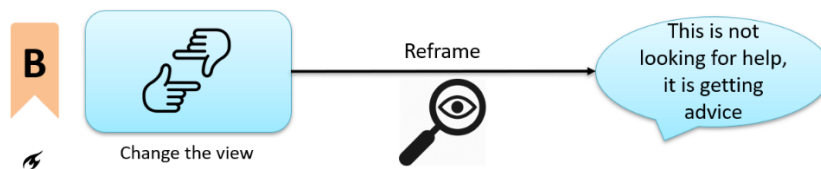
Figure 2.5: The solution A in Scenario 3

Figure 2.6: The solution B in Scenario 3

2.3.3. Results of the Focus Group Discussion
Concerns related to help-seeking behavior According to the focus group, the individuals who decided to take a self-test of suicide ideation with the purpose of confirmation might prefer having results for themselves before seeking help from other people. Because they would like to make decisions on the next step after assuring their conditions. The psychologists in the focus group mentioned that some people with suicide ideation chose committing suicide over seeking help from others, since they might consider suicide as an easier and quicker way to solve their problems. Therefore, they would rather take care of the problems by themselves than bothering their families or friends. They often considered themselves as a burden to others. Such clients preferred to be in control of their own conditions.

Another issue that the focus group had discussed was that the test takers might be afraid of getting hospitalized and losing their self-autonomy by avoiding interactions with doctors or people. The test takers might assume if they only took self-tests, they would have fewer obligations than seeing GPs or psychologists and discussing their problems. They did not have to face serious consequences in reality. People with suicidal ideation might have different kinds of fear or mistrust towards health providers. Emergency service at their places or getting hospitalized was mentioned by the participants as one of their most common concern. Previous negative experience with health support could also lead to mistrust of health providers or treatments. The discussion of the focus group indicated that this type of test takers was afraid of negative consequences of seeking help and they needed a certain amount of self-autonomy.

Because of severe suicide ideation, such individuals often had avoidant coping styles. The focus group thought that people with suicide thoughts refused to face their problems and they avoided the possibility of recovery. They experienced hopelessness and helplessness and were not able to become better by getting help from other people. Even they were not against receiving help for their conditions, it was still possible that they were afraid that they might fail to recover. Based on the discussion, it could be concluded that the clients might tend to avoid any perceived risks and feel insecure and ambivalent about help-seeking.

An extreme facilitator for potential help-seekers to seek help was the urgency of losing control. The focus group mentioned several times that help seekers using the crisis line were afraid of the negative reactions

from their families and friends if the fact that they had suicide ideation was found out. They might be at the edge of losing their jobs or partners or losing control of their suicidal thoughts. In such case, fearing negative social consequences in their lives might be one of their biggest concerns.

Concerns related to the application of the proposed interactive self-test   One issue, the focus group mentioned, was that visitors filling in a self-test might be afraid of privacy issues since they consulted mental e-Health support, which meant that the privacy of online help was an important issue for the help-seekers. An important issue that was raised during the focus group meetings was the importance of having confidence in the providers of such services. The anonymity of online services also increased the trust towards help providers, which made such help sources more attractive since there were no commitments required. In this case, anonymity was an important reason for help-seekers to seek help from the Crisis Line.

From the focus group's perspective, one concern for the proposed self-testing procedure in Scenario 1 was that the test takers might get scared by the longer process than they expected, which might cause decision overload to people who suffer from suicidal ideation. They also might be scared by direct interaction with chatbot or human chat without any reminders, which indicated that self-autonomy is also important during the self-testing procedure. One more mentioned issue in the focus group was that the reliability and validity of the self-test should be confirmed in case that the test takers were classified to the wrong level of severity. Another issue that the participants reported was that some people did not like to interact with a chatbot due to their negative attitude towards (commercial) chatbots.

The last concern, which was brought up by the focus group, was that the strategy of reframing 113 as a 'non-help provider' in Scenario 3 was in reverse to the image of 113. It was also risky to promise the help-seekers with advice for their problems when they might not receive satisfying answers from the counsellors.

Table 2.2 listed all the concerns and issues based on themes which were drawn from the focus group meetings.

Concerns related to help-seeking behavior	Concerns related to the application of the proposed interactive self-test
Being in control	Privacy and anonymity
Afraid of consequences of seeking help from professionals	Decision overload/avoidance
Self-autonomy	Self-autonomy
Perceived risk avoidance	Reliability/validity of the self-test
Insecure/ambivalence	Negative attitude towards chatbot
Fear negative social consequences	Clarity about service offered by 113

Table 2.2: Concerns and Issues

2.4. Requirements Specification

Table 2.3 presented a list of requirements which were derived from the previous literature review and the discussion results of the focus group meetings. The system design in Chapter 3 started based on this table.

1	The new self-test should include a barrier survey.
2	The new self-test should be able to resolve the most common barriers that the test takers have towards seeking help for suicidal ideation.
3	The new self-test should use appropriate strategies to resolve different barriers.
4	The new self-test should protect the privacy and anonymity of users.
5	The process of the new self-test should not be too long or too complicated.
6	The new self-test should let the users have their self-autonomy during the whole interactive process.
7	The content of the new self-test should be reliable and valid.
8	The chatbot of the new self-test should be more acceptable.
9	The new self-test should be clear with its function and service.

Table 2.3: Requirements

3

Design

3.1. Proposed Solution: An Interactive Self-Test for Suicidal Ideation

The proposed solution to the main research question is to provide the self-test for suicidal ideation in an interactive way with a barrier intervention. With the original self-test for suicidal ideation on 113 websites, test takers only receive a textual feedback with several suggestions based on their levels of risk after finishing the self-test. Test takers, especially the ones who receive the result of high-risk, might be hardly motivated by the plain text. As shown in Figure 3-1, updating the original self-test to an interactive one is the first step to create a communicating environment for the test takers. The interactive way of taking the self-test also creates a smooth transition to the following stages which are conducted in the conversation as well. In the second stage, the test takers receive feedback from a conversational agent (CA) after taking the self-test by interacting with the CA. A barrier survey is included in the interactive self-test procedure in order to apply the barrier intervention effectively in the next phase. The barrier intervention is personalized based on the barriers identified in the barrier survey and the potential suicidal risk levels from the self-test results. In the end, the test takers are offered with access to human help for counselling if their barriers are resolved and they are motivated to contact further help from 113 helpline. The barrier survey, the barrier intervention and the procedure of the interactive self-test are discussed in detail in the following sections.
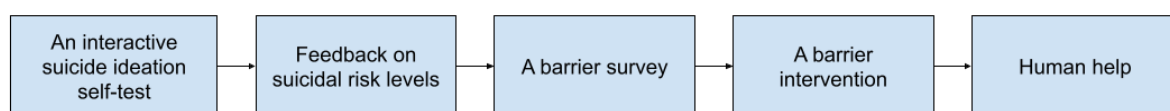
Figure 3.1: The components of the proposed solution

3.2. Barrier Intervention

3.2.1. Barrier Survey

In Chapter 2, it is mentioned that there are different barriers why potential help-seekers with suicidal ideation are not seeking help from others. To motivate such potential help-seekers, it is necessary to understand what kind of barriers they have towards seeking human help. As the first requirement stating, a barrier survey is included in the interactive self-test system. The purpose of the barrier survey is to be aware of the barriers test takers have. Based on the literature and the results from the focus group in Chapter 2, five barriers are considered as the most common ones among the people with suicidal ideation in the survey. The five barriers

are, severe suicidal ideation, self-stigma, fear or mistrust health providers, lack of mental literacy and lack of availability. After knowing the barriers test takers have, appropriate strategies can be applied to motivate them in an efficient way.

The barrier survey is placed after people with high risk of suicidal ideation receiving the feedback for their condition. The reason to do so is that people are suggested to take action on seeking help in different ways in the feedback. After that, they may or may not have plans for seeking help from others. They will be requested to take the barrier survey if they have no intentions to seek further help from any resources with respect for their self-autonomy.

Since the barrier survey may expose people with suicidal ideation to more barriers that they have not thought of by themselves, the barrier question only lists the top 3 barriers at first to prevent such risk. If the test takers do not see themselves having any of the top three barriers, more options with other barriers are available for them to choose from.

The main question in the barrier survey is: 'If you have no plans of seeking any kinds of help, what is your main concern? (It's up to you to answer this question or not.)' Five options corresponding to the top three barriers are provided for test takers to choose from, which are listed in Table 3.1. The options of other barriers are listed in Table 3.2.

Top 3 barriers	Options
Suicidal ideation	'I think I am beyond rescuing'
Self-stigma	'I think I should be able to handle it by myself.'
	'I think I should handle it by myself because I don't want to bother others'
	'I feel ashamed to talk about my suicidal ideation'
Others	Others

Table 3.1: Options based on the top three barriers to the barrier survey questions

Other barriers	Options
Fear or mistrust health providers	'I am afraid of, or I don't trust health providers'
Lack of mental literacy	'I don't think that there are professionals can help me with that'
Lack of availability	'I don't have time, or I am afraid that it would cost me much money to get help from professionals'

Table 3.2: Options of other barriers to the barrier survey question

Barriers & Strategies   With understanding the barriers of test takes through the barrier survey, the barrier intervention applies persuasive strategies to reduce test takers' barriers to seek human help. The Principles of Influence [46], mentioned in Chapter 2, are the main strategies in this session. The principles of reciprocity and scarcity are not suitable for this system based on the definitions. Reciprocity represents "One should be more willing to comply with a request from someone who has previously provided a favour or concession". Scarcity means "One should try to secure those opportunities that are scarce or dwindling". As discussed in Chapter 2.1, four other principles are applicable in this system, social validation, consistency, liking and authority. For each barrier, there are four messages based on each of the four principles. Since not every test taker might be persuaded by the same argument, multiple argument messages are developed for each barrier to have other possibilities in a dialogue. For example, a message applying the principle of social validation to help overcome the barrier of suicidal ideation: "In 2018, 70,316 person-times contact 113 via calls and online chats. Based on the interviews we had with our pervious clients, who were suffering from severe suicidal ideation and thought they were beyond rescuing, they told us that they were glad that they had called us." Another versatile message using the consistency principle to reduce different concerns with a slight of adjustment is "Taking the self-test is your first step to seek help for your suicidal ideation. Contacting 113 is the next step to get further help. Since you already take the first step, you are able to take the next step." A Barrier-Strategy matrix is filled these messages which are used in the conversations between the test takers and the chatbot. The matrix is available in **??**. The content of the matrix had been reviewed and improved by a psychologist at 113 Suicide Prevention to ensure the validity of the messages for the test takers with suicide ideation.

3.3. System Design

3.3.1. System Design

In this section, the design of the system is illustrated and explained in detail.

The interactive self-test in the system applies the questions and the choices of the SIDAS [10], which is the same as the original self-test. However, only one question is asked each time to follow a dialogue style, which differs from the original self-test in a questionnaire style. The test takers receive the next question once they finish answering the last one. At the beginning of the interactive self-test, a short introduction to the self-test is presented to the test takers first. They are informed with following information. Taking the self-test is fully anonymous and the privacy of their personal information (gender and age) is protected. There are no obligations to finish the self-test. They can quit the self-test anytime of the process. All the content of the self-test is based on published literature or psychologists' knowledge. The function of the self-test is to help individuals figure out their condition and give suggestions on their next steps in case of having any suicidal ideation. If they are interested in further help, they can reach to the free consulting service that 113 helpline offers 24 hours, 7 days a week. The test takers are informed which is in line with the 4th, 6th, 7th and 9th requirement.
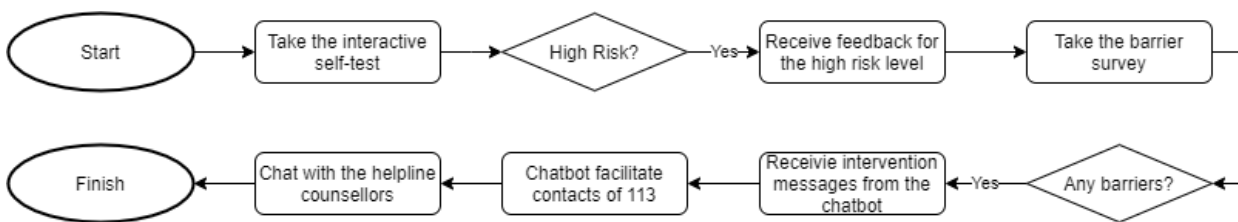
Figure 3.2: The flow for user with high risk and barriers

People who finish the self-test are divided into three groups of no risk, low risk or high risk based on their scores. Depending on the level of risk, the test takers will go through different process. People in the high-risk group with barriers will experience the longest process in the system comparing to the other groups. The process for the test takers in the high-risk group with barriers is shown in Figure 3.2. After they are identified as high-risk with suicidal ideation and they reply to the chatbot with one of the barriers, they will receive the barrier intervention from the chatbot. During the intervention, the chatbot will resolve their barriers and aim to motivate them to contact 113. Independent whether or not the test takers are convinced by the messages, the chatbot will facilitate the contact of 113 helpline. Defaulting the facilitation is to trigger the test takers to take the opportunity to contact the helpline, since people tend to follow a default option [23]. The aim of this strategy is to help these high-risk individuals to overcome their barriers bring them into contact with the counsellors where they can talk about their suicidal thoughts. The reason of applying such strategy for the high-risk group is to maximize the chances that they start to talk with the helpline as soon as possible, as the delay of such conversations might cause severe consequences. Therefore, it is needed to find an appropriate balance between autonomy and safety, where the autonomy of the high-risk individuals is ensured by the possibility of dropping out of the chat at any time.
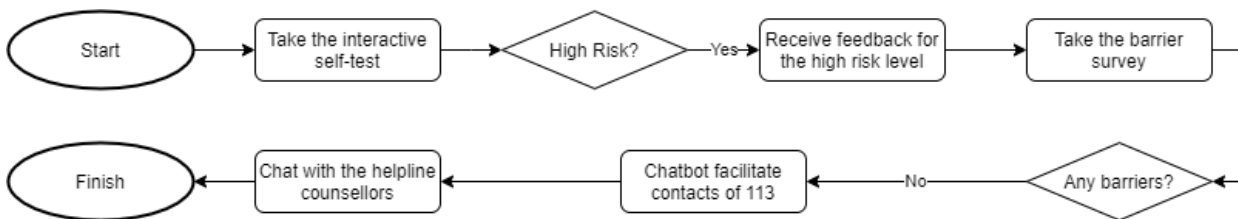
Figure 3.3: The flow for user with high risk but no barriers

For the test takers who are in the high-risk group but without any barriers, they receive the facilitation of contact directly, as shown in Figure 3.3. Then they can chat with the counsellors immediately. However, for the people with no or low risk for their suicidal ideation, as shown in Figure 3.4, they will receive a general feedback with several suggestions on what actions they can take to help themselves and a brief explanation on the common barriers they may have.
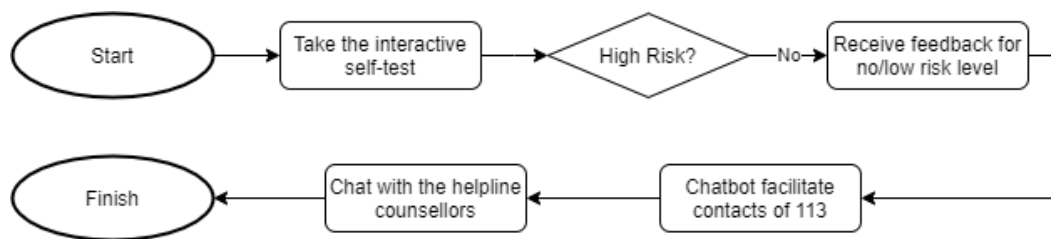
Figure 3.4: The flow for user with no/low risk

To respect the self-autonomy of the test takers, they can quit the process whenever they do not want to continue it. Thus, a button to end the session is always available to the users. Likewise, a button to contact the 113 helpline directly is always available as well. To ensure the accuracy of the interaction and to avoid the test being too long or too complicated, all the questions in the conversation are closed questions with multiple predefined replies.

3.3.2. Dialogue Design of the Barrier Intervention

The dialogue between user and the conversational agent of the interactive self-test system is the foundation of the barrier intervention. To understand user's replies accurately, in the dialogue, only closed ended questions are asked by the agent and user can reply with one of the offered messages to represent their positive or negative answers. The design of the dialogue flow between the CA and user is presented in the Figure 3-11. Several strategies and theories are adapted and applied in the dialogue flow. First of all, when user starts the conversation and answers with positive replies, CA starts with small talk by expressing appreciation to build rapport and common ground for the following dialogue. Small talk is a strategy that humans use to establish social relationships [60]. In our case, CA apply such strategy to engage user's trust in order to discuss their help-seeking problems later. In the first stage, after receiving the user's barrier answer, the CA conveys its empathy by acknowledging user's concern, which follows a Motivational Interviewing principle of expressing empathy through reflective listening [61]. Next, the CA proposes the idea of seeking professional help from 113 along with explanations to the user's barrier. After that, factual or strategic arguments are used to motivate user to take actions. The content of this part is consulted with 113 psychologists and counsellors, who suggested not to include arguments or direct confrontation to avoid causing cognitive dissonance [62]. Avoiding argument or direct confrontation is also a principle of MI. Whether user choose a positive or negative reply to the proposal of seeking help, the CA reconfirms the response (Flow 1 and 2 in Figure 3.5) by developing discrepancy between user's goals of resolve suicide ideation and the current behavior choice (e.g., plan to contact 113 or not). Since user can experience cognitive dissonance due to decision making on seeking help, one way to reduce the dissonance is to change their behavior. The MI principle of developing discrepancy user's goals and their current behavior can enhance user's motivation to change the current situation by taking actions to fulfill their goals. After reconfirming user's either positive or negative choices, the CA encourages user by expressing belief in them for making such a choice to support their self-efficacy with an optimistic attitude [61] (see Flow 3 and 4 in Figure 3.5). The element of encouraging in Flow 3 follows the MI principle of supporting self-efficacy, which serves as a motivator to let user believe that they have the possibility to begin a behavior change and it is in their control. For user with a negative attitude, with the encouraging session in Flow 4, the CA reflects to user's response with adjustment to resistance which follows the MI principle of rolling with resistance [63]. In this way, the CA remains nonjudgmental and respectful to user and it can take a second chance to send persuasive message of proposing seeking help after the encouragement. However, if user give a negative answer again, the CA accepts user's rejection (as Flow 6) to respect user's autonomy and leaves a chance for next possible conversation with user [61] [64]. Besides, the CA facilitates the contact to user who is willing to seek professional help from 113 helpline.
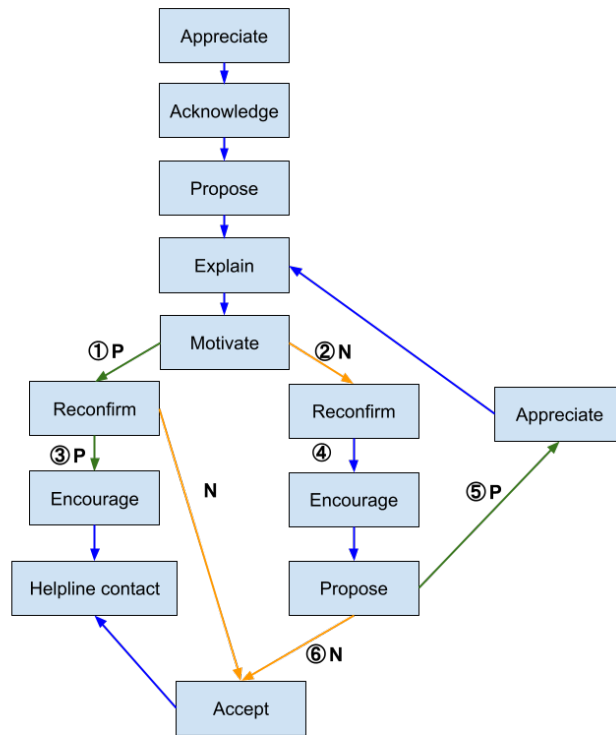
Figure 3.5: The dialogue flow design of the barrier intervention

4

Evaluation

An experiment was conducted on the designed system discussed on Chapter 3. Thus, Chapter 4 starts with explaining and arguing the formulation of the hypotheses, including an explanation of an adapted prototype using in the experiment. Next, the methods of the evaluation are described with designing details of the experiment, following by describing the results revealed from data analysis and exploration. A discussion section on the results ends the chapter. In general, this chapter aims to answer the third sub-research question as follows:

Do people feel more motivated to enter the 113 Helpline after they interacted with the conversational agent?

According to this specific research question, the hypotheses were defined to cover several aspects: motivation, feeling of being heard, perceived usefulness and satisfaction towards the conversational agent for interactive self-testing. The factor of motivation was to answer the research question directly. The feeling of being heard factor was chosen to reflect the personalization of the conversational agent in terms of its communication strategy based on user's barriers and their willingness of seeking human help. The third factor, perceived usefulness, was used to show the usefulness of the conversational agent from user's perspective. User's satisfaction to the system was considered as an overall factor covering the previous three factors and the likeliness of contacting the agent again. Both factors, perceived usefulness and satisfaction, could reflect the possibility of implementing the system in real life.

In addition, to minimize any risks of exposing participants of the experiment to suicidal thoughts, the prototype, the scenarios and the questionnaires of the experiment were adapted to a general mental health version. The participants were informed of taking part in an experiment of a mental health service system.

Previous research on conversational agents for people with risks to contact human help [58] [42], mentioned in Chapter 2, had shown that users could be persuaded by agents with resolving their barriers using appropriate communication strategies to seek help resources. Moreover, the persuasive mechanisms in previous research and the additional ones (e.g. Principles of Influence, Motivational Interviewing) applied in the proposed system have been developed and evaluated in various behavior change related studies [65] [66] [67]. Based on the discussion in Chapter 2, it is expected that conversational agent service has promising potential on motivating people with risks to seek professional human help. Therefore, in order to discover how better conversational agent supports perform than textual supports, the hypotheses were formulated in the following part:

H1: The test-takers do feel more motivated to contact a helpline for further professional help after taking the mental health self-test in an interactive way than taking the self-test for mental health in a traditional questionnaire way.

H2: The test takers reflect that comparing to the traditional self-test, the interactive self-test influence them:

A: to feel more being heard

B: to be more satisfied with the whole self-test service.

H3: The test takers' perceived usefulness of the interactive self-test is higher than the perceived usefulness of the traditional self-test.

Before starting the experiment, a pilot study with the same setup was conducted with colleagues from 113 Research department and 10 participants online (they were paid with the same rate as other participants) for

a test run. Any problems arose in the pilot was fixed to guarantee the experiment work properly. However, the data of the pilot study were not included in the analysis.

The experiment was approved by the TU Delft Human Research Ethics Committee on 11-02-2020, with the Application ID number 1034, and preregistered online through the Open Science Framework (OSF) registration platform [68].

4.1. Methods

4.1.1. Experimental Design

With a double-blind mixed design, the experiment had two conditions: the control group, and the experimental group. The participants in the control group took a mental health self-test in a traditional questionnaire way and received all persuasive messages for potential barriers towards seeking help as textual feedback. For the experimental group, the participants took a mental health self-test in an interactive way and receives barrier intervention. The barrier intervention consisted of persuasive messages based on specific barriers. Each participant of both groups received one of five barriers to seek help for mental health problems in a fictitious scenario. The participants were randomly assigned to one of the two equally sized groups by the computer. The participants of each group were asked to fill in pre- and post-questionnaires on the measures, which were used to compare within and between the two groups.

4.1.2. Materials

Prototype   The prototype in the experiment was based on the system design presented in Chapter 3. It was refined some aspects to adapt to the experimental environment and to evaluate the hypotheses. First of all, as mentioned before, the experiment focused on the topic of mental health instead of suicide ideation to minimize any risks of exposing the participants to suicidal thoughts. Thus, the phrases related to suicide in the original design were all replaced by mental health contents. Secondly, since potential high-risk test takers were considered as the most urgent group, it was decided to evaluate all the hypotheses in the most extreme case with limited participants. Moreover, the barrier intervention was where the conversational agent played an important role, barriers were necessarily included in the experiment. It was also important to see if resolving barriers would help people with high risk. Thus, the experimental prototype was especially targeting at the high-risk test-takers with barriers. In other words, the participants in the experimental group would experience all the sessions as designed in the flow (Figure 3.2). In addition, five barriers related to general mental health were included in this prototype, which were also adjusted from the original barriers of suicide ideation. The barriers were: 'I think I should be able to handle it by myself (self-stigma)', 'I feel ashamed to talk about my mental health issues (self-stigma), 'I do not want to talk about it with anyone (lack of trust with any others)', 'I am afraid of or I do not trust health providers (fear or mistrust health providers)', and 'I do not have time, or I am afraid that it would cost me much money to get help from professionals (lack of availability)'. The four persuasive strategies (social validation, consistency, liking and authority) based on Principles of Influence [46] along with the skills of Motivational Interviewing [61] were applied to address each barrier. The dialogue contents of the experimental prototype were based on the Barrier-Strategy matrix (Appendix A.1) and adapted to the topic of mental health. All the messages of the experimental version were also reviewed by 113 professionals. The chatbot service was implemented on the Qualtrics platform, an experience management survey tool for quantitative statistical analysis. The interaction between participants and the conversational agent is executed page by page (i.e. a continuous interaction from Figure 4.1, Figure 4.2 to Figure 4.3). However, due to the limitation of the platform, a full randomization of presenting different strategies to one specific barrier could not be perform on Qualtrics. Instead, an adjusted randomization with two sequences of four strategies were available in the dialogue tree of tackling one barrier. The randomization in details is in Appendix B.1.

I am glad to hear that you are interested in. Let me tell you what could benefit you.

A lot of people with mental health problems like your age who contacted CaRING helpline.

They also told us that they didn't want to talk about it at all at the beginning

However, they made the decisions to contact us at the end, which was beneficial to them.

They felt better after chatting with us.

Do you think if you will also contact the CaRING helpline?

I will think about it.

I don't think I am ready for it.

→

Figure 4.1: The screenshot of the 1st part interaction with the conversational agent with the barrier of "lack of trust with any others"

It is good to hear that you will think about contacting CaRING to feel better about yourself.

Do you want to discuss a bit more with me?

Yes, sure.

Probably next time.

→

Figure 4.2: The screenshot of the 2nd part interaction with the conversational agent with the barrier of "lack of trust with any others"

Good to hear that I can have more discussion with you.

Our previous help-seekers think that our counsellors are very understanding and patient.

Besides, chatting with us is anonymous and confidential.

What do you think of CaRING counselors?

They sound like someone good that I can talk to.
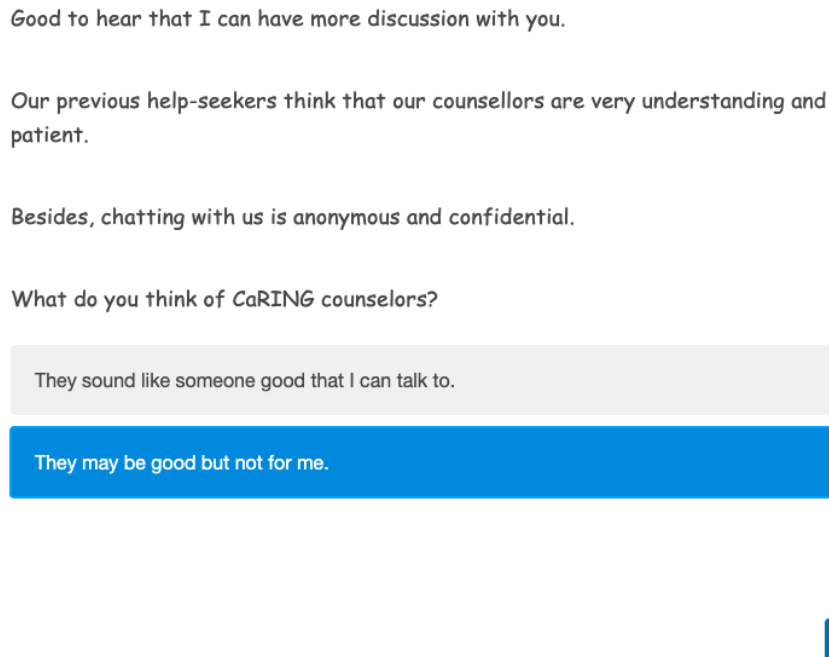
They may be good but not for me.

→

Figure 4.3: The screenshot of the 3rd part interaction with the conversational agent with the barrier of "lack of trust with any others"

Other Materials   The participants were asked to agree on a consent form about the purpose, procedure and the data management of the study before starting the experiment, which can be found in Appendix B.2.

The scenario used in the experiment represented a fictitious story of a persona experiencing serious depression in an environment with contradictory information, which could provoke a dilemma of how to solve the situation and whether to seek help. Since the participants were in the healthy condition, the scenario story was aimed to confront them with a situation where they had mental health issues but at the same time there were extensive uncertainties with the impact of seeking help. Therefore, we created such a scenario where the participants would hesitate to contact a helpline to address their mental health issues. Furthermore, as the personas targeted in the experiment were the high-risk test takers, the scenario reassembled the situation that test takers with high risk might face and which caused them to be reluctant in seeking human help. In other words, the scenario was expected to influence the healthy participants by confronting them with a fictious story where they would act in a similar way as the high-risk test takers would behave. Table 4.1 lists the major elements in the scenario description and the effects were aimed to have on the participants. The scenario ended with one barrier description out of the five barriers randomly to avoid systematic biases caused by differences between the five barriers. The scenario and barriers descriptions are available in Appendix B.3.

Elements	Effects
Being an immigrant in a different country	Uncertainty of the social atmosphere
Living with family and friends and a stable job, 1 year left for receiving a permanent resistance permit	Reasons to keep staying (impossible to go back to home country for help)
Seeing public information about mental health but with little details of possible help resources	Possibility of getting help but with unclear progress and consequences
Hearing rumors of negative reaction from the public and poor effect of the professional help	Barriers of getting help but from uncertain information sources

Table 4.1: The elements and effects of the scenario

4.1.3. Measures

Primary measures

Motivation Level: This measure was targeting on how motivated the test-takers were. Test-takers' motivation levels towards seeking professional psychological help were measured in both the pre-questionnaire and the post-questionnaire. The motivation level of each participants were measured by using two separate measures, the Attitudes Toward Seeking Professional Psychological Help – Short Form (ATSPPH-SF) [69]and a question of their willingness of contacting different sources of professional help. The willingness question is inspired by the Help-Seeking Willingness Scale (HSWS) developed by Han, Chen, Hwang, and Wei [70]. This questionnaire was answered with a four-point Likert-type scale (0= "Disagree" to 3= "Agree").

Feeling of being heard: This is a measure of how much the participants were feeling being heard by the self-test for mental health. Test-takers' feeling of being heard were measured by using the Feeling of Being Heard (FBH) questionnaire from Tielman's research on considering patient safety in autonomous e-mental health systems [58]). This questionnaire was adjusted based on the experiment. This questionnaire was answered with a 7-point scale ranging from not at all via neutral to very much.

Satisfaction: Test-takers' satisfaction with the whole self-test service was measured by using the Client Satisfaction Questionnaire (4-item) [71] [72]). This questionnaire was answered with a four-point Likert-type scale (1 = "Poor" to 4= "Excellent").

Perceived Usefulness: This was a measure of how the participants perceived the usefulness of taking the self-test for mental health. This was measured through a version of the usefulness subscale (six questions) from the Intrinsic Motivation Inventory [73]. The usefulness survey recorded participants' answers using a five-point Likert scale (1= "Strongly disagree" to 5= "Strongly agree") for each item.

Exploratory measures

Age: To explore if different age groups would react differently to the format of the self-test service, participants indicated their age group before they start the experiment. The age range was separated to 5 groups, Group 1 (18 to 29 years old), Group 2 (30 to 39 years old), Group 3 (40 to 49 years old), Group 4 (50 to 59 years old), Group 5 (60 years old or older).

Gender: To explore if different genders would react differently to the format of the self-test service, participants indicated their genders before they start the experiment. The gender options were male, female and others.

Self-involvement: To explore if the difference of participants' self-involvement on the mental health topic would influence their performance in the experiment, before starting the experiment, they were asked to answer a questionnaire (3 questions), derived from Issue Involvement Check Questions [74]. The reason for including this variable was that, since the participants from Prolific joined the experiment mainly driven by money, the participants in the control group might give positive feedback when they receive a massive text on explaining all barriers as the participants in the experiment group would do. According to the Elaboration Likelihood Model [75], there are two routes to persuasion: the central route and the peripheral route. The participants whose motivation originated from the payment reward would likely process the persuasion by taking the peripheral route. In this case, such participants might make decisions simply based on the credibility of the sources or the amount of the information rather than the logical quality of the information.

4.1.4. Participants

Participants were recruited through an online recruitment platform, Prolific. Each participant was paid £3.00 for finishing the experiment properly. Participants were at least 18 years old and had no mental health problems currently. A power analysis using G∗Power was conducted to determine the number of the participants for a medium effect size of .50 with a power of .80 at the standard .05 alpha error probability. The targeted sample size was 128 participants (64 in each group). However, 150 participants (75 in each group) were recruited in case of uncompleted surveys or invalid surveys. 147 out of 150 responses were included in the analysis, because 3 responses were completed with same answers to all the pre- and post- questionnaires.

Characteristics	N=147	Experimental Group (N=75)	Control Group (N=72)
Age groups, n (%)			
18 - 29	114 (77.55)	42(56.00)	72(100.00)
30 - 39	17 (11.56)	17(22.67)	0(0)
40 - 49	12 (8.16)	12(16.00)	0(0)
50 +	4 (2.72)	4(5.33)	0(0)
Gender, n (%)			
Male	94 (63.95)	51(68.00)	43(59.72)
Female	53 (36.05)	24(32.00)	29(40.28)
Issue involvement check score, mean (SD)	5.43 (1.03)	5.36(1.11)	5.50(0.94)
High-level involvement, n (%)	74 (50.34)	35(46.67)	39(54.17)
Low-level involvement, n (%)	73 (49.66)	40(53.33)	33(45.83)

4.1.5. Procedure

The participants received access on Prolific and then were redirected to Qualtrics to do the experiment. The experiment included four phases. The first phase was the introduction to the experiment. Each participant was asked to read and fill in a consent form. The purpose and procedure of the experiment were briefed to the participants. They were informed about exclusion policies for responses as well. Before starting the experiment, they were asked to fill in their gender, age group, and self-involvement on the topic of mental health.

In the second phase, each participant received a fictitious scenario description with one of five barriers towards seeking help from professionals. They were asked to do the experiment by placing themselves in this fictitious scenario. After that, they were asked to fill in a pre-questionnaire. The questionnaire included questions of people's attitudes and willingness towards seeking help from professionals and two comprehension check questions about the scenario.

In the third phase, the participants took a mental health self-test in two different ways based on which group they belong to. For both groups, to help the participants answer the specific questions about the symptoms of their mental health problems in the self-test, they were guided with highlighted options to answer the self-test. For the participants in Group A, they took the self-test in the traditional questionnaire way and received textual feedback including all persuasive messages on barriers towards seeking professional help. For Group B, the participants took the self-test in an interactive way and interacted with the test about their specific barriers towards seeking professional help based on the scenario.

In the last phase, the participants were asked to fill in a post-questionnaire, including questions of their feeling of being heard, their satisfaction towards the self-tests, the perceived usefulness of the self-tests, and their attitudes and willingness towards seeking professional help again.

4.1.6. Data Preparation and Statistical Analysis

The analysis of the data was conducted using R 3.6.2. The R script markdown, along with the dataset, can be accessed online through 4TU data centre [76]. For the Attitudes Toward Seeking Professional Psychological Help – Short Form (ATSPPH-SF) [69], the scores to 5 questions of the 10 questions (Q2, Q4, Q8, Q9, Q10) were reversed for the reliability check. According to Loewenthal and Lewis [77], the criteria of acceptability is an alpha of 0.60 when the scales are short. In our case, 0.68 of the Help-Seeking Willingness Scale (HSWS) [70] is considered as reliable since it consists of 5 questions. In general, an alpha of 0.75 is within the criteria of acceptability [77]. The Cronbach's alpha of each measurement is listed in the table below, the scores of all the scales are acceptable to use.

Reliability Check	Alpha			
ATSPPH-SF	Pre	0.75	Post	0.84
HSWS	Pre	0.68	Post	0.75
FBH	0.93			
CSQ	0.88			
US	0.91			

Table 4.2: The Reliability Check of All Measurements

For the Attitudes Toward Seeking Professional Psychological Help – Short Form (ATSPPH-SF), the scores to

5 questions of the 10 questions (Q2, Q4, Q8, Q9, Q10) were reversed and added to the sum of a single Attitude Score. For the Help-Seeking Willingness Scale (HSWS) and the Feeling of Being Heard scale (FBH), the scores to the questions were averaged to create a single score. For the Client Satisfaction Questionnaire (CSQ) and the Usefulness Subscale (US), the scores to the questions were summed up to create a single score.

A multilevel model was used to analyze the results. The within-subject factor was time (before and after). The fixed effect was the format of the online mental health service, which consisted of two conditions (traditional and interactive). The participants were taken into account as random intercept since it was assumed that the participants start the experiment with various starting points. The measure moment and the conditions in the hypotheses were used as independent variables in the analysis. The pre- and post-measurements of attitude and willingness towards seeking professional help, feeling of being heard, satisfaction with the service, and perceived usefulness, were used as dependent variables in the analysis. The analysis was done in two steps: First, descriptive analyses were used to perform an overall analysis in order to uncover the general differences between the two groups. The second step was to do a detailed analysis of the conditions and measurements mentioned in the hypotheses (attitude and willingness towards seeking professional help, feeling of being heard, satisfaction with the service, and perceived usefulness).

The null models and the extended models for each hypothesis were compared to test the effect of the format of the online mental health service.

The first hypothesis was tested using a multilevel analysis on Attitude score and Willingness score. The null model only included participant as random intercept. Model 1 was built on the null model and added session (moment of measurement) as fixed effect, while model 2 was built on the null model and added group (format of service) as fixed effect. Model 3 was built on the null model with adding both session and group as fixed effect. Lastly, model 4 was the full model which built on model 3 and include two-way interaction between session and group as fixed effect. These models were compared to test the added contribution of fixed effects.

The second hypothesis was tested with a multilevel analysis on feeling of being heard and satisfaction with the service. The hypothesis was examined by comparing the null model to a model including group (format of service).

The third hypothesis was also tested with a multilevel analysis on perceived usefulness. The hypothesis was examined by comparing the null model to a model including group (format of service) as fixed effect.

Covariate Check Covariate checks were performed for participants' age groups, gender and their Issue Involvement Check (IIC) score towards the topic of mental health. They showed that the age groups and gender had no effect on the Attitude score or the Willingness score. The IIC score had no effect on the Attitude score, but it had an effect on the Willingness score. Participants with high IIC score (higher than the mean) in the control condition had an increase on their post-Willingness score comparing to the pre-score. Therefore, the IIC score was included in the model comparison analysis for the Willingness score. Table 4.3 shows an overview of the means of the pre- and post- willingness score with two levels of the IIC score for the two conditions. The IIC Level of each participant were determined by the mean of the IIC score based on their groups.

IIC Level	High				Low			
Measures	Pre-HSWS		Post-HSWS		Pre-HSWS		Post-HSWS	
Group	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	4.39	1.00	4.85	0.95	4.29	1.10	4.36	1.19
Experimental	4.34	1.25	4.10	1.34	3.93	1.08	3.95	1.21

Table 4.3: Mean and standard deviation of the pre-and post-HSWS measures with two levels of the IIC score for the two groups

4.2. Results
Table 4.4 below shows an overview of the means of all the measures for the two groups.

	Pre-ATSPPH-SF		Post-ATSPPH-SF		Pre-HSWS		Post-HSWS	
Group	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	19.11	4.37	21.61	5.18	4.35	1.04	4.63	1.09
Experimental	19.56	4.85	19.44	5.05	4.12	1.17	4.02	1.26

Table 4.4: Mean and standard deviation of the pre-and post-ATSPPH-SF and pre-and post-HSWS measures for the two groups

	FBH		CSQ		US	
Group	Mean	SD	Mean	SD	Mean	SD
Control	5.69	1.06	12.38	2.61	24.94	4.10
Experimental	5.65	1.03	11.45	2.76	23.43	4.72

Table 4.5: Mean and standard deviation of FBH, CSQ and US measures for the two groups

4.2.1. Attitude and Willingness of Seeking Help

Model comparison	N	χ^2	p
ATSPPH-SF *score*			
Session (M_0 vs M_1)	294	$\chi_1^2 = 6.55$	0.0105
Group (M_0 vs M_2)	294	$\chi_1^2 = 1.65$	0.1993
Session × Group (M_3 vs M_4)	294	$\chi_1^2 = 8.74$	0.0031
HSWS *score*			
Session (M_0 vs M_1)	294	$\chi_1^2 = 1.96$	0.1614
Group (M_0 vs M_2)	294	$\chi_1^2 = 5.33$	0.0209
Session × Group (M_3 vs M_4)	294	$\chi_1^2 = 9.84$	0.0017

Table 4.6: Multilevel analysis results on motivation to seek help in both conditions : model comparisons

The results from the analysis for hypothesis 1 are presented in Table 4.6. As shown in this table, attitude score was only influenced by session, while it was not affected by group. For willingness score, it was only influenced by group but not by session. The interaction between session and group was found to significantly associated to both measures. This interaction effect can be seen between the control group and the experimental group in the following figure. Figure 4.4 shows the measure of attitude score for the two groups and compares the change with the means of the pre-measures and post-measures, which illustrates that the average attitude score of the control group increased significantly after taking the traditional mental health service but the before and after attitude scores in the experimental group barely have differences. Figure 4.5 shows the measure of willingness score for the two groups and compares the change with the means of the pre-measures and post-measures, which illustrates that the average willingness score of the control group increased significantly after taking the traditional mental health service but the before and after willingness scores in the experimental group barely have differences.
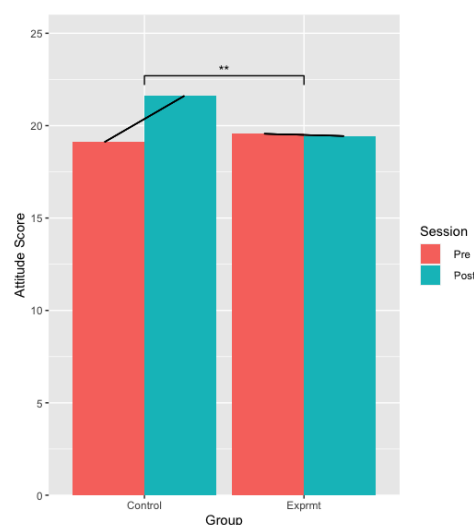

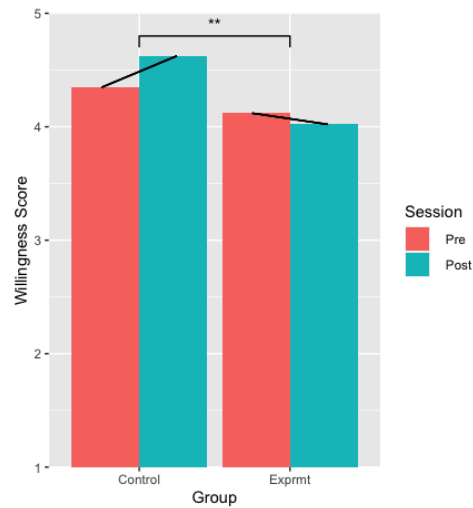Figure 4.4: Comparison of ATSPPH-SF score between both groups

Figure 4.5: Comparison of HSWS score between both groups

4.2.2. Feeling of Being Heard, Client Satisfaction and Perceived Usefulness

Model comparison	N	χ^2	p
Feeling of being heard			
Group (M_0 vs M_1)	294	$\chi^2_1 = 0.08$	0.776
Client Satisfaction			
Group (M_0 vs M_1)	294	$\chi^2_1 = 4.31$	0.038
Usefulness			
Group (M_0 vs M_1)	294	$\chi^2_1 = 4.32$	0.038

Table 4.7: Multilevel analysis results on FBH, CS and US : model comparisons

Table 4.7 above shows the results from the analysis for hypothesis 2. Group factor had no significant effect on the feeling of being heard $\chi^2_1(N = 294) = 0.08$, $p > .05$, but it shows a significant effect on the client satisfaction $\tilde{\chi}^2_1(N = 294) = 4.31$, $p < .05$. The comparison of FBH Score and CSQ Score between the two groups are shown in the figures below. Figure4.6 shows the average FBH scores of both groups have no significant differences. However, the average CSQ score of the control group is higher than the one of the experimental group, which is shown in Figure4.7.
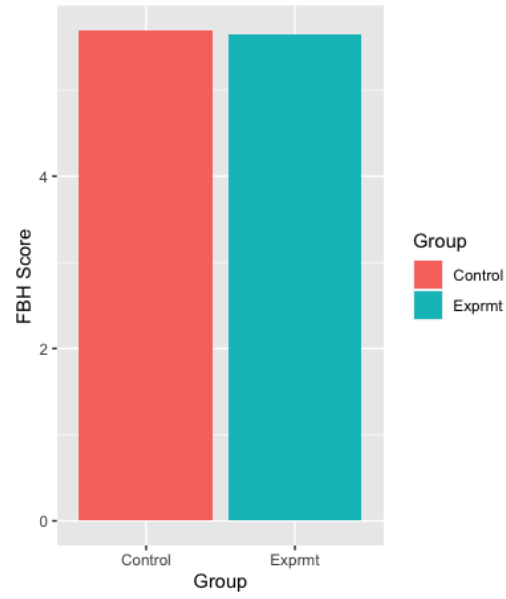
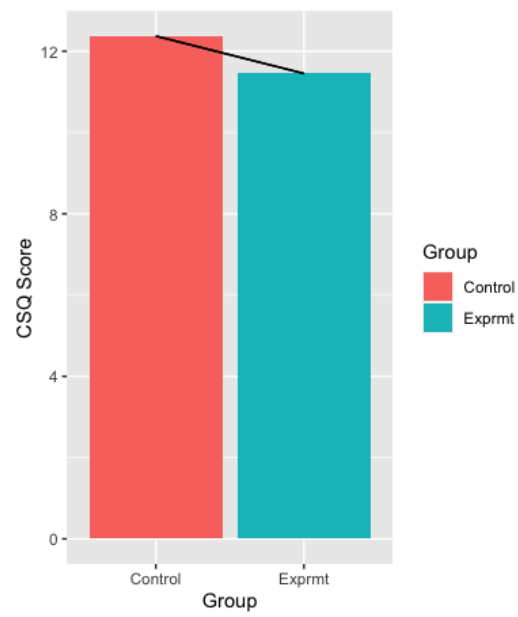Figure 4.6: Comparison of FBH score between both groups

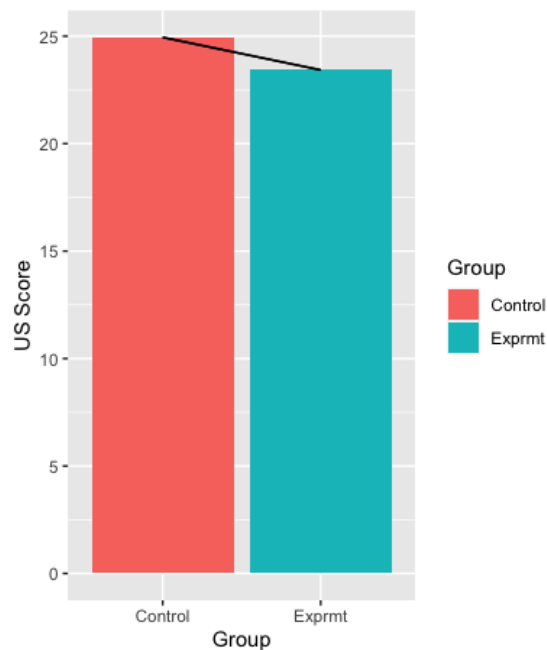Figure 4.7: Comparison of Client Satisfaction between both groups

Figure 4.8: Comparison of Perceived Usefulness between both groups

Table 4.7 also shows the results from the analysis for hypothesis 3. The usefulness was influenced by the format of mental health service in different groups $\chi^2_1(N = 294) = 4.32$, $p < .05$. The bar chart above shows the difference of the Usefulness Score between the two groups.

4.2.3. Explorative Measures

For the explorative analysis, the Issue Involvement Check score was considered as one explorative measure. The IIC score was used as a moderating variable for the analysis between the independent variables and dependent variables. A multilevel regression analysis was conducted with the IIC score as the moderating variable and the interaction effect between the IIC score and the independent variables.

Based on the results of the analysis, the IIC score by itself significantly affected the Attitude score and the Willingness score. Both the Attitude score and Willingness score of participants with high IIC score in the control group increased. However, the interaction effect between the IIC score and the independent variable (Group) had no significant effect on any of the measures. The results of the analysis in details can be found in 4.8 and 4.9.

Model: ATSPPH-SF Score ~ IIC Score + Group:IIC Score	Estimate	Std. error	t	p
Intercept	15.344	1.774	8.651	0.000
IIC Score	0.907	0.324	2.798	0.006
IIC Score:Experimental Group	-0.128	0.119	-1.071	0.286

Table 4.8: Moderation analysis of ATSPPH-SF score, IIC score and the interaction effect with Group

Model: HSWS Score ~ IIC Score + Group:IIC Score	Estimate	Std. error	t	p
Intercept	3.449	0.479	7.199	0.000
IIC Score	0.187	0.088	2.130	0.035
IIC Score:Experimental Group	-0.069	0.032	-2.142	0.034
Model: HSWS Score ~ Group:IIC Score	Estimate	Std. error	t	p
Intercept	3.449	0.479	7.199	0.000
Control Group:IIC Score	0.187	0.088	2.130	0.035
Experimental Group:IIC Score	0.118	0.089	1.326	0.187

Table 4.9: Moderation analysis of HSWS score, IIC score and the interaction effect with Group

Table 4.10 summarizes the results of the IIC score moderation analysis, including the means and standard deviations of the conditions.

	Control		Experimental	
Measurement	Mean	SD	Mean	SD
IIC Score	5.50	0.94	5.36	1.11

Table 4.10: The mean and standard deviation of the IIC score between the two groups

4.3. Discussion

Based on the analysis of the results, the traditional mental health service had positive effect on participants' attitude scores and willingness score, instead of the interactive service, which is the opposite of the first hypothesis (H1). It is indicated that the test-takers feel more motivated to contact a helpline for professional help after taking the mental health service in a traditional questionnaire way with textual feedback than taking it in an interactive way with barrier intervention. This result is contrary to our expectation, and therefore provides support for the rejection of the first hypothesis (H1). As hypothesis was built on several theories, some cautiousness seems appropriate, considering extraneous factors that might have caused this finding. For example, one possible explanation is that the scenario was problematic. The scenario might have failed to convey the urgency and severity of the situation to the participants, in which case the long conversation with acknowledgement and empathy might seem unnecessary for them. The personalized support, encouragement and empathy of the interactive service might not haven necessary for them in that scenario. Another consideration is that in the scenario the barriers were created in terms of environment, family and friends, work, money, time and how other people would react to the situation. All of these concerns in the scenario could be easily taken away with statements of how professional help actually work. However, in real-life situations, lack of motivation to seek professional help might be much more complex and difficult to dispel. This might indicate that the simulated initial low motivation situation in the experiment did not accurately reflect a real-life low motivation. Another explanation for the result against the hypothesis is the possible occurrence of cognitive dissonance [62]. Since the participants first were told about negative beliefs and concerns against seeking help, they might avoid or reject the new contradictory information told by the barrier intervention of the interactive service. The more the interactive service was trying to change the test-takers' mind, the harder the test-takers would take their initial stance of not seeking help to resolve the dissonance. Another possible explanation of the finding concerns the prototype. The interactive self-test service used in the experiment only allowed participants to choose one barrier and they could not choose another different barrier afterwards, which might not meet their needs of having multiple barriers, comparing to all the barriers presenting in the traditional service.

There were no observable differences of Feeling of Being Heard between the two groups, but the group experiencing the service in the traditional way reflected higher scores on Client Satisfaction Questionnaire. The analysis result is the opposite of Hypothesis 2, when it comes to satisfaction of self-test services, but not for feeling of being heard as the results were not significant. Again, cautiousness seems appropriate, and other causes should be considered. For example, the higher satisfaction of the control group could be explained by the simple process with the quick answers, which was straightforward. The more complex interactive service creates more opportunities for dissatisfaction, which could result in lower satisfaction.

Similar situation happened on the usefulness score. The traditional mental health service resulted in higher usefulness score, which is opposite to the third hypothesis as well. This result can be related to the first and second hypothesis. The more motivated and satisfied the users were, the more usefulness they thought of the service. Although the results are not what we expected, they all lean to the same direction.

4.3.1. Limitations

In order to conduct low-risk experiment, we decided to avoid the sensitive topic, suicide ideation, even though the service was designed in the context of suicidal people as the target audience. Instead, the general topic mental health was adopted. However, the generic topic could be one of the reasons that the scenario story was too vague to be related for participants, which ended with opposite results to the hypotheses. A possible solution for this limitation is to use a specific but common psychological issue in the experiment, such as depression or anxiety, with more details of how it affects daily life badly. While we were avoiding the topic sensitivity, we also decide to avoid fragile individuals, who were going through suicidal thoughts or other psychological problems. The ordinary population might not represent the opinion of the target group,

which might have led to difficulties with accurately relate to the urgent and severe scenario in the experiment. The future research might consider to reach for the population who recovered from being through suicidal ideation or depression. Although it is possible to conduct such experiments on suicide prevention platforms, leading to for more valid results, caution should be taken when exposing fragile audience to an experimental solution. Even though, we managed to recruit enough participants to reflect their experience with reliable measures of their attitudes, willingness, satisfaction, feeling of being heard and the usefulness. In preliminary research stage, it is more ethical to collect opinions and learn lessons with a risk-low set-up to benefit later research with the target audience, people with suicide ideation or people with suicidal thoughts experience.

The platform where the experiment was conducted caused some limitations with the interactive service prototype. The prototype was built in the online survey software Qualtrics to focus on the idea of the design instead of a whole prototype with extra effort on establishing the environment. Since Qualtrics is not the most suitable software to replicate the prototype, it cannot perform all the features with the limited functions it provides. First of all, for the interactive service, the interaction was not executed in a chat window style, but by pages, in which way it might seem less conversational to the users. The transitions between the messages with different persuasive strategies were not as continuous as in a conversational due to the limitation of Qualtrics. Secondly, the participants could only choose one barrier and they could not return to the barrier question to choose another one if they have other barriers as well. Besides, since the participants were recruited on Prolific to complete the experiment for payment, it was designed to have the participants to go through all the sessions in the system. Thus, the interactive service could be seemed to take every chance on persuading participants which could have resulted in cognitive dissonance. For later related research projects, it is suggested to develop the prototype as a conversational agent software in order to receive more valid results from participants. Despite the drawbacks above, the protype was built based on a delicate design developed from multiple literature of behavior concepts and models. The prototype was discussed by a focus group of 113 employees and the content of the conversations were referred to professional opinions from 113 psychologists and counsellors.

5

Discussion and Conclusion

5.1. Conclusion

Based on the data from 113 Suicide Prevention and related suicide literature, there is a noticeable amount of people with suicide thoughts tending not to seek for human help. This reality is quite crucial since if they do not receive proper help, they may have higher chances of committing suicide. Thanks to the suicide ideation self-test that 113 provide on their websites, it is still possible for people to know how they are doing with suicide thoughts without contacting human. This self-test function offers a good opportunity to trigger the test-takers seek for help from 113. Therefore, an interactive self-test service designed and developed based on the original self-test questionnaire is expected to be useful to reach out to suicidal individuals with low motivation of seeking human help.

The main research question that this research aimed to answer is:

Is it possible and in what way can a conversational agent motivate people to reach for human help, when they have completed an online self-test?

To answer the main research question, it was divided into the following three sub questions:

- *What kind of persuasive mechanisms could a conversational agent use to persuade people for seeking human help after completing the online self-test of suicidal ideation?*

Several potential persuasive mechanisms were discussed in Chapter 2. First of all, The Transtheoretical Model (TTM) could be the foundation of such a conversational agent to present suitable responds to different users. Based on the two behavior models, Fogg Behavior Model and COM-B system, the agent could increase user's motivation and capability and create opportunities to trigger them to take actions. For increasing one's motivation, it is possible to apply Motivational Interviewing in the agent. MI supports three basic psychological needs, autonomy, competence and relatedness, from Self-Determination Theory which is related to human motivation. Principles of Influence with six principles are known for their influence on people's behaviour, including reciprocity, consistency, social validation, liking, authority and scarcity. These principles could be used in the conversations between users and the agent.

- *How could such mechanisms be effectively encapsulated in the conversational agent?*

The conversational agent focuses on resolving test takers' specific barriers towards seeking professional human help and motivating them to seek help from 113. Therefore, the agent starts the barrier intervention by identifying test takers' barriers of seeking help from professionals to address them with appropriate strategies. The agent also guides the test takers to answer the suicidal thoughts self-test questions and showing the results of the self-test and the suggestions on seeking help before the intervention in order to make it a complete journey with a smooth transition for users. To understand users' replies accurately, only closed ended questions are asked by the agent and users can reply with one of the offered messages. The agent gives a barrier intervention based on test takers' answers to a barrier question with persuasive strategies from Principles of Influence by applying the principles of Motivational Interviewing [61] in the conversations. The conversational flow is designed based on a real-life sequence of resolving one's barriers and suggesting seeking help from 113 with respect to users' autonomy.

- *Do people feel more motivated to enter the 113 Help Line after they interacting with the conversational agent?*

An experiment was designed with a prototype of the conversational agent which was adjusted to an experimental version and was conducted with healthy individuals via Prolific (an online research recruitment platform) to answer this research question. The experiment covered several measures: participants' attitudes toward seeking professional psychological help, their help-seeking willingness, their feeling of being heard, their satisfaction of the service and the perceived usefulness of the service. It was conducted with two groups, a control group with a traditional mental health self-test with a textual feedback and an experimental group with an interactive mental health self-test service with a barrier intervention. The results showed significant differences between the control group and the experimental group. However, the differences significantly increased in the help-seeking attitude and willingness of the control condition before and after taking the traditional self-test comparing to the condition of the interactive self-test service. Additionally, the results showed the satisfaction and perceived usefulness of the traditional self-test were higher than those in the experimental group, but no noticeable differences of the feeling of being heard between the two conditions. Overall, the results imply that the participants felt more motivated to seek help from a professional helpline after taking the traditional self-test with a textual feedback comparing to those who interacted with the conversational agent based on their attitude and willingness measures. In other words, the motivation of the participants in the experimental group did not seem to change, contrary to what as expected of the proposed solution which was based on behavior change theories.

5.1.1. Limitations

Some limitations should be considered while interpreting the results, since this is the first study that combines a self-test questionnaire with an interactive barrier intervention session to our knowledge. The first limitation is concerning the lack of access to the people with suicidal thoughts or people who experienced suicide ideation to be involved in the design of the system and the experiment. Individuals with suicidal thoughts may have different focus and needs for the self-test service from those of the healthy participants. Still, the participation of 113 counsellors and psychologists in the design process could represent the opinion of people with suicidal thoughts to some extents, since the counsellors and the psychologists talk with helps-seekers with suicide ideation on a daily basis. With the input from a focus group working in the suicide prevention field, the interactive self-test service prototype was designed and evaluated.

The second limitation is that we did not study the impact of the prototype working as a chatbot, since based on the discussion of the focus group that people might not appreciate a self-test service in a chat window style. It might have effects on the results since the interaction between the conversational agent and the user could look more like a conversation in a chat. Besides, as we mentioned in the evaluation chapter, the experiment focused on examining a full experience with all the sessions in the system and we assumed that the scenario did not describe the persona in a severe situation where urgent professional help was needed. In this case, the barrier intervention could work too extreme for a less severe scenario. However, the decision of testing the full experience involving all the sessions of the system was necessary, since the people with high-risk of committing suicide need the most attention and it would be useful if it could motivate them contact human help.

5.1.2. Contribution

From the scientific perspective, the work presents a novel approach of combining a suicidal ideation self-test with a barrier intervention and transforming it into an interactive service. There were only a few studies [57] [42] on barrier intervention for suicidal ideation, but this is the first study applying a new start point for such topic and collaborating with the Dutch national suicide prevention organization. There are studies [24] [3] [28] been done on the population who received help from suicide prevention helplines, but people with suicidal thoughts who needed help but did not seek help from any professional resources were seldomly involved. In addition, this research revealed an insight of the proposed interactive self-test service with barrier intervention and the potential association between people with suicidal thoughts and their preference towards a traditional or interactive barrier intervention format. From the practical perspective, based on the experiment, the traditional self-test with a textual barrier intervention section has the potential to motivate people's help-seeking behavior comparing to the proposed interactive self-test service. Our research also presents the insight of the presentation format of a suicide ideation self-test with barrier intervention. The opposite results to our hypotheses imply that applying persuasive theories to an interactive barrier intervention within

a self-test service require for extra attention and research.

5.2. Future work

Since we learned some lessons from the results that were opposite as hypothesized, it is possible do further research on this topic to study the more appropriate way of applying a mixture of different principles form multiple theories to the barrier intervention with the self-test for people with suicidal thoughts. Alternatively, it is potential to study an interactive self-test service which is built according to one appropriate theory. Another future possibility is to change the strategy to simply provide personalized but straightforward messages without motivation interviewing like Jaroszewski's research [42].

The interactive self-test service can be extended further with interacting with users differently based on their self-test results according to the system design mention in the Chapter 3. Tielman's research [58] designed a self-referral with risk detection model which not only considered patient's risk levels, but also took their motivation into account. It resulted in positively influencing participants with negative or doubtful self-referral thoughts with proper persuasive strategies based on their risk and motivation profiles. To include the test takers' original motivation levels in their profiles can be another future direction.

To start a personalized barrier intervention, it is important to understand the specific barriers people have. However, our design of the self-test service was only focusing on one specific barrier, which did not consider the possibility that people would have other concerns at the same time. In this case, the intervention they received from the service could be incomplete and lack of other vital information. One direction for the future work is to establish a more in-depth profile of each user, with their risk level, motivation level and top three concerns of seeking help. The barrier intervention could interact with users with more personalization based on their profiles.

Another further research possibility is to study the structure or means of discussing people's barriers and asking them if they feel like seeking help. Because the opposite results to the hypotheses could be caused by cognitive dissonance [62], it might help motivate users' help-seeking behavior if we could find a way to avoid causing or to resolve their conflicting beliefs towards seeking help. In addition, a follow-up measurement on people's help-seeking behavior (e.g., whether people actually take actions on contacting the helpline) might provide more insights on the effectiveness of an interactive self-test service.

5.2.1. Advice for 113

This research is collaborated with the Dutch nation suicide prevention organization, 113 Helpline. Since 113 has the resources and access to people with suicide ideation, they could study such a self-test service with barrier intervention further with the original target audience. Involving people with suicidal thought in the design process might be potential harmful for them. Still insight of these individual might be very valuable. An alternative therefore might for 113 Helpline is to consider setting up a panel with their past clients who recovered from their suicide ideation. Evaluating a self-test service for suicide ideation with the proper population could obtain more valid, and practical results.

Because understanding the concerns and barriers of the people with suicidal thoughts is the start point for a barrier intervention, 113 could consider conducting a survey on barriers for seeking help following with the self-tests they provide on their websites. With a better and clearer understanding on reasons of people avoiding reaching for human help, the barrier intervention can be designed and developed to better suit the needs of the target audience.

One beneficial outcome of the research for 113 is that results seem to indicate that offering individuals some paragraphs containing barrier intervention messages could increase people's motivation to seek for professional help from helplines or psychologists comparing to the proposed interactive self-test service. 113 can consider about updating their current self-tests with a textual barrier intervention to positively influence the test takers' help-seeking behavior.

Bibliography

[3]   Guilherme Borges et al. "Twelve-month prevalence of and risk factors for suicide attempts in the world health organization world mental health surveys". In: *Journal of Clinical Psychiatry* 71.12 (2010), pp. 1617–1628. ISSN: 01606689. DOI: 10.4088/JCP.08m04967blu.

[6]   World Health Organization. "Preventing suicide: A global imperative". In: *Geneva: WHO Press* (2014). URL: https://apps.who.int/iris/bitstream/handle/10665/131056/9789241564779-ger.pdf.

[7]   Jan K. Mokkenstorm et al. "Is It Rational to Pursue Zero Suicides Among Patients in Health Care?" In: *Suicide and Life-Threatening Behavior* 48.6 (2018), pp. 745–754. ISSN: 1943278X. DOI: 10.1111/sltb.12396.

[9]   Jan K. Mokkenstorm et al. "Evaluation of the 113Online Suicide Prevention Crisis Chat Service: Outcomes, Helper Behaviors and Comparison to Telephone Hotlines". In: *Suicide and Life-Threatening Behavior* 47.3 (2017), pp. 282–296. ISSN: 1943278X. DOI: 10.1111/sltb.12286.

[10]   Bregje A.J. Van Spijker et al. "The Suicidal Ideation Attributes Scale (SIDAS): Community-based validation study of a new scale for the measurement of suicidal ideation". In: *Suicide and Life-Threatening Behavior* 44.4 (2014), pp. 408–419. ISSN: 1943278X. DOI: 10.1111/sltb.12084.

[11]   B. A. J. van Spijker, A van Straten, and A. J. F. M. Kerkhof. "Effectiveness of online self-help for suicidal thoughts: results of a randomised controlled trial". In: *PloS one* 9.2 (Feb. 2014). ISSN: 1932-6203. DOI: 10.1371/JOURNAL.PONE.0090118. URL: https://pubmed-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/24587233/.

[12]   Jan. K. Mokkenstorm et al. "Results and Experiences of 113Online, a Comprehensive Dutch Online Suicide Prevention Platform". In: *Suicide Prevention and New Technologies* (2013), pp. 123–149. DOI: 10.1057/9781137351692{_}10. URL: https://link-springer-com.tudelft.idm.oclc.org/chapter/10.1057/9781137351692_10.

[14]   Jason B Luoma, Catherine E Martin, and Jane L Pearson. "Suicide: A Review of the Evidence". In: *American Journal of Psychiatry* 159.6 (2002), pp. 909–916. DOI: 10.1176/appi.ajp.159.6.909.Contact.

[15]   Elke Elzinga et al. "Discussing suicidality with depressed patients: An observational study in Dutch sentinel general practices". In: *BMJ Open* 9.4 (2019), pp. 1–8. ISSN: 20446055. DOI: 10.1136/bmjopen-2018-027624.

[16]   Saskia Mérelle et al. "Characteristics associated with non-disclosure of suicidal ideation in adults". In: *International Journal of Environmental Research and Public Health* 15.5 (2018). ISSN: 16604601. DOI: 10.3390/ijerph15050943.

[17]   Mathilde M. Husky et al. "Factors associated with suicidal ideation disclosure: Results from a large population-based study". In: *Journal of Affective Disorders* 205 (2016), pp. 36–43. ISSN: 15732517. DOI: 10.1016/j.jad.2016.06.054. URL: http://dx.doi.org/10.1016/j.jad.2016.06.054.

[18]   Adam Friedlander et al. "Self-Concealment and Suicidal Behaviors". In: *Suicide and Life-Threatening Behavior* 42.3 (June 2012), pp. 332–340. ISSN: 1943-278X. DOI: 10.1111/J.1943-278X.2012.00094.X. URL: https://onlinelibrary-wiley-com.tudelft.idm.oclc.org/doi/full/10.1111/j.1943-278X.2012.00094.x.

[19]   T. Dazzi et al. "Does asking about suicide and related behaviours induce suicidal ideation? What is the evidence?" In: *Psychological Medicine* 44.16 (2014), pp. 3361–3363. ISSN: 14698978. DOI: 10.1017/S0033291714001299.

[20]   Alison L. Calear and Philip J. Batterham. "Suicidal ideation disclosure: Patterns, correlates and outcome". In: *Psychiatry Research* 278.March (2019), pp. 1–6. ISSN: 18727123. DOI: 10.1016/j.psychres.2019.05.024. URL: https://doi.org/10.1016/j.psychres.2019.05.024.

[21]   Amy Lee Seward and Keith M. Harris. "Offline Versus Online Suicide-Related Help Seeking: Chang-ing Domains, Changing Paradigms". In: *Journal of Clinical Psychology* 72.6 (2016), pp. 606–620. ISSN: 10974679. DOI: 10.1002/jclp.22282.

[22]   S. N.W. Bunt et al. "Predictors of need for help with weight loss among overweight and obese men and women in the Netherlands: A cross-sectional study". In: *BMC Health Services Research* 17.1 (2017), pp. 1–10. ISSN: 14726963. DOI: 10.1186/s12913-017-2759-1.

[24]   Alison L. Calear, Philip J. Batterham, and Helen Christensen. "Predictors of help-seeking for suicidal ideation in the community: Risks and opportunities for public suicide prevention campaigns". In: *Psychiatry Research* 219.3 (2014), pp. 525–530. ISSN: 18727123. DOI: 10.1016/j.psychres.2014.06.027. URL: http://dx.doi.org/10.1016/j.psychres.2014.06.027.

[26]   M. David Rudd, Thomas E. Joiner, and M. Hasan Rajab. "Help Negation After Acute Suicidal Crisis". In: *Journal of Consulting and Clinical Psychology* 63.3 (1995), pp. 499–503. ISSN: 0022006X. DOI: 10.1037/0022-006X.63.3.499.

[27]   Frank P. Deane, Coralie J. Wilson, and Joseph Ciarrochi. "Suicidal ideation and help-negation: Not just hopelessness or prior help". In: *Journal of Clinical Psychology* 57.7 (2001), pp. 901–914. ISSN: 00219762. DOI: 10.1002/jclp.1058.

[28]   Ronny Bruffaerts et al. "Treatment of suicidal people around the world". In: *British Journal of Psychiatry* 199.1 (2011), pp. 64–70. ISSN: 00071250. DOI: 10.1192/bjp.bp.110.084129.

[29]   Patrick W Corrigan and Amy C Watson. "Understanding the impact of stigma on people with mental illness." In: *World psychiatry : official journal of the World Psychiatric Association (WPA)* 1.1 (2002), pp. 16–20. ISSN: 1723-8617. URL: http://www.ncbi.nlm.nih.gov/pubmed/16946807%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1489832.

[30]   Patrick Corrigan. "How stigma interferes with mental health care". In: *American Psychologist* 59.7 (2004), pp. 614–625. ISSN: 0003066X. DOI: 10.1037/0003-066X.59.7.614.

[31]   A. Reynders et al. "Attitudes and stigma in relation to help-seeking intentions for psychological prob-lems in low and high suicide rate regions". In: *Social Psychiatry and Psychiatric Epidemiology* 49.2 (2014), pp. 231–239. ISSN: 09337954. DOI: 10.1007/s00127-013-0745-4.

[32]   Melanie A. Hom, Ian H. Stanley, and Thomas E. Joiner. "Evaluating factors and interventions that in-fluence help-seeking and mental health service utilization among suicidal individuals: A review of the literature". In: *Clinical Psychology Review* 40 (2015), pp. 28–39. ISSN: 18737811. DOI: 10.1016/j.cpr.2015.05.006. URL: http://dx.doi.org/10.1016/j.cpr.2015.05.006.

[34]   A. Ryan et al. "Why members of the public self-test: An interview study". In: *Family Practice* 27.5 (2010), pp. 570–581. ISSN: 02632136. DOI: 10.1093/fampra/cmq043.

[35]   Martine H.P. Ickenroth et al. "Motivation and experiences of self-testers regarding tests for cardiovascu-lar risk factors". In: *Health Expectations* 17.1 (2014), pp. 60–72. ISSN: 13696513. DOI: 10.1111/j.1369-7625.2011.00733.x.

[36]   Pinar Kuecuekbalaban, Silke Schmidt, and Holger Muehlan. "Reasons for self-testing—beyond the pas-sive users. Results from a nationwide sample in Germany". In: *Journal of Public Health (Germany)* 25.4 (2017), pp. 409–416. ISSN: 16132238. DOI: 10.1007/s10389-017-0795-2.

[37]   Debra J Rickwood, Frank P Deane, and Coralie J Wilson. "When and how do young people seek profes-sional help for mental health problems?" In: *Medical Journal of Australia* 187.S7 (Oct. 2007), S35–S39. ISSN: 1326-5377. DOI: 10.5694/J.1326-5377.2007.TB01334.X. URL: https://onlinelibrary-wiley-com.tudelft.idm.oclc.org/doi/abs/10.5694/j.1326-5377.2007.tb01334.x.

[38]   Amelia Gulliver, Kathleen M Griffiths, and Helen Christensen. "Perceived barriers and facilitators to mental health help-seeking in young people: a systematic review". In: *BMC Psychiatry 2010 10:1* 10.1 (Dec. 2010), pp. 1–9. ISSN: 1471-244X. DOI: 10.1186/1471-244X-10-113. URL: https://bmcpsychiatry.biomedcentral.com/articles/10.1186/1471-244X-10-113.

[39]   James O. Prochaska and Wayne F. Velicer. "The transtheoretical model of health behavior change". In: *American Journal of Health Promotion* 12.1 (1997), pp. 38–48. ISSN: 08901171. DOI: 10.4278/0890-1171-12.1.38.

[40] B J Fogg. "A Behavior Model for Persuasive Design". In: *Proceedings of the 4th International Conference on Persuasive Technology - Persuasive '09* (2009). DOI: 10.1145/1541948. URL: www.bjfogg.com.

[41] Susan Michie, Maartje M van Stralen, and Robert West. "The behaviour change wheel: A new method for characterising and designing behaviour change interventions". In: *Implementation Science 2011 6:1* 6.1 (Apr. 2011), pp. 1–12. ISSN: 1748-5908. DOI: 10.1186/1748-5908-6-42. URL: https://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-6-42.

[42] Adam C. Jaroszewski, Robert R. Morris, and Matthew K. Nock. "Randomized controlled trial of an online machine learning-driven risk assessment and intervention platform for increasing the use of crisis services". In: *Journal of Consulting and Clinical Psychology* 87.4 (2019), pp. 370–379. ISSN: 19392117. DOI: 10.1037/ccp0000389.

[44] Richard M. Ryan and Edward L. Deci. "A self-determination theory approach to psychotherapy: The motivational basis for effective change". In: *Canadian Psychology* 49.3 (2008), pp. 186–193. ISSN: 07085591. DOI: 10.1037/a0012753.

[45] David Markland et al. "Motivational Interviewing and Self–Determination Theory". In: *Journal of Social and Clinical Psychology* 24.6 (Oct. 2005), pp. 811–831. DOI: 10.1521/JSCP.2005.24.6.811. URL: https://guilfordjournals.com/doi/abs/10.1521/jscp.2005.24.6.811.

[47] Juan Martínez-Miranda. "Embodied Conversational Agents for the Detection and Prevention of Suicidal Behaviour: Current Applications and Open Challenges". In: *Journal of Medical Systems* 41.9 (2017). ISSN: 1573689X. DOI: 10.1007/s10916-017-0784-6.

[48] Joao Luis Zeni Montenegro, Cristiano André da Costa, and Rodrigo da Rosa Righi. "Survey of conversational agents in health". In: *Expert Systems with Applications* 129 (Sept. 2019), pp. 56–67. ISSN: 0957-4174. DOI: 10.1016/J.ESWA.2019.03.054.

[49] Aditya Nrusimha Vaidyam et al. "Chatbots and Conversational Agents in Mental Health: A Review of the Psychiatric Landscape". In: *Canadian Journal of Psychiatry* 64.7 (2019), pp. 456–464. ISSN: 14970015. DOI: 10.1177/0706743719828977.

[50] Aditya Nrusimha Vaidyam, Danny Linggonegoro, and John Torous. "Changes to the Psychiatric Chatbot Landscape: A Systematic Review of Conversational Agents in Serious Mental Illness: Changements du paysage psychiatrique des chatbots: une revue systématique des agents conversationnels dans la maladie mentale sérieuse". In: *Canadian Journal of Psychiatry* 66.4 (2021), pp. 339–348. ISSN: 14970015. DOI: 10.1177/0706743720966429.

[51] Hannah Gaffney, Warren Mansell, and Sara Tai. "Conversational Agents in the Treatment of Mental Health Problems: Mixed-Method Systematic Review". In: *JMIR Mental Health* 6.10 (2019), e14166. ISSN: 2368-7959. DOI: 10.2196/14166.

[52] Eileen Bendig et al. "Next Generation: Chatbots in Clinical Psychology and Psychotherapy to Foster Mental Health - A Scoping Review". In: *Verhaltenstherapie* 29.4 (2019), pp. 266–280. ISSN: 14230402. DOI: 10.1159/000499492.

[53] A. Bresó et al. "Usability and acceptability assessment of an empathic virtual agent to prevent major depression". In: *Expert Systems* 33.4 (Aug. 2016), pp. 297–312. ISSN: 1468-0394. DOI: 10.1111/EXSY.12151. URL: https://onlinelibrary-wiley-com.tudelft.idm.oclc.org/doi/full/10.1111/exsy.12151.

[54] Christopher Burton et al. "Pilot randomised controlled trial of Help4Mood, an embodied virtual agent-based system to support treatment of depression:" in: *Journal of Telemedicine and Telecare* 22.6 (Oct. 2015), pp. 348–355. DOI: 10.1177/1357633X15609793. URL: https://journals-sagepub-com.tudelft.idm.oclc.org/doi/10.1177/1357633X15609793?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub++0pubmed.

[55] Yael Perry et al. "Trial for the Prevention of Depression (TriPoD) in final-year secondary students: study protocol for a cluster randomised controlled trial". In: *Trials 2015 16:1* 16.1 (Oct. 2015), pp. 1–17. ISSN: 1745-6215. DOI: 10.1186/S13063-015-0929-1. URL: https://trialsjournal.biomedcentral.com/articles/10.1186/s13063-015-0929-1.

[56] Kurt Kroenke, Robert L Spitzer, and Janet B W Williams. "The PHQ-9: Validity of a Brief Depression Severity Measure". In: *Journal of General Internal Medicine* 16.9 (2001), p. 606. DOI: 10.1046/J.1525-1497.2001.016009606.X. URL: /pmc/articles/PMC1495268/%20/pmc/articles/PMC1495268/?report=abstract%20https://www-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/pmc/articles/PMC1495268/.

[57] Juan Martínez-Miranda et al. "Assessment of users' acceptability of a mobile-based embodied conversational agent for the prevention and detection of suicidal behaviour". In: *Journal of Medical Systems* 43.8 (2019), pp. 1–18. ISSN: 1573689X. DOI: 10.1007/s10916-019-1387-1.

[58] Myrthe L. Tielman et al. "Considering patient safety in autonomous e-mental health systems - Detecting risk situations and referring patients back to human care". In: *BMC Medical Informatics and Decision Making* 19.1 (2019), pp. 1–16. ISSN: 14726947. DOI: 10.1186/s12911-019-0796-x.

[59] Janet Smithson. "Using and analysing focus groups: Limitations and possibilities". In: *International Journal of Social Research Methodology* 3.2 (2000), pp. 103–119. DOI: 10.1080/136455700405172.

[60] T. Bickmore and J. Cassell. "Relational agents: A model and implementation of building user trust". In: *Conference on Human Factors in Computing Systems - Proceedings* (2001), pp. 396–403.

[61] J. Passmore. "Motivational Interviewing-A model for coaching psychology practice Motivational Interviewing-a model for coaching psychology practice". In: *The Coaching Psychologist* 7.1 (2011), pp. 35–29.

[63] SA Friederichs et al. "Motivational interviewing in a web-based physical activity intervention: questions and reflections". In: *Health promotion international* 30.3 (Sept. 2015), pp. 803–815. ISSN: 1460-2245. DOI: 10.1093/HEAPRO/DAT069. URL: https://pubmed-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/24101160/.

[64] RM Ryan and EL Deci. "Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being". In: *The American psychologist* 55.1 (2000), pp. 68–78. ISSN: 0003-066X. DOI: 10.1037//0003-066X.55.1.68. URL: https://pubmed-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/11392867/.

[65] Harri Oinas-Kukkonen. "A foundation for the study of behavior change support systems". In: *Personal and Ubiquitous Computing* 17.6 (Aug. 2013), pp. 1223–1235. DOI: 10.1007/S00779-012-0591-5.

[66] Kristian Torning and Harri Oinas-Kukkonen. "Persuasive system design : State of the art and future directions". In: *ACM International Conference Proceeding Series* 350 (2009). DOI: 10.1145/1541948.1541989.

[67] Robert B. Cialdini and Noah J. Goldstein. "Social Influence: Compliance and Conformity". In: *Annual Review of Psychology* 55 (Jan. 2004), pp. 591–621. DOI: 10.1146/ANNUREV.PSYCH.55.090902.142015. URL: https://www-annualreviews-org.tudelft.idm.oclc.org/doi/abs/10.1146/annurev.psych.55.090902.142015.

[69] E. H. Fischer and A Farina. "Attitudes toward seeking professional psychological help: A shortened form and considerations for research". In: *Journal of College Student Development* 36.4 (1995), pp. 368–373.

[70] DER-YAN HAN et al. "Effects of psychoeducation for depression on help-seeking willingness: Biological attribution versus destigmatization". In: *Psychiatry and Clinical Neurosciences* 60.6 (Dec. 2006), pp. 662–668. ISSN: 1440-1819. DOI: 10.1111/J.1440-1819.2006.01580.X. URL: https://onlinelibrary-wiley-com.tudelft.idm.oclc.org/doi/full/10.1111/j.1440-1819.2006.01580.x.

[71] CC Attkisson and R Zwick. "The client satisfaction questionnaire. Psychometric properties and correlations with service utilization and psychotherapy outcome". In: *Evaluation and program planning* 5.3 (1982), pp. 233–237. ISSN: 0149-7189. DOI: 10.1016/0149-7189(82)90074-X. URL: https://pubmed-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/10259963/.

[73] E McAuley, T Duncan, and VV Tammen. "Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: a confirmatory factor analysis". In: *Research quarterly for exercise and sport* 60.1 (1989), pp. 48–58. ISSN: 0270-1367. DOI: 10.1080/02701367.1989.10607413. URL: https://pubmed-ncbi-nlm-nih-gov.tudelft.idm.oclc.org/2489825/.

[74] Durairaj Maheswaran and Joan Meyers-Levy. "The Influence of Message Framing and Issue Involvement". In: *Journal of Marketing Research* 27.3 (Aug. 1990), p. 361. DOI: 10.2307/3172593.

[75] Richard E. Petty and John T. Cacioppo. "The elaboration likelihood model of persuasion". In: *Advances in Experimental Social Psychology* 19.C (1986), pp. 123–205. ISSN: 00652601. DOI: 10.1016/S0065-2601(08)60214-2.

[77] Kate Miriam Loewenthal and Christopher Alan Lewis. "An Introduction to Psychological Tests and Scales". In: *An Introduction to Psychological Tests and Scales* (Oct. 2018). DOI: 10.4324/9781315782980. URL: https://www-taylorfrancis-com.tudelft.idm.oclc.org/books/mono/10.4324/9781315782980/introduction-psychological-tests-scales-kate-loewenthal-christopher-alan-lewis.

A

Design Appendices

A.1. The Suicide Barrier-Strategy matrix

Strategies \Barriers	Suicidal Ideation	Self-stigma(weakness)
Social validation ('more willing to comply with a request for behavior if it is consistent with what similar others are thinking or doing')	"In 2018, 70,316 person-times contact 113 via calls and online chats. Based on the interviews we had with our pervious clients, who were suffering from severe suicidal ideation and thought they were beyond rescuing, they told us that they were glad that they had called us."	"A role model with powerful image (choosing role model depends on the gender and age of test taker) also seek help in a difficult circumstance. Suicide ideation is a hard challenge for everyone, including you. We are here to offer you some extra help to overcome it." (Go against their thought) "We understand that you would like it do it on your own. Chatting with our counsellors is a source you can use to gather more information to help yourself. And again, you are still in control of the situation." (In line with their idea)
Liking ('more willing to comply with the requests of friends or other liked individuals')	"Our counsellors are really friendly and open-minded. We would like to listen to you. Our helpline consists of people from different age groups. We work here because we or our closed ones had experience with suicidal thoughts. (Pictures showing friendly counsellors and the mixed group)"	"It is good that you have reached to us. We are trained to chat with people suffering from suicidal thoughts, and we talk with lots of people with suicidal ideation every day. Our counsellors have a strong mind to do this special task."
Consistency ('more willing to comply with requests for behaviors that are consistent with that position after committing themselves to a position')	"We understand that you may feel helpless and hopeless at this point. But you made a good decision to take the self-test to be aware of your conditions. You have spent your time on the self-test, for which you could have done other things. Since you are here already, you might want to take the chance to chat with us."	"Taking a self-test for suicidal ideation is your first step of helping yourself, which is a strong move. Chatting with our counsellors can be another tough action for you to take as your next step."
Authority ('more willing to follow the suggestions of someone who is a legitimate authority')	"A psychologist who had been through suicidal ideation (male or female depends on the gender of test taker) suggests based on research that, people with suicidal ideation will feel better after disclose their suicidal thoughts. 113 is the leading expertise on suicide in the Netherlands. No matter how bad it looks like now, you could feel less stressful once you open to someone. We are always here for you."	"Psychological research has showed that disclosing your thought to someone is a way to help yourself with suicidal thoughts. 113 is the leading expertise on suicide in the Netherlands. Our counsellors are professionally trained, and we are experienced by having countless conversations with people with suicidal ideation."
Others	"Are you concerns with your result of the self-test? Do you have any questions towards the result of the self-test? You can always contact 113 to discuss about your confusion."	

Strategies \Barriers	Self-stigma(ashamed)	Fear/mistrust
Social validation	"A lot of people with suicidal thoughts like your age who contacted 113, also told us that they felt ashamed at the beginning. However, they made good decisions to contact us at the end. By chatting with us, they realized that it was not shameful of having suicidal thoughts."	"We are open to communicate and being transparent with you to minimize any negative feelings. Some of our previous clients who had unpleasant experience with mental health providers in the past, they gave us and themselves a chance to chat with us. We are always available for you."
Liking	"Our previous clients think that our counsellors are very understanding and patient. We are here to listen to you without judging you in any circumstances. We will listen to you carefully and think along with you in order to help you."	"Our previous clients who contacted us think that our counsellors are quite friendly. Chat with us is anonymous and confidential. Here is a video showing the process of chatting with us."
Consistency	"Taking the self-test is your first step to seek help for your suicidal ideation. It is good that you took the first step, contacting 113 is the next step to get further help. 113 help line is a safe and non-judgmental place. Our service is fully anonymized."	"It is great that you took your first step to take a self-test from us. Contacting us can your next step to get to know us more."
Authority	"We know that it is hard to talk about suicidal thoughts, since we are from the national suicide prevention organization 113. It is understandable that you might feel ashamed. However, our counsellors are trained to guide you to talk. 113 is built up to break the taboo of talking about suicide."	"We are a unique organization focusing on suicidal prevention. We are not like other general mental health provides. Our counsellors are trained to talk with people having suicidal thoughts."
Others		"If you are worried about police or ambulance showing up at your door after contacting 113, we can totally understand that. However, we are sure that no one would go to your door. Just relax and chat with us."

Strategies \Barriers	Lack of mental literacy	Lack of availability
Social validation	"In 2018, 70,316 person-times contact 113 via calls and online chats. Based on the interviews we had with our pervious clients, who were suffering from suicidal ideation, they told us that they were glad that they had called us."	"In 2018, 70,316 person-times contact 113 via calls and online chats. Based on the interviews we had with our pervious clients, who were suffering from suicidal ideation, they told us that they were glad that they had called us."
Liking	"Our counsellors are friendly people with a warm heart. We will listen to your carefully and we can understand you well. Chat with us is anonymous and confidential. Here is a video showing the process of chatting us."	"Our counsellors are friendly people with a warm heart. We will listen to your carefully and we can understand you well. Chat with us is anonymous and confidential. Here is a video showing the process of chatting us."
Consistency	"You have come to the right place for your condition. Taking the self-test is your first step to seek help for your suicidal ideation. Contacting 113 is the next step to get further help. Since you already take the first step, you are able to take the next step."	"Taking the self-test is your first step to seek help for your suicidal ideation. Contacting 113 is the next step to get further help. Since you already take the first step, you are able to take the next step."
Authority	"Suicidal ideation is surely one kind of mental health problem. When suicidal thoughts start to affect your lives, you should seek professional help. 113 is a national suicide prevention organization. Research on suicidal ideation have showed that disclosing suicidal thoughts to others could help people with suicidal ideation."	"Research on suicidal ideation have showed that disclosing suicidal thoughts to others could help people with suicidal ideation. Our service is available 24/7 and it is free of charge. You can contact us via calls or chats whenever you are free or whenever you need to talk with someone."
Others	"Behind the chat or telephone, you will find our expert employees who are used to talking about suicide, who can think along with you about a way to relax and find distraction, what can help you in this situation and how you can take the next step."	

B

Evaluation Appendices

B.1. The Randomization Set-up in the Experiment
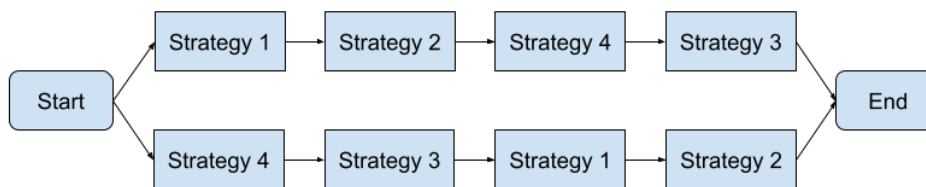

Figure B.1: The randomization set-up in the experiment

B.2. Informed Consent Form of the Experiment

Content   This study is conducted to explore people's opinion on the ability and the usability of a self-test for mental health. With this study, we would like to see how easy or difficult it is for people to take a self-test for mental health in the system. Also, we would like to see how much effect the feedback of the self-test has on participants to engage with professional counsellors of an online helpline. In this study, we will first give you an fictitious scenario and persona for you to play in the experiment, and then we will ask you based on the scenario and the persona you play to complete a self-test for mental health with guidance, a questionnaire on your personal willingness of seeking help and a questionnaire on the usability of the system.

Risks   A potential risk identified is that some participants might confuse the offered fictitious scenario with a description of the actual situation in their country. To avoid this confusion, the experiment will end with a debriefing text which describing the actual situation. Additional risk identified is that mental health topics of experiment might be upsetting for some people. Therefore, we suggest that participants with mental health problems (including suicide ideation) not to join this experiment. In case you have negative feelings caused by the experiment, note that at the end of the experiment, we will list resources that might help you in relieving this feeling.

In in case of doubts or concerns, do not hesitate to contact the research team at the e-mail address above. Furthermore, if you, as a result of participating in this study, feel the need to talk to someone about your mental health, know that general practitioners or employees at national helplines (a list will be given at end of the experiment) are professionals that you can turn to.

Withdrawal and Exclusion   Participation is entirely voluntary, and you may withdraw at any time and without consequences. However, withdrawing also means that the data that you have provided cannot contribute

to the study. We therefore cannot reimburse you in case of withdrawal. If you have not completed the study by the time data collection finishes, we regard this as a withdrawal. If you have completed the study but would still like to withdraw, please contact the research team at the e-mail address above. Lastly, we will assess whether you have formulated understandable and suitable responses. If this is not the case, we must exclude you from the study and retain the right not to reimburse you.

Data Storage For the purposes of this study, we will collect personal data only until you have been reimbursed. This identifying data will never be stored outside of Qualtrics. Upon storing, all person identifying information will be replaced with a participant identification code. During analysis, data will be stored anonymized and securely on the private network of 113 (a Dutch crisis helpline). Upon publication of the research, it will also be made available as open access on a national database for research data (e.g. 4TU.ResearchData). Although fully anonymized, this public data set will include your age and gender. The data set will be archived for the duration of at least 10 years. If you have any questions or concerns about your data, do not hesitate to contact the research team at the e-mail address provided above.

Table B.1: Consent Form Checklist

Please tick the appropriate boxes	Yes	No
Taking part in the study		
I have read and understood the study information. I have been able to ask questions about the study and my questions have been answered to my satisfaction.		
I understand that people with mental health problems (including suicide ideation) are advised not to participate in this experiment.		
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.		
I understand that taking part in the study involves the completion of a self-test for mental health as well as a questionnaire on willingness of seeking help based on my opinion in role of fictitious persona. The self-test will not reflect my personal situations but be based on predefined fictitious scenarios. Finally, I understand that I will be asked to complete a system usability questionnaire.		
Use of the information in the study		
I understand that information I provide will be used for scientific publications by the researcher.		
I understand that personal information collected about me, with the exception my gender and age, will not be shared beyond the study team.		
Future use and reuse of the information by others		
I give permission for my age, my gender, the self-test, personal opinion on willingness and usability data that I provide to be archived anonymized and open access in a repository, such as the 4TU.ResearchData repository, so it can be used for future research and learning.		

Do you agree that you have been sufficiently informed about the nature and potential risks of the study and that you are aware that your participation is voluntary?
Yes, I agree and I would like to participate. □

B.3. The Scenarios and Barriers of the Experiment

Scenario Description: In this scenario, you, as Robin, are living in a country, called Bapaya (which is not a real country). This country and its culture are quite unlike the Netherlands. You moved to Bapaya 6 years ago. Your family and friends are all living in Bapaya. You also have a stable job with a good salary here. Based on the immigration law in Bapaya, you will receive your permanent resistance permit after living here for 7 years. You are not sure how you should handle the following situation in this country.

In the past few months, when you are living in Bapaya, you have been having some mood problems. You feel bad about yourself. You seldom feel happy and you are depressed most of the day. You have no interests or no energy to do activities. You even have difficulties to sleep well. Because of all the above things happening to you, you are quite concerned about your own mental health.

You saw on TV news once saying that around 1-in-7 people globally had one or more mental or substance use disorders. At the end of the message, it was mentioned briefly that GPs and psychologists could help people with such problems in Bapaya. You also found a helpline available online in Bapaya for mental health issues where you could also get help.

In the meantime, you also heard some rumors from other people in Bapaya were saying that the public took mental health problems negatively. Therefore, you might lose your job and your family and friends might turn their back on you. You also heard that some people in Bapaya thought it was not quite helpful to get professional treatments.

Barriers:

- I think I should be able to handle it by myself.

    – You have not seen much mental health information available in Bapaya. People around you seldomly discuss about mental health. You also have not seen much discussions about mental health on TV. It seems that people here have little knowledge about mental health. You find that there are some self-help books available for your mental health problems. You also find a successful self-help case in the introduction of a self-help book.

- I feel ashamed to talk about my mental health issues.

    – Since you were having those mood issues above, you were not working enough. You even start drinking a lot of alcohol. You also start gambling and you even owned some money because of gambling. During this period, you ignore your family and friends. You do not want other people to know about all the things you have done. You have seen on TV series and movies that when people get professional psychological help, they need to tell all their behaviors/stories.

- I do not want to talk about it with anyone.

    – Once upon, you noticed that your family and friends gossip about your Uncle Bob, who got divorced a year ago. They made assumptions on Uncle Bob's divorce when they told his story to others. The story about Uncle Bob they told others was different from what you knew about his divorce. They were also discussing that he made a bad choice and he should not get divorced.

- I am afraid of or I do not trust health providers.

    – You had no experience with metal health providers in Bapaya. You heard rumors that they might let the immigration department of Bapaya know about your condition, you might lose your resistance permit. You also heard rumors in your company that a college got fired because of mental health problems.

- I do not have time, or I am afraid that it would cost me much money to get help from professionals.

    – You are quite busy with your work and your family. You overheard someone once when you were buying groceries in a supermarket, that it was a complicated procedure to make an appointment for mental health issues. It would also take a long time to sit in a waiting room for an appointment with psychologists. You also heard they were talking about the cost for getting mental health treatments being expensive. However, you are planning to buy a nice house in Bapaya.

Summary:

- You live in a country called Bapaya for 6 years.

- You are experiencing some mental health problems.

- You saw on TV that it was common to have mental health problems and you can seek for professional help.

- You heard rumors that the public took mental health problems negatively and professional help might be not helpful.

- You are hesitating if you should ask for professional help.

Based on the mix of information, you are hesitating if you should ask for professional help.