Ben-Gurion University of the Negev

Faculty of Engineering Sciences

Department of Industrial Engineering & Management

Comparing inclusive and non-inclusive co-designing process of a social assistive stress management robot application for older adults

Final year engineering project

Reut Alon

Supervisors:

Prof. Yael Edan

Dr. Ittay Mannheim

August 20th, 2024

Abstract

Technology can be used to recognize and manage stress, particularly robotic interventions, which can potentially assist older adults and people with dementia. However, barriers such as ageism can hinder the effective implementation of such technological solutions, even in digital technologies intended to serve older adults (Mannheim, Wouters, et al., 2023), although the involvement of stakeholders in the design process is considered a main factor that influences the acceptance of robots (Frennert & Östlund, 2014).

This project aimed to examine the influence of the involvement of older adults in the design process of a stress management robot application intended for older adults on the perceived benefit and acceptance of the robot.

This project included two design processes:

1. Non-inclusive design process: A design process of a stress management robot application involving only the researcher as a part of an academic course.
2. Inclusive design process: A design process of a stress management robot application involving older adults as a part of a co-design workshop developed for this project.

A between-group experiment designed to examine the relationships between stress levels, perceived usefulness (PU), perceived ease of use (PEOU), and behavioral intention (BI) across two prototypes (independent variables) of stress management robot applications (one designed in a non-inclusive design process, the other in an inclusive design process with older adults).

Dependent variables were stress level, perceived usefulness (PU), perceived ease of use (PEOU), and behavioral intention (BI). The independent variable was the robot application type (prototype A = application designed in a non-inclusive process, prototype B = application designed in an inclusive process).

There were no significant results concerning mean RMSSD, but it was shown that the mean RMSSD of the group of prototype B stayed closer to the baseline's mean RMSSD. Moreover, TAM questionnaire analysis with the Mann-Whitney U test showed in a significant level of 0.05 that prototype A was perceived as a little more useful and likely to be used, than prototype B.

In future work, it is recommended to involve older adults with suitable professional backgrounds (such as developers and designers) and change the flow of the experiment.

Keywords: Older adults, co-design, social robot, stress, stress management robot application.

Table of contents

1. Introduction 7

1.1. Problem description 7

1.2. Objectives 8

2. Literature review 9

2.1. Stress 9

2.2. Interventions to manage stress levels 10

2.3. Stress prediction, identification, and analysis using digital technology and algorithms 12

2.4. Robots as a caring supporter for older adults 13

2.5. Factors affecting technology acceptance 13

2.6. Involvement of older adults in the digital technology design process 15

2.7. Insights from literature review 17

3. Methods 18

3.1. Overview 18

3.2. Interview analysis 18

3.3. Design processes 19

3.4. Experimental design 22

4. Results 31

4.1 Comparison of robot application designs 31

4.2 Co-design workshop analysis 36

4.3 Experiment analysis 40

5. Discussion 51

5.1 Experimental factors 51

5.2 Co-design workshop factors 52

5.3 General factors 53

6. Limitations 54
7. Conclusion and future work 56
7.1 Recommendations 56
7.2 Future work 57
8. References 58
9. Appendixes 64
Appendix 1 - Fundamentals of Human-Computer Interaction course syllabus 64
Appendix 2 – Fundamentals of Human-Computer Interaction course sub-submissions 64
Appendix 3 – Ethical Approval 71
Appendix 4 – Consent forms 77
Appendix 5 – Questionnaire protocol 80
Appendix 6 – Co-design workshop sessions protocols 89
Appendix 7 – Stroop test 101
Appendix 8 – Temi robot's sequences in the experiment 105
Appendix 9 – Experiment checklist 110
Appendix 10 – Older adults invitation for participating in co-design workshop and experiment 112
Appendix 11 – Data analysis code 112
Appendix 12 – GitHub link 121
Appendix 13 - Perceived Stress Scale (PSS) questionnaire score scale calculation 122
Appendix 14 - A list of insights from the researcher's observation during the experiment 122

List of Figures

Figure 1 – Co-design workshop Empathy map outcome 21

Figure 2 – Application color options presented to the co-design workshop participants 22

Figure 3 – Emotibit sensor with a case on the wrist and the EmotiBit Oscilloscope software 24

Figure 4 - Flow of the experiment 27

Figure 5 – TAM of a stress management robot application 28

Figure 6 – Final robot's face design of prototype A (non-inclusive design process) 31

Figure 7 – Robot's face and accessories of prototype B (inclusive design process) 32

Figure 8 – Stress management robot application sketches and content ideas 38

Figure 9 - Participants preferences of the stress management robot application design and content 39

Figure 10 – Graph of Perceived Stress Scale Test (PSS) scores analysis 41

Figure 11 – Mean RMSSD graphic visualization 45

Figure 12 – Measured stress levels analysis by groups 46

Figure 13 – Boxplot graph of PU and its score related to age group 48

Figure 14 – Boxplot graph of PU and its score related to the robot application type 48

Figure 15 – Boxplot graph of BI and its score related to age group 49

Figure 16 – Boxplot graph of BI and its score related to the robot application type 49

List of Tables

Table 1 - Dependent variable 26

Table 2 - Stress patterns conditions 30

Table 3 – Robot verbal interaction transcription 33

Table 4 – Visual comparison between the design processes outcome applications 36

Table 5 – Participants age and gender data by groups 40

Table 6 – PSS survey score analysis 41

Table 7 – Experiment levels recording data and statistics 42

Table 8 – Group stress data statistics 44

Table 9 – Hypothesis independent-samples Mann-Whitney U test on RMSSD ($\alpha = 0.05$).... 45

Table 10 – Dependent variable statistics by prototype groups 47

Table 11 – Mann-Whitney U test on TAM ($\alpha = 0.05$)..... 50

1. Introduction

1.1. Problem description

Stress is a natural response in humans that assists the personal management of difficult situations in our lives, such as a lack of resources to cope with environmental demands, and threats (Godoy et al., 2018; Maddock & Pariante, 2001; World Health Organization, 2023). During stressor situations, the body starts to react with a series of responses, aiming to improve the individual's ability to confront the current situation and similar challenges in the future.

Chronic stress cases may cause physical, health problems, or mental health conditions, affect the body's immune system, and aggravate such existing problems specifically in individuals with a history of health problems (Maddock & Pariante, 2001; World Health Organization, 2023).

One of the age groups that may be affected by stress is older adults. Between 2015 to 2050 the proportion of the population of older adults in the world (60 years or older), will nearly double, while the number of older adults the age of 80 years or older predicted to triple between 2020 and 2050 (World Health Organization, 2022). It is suggested that despite the increase in life expectancy, the extra years of life are characterized by poor health, which affects society more negatively.

A common condition among older adults is dementia. Dementia refers to diseases that impact, among other things, the memory and the patient's ability to execute his daily routine (World health organization (WHO), 2023). People with dementia experience different symptoms, among difficulties in the area of language, such as writing, verbal expression, and understanding, which is considered a common symptom (Banovic et al., 2018). Difficulties in the area of language may lead to specific challenges in expressing the feelings and wishes of individuals. Language-related symptoms typically manifest in the early stages of dementia and evolve substantially as the disease progresses. People with dementia may experience negative feelings about difficulties in the area of language as well (such as stress). On top of that, caregivers of people with dementia can not always notice a problem or negative feelings that the patient is coping with, or can not always take care of it due to many reasons.

Therefore, interventions aimed at identifying and addressing unattended stress in older adults, specifically those with dementia, may mitigate the manifestation of stress-related adverse effects, such as challenging behaviors (Gerritsen et al., 2019). Due to behavioral and

psychological symptoms, people with dementia are more likely to receive potentially sedative-hypnotics and antipsychotics (Deardorff et al., 2023). These medications, when misused or combined problematically with other drugs, can increase the risk of adverse events, including hospitalizations and medication errors, compared to people without dementia.

Technology can be used to recognize and manage stress, particularly robotic interventions, which can potentially assist older adults and people with dementia. However, barriers such as ageism can hinder the effective implementation of such technological solutions, even in digital technologies intended to serve older adults (Mannheim, Wouters, et al., 2023). When developing digital technology it is important to include older adults in the design process to avoid ageism. Moreover, the involvement of stakeholders in the design process is considered a main factor influencing the acceptance of robots (Frennert & Östlund, 2014).

1.2. Objectives

This study aimed to understand the influence of the involvement of older adults in the design process of a stress management robot application on the acceptance and perceived benefit of other older adult users of this robot application.

To examine this, two designs of a stress management robot application were developed as part of this final project and compared during a specially designed experiment. The first design was an outcome of a non-inclusive design process that did not include older adults; the second design was an outcome of an inclusive process that included older adults in the design process.

A design study is a project focused on problem analysis, incorporating design validation and projecting design conclusions to enhance design guidelines (Sedlmair et al., 2012). The key contributions of a design study encompass the characterization and abstraction of the problem, the establishment of a validated visualization design, and reflective insights on the design study, including its retrospective analysis of other pertinent works. Importantly, the design study is not characterized by a linear progression; rather, its various phases exhibit significant overlap, rendering it an iterative and dynamic process.

2. Literature review

2.1. Stress

Stress is a natural response in humans that assists the personal management of difficult situations in our lives (World Health Organization, 2023). This physiological reaction arises when an individual lacks the resources to cope with the environmental demands (Maddock & Pariante, 2001). When the brain perceives a situation as a threat or beyond the individual's capacity to manage, the body starts to react with a series of responses, including physiological and behavioral changes, aimed at improving the person's actions (Godoy et al., 2018). These responses and alterations aim to improve the individual's ability to confront the current situation and similar challenges in the future.

According to the Mental Health Foundation (2018), a survey that included 4,619 participants found that 74% of them felt stress that they were not able to cope with or that made them overwhelmed in the year before the survey. In another survey that included 3,185 participants who reside in the United States, only 12% felt little or no stress in the month before the survey (The Harris Poll, 2023).

In light cases, stress can lead to a range of emotions (such as worry, mental tension, anxiety, etc.), while in more severe cases can cause physical, health problems or mental health conditions for example body pains or depression (Maddock & Pariante, 2001; World Health Organization, 2023). In chronic stress cases in individuals with a history of health problems, stress may aggravate such existing problems. Furthermore, severe cases of stress or chronic stress may have effects on the body's immune system (Maddock & Pariante, 2001). In contrast to cases of short-term, acute stress, in which the body can boost certain aspects of the immune response when people experience chronic, long-term stress, this tends to suppress the immune system. This prolonged suppression can make people more vulnerable to getting sick or developing infections, as it impairs the body's ability to fight off germs and diseases. Severe or ongoing stress has been linked to changes in certain immune system chemicals, but the full medical implications of these stress-related changes are still not entirely clear. Importantly, for people with dementia, stress can manifest in various ways.

Dementia refers to diseases that impact, among other things, the memory and the patient's ability to execute his daily routine (World health organization (WHO), 2023). A new case of dementia emerges every 3 seconds (Alzheimer’s Disease International, 2020). In 2020, there

were over 55 million people with dementia worldwide, with projections estimating 78 million people with dementia in 2030, and 139 million people with dementia in 2050.

People with dementia can experience changes in their mood or behavioral changes, including personality changes, a range of negative feelings related to memory loss (such as anxiety and sadness), and social isolation (World health organization (WHO), 2023). Another common symptom among people with dementia is difficulties in the area of language, such as writing, verbal expression, and understanding (Banovic et al., 2018), which may lead to specific difficulty in expressing the feelings and wishes of the individual. Language-related symptoms typically manifest in the early stages of dementia and evolve substantially as the disease progresses. People with dementia may experience negative feelings, such as stress, about difficulties in the area of language as well.

To mitigate the adverse impact of language-related challenges among people with dementia, it is recommended to adopt effective communication strategies with the individuals. Such strategies include simplifying the conversation, accessing the patient from the front, and giving the patient enough time to process the conversation and respond.

Stress in people with dementia can be caused not only as a byproduct of loss of abilities due to dementia symptoms. Sharp (2019) mapped four more main themes that can cause people with dementia to experience stress. The themes are stress sourced in family relationships, unpredictable challenges in daily life as an outcome of new symptoms, straggling the changes that dementia brings to the individuals' lives and identities, and the attempts by people with dementia to maintain a sense of control over their lives and circumstances.

2.2. Interventions to manage stress levels

Because of the prevalence of stress in the population and the physical and psychological health conditions that can be caused by it, it is important to know stress management techniques, which can aid in reducing stress levels and negative health outcomes of severe cases of stress or chronic stress (Varvogli & Darviri, 2011). Numerous techniques are available for stress management, applicable not only to individuals experiencing heightened stress levels but also to those in good health. Integrating stress management practices into one's daily routine has shown to be effective in improving the health of the individual. Stress management techniques that have been reviewed in their research have not been recorded as techniques with negative side effects (such as guided imagery, diaphragmatic breathing,

and transcendental meditation). In addition, they mention that health professionals, as well as caregivers, can use the techniques that are mentioned in their research on a diverse population (healthy or with background health issues), after having proper training.

Mindfulness-based stress reduction (MBSR) represents a stress management technique evaluated among older adults, typically administered through a series of group sessions facilitated by health professionals, social workers, or psychologists (Varvogli & Darviri, 2011). The impact of MBSR on the stress levels among older adult users was inconclusive. Li & Bressington (2019) found that there were no observed benefits of MBSR among older adults who are coping with stress, although they reserved from the reliability of this conclusion. Another study, along with Li & Bressington (2019), found no significant effects on older adults' stress levels but noted this outcome could be influenced by the initial lower stress levels of the user in the study (Hazlett-Stevens et al., 2019).

Effective stress mitigation involves the adoption of coping strategies that change between each individual. Studies have shown that in the case of people with dementia, person-centered care is the best method of care for them and it is related to positive outcomes for individual's well-being, and positive visitors' opinions about the place individuals stay in (Edvardsson et al., 2014). Despite its recognized efficacy, there are no specific implementations of successful person-centered care, and not many studies experiment with interventions regards on predictors of successful person-centered care methods.

Another study that reviewed the relationship between stress and mindfulness techniques, including meditation, in people with dementia or mild cognitive impairment found that such training facilitates stress reduction, and reported sustained engagement in mindfulness and meditation practices by a majority of participants even six months post-experiment (Russell-Williams et al., 2018). Beyond stress alleviation, these practices exhibited multifaceted benefits, such as improving sleep quality, retrospective memory function, and systolic blood pressure.

Due to behavioral issues and mood disorders, people with dementia tend to receive, among other things, more sedative-hypnotics and antipsychotics, that can be misused or combined problematically with other drugs (Deardorff et al., 2023). Misuse of medication can lead to hospitalization and medication errors in people with dementia with a high probability, compared to people without dementia. Additionally, the use of sedative-hypnotics medications in people with dementia has been linked to accelerated cognitive decline and

death in addition to hospitalizations. Most people with dementia are willing to decline medication if it's possible and recommend physicians and pharmacists take a more holistic approach when it's doable. Parsons (2017) claimed as well that many researchers found a link between polypharmacy and potentially inappropriate prescribing to sickness and death, not specifically in people with dementia, and that people with dementia are at risk of having polypharmacy and potentially inappropriate prescribing. In addition, it was found that poor cognitive function is linked to non-adherence to taking medication, and external intervention, such as caregivers for example, is required to help increase the chances of adherence to taking the medication (Smith et al., 2017).

Over the above, caregivers may find it challenging to provide people with dementia with the desired level of care (Edvardsson et al., 2014). Not only people with dementia do not always get the treatment they need, but also dissatisfaction among the staff about the care quality they give is a primary factor contributing to job quit of elder caregivers. Additionally, caregivers of people with dementia face the risk of experiencing stress by themselves and physical illness (Gilhooly et al., 2016).

It is possible to manage stress levels in experiments by different methods (Bali & Jaggi, 2015). One of those methods is the Stroop test, which can be used as a stressor task in experiments to increase the stress levels of the participant. Stroop test is considered as a psychological or cognitive stressor. In the task, the participant gets names of colors that are colored in different colors than the name (for example, the word red is colored in green), and should identify the name of the color that the word is colored in (in the example, the correct answer is green).

2.3. Stress prediction, identification, and analysis using digital technology and algorithms

Digital technology, such as wearable sensors and machine learning algorithms, can assist in the assessment and prediction of stress and in reducing stress levels in stressors situations when appear.

Wearable EDA measurements are promising for perceived stress predictions and stress management in healthy people and under laboratory conditions (Klimek et al., 2023). Machine learning algorithms can assist in the classification of stress, for instance, the SVM algorithm (Ahuja & Banga, 2019). Phone applications can be useful for stress level management. "Calm" is an example of phone applications that aid reduce stress, and was found effective for improving mindfulness and self-compassion among students as well (Huberty et al., 2019).

Hwang & Jo (2019) found that the application they examine not only aids in stress reduction but also contributes among other things to lowering depression and increasing self-efficacy.

2.4. Robots as a caring supporter for older adults

Robots can monitor older adults, support their daily activities, and be involved in the care of older adults, for example, to address the shortage of healthcare professionals (Frennert & Östlund, 2014). To fulfill this role, the robot as a caregiver of humans, needs to identify and react according to the person's needs and assist him, follow "human rules", such as identifying the person in front of it, and is expected to be predictable, reliable, and pose no threat to its surroundings.

Examination of the implementation of robots in the treatment of older adults has shown that this method has a positive health effect on test users and includes a stress reduction among the test subjects (Góngora Alonso et al., 2019). Specific investigations into the implementation of robots in the treatment of older adults with dementia have shown that the use of biomimetic robots or a social robot group therapy helped to improve indicators, including an improvement in the subjects' ability to cope with stress and social abilities (Chu et al., 2017; Valentí Soler et al., 2015). Biomimetic robots are robots that mimic the biological characteristics of humans or animals (Gao et al., 2019).

2.5. Factors affecting technology acceptance

Over the years some models were built to predict the adoption and use of different technologies by different stakeholders. One of the models that were developed is the Technology Acceptance Model (TAM), which examines the adoption and use of new technologies based on perceived usefulness and perceived ease of use (Venkatesh & Bala, 2008). The TAM model defines perceived usefulness as the level of belief that using the technology will improve his / her performance in a particular task. Perceived ease of use is defined as the level of effort needed from the individual to use the technology, aiming the examine technology will require as little effort as possible to use it.

Many factors influence the acceptance of technology by potential users in general and the acceptance of robots by older adult users in particular. A main factor influencing the acceptance of robots is involving stakeholders in the design process (Frennert & Östlund, 2014). Other factors that can affect are the attitude of society towards robots,

implementation of the users' expectations on the robot while taking into consideration social and cultural implications of the robot, development of the robot as a part of other products, the safety of the user and the environment, accessibility, usability, and sociodemographic factors.

Specifically among older adults, the willingness to adopt technology depends to some extent on the technology itself, the demographic characteristics of the user, and the users' trust and confidence in their ability to learn the technology and master it (Berkowsky et al., 2017). Moreover, the perceived value of the technology by the user and the impact on his quality of life are significant predictors of the adoption of technology among older adults, and as these factors are perceived as more positive by the user, his tendency to adopt the technology will increase. Older adults tend not to want to use technology that requires them to use declining abilities such as vision, memory, and dexterity.

Psychological variables and the social and physical environment predominantly influence the acceptance of robots by older adults with dementia (Whelan et al., 2018). The robots need to be personalized, compatible with user expectations, and feet of environmental considerations. The user should feel comfortable with the robot, especially in the interaction with the robot. People with dementia will better accept robots that use humanlike communication and meet the user's needs, including psychological and social needs. Moreover, a preference for human-like social robots is evident among older adults with dementia when compared to service robots and social robots that are not human-like (Ke et al., 2020). Additionally, these individuals report that they experience challenges in using robots, stemming from cognitive decline that affects their ability to learn how to use the robot. Additional aspects that can influence the robot's perceptions of users and the users' attitudes towards the robot are the design of the robot (Liberman-Pincu et al., 2021), and the adaptability of the interface to meet older adult users' needs and abilities. Such adaptability facilitates flexibility in technology use, particularly benefiting users with low technological experience (Di Nuovo et al., 2018). Adaptability is not only needed in the interface aspect but in the design itself as well, especially in robots for personal uses, due to cultural differences or personal preferences that influence the perception of the robot and the interaction with it (Liberman-Pincu et al., 2023, 2024).

2.5.1 Social robot design implementation

The design of social robots has changed through the years. In their survey, Mahdi et al. (2022) presented the evolution of social robots' design by separating them into three main periods. The initial phase encompasses the years preceding 2005. During this period, designs of social robots were considered innovative and creative, and they influenced the design of social robots in later years. During this period there were not many conferences or journals focused on HRI research. The next period included the years between 2006 and 2012. In these years, many new designs of social robots appeared, and there was a great interest in bringing the robots outside of the laboratories and research field to everyday use. The robots were mostly humanoid-shaped, and there was not much variation in the design of the social robots. In 2006, the first conference on HRI was held, and since then HRI discourse has begun in the framework of conferences, journals, and forums. The third period unfolded from 2013 to 2020, marked by a diminished influx of novel social robot designs compared to preceding periods. The appearance of the robots is slightly different, which resulted in more affordable social robots. The availability of cheap, open-source hardware also contributed to the design of the robots, fostering the creation of open-source social robot designs.

Furthermore, a set of guidelines have proffered with recommendations for the efficacious and successful design of social robots, derived from their synthesis of the analyzed studies. A subset of their principal recommendations includes the following:

1. Engage in co-design processes involving end-users to enhance the long-term viability and success of the social robot.
2. Decide on the equipped interaction modalities of a social robot to avoid inconvenience among end-users. For example, talking dog-shaped social robots can cause inconvenience, because dogs can not talk in reality.
3. Deliberate on the robot's color and appearance to prevent attributing race to a robot that can lead to racial bias towards the robot.

2.6. Involvement of older adults in the digital technology design process

Several researchers investigate the facets of incorporating end users, particularly older adults, in the digital technology design process. Fischer et al. (2020) conclude from their review that the literature provides inconclusive evidence regarding the benefits of co-designing technology with older adults. Moreover, there is little information about the impact of

involving older adults in the design process on older adults' adoption and acceptance of the technology. On one hand, co-designing technology with older adults can aid in dealing with stereotyping of older adults and aging, fostering positive sentiments towards participation in the design process among older adults, and may enhance the quality of the design. On the other hand, the co-design process does not guarantee a specific outcome.

In many of the studies that investigated and reviewed older adults and their involvement in the design process of technologies, stereotypes and prejudice were identified, for example about older adults' technological abilities and their capabilities to take part in the design process of technology's product (Mannheim et al., 2019). Additionally, ageism was observed to influence decisions made during the design process in some studies. Iversen et al. (2009) describe ageism as stereotypes, prejudice, or discrimination of older adults due to their Despite ageism can encompass biases against individuals of all age groups, the majority of researchers have concentrated on its impact on older adults (Nelson, 2015). Ageism directed toward this group is deeply entrenched in various facets of society, reinforcing the perception that aging is inherently undesirable. This bias can influence the attitudes of both family members of older adults residing in care facilities and professionals, such as physicians and counselors, who assist older adults in their daily lives. Such ageist attitudes may manifest in perceptions of older adults as less capable or overly dependent.

In practice, the involvement of older adults in the design process tends to be limited to the initial and final phases, such as the usability testing, rather than in the design phase (Mannheim, Wouters, et al., 2023). Even when older adults were involved in the design phase, it was poor. Stereotypes and prejudice were applied in the phase of recruitment of older adult participants as well. For example, older adults with low technological abilities or people who are considered not active or healthy are often excluded from the design process. The gap between the theory of involving older adults in the design process of digital technology and its implementation may suggest that technologies that were designed for older adults with poor involvement of older adults in the design process, may lead to a not optimal outcome.

A different study emphasizes examples of successful and less successful design processes of digital technology, such as phone applications and robots, which are intended to serve older adults (Mannheim, Weiss, et al., 2023). The study participants describe the successful involvement of older adults in the design process of digital technology for older adults by the inclusion of relevant individuals from the initial phase, continuous engagement throughout

the design process, attentiveness to their needs, and incorporation of their feedback. This fosters a sense of partnership, respect, and acknowledgment for participants. In contrast, less successful involvement occurs when older adults do not align with the technology's intended goals or are only involved in later stages of the process. Particularly in healthcare-related technologies, such as an assistive robot, participants felt that the design of these technologies is stereotypical of elderly users' imagery.

One of the examples of the exclusion of older adults that originates from ageism-based beliefs is the exclusion of adults from clinical trials and health services that use digital technologies, due to the prejudices of health professionals that older people cannot use digital technologies (Mace et al., 2022).

2.7. Insights from literature review

Caregivers can not always notice a problem that the patient is dealing with, or can not always take care of it right away. It is especially problematic when older adults, or older adults with dementia particularly, feel uncomfortable, for instance in stressful situations. A solution of an assistive robot for the caregivers that will identify stress in older adults or people with dementia and aid in reducing their stress levels may be significant in the treatment of people with dementia, to the individuals themselves, and their caregivers.

The design process of digital technologies, such as an assistant robot, that are intended to serve older adults sometimes excludes older adults from the process due to ageism and prejudicial attitudes, and therefore lead often to designing technologies with poor usability.

This study will experiment with the effects of the involvement of older adults in the design process of a stress management robot application intended for older adults on the perceived benefit and acceptance of the robot by older adults.

3. Methods

3.1. Overview

This design study compared a non-inclusive design process and an inclusive design process of a stress management robot application for older adults by comparing their outcomes in an experiment specifically designed for this project.

The study included:

1. An analysis of interviews with different stakeholders about their retrospective of co-designing social robots intended for older adults.
2. Design of a robot application for stress management of older adults, implemented on a Temi robot (prototype 1, non-inclusive process).
3. Co-design workshop with five older adults and the researcher of a robot application for stress management of older adults, using the Temi robot (prototype 2, inclusive process).
4. Experiment that evaluated the perceived usefulness, perceived ease of use, and behavioral intentions of each robot application prototype. Prototype A and prototype B are the outcomes of the two compared design processes (prototype A = application designed in a non-inclusive process, prototype B = application designed in an inclusive process).

3.2. Interview analysis

For getting another scope of attitudes toward older adults in the design process of robots and recommendations for the design itself, this study included an analysis of interviews that were collected for another study, with different stakeholders about their retrospective perspectives of co-designing social robots intended for older adults.

The interviews included 18 developers and researchers, males and females, aged 28-67, from Asia, Europe, Australia, the USA, and Africa, with different professional backgrounds including using different robots in their research or in the companies they work at.

The interviews were analyzed using the thematic analysis method (Braun & Clarke, 2006; Creswell et al., 2012).

3.3. Design processes

Two different design processes were executed. Both processes aimed to design a robot application for the stress management of older adults.

The first design process included only the researcher in the design team and was designed as part of an academic course (Fundamentals of a Human-Computer Interaction course was held at Ben Gurion University). This design process represented a design process that often happens, in which older persons are not involved and only the ideas and perceptions of a (young) designer influence the outcome.

The second design group included two older adults, (ages of 78, and 84) who were recruited from "Beit Yona", an assistive living community in Be'er-Sheva, and the researcher. Participants knew Hebrew (read, write, and speak). To prevent biases in the first robot application design by the researcher, the workshop took place after the first design was completed.

The resulting application was subsequently compared to the researcher-designed version used in the experiment, with a detailed comparison (see section 4.3).

3.3.1 Non-inclusive design process

The non-inclusive design process in this research was incorporated through an academic course. This design involved the researcher working under the guidance of the course lecturer, incorporating stress-reduction solutions sourced from academic literature. During the course, various principles related to the human-computer interface were studied, such as usability, design thinking, and human-robot interaction (see Appendix 1). Each group of students was asked to design an application or interface as the course final project, based on the theoretical information learned in the course. The project included the following sub-submission (see Appendix 2):

1. A class presentation of the problem and its suggested solution, using an application.
2. The background the research included literature and competitive review.
3. Writing a description of four different users of the suggested application-based solution.

The researcher designed a stress management robot application and got feedback on the application design and content from the other group members. After submitting the final

project[1] to the course lecture and receiving her feedback that focused mainly on the robot's face design, the researcher decided to change the robot's face to her own designed face (rather than using the default face of the robot that designed by the robot's manufacturing company). The main changes to the face that were made are:

- Chancing the background of the face to match the color of the designed stress management application (light pink).
- Movement of the mouth while the robot is "speaking" to simulate the lip movement of speech, as in humans.
- Movement of the eyes which included a blink-like movement, without moving the pupils. In order not to burden the user with stimuli, the researcher feared that a lot of movement on the small screen together with the robot's speech, which is not usual in a situation where the user is experiencing stress, could increase the user's stress level.

3.3.2 Inclusive design process

The inclusive design process in this research was incorporated through a co-design workshop with older adults to develop a stress management robot application.

The co-design workshop with older adults included three one-hour sessions. Three participants were involved, two attended all sessions and one participated solely in the second session. Only one participant owned a cellphone and computer, while the others had no personal digital devices. Notably, none of the participants had a technological background in their pre-retirement occupations. Each session was documented using video recording, a voice recorder application on the researcher's smartphone, and a written protocol that was made during each session. Photos of the participants and their outputs were also collected during the sessions (see Appendix 3).

3.3.2.1 First co-design workshop session

The first session aimed to familiarize the workshop members with the problem we want to solve with the robot application.

This session commenced with a sing-along competition designed to familiarize participants with stressful situations. Participants were given words and asked to identify songs containing

[1] Video summering of course outcomes: https://www.canva.com/design/DAF_kJUna-0/wMiNtInPvdHeGWTTLtgIeA/view?utm_content=DAF_kJUna-0&utm_campaign=designshare&utm_medium=link&utm_source=editor

those words. The participant who responded fastest and correctly got a point. The participant with the higher amount of points won. Following this activity, participants were asked about their feelings during the game.

Subsequently, through a facilitated discussion, participants were informed about the problem that motivated the development of a stress management robot application. Key points from the literature review were presented. Participants were then asked to identify the primary characteristics of a robot intended for caregiving or stress management. Each participant selected an image of a robot they found intriguing or suitable for the intended role and explained their choice. Based on the discussion, the group collaboratively created an empathy map.

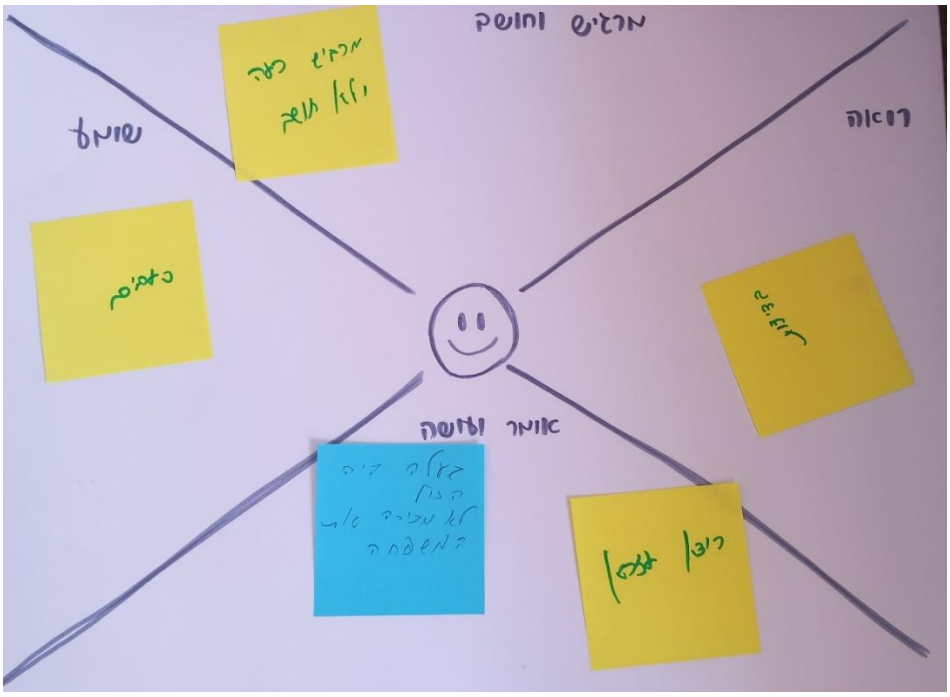


Figure 1 – Co-design workshop Empathy map outcome

3.3.2.2 Second co-design workshop session

The second session aimed to design the robot application to get a draft of the application design by the end of the session.

Participants completed questionnaires regarding their technological experience and background (see Appendix 5.1). After a brief reminder of the previous session, participants were introduced to the Temi robot, which is the platform for the application. They were then tasked with drawing and describing the application based on the previously created empathy map, focusing on face design, content, appearance, accessories, character, and attributes.

Each participant presented their ideas to the group, explaining the rationale behind their choices. Next, the group created a collective sketch of the desired application.

Post-session, the researcher developed the application according to the participants' ideas and preferences.

3.3.2.3 Third co-design workshop session

The third session aimed to create the final design of the robot application.

In this final session, participants tested the application that was developed based on their collective ideas. The researcher then solicited feedback on their experiences and feelings during the use of the application.

Participants were allowed to suggest modifications or improvements to the application based on their user experience. The researcher presented various options for each application window[2], including appearance (like icons and colors), and content.

Figure 2 – Application color options presented to the co-design workshop participants

To mitigate potential biases, each participant was asked to write their preferences in writing and subsequently explain the reasoning behind their choices.

3.4. Experimental design

The experiment was designed as an inter-subject study to examine the influence of the involvement of older adults in the design process of robot application on the acceptance and perceived benefit of older adults.

The study employed a between-group comparative analysis to examine the relationships between stress levels (stressed or not), perceived usefulness, perceived ease of use, and behavioral intention across two prototypes of stress management robot applications (one

[2] Presented options for the application design:
https://view.genially.com/6660b6ff572bf000135fad2e/interactive-content--3

designed in a non-inclusive design process, the other in an inclusive design process with older adults).

3.4.1 Variables

3.4.1.1 Dependent Variables

- Stress level
- Perceived usefulness (PU)
- Perceived ease of use (PEOU)
- Behavioral intention (BI)

3.4.1.2 Independent Variable

- Robot application type (prototype A = application designed in a non-inclusive process, prototype B = application designed in an inclusive process).

3.4.2 Participants

Participants included were defined as those with normal vision or who wear vision aids such as glasses for corrections to their vision, are not color blind, and are familiar with Hebrew (read, write, and speak).

The initial screening of participants who are colorblind or have abnormal vision was through the invitation to participate in the experiment. Additional filtering was done when filling out the questionnaires at the beginning of the experiment. Each participant was required to confirm that to the best of his / her knowledge, he / she sees normally and sees colors normally. No vision test or color blindness test were performed, because this is not the essence of the experiment, and the use that each participant made of differentiating between colors was only to answer a Stroop test, as detailed in section 3.4.2.

3.4.3 Tools and measurements

The tools and measurements include objective and subjective measures.

3.4.3.1 Tools

The researcher, using the Canva website, created a YouTube video[3] that was screened in phase 3 of the experiment (Relaxing session and baseline stress measurement). The video is 2 minutes long and includes the sound of waves crashing and a video clip of a beach at sunset time. This video aimed to help participants relax, additionally to breathe deeply, to measure

[3] Relaxing video: https://youtu.be/oflmKyMGm5k

their baseline level of stress, which was the control group of the RMSSD measurements at the next phases of the experiment.

3.4.3.2 Objectives measures

The objectives measures aim to quantify the benefit of the robot application and included:

- Body indicators – measured with the wearable biometric sensor of Emotibit[4] company. By attaching the sensor to different body parts, such as the arm, head, or leg, with a strap, and connecting the sensor to an SD card and Wi-Fi, the sensor streams and records sensed biometric data. The sensor was placed on the participant's wrist, on the hand that is rarely in use (the hand the participant does not write with). The recorded data that was analyzed in the experiment is the inter-beat interval (IBI). IBI is the time period between successive heartbeats (Shaffer & Ginsberg, 2017). Heart rate variability (HRV), is the changes in the IBI, which can be used for predicting different mental incidence, such as stress.

Figure 3 – Emotibit sensor with a case on the wrist and the EmotiBit Oscilloscope software

Root Mean Square of Successive Differences (RMSSD) RMSSD, an established indicator of heart rate variability, was calculated for each participant across all four experimental phases as detailed in section 3.4.4, using the recorder IBI data from the Emotibit sensor.

$$RMSSD = \sqrt{\frac{\sum_{i=1}^{N-1}(IBI_i - IBI_{i+1})^2}{N-1}}$$

[4] Emotibit company website: https://www.emotibit.com/

- Stroop test results – the results designed to compare the user's performance before and after using the robot application for stress management, by evaluating the stress level of the individual. This test served mainly as a means to prompt a stressful situation and reaction. In the Stroop test the user needs to mark the color that the word is colored in (Bali & Jaggi, 2015). One of the tasks in the test is showing the user the word "red" which is colored in green. The correct answer to this task is green because this is the color that the word is colored in.

3.4.3.3 Subjective measures

The subjective performance measures were assessed via standard questionnaires and included:

- Perceived Stress Scale (PSS) questionnaire (see Appendix 5.2) was administered at the onset of the experiment to assess participants' general stress levels, as these could influence experimental outcomes. This survey was given to participants only at the beginning of the experiment because it refers to stress levels experienced by the participants during the last month. The survey consisted of 10 statements, translated into Hebrew. Participants rated each statement on a scale from 1 (never) to 5 (very often). One participant noted the absence of an "always" option in the rating scale.

  Scores were calculated as follows (Baik et al., 2019):

  - For statements 1-3, 6, and 9-10, the sum of the provided responses was calculated.
  - For statements 4-5 and 7-8, scores were reversed (e.g., a score of 1 was converted to 5, 2 to 4, 3 remained unchanged, etc.).

  Final scores were categorized as follows (Torales et al., 2020):

  (For the categories limit calculation, see Appendix 13)

  - Low stress: ≤ 23 points
  - Medium stress: 24-36 points
  - High stress: ≥ 37 points
- The Technology Acceptance Model (TAM) questionnaire (see Appendix 5.3) aimed to measure the perceived benefit and acceptance of the robot application by the experiment users (Saari et al., 2022). This questionnaire includes 32 items rated from 1 (extremely disagree) to 7 (extremely agree), that measure the acceptance of the robot application, translated into Hebrew (see Appendix 5.3). The subjective norms

that were analyzed are perceived usefulness (PU), perceived ease of use (PEOU), and behavioral intention (BI).

Table 1 presents the questions that each of those subjective norms included.

Dependent variable	Question
Perceived Usefulness (PU)	השימוש ברובוט יכול לעזור לי בהפחתת סטרס (עקה).
	השימוש ברובוט יכול לשפר את היעילות שלי בהפחתת סטרס (עקה).
	אני מוצא/ת שהרובוט יכול להיות שימושי להפחתת סטרס (עקה).
Perceived Ease of Use (PEOU)	האינטראקציה שלי עם הרובוט ברורה ומובנת.
	האינטראקציה עם הרובוט אינה דורשת מאמץ נפשי גדול.
	אני מוצא/ת את הרובוט קל לשימוש.
	אני מוצא/ת שזה קל להבוין את הרובוט לעשות את מה שאני רוצה שיעשה.
Behavioral intention (BI)	בהנחה שהרובוט יהיה בשימוש קבוע במקום מגוריי, הייתי משתמש/ת ברובוט אם הוא יהיה נגיש לי.
	בהנחה שהרובוט יהיה בשימוש קבוע, אני עשוי/ה להשתמש ברובוט אם הוא יהיה נגיש.
	בהנחה שהרובוט יהיה בשימוש קבוע במקום מגוריי, הייתי מתכנן/ת להשתמש ברובוט בעתיד.

Table 1 - Dependent variable

3.4.4 Procedure

The experiment included seven phases, 6 of them facilitated by the Temi robot (see Figure 4). The experimental protocol was designed to be presented on Temi's display screen, with all phases, including the explanation phase of the experiment. However, during the first experiment, this approach proved problematic. The first participant requested to withdraw from the experiment immediately following Temi's explanation of the experiment. This reaction necessitated a methodological adjustment. In light of that, the experiment was modified and the explanation about it was delivered by the researcher to mitigate potential participant discomfort.

Initially, the researcher explained to the participants about the experiment, who then signed the consent form, and filled out the Perceived Stress Scale (PSS) questionnaire. During phases 2-6, the participants wore an Emotibit sensor on the non-dominant wrist. The sensor

remained in place and recorded the physiological measurements throughout the experiment, being removed either after the second Stroop test or upon completion of the last phase of the experiment.

Physiological data were recorded using the Emotibit Oscilloscope software, which facilitated real-time note logging, among other features. Four phases were documented:

1. Baseline phase (see phase 3 in Figure 4): Participants viewed a researcher-created video. This phase established a relaxed state baseline for subsequent comparative analysis.
2. First Stroop test (see phase 4 in Figure 4): Participants completed a one-minute Stroop test. This phase was designed to induce stress, to objectively examine the effect of using the robotic application on the participant's stress levels. The remaining time to solve the test was shown to the participant at the top of the screen and was read several times by the researcher during the test, in an attempt to increase the pressure exerted on the participant.
3. Robot application interaction (see phase 5 in Figure 4): Participants engaged with a stress management robot application. Usage patterns varied, with some participants fully utilizing the application and others exploring available options. Some of the participants were asked to end the using of the application, due to time limitations as a result of the experiment schedule.
4. Second Stroop test (see phase 6 in Figure 4): A second one-minute Stroop test was administered to assess post-intervention stress levels. Time pressure was again shown verbally and visually.

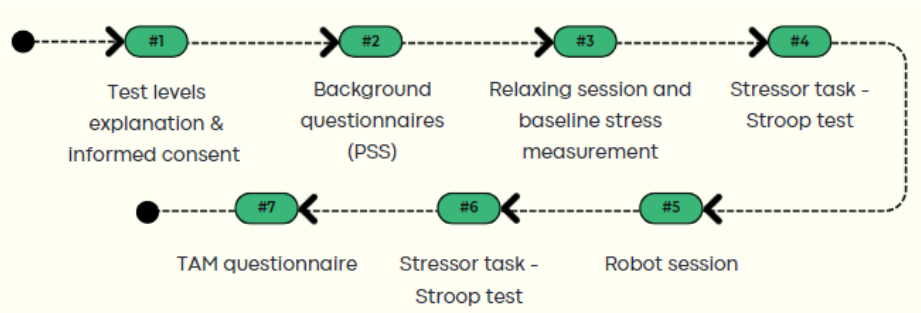


Figure 4 - Flow of the experiment

The Temi robot provided further instructions, and participants watched a relaxing video designed to create and measure a baseline level of the body indicators (video length is 2

minutes). Next, they had one minute to solve as many questions of the Stroop test as they were able to solve. This phase aimed to increase the stress level of the user. Following this, one of the designed robot applications was displayed on the robot screen, in an attempt to reduce the stress level that increased during the Stroop test. Finally, the participants took another Stroop test using the same method (answering as many questions as he / she could in one minute) and answered the Technology Acceptance Model (TAM) questionnaire.

Stress levels were quantified by the Emotibit sensor's data, and Perceived Stress Scale (PSS) questionnaire, while user acceptance and perceived benefit were evaluated through questionnaires.

3.4.5 Analysis

The research question is "Does the involvement of older adults in the design process of a stress management robot application intended for older adults increase the perceived benefit and acceptance of the robot?". I assumed that the involvement of older adults in the design process of technology in general, and robot application in particular, that intended to serve older adults will adults increase the perceived benefit and acceptance of the robot.

Meaning, that I expected to see higher PU, PEOU, and BI mean scoring by the participants of group prototype B than the mean scoring by the participants of group prototype A.

Additionally, I expected to see higher levels of mean RMSSD and smaller differences of mean RMSSD between different phases in the experiment in the prototype B group than in the prototype A group.

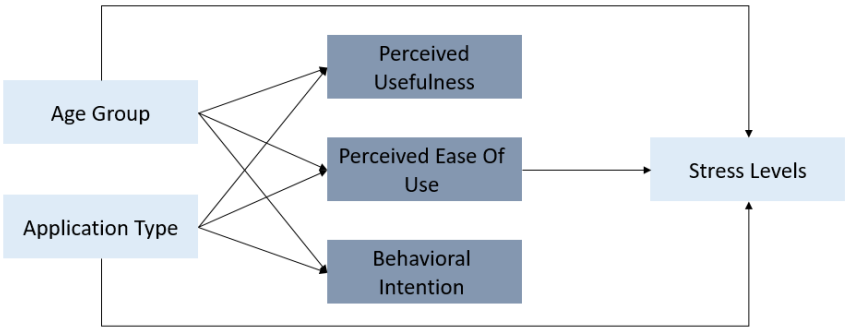


Figure 5 – TAM of a stress management robot application

The analysis included visual analysis of boxplot graphs of TAM survey scores and statistical tests (Mann–Whitney U test) on the relation between stress, PU, PEOU, and BI to the design of robot application (prototype A or prototype B).

The general stress levels of the participants were analyzed using PSS survey scores.

The stress levels during the experiment were analyzed using a calculation of RMSSD from IBI recorded data by using the Emotibit sensor.

A statistical analysis was conducted on the average RMSSD levels derived from the participants' IBI recorded data, as well as the average RMSSD differences across various phases of the experiment.

Table 2 presents the types of stress situations during the experiment, resulting in a comparative analysis of stress levels across the experimental phases. The analysis was conducted by comparing the mean Root Mean Square of Successive Differences (RMSSD) values of each of the three latter phases (Stroop Test 1, Application Usage, and Stroop Test 2) to the mean RMSSD of the baseline phase.

Lower RMSSD values in the subsequent phases, relative to the baseline, were interpreted as indicators of elevated stress levels. Based on the observed stress patterns throughout the experiment, participants were classified into eight distinct categories. These categories reflect the various combinations of stress responses across the three post-baseline phases, always about the individual's baseline measurements.

This categorization scheme allows for a broad understanding of how participants' stress levels changed throughout the different stages of the experiment, providing insights into the differential effects of each phase on physiological stress indicators.

	Type	**Stroop1**	**App**	**Stroop2**
1	Not stressed at all	Not stressed	Not stressed	Not stressed
2	Stressed at Stroop 2	Not stressed	Not stressed	Stressed
3	Stressed at app using	Not stressed	Stressed	Not stressed
4	Stressed at app using & Stroop2	Not stressed	Stressed	Stressed
5	Stressed at Stroop 1	Stressed	Not stressed	Not stressed
6	Stressed at Stroop 1 & Stroop 2	Stressed	Not stressed	Stressed

7	Stressed at Stroop 1 & app using	Stressed	Stressed	Not stressed
8	Stressed at all the phases	Stressed	Stressed	Stressed

Table 2 - Stress patterns conditions

4. Results

This chapter presents an analysis of the study's key components, which include:

1. Comparison of robot application designs: An analysis of the differences between the two outcomes of the robot application design processes (inclusive and non-inclusive).
2. Co-design workshop: An analysis of the inclusive design process.
3. Experiment analysis: This section includes several components:
    a. Perceived Stress Levels (PSS) survey: An evaluation of participants' perceived stress levels over the past month assessed using the PSS survey.
    b. Objective Stress Measurement: An assessment of participants' stress levels using the Emotibit sensor as an objective indicator of the robot application's efficacy.
    c. Technology Acceptance Model (TAM) survey: An analysis of the TAM survey to gauge the perceived benefits and acceptance of the robot application.

4.1 Comparison of robot application designs

Two robot applications were developed by different design teams to examine the impact of older adult involvement in the design process on the acceptance and perceived benefits of stress management robot applications, two robot applications were developed by different design teams.

The first application[5] (prototype A) involved the researcher, incorporating stress-reduction solutions sourced from academic literature.

Figure 6 – Final robot's face design of prototype A (non-inclusive design process)

[5] Research designed application: https://view.genially.com/66648f42f01fdd001450212c/interactive-content--

The second application[6] (prototype B) was developed as part of a co-design workshop with older adults. During this workshop, participants were presented with key insights from the literature review included in this report to give the theoretical background for the application idea. The content of the application was developed based on the preferences and relaxation strategies of the older participants.

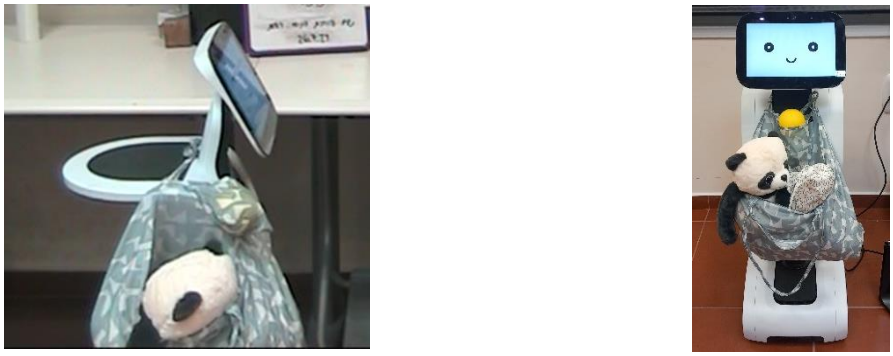


Figure 7 – Robot's face and accessories of prototype B (inclusive design process)

While both applications appear similar at first, sharing a common design language, several distinct elements differentiate them. Here are the main of them:

- Color scheme: The first application features light pink and light green hues, whereas the second employs slightly darker pink and blue hues.
- Robot face design: In the first application, the robot's face[7], designed by the researcher, is light pink, matching the background color of the application, with moving lips to simulate speech. The eyes include fixed pupils with a blinking effect. The second application uses a face designed by the robot's manufacturing company, featuring a white background, a static smile that shifts side to side, moving pupils, and slight eyelid movement during speech, without a blinking effect.
- Button design: The first application includes both text and icons on buttons to facilitate cognitive ease for users, while the second application includes text-only buttons, as workshop participants felt icons cluttered the screen. Additionally, the exit and back buttons differ slightly in design between the two applications.

[6] Co-designed application: https://view.genially.com/6660e61f8400e100144fd965/interactive-content--3
[7] Robot's face example: https://youtu.be/DRKcYOkzDi0

- Content options: The first application offers four main activities (listening to songs, practicing meditation, playing an online puzzle game, and practicing breathing). Only the song-listening option provides further choices, allowing selection between English and Hebrew songs, with five options per language. In contrast, the second application provides six main activities (listening to songs, exercising, watching relaxing videos, playing online games, listening to lectures, and watching movies), each with at least three sub-options.
- Robot verbal interaction: In the interaction with the robot, users are prompted to engage in a preliminary conversation before selecting a relaxing activity. Each interface incorporates a distinct set of questions posed by the robot as part of the application process. The application designed solely by the researcher includes two questions, followed by an explanation of the application presented post-conversation. In contrast, the interface developed during the co-design workshop features seven questions preceding the explanation of the application.

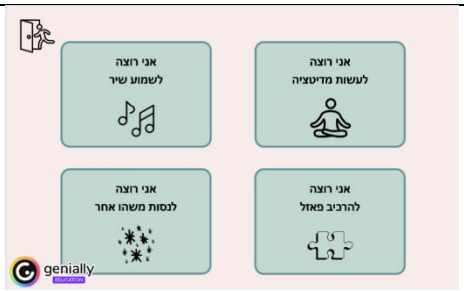
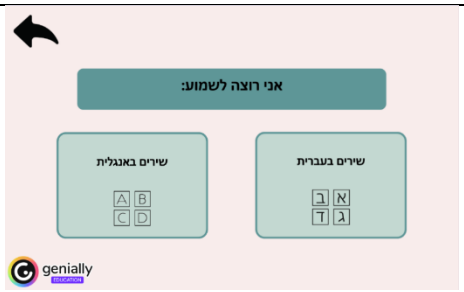
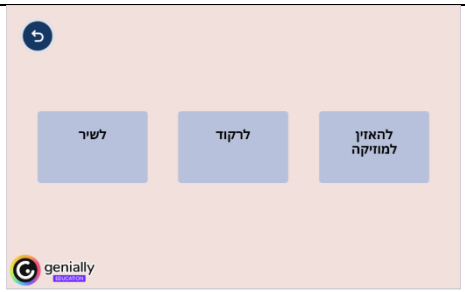
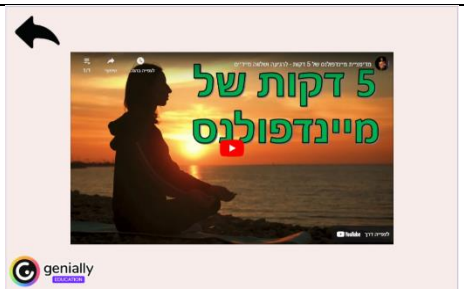
Prototype A interaction transcription	**Prototype A interaction transcription**
1. שלום, אני טימי. באתי לעזור לך. איך קוראים לך? 2. איך את/ה מרגיש/ה? 3. האם יש משהו שאני יכול לעשות? 4. לקחת את כל הבדורים שאת/ה לוקח/ת? 5. אכלת? 6. שתית? 7. מה את/ה אוהב/ת? 8. יש כמה דברים שנוכל לעשות ביחד. חלקם יוצגו על גבי המסך שלי וחלקם נמצאים בסלסלה שמונחת עליי, עת יכולה להוציא אותם ממנה.	1. היי, קוראים לי טִימִי. רציתי לשאול, איך את/ה מרגיש/ה? 2. מה גרם לך להרגיש ככה? 3. אם תרצה/י יש לי כמה רעיונות לדברים שנוכל לעשות יחד כדי לעזור לך להירגע. בכל שלב, תוכל/י לצאת בלחיצה על הכפתור אני מעדיף/ה לצאת.

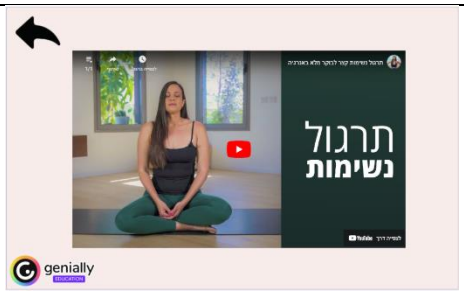
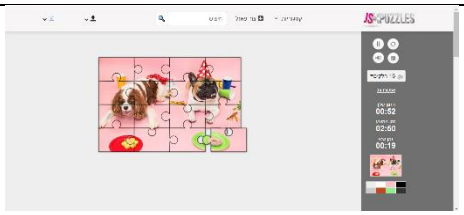
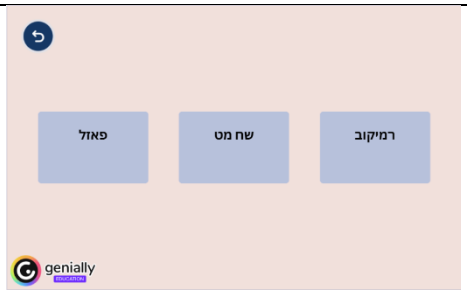
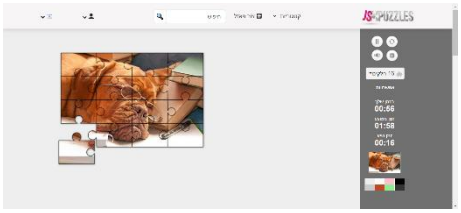
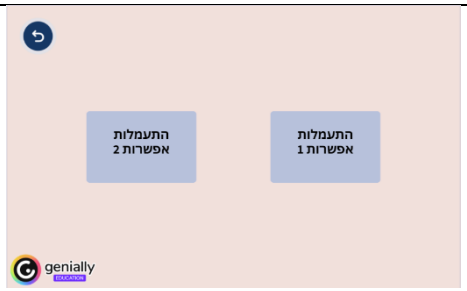
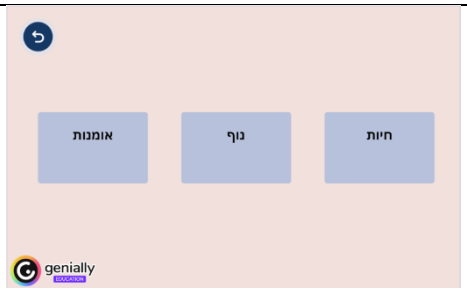
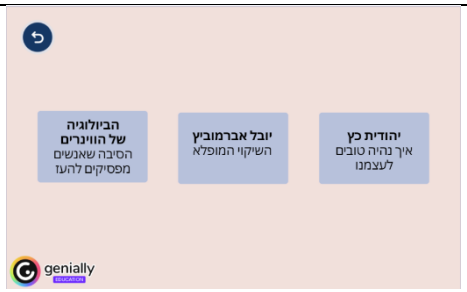
Table 3 – Robot verbal interaction transcription

- Robot accessories: Co-design workshop participants wish to be able to physically touch and feel the robot in stressful situations. They chose to include a bag containing soft elements: a teddy bear, a pillow, and a small ball to facilitate relaxation through tactile

interaction, replacing a hug that can be given to a person to aid relaxation, while the researcher in her design (prototype A) did not include any accessories added to the robot.

Table 4 presents a visual comparison of key features across both design processes' outcomes (prototype of stress management robot applications), categorized by functionality.

Category	Prototype A	Prototype B
(1) Home page		
(2) Music	 	
(3) Meditation		Not featured

Category	Prototype A	Prototype B
(4) Breathing exercises		Not featured
(5) Online games		 
(6) Physical exercises	Not featured	
(7) Relaxing videos	Not featured	
(8) Lectures	Not featured	

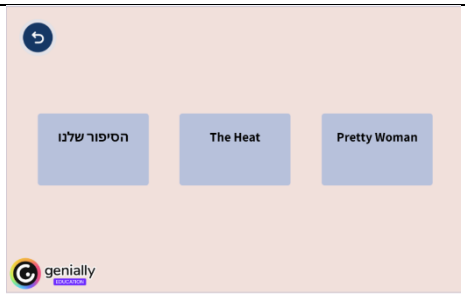
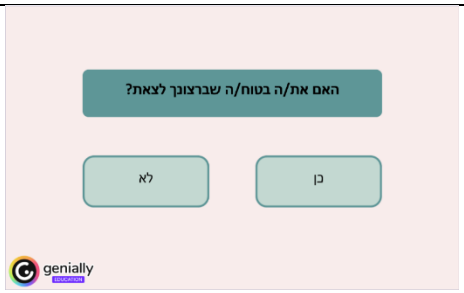
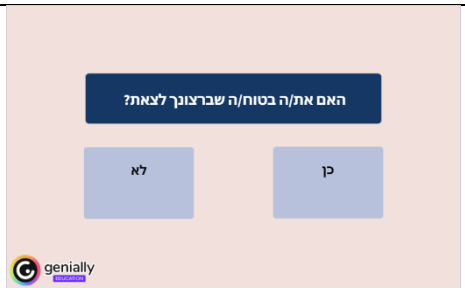
Category	Prototype A	Prototype B
(9) Movies	Not featured	
(10) Log-out		

Table 4 – Visual comparison between the design processes outcome applications

4.2 Co-design workshop analysis

The following section delineates the main themes and insights that emerged from the participants during these sessions.

4.2.1 First co-design workshop session analysis

This section delineates the key insights from three different activities that were delivered by the researcher in the first session of the co-design workshop, as detailed in section 3.3.2.1.

4.2.1.1 Sing-along contest

1. After the sing-along contest, participants were asked how they felt during the contest. After one of them answered that she felt stressed, the researcher asked them what stress is. Participants conceptualized stress as uncomfortable feelings, fear, and shame.

4.2.1.2 Presentation of the problem and key points from the literature review

1. After the researcher explained to the participants what is stress, the group talked about the things that stress can cause. Next, the researcher asked what aids the participants in coping with stress. Both of the participants answered that being with other people can aid them in coping with stressful situations.
2. One of the participants suggested that robots are better and smarter than people when asked why robots are suitable for managing stress.

4.2.1.3 Caregiver of stress management robot activity

1. The characteristic of a caregiver robot or a stress management robot as perceived by the participants is a friendly and intelligent robot, it does not need to be authoritarian.
2. The participants suggested that a caregiver robot or a stress management robot will have something soft that can be touched, it does not give orders, has a name, and does not make the user cry. One suggested that the robot would aid in relaxing with a hug, and the other suggested that the robot would aid in relaxing with a conversation. Participants did not agree on that.
3. The gender of a caregiver robot or a stress management robot is not important to the participants.
4. One of the participants emphasized the importance of seeing eyes in the caregiver robot or a stress management robot.

4.2.2 Second co-design workshop session analysis

This section delineates the key insights from activities that were delivered by the researcher in the second session of the co-design workshop, as detailed in section 3.3.2.2.

4.2.2.1 General points

1. The participants frequently suggested during this session incorporating animal-inspired elements, such as a dog face for the robot, or screening video of animals on the robot screen. This follows from the previous session in which they asked if a comparison was made between the impact of the help of a robot and the impact of the help of an animal in reducing stress levels among humans.
2. One of the participants relates the use of the robot in various situations that are not necessarily related to stress, such as illness.
3. One of the participants noted that the robot has good eyes, and told it that they "will be good friends".

4.2.2.2 Characterization of the robot application's features

1. In the pre-discussion of the drawing and writing the robot application characteristics and features, two participants advocated that the robot will have the ability to engage in dialogue to facilitate relaxation. One of them suggested that the robot would explain what to do in a stressful situation. The other participant suggested that the robot will play music to help to relax in a stressful situation.

2. In the pre-discussion of the drawing and writing the robot application characteristics and features, the participants also suggested that the robot will call for another person for help to help a person in a stressful situation.
3. In the assignment of drawing the robot and writing its characteristics, the participants suggested that the robot will talk and listen, play music, play sports videos, and include the option to play on its screen. Finally, they agreed with the sentences that the robot will say at the beginning of the use of the application and will suggest playing music, doing exercises, showing animals, and showing movies.
4. In the assignment of drawing the robot and writing its characteristics, two out of three participants sketched the robot with human-like features, such as limbs and a face (see Figure 8).
5. When selecting relaxation options, participants chose activities that personally relaxed them or aligned with their hobbies. For instance, the chosen games were favorites of the participants and ones they regularly played.

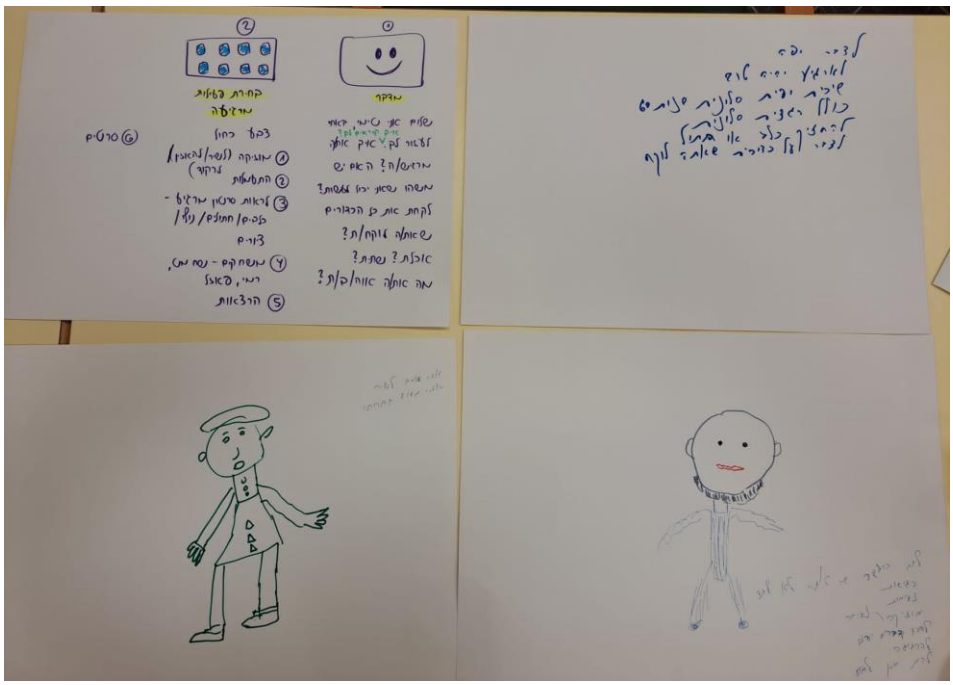


Figure 8 – Stress management robot application sketches and content ideas

4.2.3 Third co-design workshop session analysis

This section delineates the key insights from activities that were delivered by the researcher in the third session of the co-design workshop, as detailed in section 3.3.2.3.

4.2.3.1 Using the developed robot application

1. The participants used the prototype of the application that the researcher created based on their preferences from the last session. They said that the using made them feel good, and one noted that she could see herself using the application for more than a few minutes.

4.2.3.2 Robot application improvements

1. One of the participants asked to have a longer and meaningful conversation with the robot as a relaxation option. They did not agree on the length of the conversation, because the other participant thought that the conversation with the robot should be short and that the user would be able to stop the conversation with the robot in the middle.
2. The participants agreed that the robot will not have clothes, but it will have soft accessories that can be used by the user in a stressful situation.
3. One participant suggested that lectures on security and the political situation in Israel were calming for him. However, this option was excluded from the application due to the current sensitive security situation in Israel, which might evoke stress, anxiety, or fear in others.

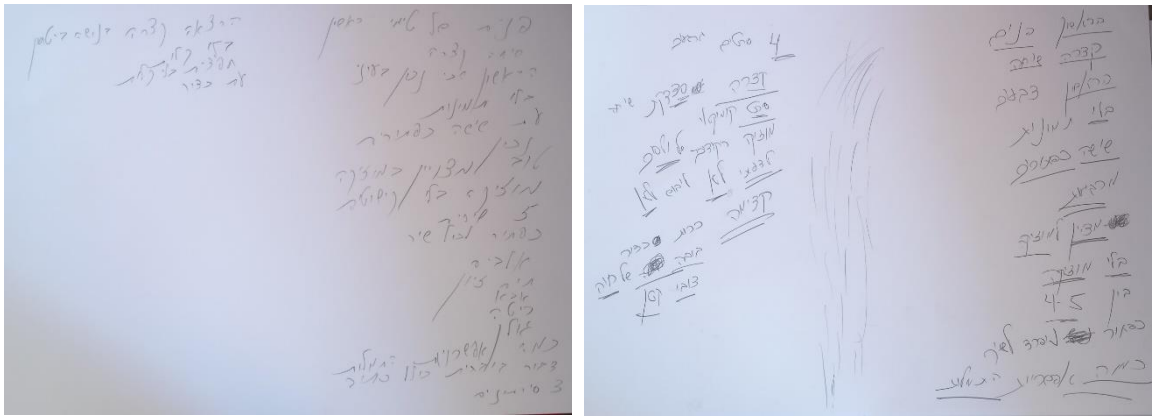


Figure 9 - Participants preferences of the stress management robot application design and content

4.3 Experiment analysis

4.3.1 Participants

Perceived usefulness, perceived ease of use, and behavioral intention were evaluated using the Technology Acceptance Model (TAM) survey (subjective measure).

The experiment involved 51 participants divided into four groups, of which 42 were included in the final analysis. Participants were sampled by four groups of younger and older adults, which saw prototype A (included 20 participants) or B (included 22 participants):

1. Young participants – prototype A: This group initially consisted of 15 participants. Due to technical issues with the Emotibit sensor, data from 3 participants were excluded.
2. Young participants – prototype B: This group initially included 17 participants. After excluding 4 participants due to sensor malfunctions.
3. Older adults – prototype A: This group included 10 participants, with data from 1 participant excluded due to sensor issues, and 1 participant asked to end her participation shortly after the start of the experiment.
4. Older adults – prototype B: This group included 9 participants, all of whom were included in the analysis.

More detailed data about the groups that are listed above is presented in Table 5.

Group	Amount of participants	Min age	Max age	Mean age	SD age	Females	Males
1	12	23	28	25	2	8	4
2	13	23	27	24	1	10	3
3	9	79	86	82	2	6	3
4	9	74	91	80	5	6	3

Table 5 – Participants age and gender data by groups

4.3.2 Stress

4.3.2.1 Perceived Stress Scale (PSS) survey analysis

Initial stress levels were measured by the Perceived Stress Scale (PSS) survey. The overall average stress level among participants was categorized as medium (approximately 26 points).

It can be seen that initial levels of stress were similar between groups (see Table 6). Furthermore, the SD is similar between the examined groups and stands at approximately 5 points.

Group	Mean PSS score	SD
Prototype A	25.60	5.43
Prototype B	26.55	5.62
Total	26.10	5.49

Table 6 – PSS survey score analysis

As shown in Figure 10, all groups included a greater amount of participants who were defined as having a moderate level of stress in general. Almost equal numbers of participants were categorized as experiencing low stress (7 participants in each group), and medium stress (13 participants in the group of prototype A; 14 participants in the group of prototype B). Only the group of prototype B included one participant who was defined as experiencing a high level of stress.

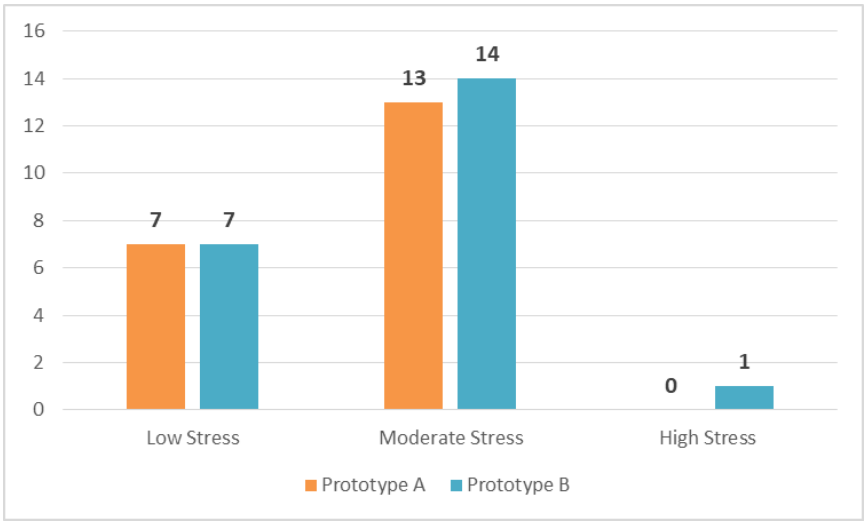


Figure 10 – Graph of Perceived Stress Scale Test (PSS) scores analysis

Some participants, particularly among the group of older adults, reported heightened stress and anger, attributing these feelings to the ongoing war in Israel.

4.3.2.2 Physiological measurements analysis

Table 7 presents the recording duration data for each of the four experimental phases.

The baseline phase recording time was observed with an SD of approximately 25% (approximately 30 seconds) of the total relaxing video duration (2 minutes). This SD was consistent across all examined groups.

Recording times for Stroop Test 1 and Stroop Test 2 were consistent with the expected duration of each phase, which was approximately one minute.

The application usage phase was observed with a mean duration of approximately 8 minutes and an SD of approximately 5 minutes. It is important to note that this phase was subject to two confounding factors:

- Some participants were required to end their application use during their usage due to scheduling constraints imposed by subsequent experiments.
- Other participants, particularly those in older age groups, were allowed to use the application for as long as they desired.

	Group	Minimum	Maximum	Mean	SD
Baseline	Prototype A	39 s	2 min 46 s	1 min 47	27 s
	Prototype B	25 s	2 min 25 s	1 min 49	29 s
	Total	25 s	2 min 46 s	1 min 48 s	28 s
Stroop 1	Prototype A	52 s	1 min 37 s	1 min 1 s	9 s
	Prototype B	50 s	1 min 1 s	58 s	3 s
	Total	50 s	1 min 37 s	59 s	7 s
Application using	Prototype A	1 min 45 s	20 min 2 s	8 min 12 s	4 min 51 s
	Prototype B	4 min 30 s	23 min 18 s	9 min 35 s	4 min 54 s
	Total	1 min 45 s	23 min 18 s	8 min 55 s	4 min 52 s
Stroop 2	Prototype A	46 s	1 min 9 s	58 s	5 s
	Prototype B	50 s	1 min 2 s	59 s	3 s
	Total	46 s	1 min 9 s	58 s	4 s

Table 7 – Experiment levels recording data and statistics

Table 8 presents the calculated mean RMSSD data for each of the four experimental phases. A significant disparity was noted between the stress levels of participants utilizing prototype A and those using prototype B. Specifically, the group using prototype B exhibited higher stress

levels (lower relaxation) compared to the prototype A group during the baseline phase (watching a relaxing video).

On the other hand, the analysis of RMSSD differences across the experimental stages revealed that in the phases of Stroop 1, application usage, and Stroop 2, the prototype B group appeared to be relatively more relaxed (less stressed) than the prototype A group. Furthermore, during the application usage phase, the stress levels of participants in the prototype B group were more closely aligned with the baseline compared to those in the prototype A group.

Lastly, an examination of the RMSSD differences between Stroop test 1 and Stroop test 2 indicated that participants in the prototype A group experienced increased stress during Stroop test 2, whereas those in the prototype B group reported feeling more relaxed during the same test. In this case, the stress levels of participants in the prototype B group were more closely aligned with the baseline compared to those in the prototype A group as well as the other cases.

	Group	**Mean**	**SD**
Baseline mean RMSSD	Prototype A	3,066.62	4,155.92
	Prototype B	1,767.00	1,059.14
	Total	2,385.87	3,001.68
Stroop 1 mean RMSSD	Prototype A	1,535.78	1,977.25
	Prototype B	1,555.55	746.39
	Total	1,546.13	1,448.16
Difference between Baseline to Stroop 1 mean RMSSD	Prototype A	-1,530.85	4,686.61
	Prototype B	-211.45	1,401.00
	Total	-839.74	3,410.10
Application using (app) mean RMSSD	Prototype A	2,150.78	1,609.13
	Prototype B	1,715.39	738.46
	Total	1,922.72	1,235.99
Difference between Baseline to app mean RMSSD	Prototype A	-915.84	3,664.47
	Prototype B	-51.61	1,042.78
	Total	-463.15	2,640.21
	Prototype A	1,853.98	1,931.70

	Group	Mean	SD
Stroop 2 mean RMSSD	Prototype B	1,531.24	890.07
	Total	1,684.93	1,470.24
Difference between Baseline to Stroop 2 mean RMSSD	Prototype A	-1,212.64	3,949.15
	Prototype B	-235.76	1,211.11
	Total	-700.94	2,867.48
Difference between Stroop 1 to Stroop 2 mean RMSSD	Prototype A	318.21	2,538.54
	Prototype B	-24.31	1,101.00
	Total	138.80	1,907.14

Table 8 – Group stress data statistics

Further statistical analyses using the Mann–Whitney U test (see Table 9) were conducted to evaluate the research hypotheses related to the participants' stress levels concerning the type of application being tested (prototype A or prototype B), with a significant level of 0.05. These analyses did not yield any statistically significant results, therefore, it is not possible to say with certainty the results written above.

	Null hypothesis	Asymptotic significance	Decision
1	The distribution of BL_Mean_RMSSD is the same across categories of Prototype.	0.801	Retain the null hypothesis.
2	The distribution of S1_Mean_RMSSD is the same across categories of Prototype.	0.074	Retain the null hypothesis.
3	The distribution of Dif_BL_S1 is the same across categories of Prototype.	0.247	Retain the null hypothesis.
4	The distribution of App_Mean_RMSSD is the same across categories of Prototype.	0.98	Retain the null hypothesis.

	Null hypothesis	Asymptotic significance	Decision
5	The distribution of Dif_BL_App is the same across categories of Prototype.	0.546	Retain the null hypothesis.
6	The distribution of S2_Mean_RMSSD is the same across categories of Prototype.	0.42	Retain the null hypothesis.
7	The distribution of Dif_BL_S2 is the same across categories of Prototype.	0.42	Retain the null hypothesis.
8	The distribution of Dif_S1_S2 is the same across categories of Prototype.	0.481	Retain the null hypothesis.

Table 9 – Hypothesis independent-samples Mann-Whitney U test on RMSSD ($\alpha = 0.05$)

Figure 11 visualizes the findings that are written based on Table 9, regarding only the RMSSD measurements. From this graph, it is clear that the stress levels of participants from group prototype B remain close to the baseline, while the stress levels of participants from group prototype A are moving away. Overall, the trend of the stress levels is quite similar between the prototype's groups, although there is a difference in the observed stress levels.

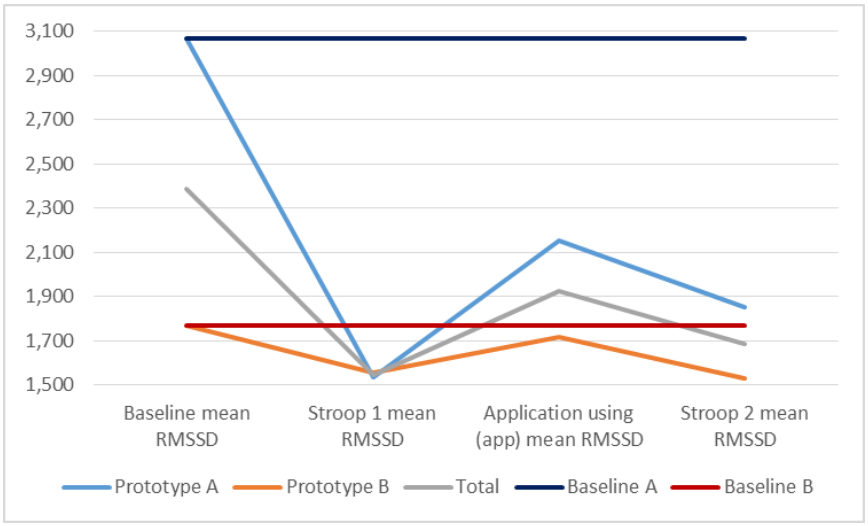
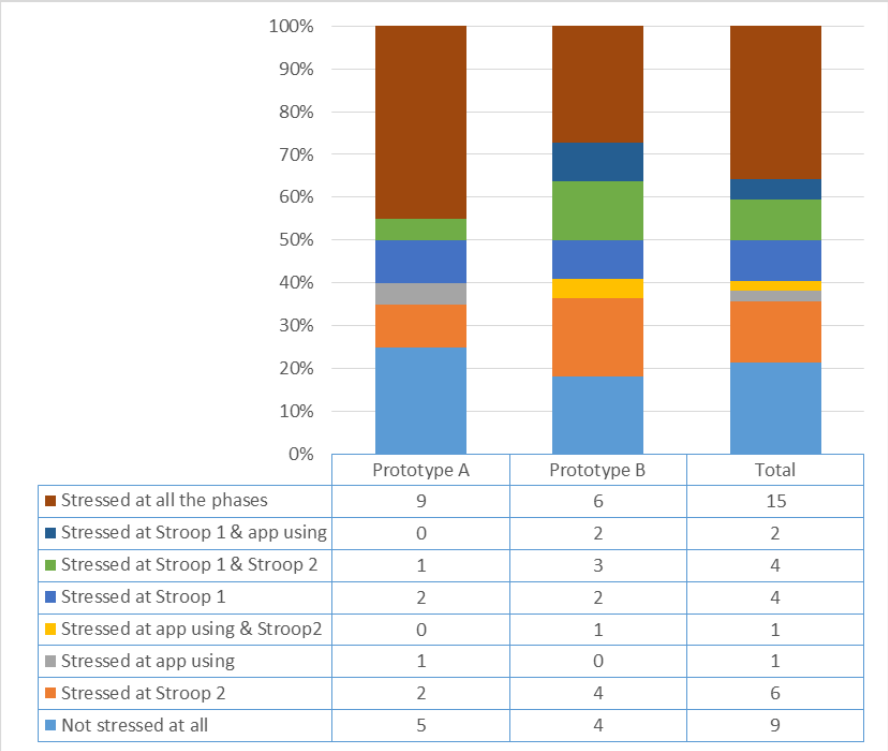


Figure 11 – Mean RMSSD graphic visualization

The analysis of the stress levels across the experimental phases created 8 categories of stress situations during the experiment and revealed that 50% of participants either maintained elevated stress levels throughout the experiment or showed no significant stress elevation at any point (see Figure 12). Only 10% of participants exhibited stress reduction following the first Stroop test.



	Prototype A	Prototype B	Total
Stressed at all the phases	9	6	15
Stressed at Stroop 1 & app using	0	2	2
Stressed at Stroop 1 & Stroop 2	1	3	4
Stressed at Stroop 1	2	2	4
Stressed at app using & Stroop2	0	1	1
Stressed at app using	1	0	1
Stressed at Stroop 2	2	4	6
Not stressed at all	5	4	9

Figure 12 – Measured stress levels analysis by groups

The analysis of the results for each group shows that both groups included participants who maintained elevated stress levels throughout the experiment, and participants who decreased RMSSD levels during the second Stroop test. The group of prototype A included more participants who were categorized as feeling stressed throughout the experiment and more participants categorized as not feeling stressed at all.

The same amount of participants felt stressed only at the Stroop 1 test (with different proportions between the groups, due to the different amount of participants included in each group).

Only the group of prototype B included participants who relaxed during the second Stroop test or felt stressed in the application usage and the second Stroop test, whereas only the group of prototype A included participants who felt stressed only during the usage of the application.

4.3.3 Technology Acceptance Model (TAM) survey analysis

For each of the dependent variables, a mean and SD calculation was performed (see Table 10). The analysis indicates that prototype A is perceived as more useful (PU) and that there is a stronger behavioral intention (BI) to adopt its use if the robot and application are made accessible. However, prototype B is perceived as easier to use (PEOU).

Despite these perceptions, statistical analyses, using the Mann–Whitney U test, were conducted on the statistical data in Table 10 and additional research hypotheses related to PU, PEOU, and BI concerning the type of application being tested (prototype A or prototype B), did not yield statistically significant results.

Dependent variable	Group	Mean	SD
Perceived Usefulness (PU)	Prototype A	4.82	1.79
	Prototype B	4.09	1.69
	Total	4.825	2.5
Perceived Ease of Use (PEOU)	Prototype A	5.89	1.34
	Prototype B	6.02	1.38
	Total	3.827	0.818
Behavioral intention (BI)	Prototype A	4.80	1.85
	Prototype B	4.05	1.88
	Total	4.978	2.463

Table 10 – Dependent variable statistics by prototype groups

A closer examination by the age group related to PU revealed no significant difference in the mean levels of intention to use a robot in the future when segmented by age groups:

- Younger adults: mean = 4.48
- Older adults: mean = 4.31

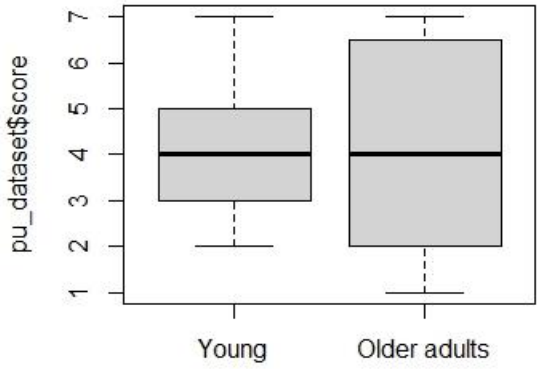


Figure 13 – Boxplot graph of PU and its score related to age group

Similarly, when segmented PU by the type of robot application, no substantial difference was observed:

- Researcher-designed application: mean = 4.8
- Co-designed application: mean = 4.06

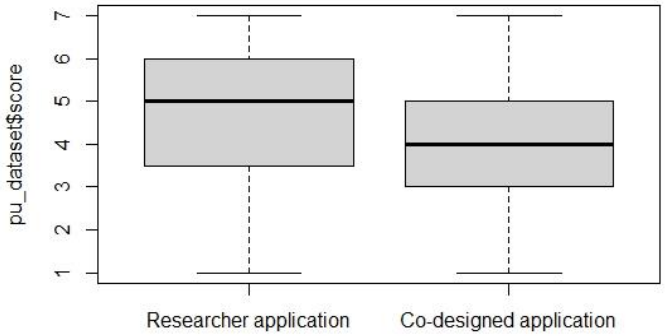


Figure 14 – Boxplot graph of PU and its score related to the robot application type

A closer examination by the age group related to BI revealed no significant difference in the mean levels of intention to use a robot in the future when segmented by age groups:

- Younger adults: mean = 4.24
- Older adults: mean = 4.65

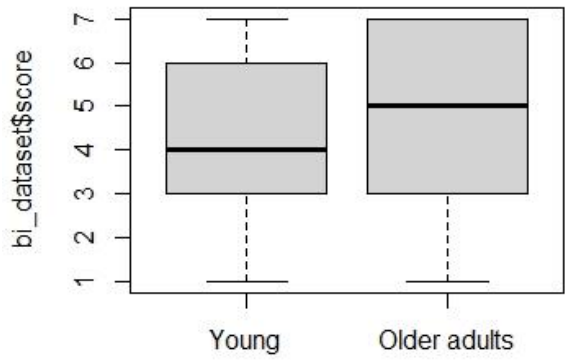


Figure 15 – Boxplot graph of BI and its score related to age group

Similarly, when segmented BI by the type of robot application, no substantial difference was observed:

- Researcher-designed application: mean = 4.8
- Co-designed application: mean = 4.05

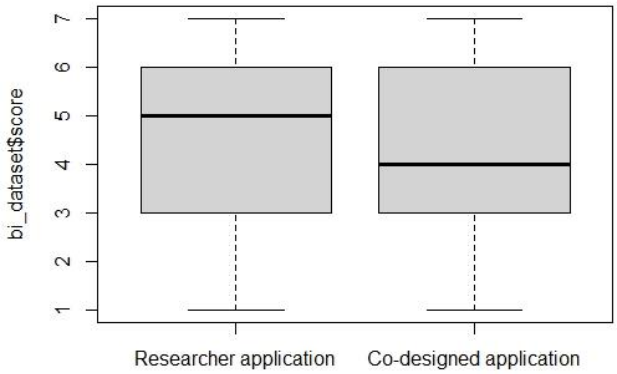


Figure 16 – Boxplot graph of BI and its score related to the robot application type

The high variability in overall responses appears to be primarily attributable to the diverse responses within the older adult group in both cases (PU and BI). This suggests that factors beyond age and application type may be influencing user acceptance, perceived usefulness, and intention to use.

Further statistical analyses using the Mann–Whitney U test were conducted to evaluate the research hypotheses related to the participants' PU, PEOU, and BI concerning the type of application being tested (prototype A or prototype B) with a significance level of 0.05. Table 11 describes the results of this test.

- PU – the null hypothesis was rejected (p-value < α), meaning the difference between prototype A to prototype B concerning PU was statistically significant. The observed

standardized effect size indicated that the differences between the prototype's group were small. Additionally, a score of PU in the group of prototype A had a probability of 62% to be greater than a score of PU in the group of prototype B.

- PEOU – the null hypothesis was not rejected (p-value > α), meaning the difference between prototype A to prototype B concerning PEOU was not statistically significant.
- BI – the null hypothesis was rejected (p-value < α), meaning the difference between prototype A to prototype B concerning BI was statistically significant. The observed standardized effect size indicated that the differences between the prototype's group were small. Additionally, a score of BI in the group of prototype A had a probability of 61% to be greater than a score of BI in the group of prototype B.

To sum up, with a significance level of 0.05 prototype A is perceived a little more as useful and was a little more likely to be used than prototype B. This is in contradiction to the research hypothesis.

Dependent variable	**p-value**	**Standardized effect size**	**Common language effect size**
Perceived Usefulness (PU)	0.019	0.21 (small)	0.62
Perceived Ease of Use (PEOU)	0.255	0.088 (small)	0.45
Behavioral intention (BI)	0.026	0.2 (small)	0.61

Table 11 – Mann-Whitney U test on TAM ($\alpha = 0.05$)

Some participants mistakenly included the Stroop test as part of the examined robot application, potentially biased their responses.

5. Discussion

The objective of this research was to investigate the impact of involving older adults in the design process of a stress management robot application on its acceptance and perceived benefits by other older adults. In a comparison between the two outcomes from the design processes, 6 main differences were found. We assumed that engaging older adults in the development of technology intended for older adults use would enhance the PO, PEOU, and BI. This assumption is based on the premise that involving end users in the design process improves the product's alignment with the target users, thereby increasing acceptance and perceived benefits. No significant results were observed concerning prototype and stress levels, but it has been shown that the mean RMSSD levels of participants in the group of prototype B during the Stroop tests and the application usage were closer to the mean RMSSD of the baseline. Analysis of the TAM questionnaire with a Mann-Whitney U test evinces that in a significance level of 0.05 prototype A is perceived a little more as useful and was a little more likely to be used than prototype B.

The co-design workshop analysis emphasized the attitudes of older adult participants toward robots and their ways of coping with stress.

5.1 Experimental factors

Prototype A was perceived as more usable and was more likely to be used compared to prototype B even though that older adults, who are part of the stakeholders, did not participate in the design process, in contradiction to the research hypothesis and contrary to other evidence from the literature (Frennert & Östlund, 2014). This finding contradicts the other test results. Although they are not significant, it can be seen that in terms of trends in the mean RMSSD levels, it seems that prototype B has a more positive effect on the users, namely it is more efficient and brings them significantly closer to the mean RMSSD levels of the baseline phase than the results measured for prototype A.

The gap between the significant experimental results and the observed results (which were not significant) may be due to several reasons:

1. Reliability of IBI measurements in the baseline phase that affected the RMSSD: Various malfunctions occurred in the relaxing video while participants watched it. The breaks that were caused due to those malfunctions could interrupt the measurements by creating stress, or the participants got used to the video that was played 2 or 3 times

sometimes until it worked. It may create a relatively high variation of time measurements between participants that may affect the quality of the results. It is possible that if the variation were lower the results would be more accurate because the same amount of data would have been collected on each user.

2. Factors affecting technology acceptance: There may have been additional factors affecting the behavioral intentions of the participants that were not examined in this research, such as demographic characteristics, trust in the technology, and the ability of the participants to learn it (Berkowsky et al., 2017).
3. External stressors: The effects of external stressors (e.g., impending academic examinations, ongoing concerns due to the war in Israel) may have influenced and biased the results of the experiment conerrning the measured IBI levels and affected the gap between the perceived usefulness and the actual impact of each prototype.
4. Shortening the use of the prototype: Some of the participants were asked to shorten the use of the application due to time constraints resulting from the experiment's schedule. It is possible that this prevented them from successfully lowering their stress levels and affected the stress levels measured throughout the experiment.
5. Stress coping abilities: Some participants showed minimal stress reactivity and may have coped better with stressful situations or did not find the experimental tasks challenging enough to elicit a stress response. This result may also have affected the observed RMSSD levels and the impact on the observed gap between the results of the TAM questionnaire analysis and the analysis of the physical measures.

5.2 Co-design workshop factors

During the design workshop, different attitudes of the adults were observed toward the robot and towards actions that help reduce stress. Approaches to reduce stress resulting from the humanization of the robot are possible or offering solutions that do not involve the robot (such as using animals to reduce stress levels) affect the actual usability of the prototype designed as part of the co-design process.

On the one hand, there are elements in the prototype created in this process that were supposed to increase the desire to adopt it, such as activities in the prototype that can be customized (Whelan et al., 2018) of the user. For example, the given options under the music category - to listen to the song, dance along with it, or sing along with it. On the other hand,

the design process with older adults does not need to bring any results (Fischer et al., 2020). Including participants in the design processes (inclusive and non-inclusive) with suitable professional background would have affected the experimental indicators differently

5.3 General factors

Another factor that may have influenced the usability and acceptance of each of the prototypes is the participants' first impression of the robot or prejudices about using the robot. Some were stressed by the robot (such as the participant who withdrew from the experiment immediately after the robot explained the experiment), for example as a result of the novelty effect, and there may have been participants who were left with a positive first impression that encouraged acceptance and perceived usefulness of the prototype. It is also possible that gaps between the perception of the technology and the technology itself affected the users' first impression of the robot. Users may perceive robots as advanced technology with high and innovative capabilities, but in practice, the robot is perceived as having limited and few capabilities.

6. Limitations

1. The quality and speed of the Internet affected the videos shown during the experiment, among others the relaxing video shown in the baseline phase, which affected the quality of the calculated average RMSSD level result, due to the disturbances created during the measurement. This can be improved by higher quality internet and delivering the experiment in rooms with higher internet reception (e.g. rooms above ground level).
2. The experiment took place during a war that occurred in Israel, which may bias the answers of the participants in the PSS questionnaire, and the average RMSSD levels calculated in the experiment.
3. There is a large difference in the technological experience of the participants in the workshop and the experiment, which may affect the research results which are not significant or have a relatively large standard deviation. Future studies should examine this factor as part of the study, for example in pre-experiment surveys.
4. Some users were asked to end the use of the application due to a time limit created by experiments set afterward, therefore it was not possible to analyze the time of use of the application. This can be solved by separating the experiment phases that do not include the application usage to another device such as a computer or tablet.
5. Some of the participants may have experienced a novelity effect, which affected the results of the experiment.
6. The recording times of the stages shown in the experiment do not necessarily represent the time that the various stages were conducted, due to differences between the start/end times of the stage. Additionally, the speed of writing the logged notes and keeping them by the researcher during the experiment is due to dependence on the recording intervals by the sensor (it does not record the data continuously. In future studies, it is recommended to make the notes log automatically.
7. The experiment was modified and the explanation about it was delivered by the researcher to mitigate potential participant discomfort, due to the withdrawal of the first participant from the experiment immediately after the robot explained the experiment.

8. Due to malfunctions, some of the participants used a robot colored white, and some used a robot colored black. This may affect the results and add a new factor that influences robot acceptance (Liberman-Pincu et al., 2023). The black-colored robot may perceived as more formal than caregiving, in comparison to the white-colored robot. In future studies, it is recommended to have a backup version of the robot that is similar as much as possible to the original robot.
9. Due to malfunctions in the Emotibit sensor, some of the participants who took the experiment were excluded from the results analysis. It is recommended to have a backup sensor and to take a break every 2-3 hours of consecutive experiments to charge the sensor and refresh the software.

7. Conclusion and future work

The findings from the analysis of the results provide insights into the differential stress responses across age groups and experimental conditions, highlighting the complex interplay between cognitive tasks, technological interventions, and physiological stress indicators.

The significant results of the experiment showed contrary to the research hypothesis that the outcome of the non-inclusive design process was perceived as more useful and there were greater intentions to use it, compared to the outcome of the inclusive design process. The conclusion that the non-inclusive design is better for technologies that are used by adults cannot be accepted absolutely, because some of the results of the experiment are not significant and it is recommended to conduct this study one more time with adjustments of the design processes and experiment processes.

7.1 Recommendations

- Co-design workshop participants: It is noteworthy that not only did some participants in the co-design workshop (inclusive design process) lack a professional background in technology, but some also did not own any technological devices (including smartphones and cellphones). I would recommend for future work to recruit older adults with professional technology backgrounds and older adults with professional design backgrounds (from the academy or the industry), as is done in the design of technologies in the industry (the design process involves suitable professionals), to increase the benefit and acceptance of this design process outcome.
- Application videos: Some of the robot application windows included links to YouTube videos. Some of the videos included static pictures (instead of video clips). For future designs, I would recommend adding video clips to raise the user's level of interest in the application and focus him on it. It is possible that in a situation where a static image is displayed, the user gets bored or is not focused enough on the content of the application, and relaxation is not created, because the focus is not drawn to the application from the stressful situation.
- Using the robot throughout the whole experiment: The first intention was to use the robot throughout the whole experiment. This was aiming the participants will get used to using the robot until will got to the phase of the stress management robot

application, to view more reliable outcomes from the experiment (fearing that using the robot for the first time during the application use phase would cause stress that affects the measured stress level). Some of the participants noted while filling out the TAM survey that they were not feeling relaxed during the Stroop test, meaning they thought it was part of the examination application. For future work, I would recommend changing the experiment and its platform.

7.2 Future work

One of the possibilities for future research is to expand this research by changing the design processes to include participants with an appropriate professional background and developing identical design processes that in both cases will include workshops that will be conducted by the researcher. If this study is repeated, the experimental methodology must be changed. After changing the design and experimental methods, it is recommended to do the same process with people with dementia, because originally the stress management robot application was intended to serve them.

Another possibility for future research is in the technological aspect of connecting the sensor to the robot for the robot to detect a state of stress as a result of the change in the measured parameters of the person wearing the sensor.

Different future research includes examining the effect of older adults' attitudes towards robots on the quality of the design process of a product that uses a robot and the product obtained from the process.

It is possible to examine the perceived acceptance and benefit by younger adults of an older adults' inclusive design process outcome of a stress management robot application intended for older adults.

8. References

Ahuja, R., & Banga, A. (2019). Mental stress detection in university students using machine learning algorithms. *Procedia Computer Science, 152.* https://doi.org/10.1016/j.procs.2019.05.007

Alzheimer's Disease International. (2020). Dementia statistics. Https://Www.Alzint.Org/about/Dementia-Facts-Figures/Dementia-Statistics/.

Baik, S. H., Fox, R. S., Mills, S. D., Roesch, S. C., Sadler, G. R., Klonoff, E. A., & Malcarne, V. L. (2019). Reliability and validity of the Perceived Stress Scale-10 in Hispanic Americans with English or Spanish language preference. *Journal of Health Psychology, 24(5).* https://doi.org/10.1177/1359105316684938

Bali, A., & Jaggi, A. S. (2015). Clinical experimental stress studies: Methods and assessment. *Reviews in the Neurosciences, 26(5).* https://doi.org/10.1515/revneuro-2015-0004

Banovic, S., Zunic, L., & Sinanovic, O. (2018). Communication Difficulties as a Result of Dementia. *Materia Socio Medica, 30(2)*. https://doi.org/10.5455/msm.2018.30.221-224

Berkowsky, R. W., Sharit, J., & Czaja, S. J. (2017). Factors Predicting Decisions about Technology Adoption among Older Adults. *Innovation in Aging, 2(1)*. https://doi.org/10.1093/geroni/igy002

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3(2).* https://doi.org/10.1191/1478088706qp063oa

Chu, M. T., Khosla, R., Khaksar, S. M. S., & Nguyen, K. (2017). Service innovation through social robot engagement to improve dementia care quality. *Assistive Technology, 29(1).* https://doi.org/10.1080/10400435.2016.1171807

Creswell, J. D., Irwin, M. R., Burklund, L. J., Lieberman, M. D., Arevalo, J. M. G., Ma, J., Breen, E. C., & Cole, S. W. (2012). Mindfulness-Based Stress Reduction training reduces loneliness and pro-inflammatory gene expression in older adults: A small randomized controlled trial. *Brain, Behavior, and Immunity, 26(7).* https://doi.org/10.1016/j.bbi.2012.07.006

Deardorff, W. J., Jing, B., Growdon, M. E., Yaffe, K., Boscardin, W. J., Boockvar, K. S., & Steinman, M. A. (2023). Medication misuse and overuse in community-dwelling persons with dementia. *Journal of the American Geriatrics Society, 71(10).* https://doi.org/10.1111/jgs.18463

Di Nuovo, A., Broz, F., Wang, N., Belpaeme, T., Cangelosi, A., Jones, R., Esposito, R., Cavallo, F., & Dario, P. (2018). The multi-modal interface of Robot-Era multi-robot services tailored for the elderly. *Intelligent Service Robotics, 11(1).* https://doi.org/10.1007/s11370-017-0237-6

Edvardsson, D., Sandman, P. O., & Borell, L. (2014). Implementing national guidelines for person-centered care of people with dementia in residential aged care: Effects on perceived person-centeredness, staff strain, and stress of conscience. *International Psychogeriatrics, 26(7).* https://doi.org/10.1017/S1041610214000258

Fischer, B., Peine, A., Östlund, B., & Heyn, P. C. (2020). The Importance of User Involvement: A Systematic Review of Involving Older Users in Technology Design. *In Gerontologist (Vol. 60, Issue 7).* https://doi.org/10.1093/geront/gnz163

Frennert, S., & Östlund, B. (2014). Review: Seven Matters of Concern of Social Robots and Older People. *International Journal of Social Robotics, 6(2).* https://doi.org/10.1007/s12369-013-0225-8

Gao, Z., Shi, Q., Fukuda, T., Li, C., & Huang, Q. (2019). An overview of biomimetic robots with animal behaviors. *Neurocomputing, 332.* https://doi.org/10.1016/j.neucom.2018.12.071

Gerritsen, D. L., Smalbrugge, M., Veldwijk-Rouwenhorst, A. E., Wetzels, R., Zuidema, S. U., & Koopmans, R. T. C. M. (2019). The Difficulty With Studying Challenging Behavior. *In Journal of the American Medical Directors Association (Vol. 20, Issue 7).* https://doi.org/10.1016/j.jamda.2019.01.148

Gilhooly, K. J., Gilhooly, M. L. M., Sullivan, M. P., McIntyre, A., Wilson, L., Harding, E., Woodbridge, R., & Crutch, S. (2016). A meta-review of stress, coping and interventions in dementia and dementia caregiving. *BMC Geriatrics, 16(1).* https://doi.org/10.1186/s12877-016-0280-8

Godoy, L. D., Rossignoli, M. T., Delfino-Pereira, P., Garcia-Cairasco, N., & Umeoka, E. H. de L. (2018). A comprehensive overview on stress neurobiology: Basic concepts and clinical implications. *In Frontiers in Behavioral Neuroscience (Vol. 12).* https://doi.org/10.3389/fnbeh.2018.00127

Góngora Alonso, S., Hamrioui, S., De La Torre Díez, I., Motta Cruz, E., López-Coronado, M., & Franco, M. (2019). Social Robots for People with Aging and Dementia: A Systematic Review of Literature. *In Telemedicine and e-Health (Vol. 25, Issue 7).* https://doi.org/10.1089/tmj.2018.0051

Hazlett-Stevens, H., Singer, J., & Chong, A. (2019). Mindfulness-Based Stress Reduction and Mindfulness-Based Cognitive Therapy with Older Adults: A Qualitative Review of Randomized Controlled Outcome Research. *In Clinical Gerontologist (Vol. 42, Issue 4).* https://doi.org/10.1080/07317115.2018.1518282

Huberty, J., Green, J., Glissmann, C., Larkey, L., Puzia, M., & Lee, C. (2019). Efficacy of the mindfulness meditation mobile app "calm" to reduce stress among college students: Randomized controlled trial. *JMIR MHealth and UHealth, 7(6).* https://doi.org/10.2196/14273

Hwang, W. J., & Jo, H. H. (2019). Evaluation of the effectiveness of mobile app-based stress-management program: A randomized controlled trial. *International Journal of Environmental Research and Public Health, 16(21).* https://doi.org/10.3390/ijerph16214270

Iversen, T. N., Larsen, L., & Solem, P. E. (2009). A conceptual analysis of ageism. *Nordic Psychology, 61(3).* https://doi.org/10.1027/1901-2276.61.3.4

Ke, C., Lou, V. W. qun, Tan, K. C. kian, Wai, M. Y., & Chan, L. L. (2020). Changes in technology acceptance among older people with dementia: the role of social robot engagement. *International Journal of Medical Informatics, 141.* https://doi.org/10.1016/j.ijmedinf.2020.104241

Klimek, A., Mannheim, I., Schouten, G., Wouters, E. J., & Peeters, M. W. H. (2023). Wearables Measuring Electrodermal Activity to Assess Perceived Stress in Care: A Scoping Review. *In Acta Neuropsychiatrica*. https://doi.org/10.1017/neu.2023.19

Li, S. Y. H., & Bressington, D. (2019). The effects of mindfulness-based stress reduction on depression, anxiety, and stress in older adults: A systematic review and meta-analysis. *In International Journal of Mental Health Nursing (Vol. 28, Issue 3).* https://doi.org/10.1111/inm.12568

Liberman-Pincu, E., Bulgaro, A., & Oron-Gilad, T. (2023). I Am in Love with the Shape of You: The Effect of Mass Customization on the Human-Robot Relationship. *Communications in Computer and Information Science, 1997 CCIS.* https://doi.org/10.1007/978-3-031-49368-3_1

Liberman-Pincu, E., David, A., Sarne-Fleischmann, V., Edan, Y., & Oron-Gilad, T. (2021). Comply with me: Using design manipulations to affect human–robot interaction in a covid-19

officer robot use case. *Multimodal Technologies and Interaction, 5(11).* https://doi.org/10.3390/mti5110071

Liberman-Pincu, E., Korn, O., Grund, J., van Grondelle, E. D., & Oron-Gilad, T. (2024). Designing Socially Assistive Robots Exploring Israeli and German Designers' Perceptions. *ACM Transactions on Human-Robot Interaction, 13(2), 1–27.* https://doi.org/10.1145/3657646

Mace, R. A., Mattos, M. K., & Vranceanu, A. M. (2022). Older adults can use technology: why healthcare professionals must overcome ageism in digital health. *In Translational Behavioral Medicine (Vol. 12, Issue 12).* https://doi.org/10.1093/tbm/ibac070

Maddock, C., & Pariante, C. M. (2001). How does stress affect you? An overview of stress, immunity, depression and disease. *In Epidemiologia e Psichiatria Sociale (Vol. 10, Issue 3).* https://doi.org/10.1017/S1121189X00005285

Mahdi, H., Akgun, S. A., Saleh, S., & Dautenhahn, K. (2022). A survey on the design and evolution of social robots — Past, present and future. *Robotics and Autonomous Systems, 156.* https://doi.org/10.1016/j.robot.2022.104193

Mannheim, I., Schwartz, E., Xi, W., Buttigieg, S. C., McDonnell-Naughton, M., Wouters, E. J. M., & van Zaalen, Y. (2019). Inclusion of older adults in the research and design of digital technology. *International Journal of Environmental Research and Public Health, 16(19).* https://doi.org/10.3390/ijerph16193718

Mannheim, I., Weiss, D., van Zaalen, Y., & Wouters, E. J. M. (2023). An "ultimate partnership": Older persons' perspectives on age-stereotypes and intergenerational interaction in co-designing digital technologies. *Archives of Gerontology and Geriatrics, 113.* https://doi.org/10.1016/j.archger.2023.105050

Mannheim, I., Wouters, E. J. M., Köttl, H., van Boekel, L. C., Brankaert, R., & van Zaalen, Y. (2023). Ageism in the Discourse and Practice of Designing Digital Technology for Older Persons: A Scoping Review. *In The Gerontologist (Vol. 63, Issue 7).* https://doi.org/10.1093/geront/gnac144

Mental Health Foundation. (2018). Stress: statistics. Https://Www.Mentalhealth.Org.Uk/Explore-Mental-Health/Statistics/Stress-Statistics.

Nelson, T. D. (2015). Ageism. *In Handbook of Prejudice, Stereotyping, and Discrimination: 2nd Edition.* https://doi.org/10.4324/9780203361993-21

Parsons, C. (2017). Polypharmacy and inappropriate medication use in patients with dementia: an underresearched problem. *In Therapeutic Advances in Drug Safety (Vol. 8, Issue 1).* https://doi.org/10.1177/2042098616670798

Russell-Williams, J., Jaroudi, W., Perich, T., Hoscheidt, S., El Haj, M., & Moustafa, A. A. (2018). Mindfulness and meditation: Treating cognitive impairment and reducing stress in dementia. *Reviews in the Neurosciences, 29(7).* https://doi.org/10.1515/revneuro-2017-0066

Saari, U. A., Tossavainen, A., Kaipainen, K., & Mäkinen, S. J. (2022). Exploring factors influencing the acceptance of social robots among early adopters and mass market representatives. *Robotics and Autonomous Systems, 151.* https://doi.org/10.1016/j.robot.2022.104033

Sedlmair, M., Meyer, M., & Munzner, T. (2012). Design study methodology: Reflections from the trenches and the stacks. *IEEE Transactions on Visualization and Computer Graphics, 18(12).* https://doi.org/10.1109/TVCG.2012.213

Shaffer, F., & Ginsberg, J. P. (2017). An Overview of Heart Rate Variability Metrics and Norms. *In Frontiers in Public Health (Vol. 5).* https://doi.org/10.3389/fpubh.2017.00258

Sharp, B. K. (2019). Stress as Experienced by People with Dementia: An Interpretative Phenomenological Analysis. *Dementia, 18(4).* https://doi.org/10.1177/1471301217713877

Smith, D., Lovell, J., Weller, C., Kennedy, B., Winbolt, M., Young, C., & Ibrahim, J. (2017). A systematic review of medication nonadherence in persons with dementia or cognitive impairment. *In PLoS ONE (Vol. 12, Issue 2).* https://doi.org/10.1371/journal.pone.0170651

The Harris Poll. (2023). APA 2023 Stress in America Topline Data. Https://Www.Apa.Org/News/Press/Releases/Stress/2023/November-2023-Topline-Data.Pdf.

Torales, J., Ríos-González, C., Barrios, I., O'Higgins, M., González, I., García, O., Castaldelli-Maia, J. M., & Ventriglio, A. (2020). Self-Perceived Stress During the Quarantine of COVID-19 Pandemic in Paraguay: An Exploratory Survey. *Frontiers in Psychiatry, 11*. https://doi.org/10.3389/fpsyt.2020.558691

Valentí Soler, M., Agüera-Ortiz, L., Olazarán Rodríguez, J., Mendoza Rebolledo, C., Pérez Muñoz, A., Rodríguez Pérez, I., Osa Ruiz, E., Barrios Sánchez, A., Herrero Cano, V.,

Carrasco Chillón, L., Felipe Ruiz, S., López Alvarez, J., León Salas, B., Cañas Plaza, J. M., Martín Rico, F., & Martínez Martín, P. (2015). *Social robots in advanced dementia. Frontiers in Aging Neuroscience, 7(JUN).* https://doi.org/10.3389/fnagi.2015.00133

Varvogli, L., & Darviri, C. (2011). Stress management techniques: Evidence-based procedures that reduce stress and promote health. *In Health Science Journal (Vol. 5, Issue 2).*

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39(2).* https://doi.org/10.1111/j.1540-5915.2008.00192.x

Whelan, S., Murphy, K., Barrett, E., Krusche, C., Santorelli, A., & Casey, D. (2018). Factors Affecting the Acceptability of Social Robots by Older Adults Including People with Dementia or Cognitive Impairment: A Literature Review. *In International Journal of Social Robotics (Vol. 10, Issue 5).* https://doi.org/10.1007/s12369-018-0471-x

World Health Organization. (2022, October 1). Ageing and health. Https://Www.Who.Int/News-Room/Fact-Sheets/Detail/Ageing-and-Health.

World Health Organization. (2023, February 21). Stress. Https://Www.Who.Int/News-Room/Questions-and-Answers/Item/Stress.

World health organization (WHO). (2023). Dementia. https://www.who.int/news-room/fact-sheets/detail/dementia

9. Appendixes

Appendix 1 - Fundamentals of Human-Computer Interaction course syllabus

Ben-Gurion University of the Negev

Department of Industrial Engineering and Management

Human-Computer Interaction

364 – 1 – 1711

Ela Liberman Pincu

Fall Semester 2023-2024

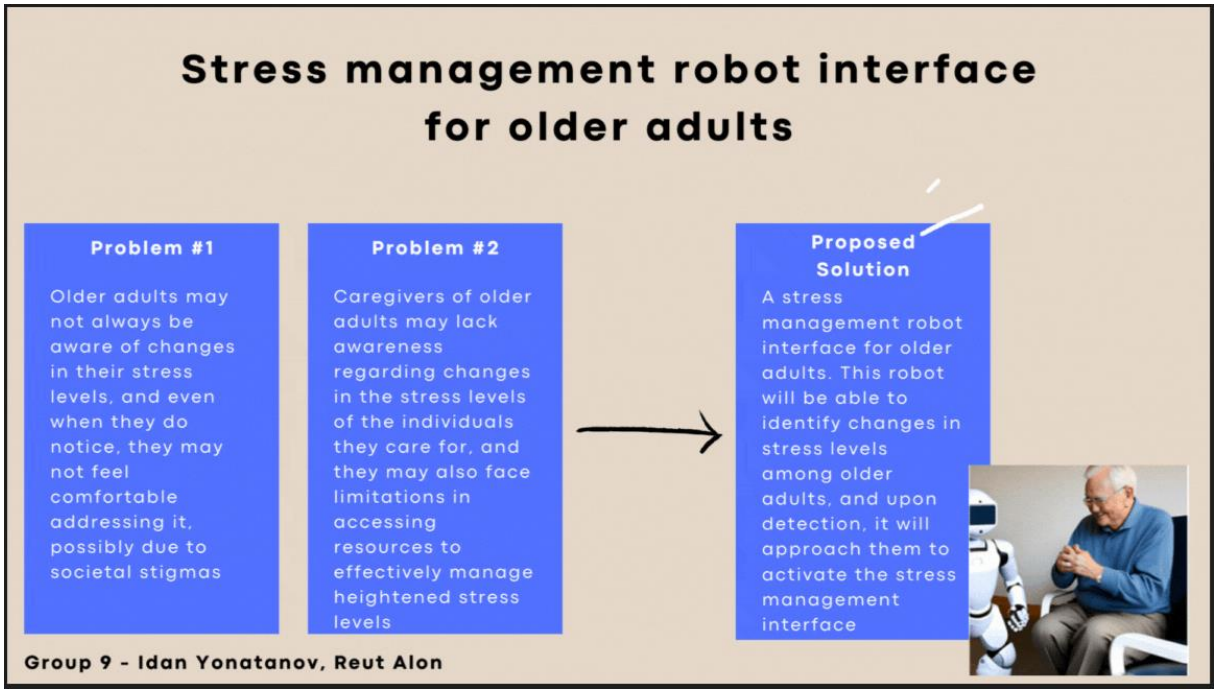
Class: Wednesdays 11am-2pm

Description of Meetings

31/01	FULE methodology- Functionality, Usability, Look-and-Feel and Evaluation	
07/02	Human-robot interaction	
14/02	Design thinking	
21/02	Usability heuristics	+ Individual assignment
28/02	Presenting personal assignments	In class or by email
06/03	UX Strategy	
13/03	Final Project Presentation	**Zoom

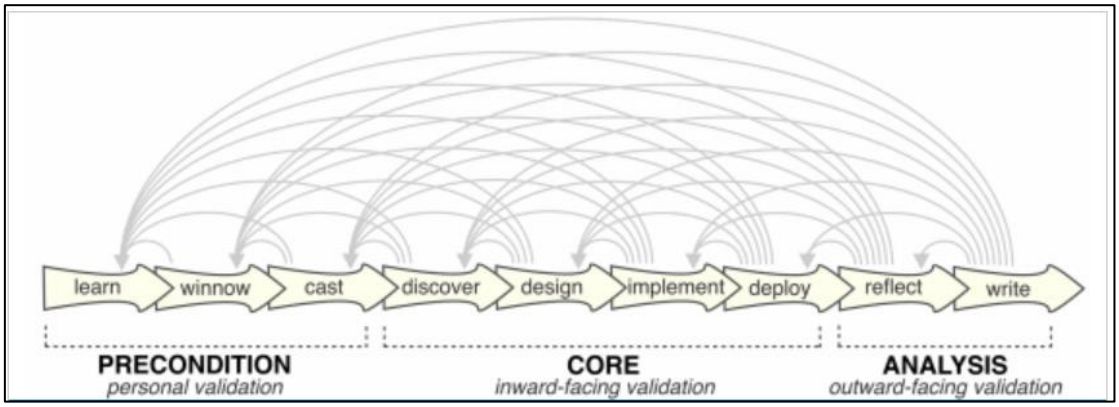
Appendix 2 – Fundamentals of Human-Computer Interaction course sub-submissions

2.1 The problem and it's application based solution



2.2 HomeWork 1 – Research: Literature and competitive review

- **Literature review:**
  - Design insights: The design study should include the next steps: learn, winnow, cast, discover, design, implement, deploy, reflect, and write (Sedlmair, Meyer & Munzner, 2012). The design study is not characterized by a linear progression; rather, its various phases exhibit significant overlap, rendering it an iterative and dynamic process. Since the robot's type is a social robot, it should follow the "social rules" of humans, and act by human cognitive behavior to be able to cope and react to human feelings (Mahdi, Akgun, Saleh, & Dautenhahn, 2022). As a social robot that intends to serve older adults with dementia, it is best to follow the Alzheimer's Association Sugden-Best suggestions for effective communication strategies, such as: accessing the person from the front, using the person's name before starting the conversation, using simple language, and use proper facial expressions (Banovic, S., Zunic, L. J., & Sinanovic, O. (2018). Another thing to notice when using robots for the care of older adults with dementia is that they prefer small animal-shaped or humanoid robots, that do not leave the impression that they are replacing human care provided (Góngora Alonso, Hamrioui, de la Torre Díez, Motta Cruz, López-Coronado & Franco, 2019). Additionally, Whelan, Murphy, Barrett, Krusche, Santorelli & Casey (2018) found in their research that 60% of the test users preferred the robot to stop 0.45-3.6 meters from them (0.5 m is the edge of the intimate zone for human-human contact).



The picture is taken from Sedlmair et al. (2012) paper

  - A summary of open questions:
    # What are the recommendations for visual designing applications for older adults with dementia?

What is the best volume and tone of voice to use to speak to older adults with dementia?

Which persona should be the voice of the robot? (child/adults, women/men/Siri style…)

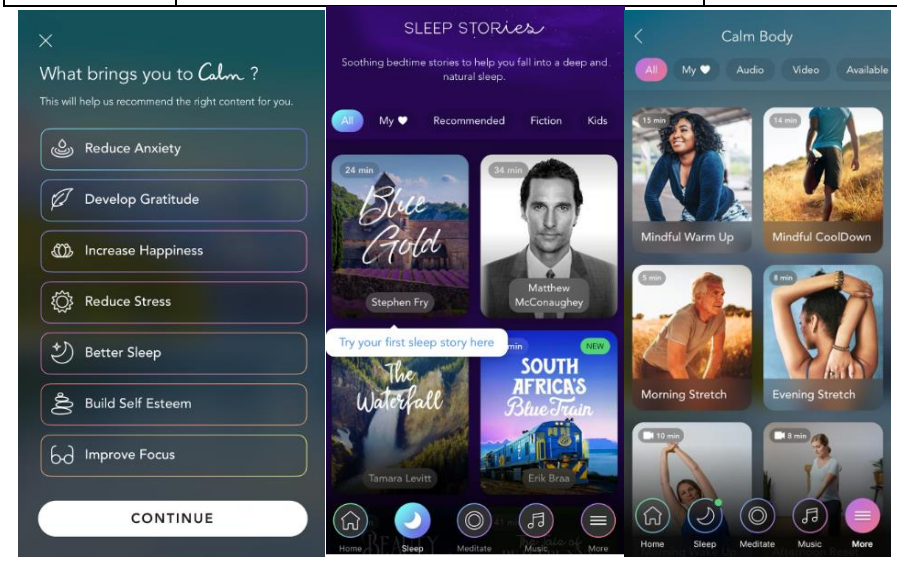
- **Competitive review:**
  - CALM Robot - CALM Robot is a project that involves the co-design of a smart stress-relief robot that uses tactile sense to guide slow deep breathing exercises.

Parameter	**Pros**	**Cons**
User needs	Soothes with breath exercise	Limited by only using one option for relaxation
Interaction	By hugging the robots	Does not possess advanced communication skills. It cannot engage in complex verbal conversations, which may be a limitation for users seeking more interactive dialogue
Visual designed	Soft and gentle	Does not provide personalization options

  - Calm- Calm is a popular meditation and relaxation application that provides guided meditation sessions, sleep stories, and calming music. It's suitable for users of different age groups, including older individuals.

Parameter	**Pros**	**Cons**
User needs	Provides many options for reducing tension and anxiety	Calm offers a subscription-based model, and some users may find the cost prohibitive. This can limit access to certain features for those

		who are unable or unwilling to pay for a subscription
Interaction	Calm boasts an intuitive and user-friendly interface. Navigating the app is straightforward, making it easy for users to access various features and content	Users who are less familiar with technology might find the app's interface or features a bit complex
Visual designed	Calm features a clean and minimalistic design, which helps users focus on content without unnecessary distractions. The simplicity of the interface contributes to a calming and user-friendly experience	Users with visual impairments might find the default text size or color contrast challenging. More options to adjust text size, font, and contrast could improve readability for a broader range of users



- PARO- Paro is a therapeutic robot designed to resemble a baby harp seal. It responds to touch, makes sounds, and has expressive features to provide emotional support and comfort. Paro has been used in various settings, including healthcare facilities and homes, to assist individuals experiencing stress, anxiety, or loneliness.

Parameter	**Pros**	**Cons**
User needs	PARO can recognize and respond to human emotions. It can detect changes in tone of voice and respond with appropriate sounds	Some individuals may prefer more dynamic or varied interactions, and

	and movements, creating a more emotionally attuned interaction	PARO's limited range of responses may not meet their expectations
Interaction	PARO is equipped with various sensors, including tactile sensors on its body, it responds to touch which creates a responsive and interactive experience	Does not possess advanced communication skills. It cannot engage in complex verbal conversations, which may be a limitation for users seeking more interactive dialogue
Visual designed	PARO is designed to be soft, cuddly, and huggable. Its tactile and physical presence allows users to hold, pet, and hug the robot, simulating the comforting sensation of interacting with a living creature	Does not provide personalization features

- **Synthesis:**
  - Which designing factors influence robot adoption among older adults with dementia?
  - Which challenges are caregivers of older adults with dementia coping with?
  - Which stress management technique can help reduce stress levels among older adults with dementia?
- **References:**

  - Banovic, S., Zunic, L. J., & Sinanovic, O. (2018). Communication difficulties as a result of dementia. Materia socio-medica, 30(3), 221.
  - Góngora Alonso, S., Hamrioui, S., de la Torre Díez, I., Motta Cruz, E., López-Coronado, M., & Franco, M. (2019). Social robots for people with aging and dementia: a systematic review of literature. Telemedicine and e-Health, 25(7), 533-540.

- Mahdi, H., Akgun, S. A., Saleh, S., & Dautenhahn, K. (2022). A survey on the design and evolution of social robots—Past, present and future. Robotics and Autonomous Systems, 104193.
- Sedlmair, M., Meyer, M., & Munzner, T. (2012). Design study methodology: Reflections from the trenches and the stacks. IEEE transactions on visualization and computer graphics, 18(12), 2431-2440.
- Whelan, S., Murphy, K., Barrett, E., Krusche, C., Santorelli, A., & Casey, D. (2018). Factors affecting the acceptability of social robots by older adults including people with dementia or cognitive impairment: a literature review. International Journal of Social Robotics, 10(5), 643-668.

2.3 The description of four application users

1. משתמש פורמלי – מבוגר בבית אבות.
   - בני 75 ומעלה.
   - ללא חשיבות למגדר.
   - מצפה לראות ממשק ידידותי, שלא ייאם עליו מבחינה טכנולוגית, שידבר בקול נעים, שלא ירגיש שהוא מחליף את המטפלים המקצועיים, דיבור בשפה פשוטה, לא מהירה, קל לתפעול, מעט תקלות טכניות.
2. משתמש פורמלי – מבוגר בבית.
   - בני 75 מעלה.
   - ללא חשיבות למגדר.
   - מצפה לראות ממשק ידידותי, שלא ייאם עליו מבחינה טכנולוגית, שידבר בקול נעים, שלא ירגיש שהוא מחליף את המטפלים המקצועיים, דיבור בשפה פשוטה, לא מהירה, שהתנועה שלו במרחב לא תזיק לבית, קל לתפעול, מעט תקלות טכניות.
3. משתמש לא פורמלי – משפחה של המבוגר.
   - במגוון גילאים.
   - ללא חשיבות למגדר.
   - שיתייחס בנחמדות ובכבוד למבוגר, שיהיה קל לתפעול, שלא יידרש הרבה תיווך של הרובוט למבוגר על ידי גורם שלישי, שיהיה עם מעט תקלות, שתהיה תמיכה טכנית טובה.
4. משתמש לא פורמלי – גורמים רפואיים ומטפלים בבתי אבות.
   - טווח גילאים 20-67 (גילאי העבודה).
   - ללא חשיבות למגדר.

- שיסייע בעבודה היומיומית, שיהיה קל לתפעול, שלא יידרש הרבה תיווך של הרובוט למבוגר על ידי גורם שלישי, שיהיה עם מעט תקלות, שתהיה תמיכה טכנית טובה, שיהיה אוטונומי (מינימום התערבות של אדם בהפעלה).

Appendix 3 – Ethical Approval

Ben-Gurion University of the Negev ~ Human Subjects Research Committee

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

I. General

Name of Research Project: Biases and attitudes towards co-designing a social assistive stress management robot application for older adults

To which agency is the proposal being submitted (or has been submitted):

Principal Investigator/s (or academic supervisor/s):

Name: Yael Edan

Department: Department of Industrial Engineering & Management

Academic position: Prof

University Telephone: 08-6472232

Mobile Phone:

University Email: yael@bgu.ac.il

Other Email:

Name: Ittay Mannheim

Department: Department of Industrial Engineering & Management

Academic position: Postdoc researcher

University Telephone:

Mobile Phone: 0547945544

University Email: ittaym@post.bgu.ac.il

Other Email: ittay.mannheim@gmail.com

Name(s) of those conducting the research (if different from above):

Name: Reut Alon

Department: Department of Industrial Engineering & Management

Academic position: Student

University Telephone:

Mobile Phone: 054-7260111

Name:

Department:

Academic position:

University Telephone:

Mobile Phone:

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

Email: alre@post.bgu.ac.il **Email:**

II. Consent to Participate

Are the subjects able to legally consent to participate in the research? ☒Yes/ ☐No

If yes, proceed to 1 If no, proceed to 2 and complete a, b, c.

1. Will the subjects be asked to sign a consent form? ☒Yes / ☐ No

   If you answered no, please explain here:

2. If a subject cannot legally consent (minors, mentally incapacitated, etc.):

   a. Will the subject's legal guardian be asked to sign a consent form? ☐Yes / ☐ No

   If you answered no, please explain here:

   b. Will the subject be asked to give oral consent? ☐Yes / ☐ No

   c. Are the instructions appropriate to the subjects' level of understanding? ☐Yes / ☐ No

Comments:

III. Discomfort:

3. Will the participants be subjected to physical discomfort? ☐Yes / ☒ No

4. Will the participants be subjected to psychological discomfort?: ☒Yes / ☐ No

If you answered yes to question 3 or 4 above, add here a detailed explanation of the circumstances

We do not expect that during the experiment the participants will feel severe psychological discomfort, but since the participants are performing a Stroop test and some of them are meeting a robot for the first time and wearing a sensor for the first time, some of them may feel slightly stressed.

IV. Deception

5. Does the research involve deceiving the subjects? ☐Yes / ☒ No

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

6. Is the decision on the part of the subject to participate in the study based on deception? (For example, if they are informed only after the event of their participation.)
☐ Yes / ☒ No

If you answered yes to question 5 or 6 above, add here a detailed explanation why deception is necessary:

V. Debriefing of Subjects

If the study involves any discomfort or deception, it is necessary to personally debrief the subjects after the experiment in order to explain the reasons for the discomfort and/or deception. If the study does not involve any discomfort or deception, the subject should be provided, upon completion of the experiment, with a brief written description of the study's objectives.

7. Will the subjects be debriefed orally? ☐ Yes / ☒ No

8. Will the subjects be debriefed in writing? ☐ Yes / ☒ No

If you answered no to **both 7 and 8** above, explain below: Because the study does not involve deception of the participants and does not involve creating intentional psychological discomfort, we will not debrief, but we will mention in the part of the concent signing that the meeting with the robot, filling the Stroop test and wearing the sensor can cause changes in stress levels.

VI. Compensation for Participation

9. Will the subjects receive compensation for participation? ☐ Yes / ☒ No

If the compensation is monetary, give details:

Other type of compensation detail here:

If you answered no to question 9, explain the basis for participation: Participation is voluntary.

VII. Privacy:

10. Will audio and/or visual recordings be made of the subjects? ☒ Yes / ☐ No

11. If yes, are they informed of this fact in the consent form? ☒ Yes / ☐ No

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

12. Will the data collected contain identifying details about the subjects? ☒Yes / ☐ No

13. If the data contains identifying details, what steps will you take to ensure the confidentiality of the information? How will the data be stored? What will be done with identifying information or recordings of the subjects at the end of the research?

    Since the participants in the experiment can be identified through their videos that will be recorded during the experiment, although no personal details about them will be collected during the experiment, the videos will be saved in a password-protected folder on the university research drive (one-drive). Files will be named using a participant number identifier.

    In the recordings of the co-design workshop, only sound will be recorded (no image) and no personal information will be collected about them during the workshop sessions. Details of the participants in the workshop will be kept in a separate password protected file for contact purposes.

VIII. Withdrawal from the Study:

14. Will subjects be informed that they may withdraw from the study at any time? ☒Yes / ☐ No

15. Will the subjects incur any loss, monetary or other, if they withdraw from the study before its completion? ☐Yes / ☒ No

    If you answered yes to question 15, specify the loss that will be incurred and why:

IX. Research equipment

16. Does the research entail the use of equipment other than standard equipment, such as computers, video recording equipment? ☒Yes/ ☐No

17. If yes, does the equipment being used meet safety standard for use with human subjects? Please specify which standards. ☒Yes/ ☐No

    The experiment will include the use of Temi robot and Emotibit sensor.

    Although Temi robot is a porsonal robot for home use, it does not have a specific safety standart document. The Temi robot's company ensure that the robot follows top regulation and quality standards that related to data security, using the Amazon Web Services to secure Temi

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

cloud platform (as described at the FAQ in the Temi website - https://www.robotemi.com/faq/).

Emotibit sensor created for research, personal health and education, but does not have a specific safety standart document.

Signatories:

Name: Yael Edan **Position**: Prof

Signature: _____ **Date**: 15/05/2024

Name: Ittay Mannheim **Position**: Postdoc researcher

Signature: _____ **Date**: 15/05/2024

Title of Research Project: Biases and attitudes towards co-designing a social assistive stress management robot application for older adults

Ben-Gurion University of the Negev ~ Human Subjects Research Committee

APPLICATION FOR APPROVAL TO USE

HUMANS AS SUBJECTS IN EMPIRICAL STUDY

This section is to be filled out by a member of the Human Subjects Research Committee only

Decision of the Committee:

Approval for research: ☑ Granted / ☐ Denied

The decision of this committee pertains only to ethical considerations involved in the conduct of the research.

Comments to the researcher in the event that application has been denied:

_____

Signature of committee:

Name: Yakir Berchenko

Signature: _____ **Date**: 27.5.2024

Appendix 4 – Consent forms

4.1 Co-design workshop consent form

נספח 1 – פרוטוקול המחקר

מחקר בנושא: גישות כלפי עיצוב משותף עם מבוגרים של אפליקציה לרובוט סיוע חברתי להורדת סטרס (עקה)

נבדק/ת יקר/ה,

בבקשה קרא/י דף הסבר זה באשר לניסוי. במידה ויש שאלות לך, אשמח לענות.

בבקשה וודא/י כי את/ה מבין/ה היטב את שלבי המחקר. לאחר קריאת דף זה, נא מלא/י את נספח מספר 2 – טופס הסכמה להשתתף בסדנת העיצוב המשותפת.

מטרת הפרויקט: פרויקט גמר הנדסי אשר בוחן גישות כלפי עיצוב משותף עם מבוגרים של אפליקציה לרובוט סיוע חברתי המיועד להורדת סטרס (עקה) בקרב מבוגרים.

חוקרים אחראיים: פרופסור יעל אידן וד"ר איתי מנהיים.

המחקר הנוכחי נערך באוניברסיטת בן-גוריון ומבצע השוואה בין עיצובים שונים של אפליקציות לרובוטים במספר מדדים.

כחלק מהמחקר נעבור סדנה בת שלושה מפגשים, כאשר אורך כל מפגש הוא כשעה וחצי. במהלך הסדנה תתבקשו לעצב אפליקציה (יישומון) לרובוט. הסבר מפורט על מטרת האפליקציה והכנה מקצועית יועברו לאחר מתן הסכמתך להשתתפות בסדנה על ידי מנחת הסדנה.

ההשתתפות בסדנה הינה בהתנדבות. הנתונים שיאספו הינם חסויים ויהיו גלויים רק לעורכי המחקר.

לאחר מתן הסכמת השתתפות של חברי הסדנה ופעילות היכרות קצרה, הסדנאות יוקלטו (שמע ותמונה) באמצעות מצלמת וידאו. ייתכן ותובנות חשובות מהסדנה יירשמו גם הם ללא פרטי זיהוי של הדובר/ת. ההקלטה תישמר בתיקייה המוגנת באמצעות סיסמה ותהיה גלויה רק לעורכי המחקר. לא ייאספו פרטים אישיים או מזהים עליך במהלך הסדנה. אנו שומרים את פרטיך בקובץ נפרד לטובת אפשרות ליצירת קשר.

בתום המחקר כל הטפסים ימסרו לחוקר הראשי הממונה על המחקר וישמרו באחריותו.

בכל עת ובכל שלב תוכל/י אם תרצה/י להפסיק את השתתפותך במחקר.

אם מכל סיבה שהיא הינך חש/ה שלא בנוח, את/ה יכול/ה לעצור ולבקש ממנחת הסדנה להפסיק.

תודה רבה על שיתוף הפעולה!

במידה ומתעוררות אצלך שאלות כלשהן לגבי הניסוי הנך רשאי לפנות באימייל ל:alre@post.bgu.ac.il

בברכה,

מנחת הסדנה – רעות אלון

נספח 2 – טופס הסכמת הנבדק להשתתפות בסדנת העיצוב המשותפת

לאחר שקראת את טופס תאור הניסוי:

אני החתום/ה מטה:

שם פרטי:	שם משפחה:
תעודת זהות:	

מצהיר/ה בזה כי אני מסכים/ה להשתתף בסדנת העיצוב, כמפורט במסמך המפרט את חלקי הסדנה.

מצהיר/ה בזה כי הוסבר לי על-ידי:

שם החוקר הראשי/חוקר (נסיין מסביר):

כי הסדנה נערכת בנושא

כי אני חופשי/ה לבחור שלא להשתתף בסדנה וכי אני חופשי/ה להפסיק בכל עת את השתתפותי.

כי מובטח שזהותי האישית תשמר סודית על-ידי כל העוסקים והמעורבים במחקר ולא תפורסם בכל פרסום כולל בפרסומים מדעיים, כולל הקלטות השמע וציטוטים שלי שיוקלטו וירשמו במהלך הסדנה.

4.2 Experiment consent form

טופס הסכמה מדעת למחקר בנושא: גישות כלפי שימוש ברובוט חברתי להורדת סטרס (עקה)

נבדק/ת יקר/ה,

בבקשה קרא/י דף הסבר זה באשר לניסוי. במידה ויש שאלות לך, אשמח לענות.

בבקשה וודא/י כי את/ה מבין/ה היטב את שלבי המחקר. לאחר קריאת דף זה, נא מלא/י את טופס ההסכמה להשתתפות בניסוי ואת טופס ההצהרה על ראייה תקינה.

מטרת המחקר לבחון את השימוש ברובוט חברתי להפחתת סטרס (עקה).

חוקרים אחראיים: פרופסור יעל אידן וד"ר איתי מנהיים.

המחקר הנוכחי נערך באוניברסיטת בן-גוריון ומבצע השוואה בין עיצובים שונים של אפליקציות לרובוטים במספר מדדים.

את הוראות הניסוי יעביר הרובוט טימי, וביצוע החלקים השונים בניסוי יהיה על גבי המסך שבראש הרובוט. לאחר חתימה על טופס זה, עורכת הניסוי תלביש לך חיישן על פרק כף ידך החלשה (זו שאינך כותב/ת בעזרתה), על מנת למדוד את המדדים הפיזיולוגיים הבאים:

PPG – קצב הלב, שונות קצב הלב, נשימה, רוויית חמצן והידרציה.

EDA – מוליכות עורית.

טמפרטורת הגוף.

השימוש בחיישן בטוח ולא אמור לגרום לאי נוחות.

במסגרת המחקר תידרש/י לפתור כמה שיותר שאלות בשני מבחני סטרופ שונים בזמן מוגבל, עליהם טימי יסביר לך בהמשך. לאחר המבחן הראשון טימי יציג לך את העיצוב של האפליקציה (יישומון) הנבחן במסגרת הניסוי, ובסיום ההצגה תבצע/י מבחן סטרופ נוסף. לאחר השלמת המבחן השני, תידרש/י למלא שאלון סיום. הסבר מפורט על שלבי הניסוי והוראות מפורטות של מבחן סטרופ יינתנו מיד לאחר מתן הסכמתך להשתתפות בניסוי באמצעות טופס זה ולאחר לבישת החיישן כאמור לעיל. ההסבר יינתן בעל פה על ידי הרובוט טימי ובאמצעות דף הנחיות.

משך המחקר הינו כחצי שעה. הניסוי בהתנדבות. הנתונים שיאספו הינם חסויים ויהיו גלויים רק לעורכי המחקר.

החל משלבי הניסוי הבאים וידאו של פניך יוקלט באמצעות מצלמה. הוידאו יישמר בתיקייה המוגנת באמצעות סיסמה ויהיה גלוי רק לעורכי המחקר.

בתום המחקר כל הטפסים ימסרו לחוקר הראשי הממונה על המחקר וישמרו באחריותו.

בכל עת ובכל שלב תוכל/י אם תרצה/י להפסיק את השתתפותך במחקר.

אם מכל סיבה שהיא הינך חש/ה שלא בנוח, את/ה יכול/ה לעצור ולבקש מעורכת הניסויים להפסיק.

תודה רבה על שיתוף הפעולה!

במידה ומתעוררות אצלך שאלות כלשהן לגבי הניסוי הנך רשאי לפנות באימייל לרעות: alre@post.bgu.ac.il

בברכה,

עורכת הניסוי – רעות אלון

טופס הסכמת הנבדק לעריכת הניסוי

לאחר שקראת את טופס תיאור הניסוי:

אני החתום/ה מטה:

מצהיר/ה בזה כי אני מסכים/ה להשתתף בניסוי, כמפורט במסמך המפרט את חלקי הניסוי.

מצהיר/ה בזה כי הוסבר לי על-ידי רעות (עורכת הניסוי) וטימי (הרובוט):

כי הניסוי נערך בנושא גישות כלפי שימוש ברובוט חברתי להורדת סטרס (עקה).

כי אני חופשי/ה לבחור שלא להשתתף בניסוי וכי אני חופשי/ה להפסיק בכל עת את השתתפותי בניסוי.

כי מובטח שזהותי האישית תשמר סודית על-ידי כל העוסקים והמעורבים במחקר ולא תפורסם בכל פרסום כולל בפרסומים מדעיים, כולל סרטון הוידאו שלי שיוקלט במהלך הניסוי.

מספר משתתף/ת:	תאריך:
חתימה:	

טופס הצהרה על ראייה תקינה

אני החתום/ה מטה:

מצהיר/ה כי ככל שידוע לי אני רואה צבעים בצורה תקינה.

מצהיר/ה שהראייה שלי תקינה או מתוקנת באמצעות משקפי ראייה או עדשות מגע בהם אשתמש במהלך הניסוי.

מצהיר/ה שהוסברו לי בפירוט כל חלקי הניסויי והסכמתי ליטול בו חלק לאחר שנענו כל שאלותיי לגבי כל אחד מחלקי הניסוי.

*הצהרה זו הינה סודית ואינה ניתנת להעברה או שימוש לצורך שום דבר או גורם אחר פרט לצורכי מחקר זה.

מספר משתתף/ת:	תאריך:
חתימה:	

חוקרת:	תאריך:
חתימה:	

Appendix 5 – Questionnaire protocol

5.1 Co-design workshop background questionnaire

1. מה גילך? _____
2. מה המגדר שלך?
   א. גבר
   ב. אישה
   ג. אחר
   ד. מעדיף/ה לא ציין
3. מה ההשכלה שיש לך?
   א. פחות מ-12 שנות לימוד
   ב. 12 שנות לימוד

ג. לימודים מקצועיים

ד. השכלה גבוהה (אוניברסיטה / מכללה)

4. מה המקצוע האחרון או הנוכחי בו עבדת?

_____

חלק ב': השאלות הבאות מתמקדות בשימוש שאת/ה עושה באמצעים דיגיטליים כיום

5. באילו אמצעים דיגיטליים השתמשת **<u>בשבוע האחרון?</u>**

(**סמן/י את כל התשובות הנכונות עבורך**):

א. טלפון חכם (סמארטפון)

ב. מחשב לוח (טאבלט, כגון אייפד)

ג. מחשב נייח

ד. מחשב נייד

ה. טלוויזיה חכמה

ו. שעון חכם

ז. עוזר קולי כגון אקלסה או גוגל הום

אחר, אנא פרט/י:_____

_____

_____

_____

מטרות השימוש באמצעים דיגיטליים הן מגוונות. עבור כל אחת ממטרות השימוש הבאות, ציין/י במקום המתאים בטבלה מה הייתה תדירות השימוש שלך <u>במהלך השבוע האחרון</u>?

	1 בכלל לא	2 פעם אחת בשבוע האחרון	3 כמעט כל יום בשבוע האחרון	4 כל יום בשבוע האחרון	5 מספר פעמים ביום בשבוע האחרון
6. **תקשורת בינאישית אחד-על-אחד**, באמצעות דואר אלקטרוני, וואטסאפ, רשת חברתית (כגון הודעה פרטית בפייסבוק),	1	2	3	4	5

שיחות קוליות או וידאו (כגון סקייפ, זום) וכד'					
7. **תקשורת בינאישית קבוצתית**, באמצעות קבוצות וואטסאפ, רשימות תפוצה, רשתות חברתית (כגון פייסבוק), שיחות ועידה קוליות או וידאו (כגון סקייפ, זום) וכד'	1	2	3	4	5
8. **חיפוש מידע**, כגון מידע על נושאי בריאות, צרכנות, כספים, חדשות וכד'	1	2	3	4	5
9. **ביצוע משימות**, כגון קניות, תשלום חשבונות, ניהול חשבון הבנק, הזמנת תורים וכד'	1	2	3	4	5
10. **פעילות פנאי קבוצתית** כגון מועדון חברתי, הרצאה, פרלמנט וכד'	1	2	3	4	5
11. **פעילויות פנאי אישית**, כגון משחקים, סרטים, מוסיקה, אלבומי תמונות וכד'	1	2	3	4	5

12. מה מבין האפשרויות הבאות מגביל עבורך את השימוש באמצעים דיגיטליים?

(**סמן/י את כל התשובות הנכונות עבורך**)

א. שום דבר לא מגביל את השימוש שלי באמצעים דיגיטליים

ב. זמינות של מכשיר דיגיטלי (למשל מחשב, סמארטפון, טאבלט)

ג. זמינות חיבור לאינטרנט

ד. יש דברים שאני לא יודע/ת לעשות

ה. יש דברים שאני חוששת לעשות

ו. אתרים לא ידידותיים

ז. שליטה בשפות זרות

ח. קושי בקריאת האותיות הקטנות

ט. זמן

י. כוח

יא. סבלנות

יב. אחר, אנא פרט/י:

_____

5.2 Perceived Stress Scale (PSS) translated questionnaire

1. מספר משתתף: _____
2. מה הגיל שלך? _____
3. מה העיסוק או עבודה הנוכחיים או האחרונים שלך? _____

בשאלת הבאות, נשאל אותך לגבי התחושות שהרגשת בחודש האחרון. אנא ענה/י בכנות, באופן הנכון לגביך. יש לדרג כל שאלה בין 1 ל-5, כאשר 1 מתייחס לכך שלא חווית כלל את האמור בחודש האחרון, ו-5 מתייחס לכך שחווית לעיתים קרובות את האמור.

בחודש האחרון, באיזו תדירות:

	אף פעם 1	כמעט אף פעם 2	לפעמים 3	לעיתים קרובות 4	לעיתים קרובות מאוד 5
4. היית עצבני/ת בגלל משהו שקרה באופן בלתי צפוי?					
5. הרגשת שאינך יכול/ה לשלוט בדברים החשובים בחייך?					
6. הרגשת לחוץ/ה?					
7. הרגשת בטוח/ה ביכולת שלך לנהל את הבעיות האישיות שלך?					

8. הרשתם שדברים הולכים בדרך שאת/ה רוצה?					
9. הרגשת שאינך יכול/ה להתמודד עם כל הדברים שהיו לך לעשות?					
10. היית מסוגל/ת לשלוט בדברים שמרגיזים אותך בחיים?					
11. הרגשת שאת/ה שולטת בדברים?					
12. התעצבנת בגלל דברים שקרו שלא בשליטתך?					
13. הרגשת שהקשיים מצטברים עד כדי כך שלא יכולת להתגבר עליהם?					

5.3 Technology acceptance model (TAM) questionnaire

1. מספר משתתף: _____

Q4

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל 1	2	3	4	5	6	מסכים/ה מאוד 7
אנשים שמשפיעים על ההתנהגות שלי חושבים שאני צריך/ה להתנסות עם הרובוט.	○	○	○	○	○	○	○
אנשים החשובים לי חושבים שאני צריך/ה לנסות את הרובוט.	○	○	○	○	○	○	○
לאנשים בסביבה שלי שמשתמשים ברובוט יש יותר יוקרה ביחס לאלה שלא.	○	○	○	○	○	○	○
אנשים בסביבה שלי שמשתמשים ברובוט מושכים הרבה תשומת לב.	○	○	○	○	○	○	○

Q5

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל 1	2	3	4	5	6	מסכים/ה מאוד 7
השתתפות בניסוי הזה עם הרובוט מהווה סממן סטטוס בסביבה שלי.	○	○	○	○	○	○	○
איכות התוצאה (הורדת רמות הסטרס) שאני משיג/ה בשימוש ברובוט הזה היא גבוהה.	○	○	○	○	○	○	○
אין לי בעייה עם איכות התוצאה (הורדת רמות סטרס) של הרובוט הזה.	○	○	○	○	○	○	○
אני מדרג/ת את איכות התוצאה של הרובוט כמצויינת (סיוע בהורדת רמות סטרס).	○	○	○	○	○	○	○

Q6

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל 1	2	3	4	5	6	מסכים/ה מאוד 7
אין לי בעייה לספר לאחרים על תוצאות השימוש ברובוט (מסייע בהורדת רמות סטרס).	○	○	○	○	○	○	○
אני מאמין/ה שאני יכול/ה להסביר לאחרים את ההשלכות של השימוש ברובוט.	○	○	○	○	○	○	○
התוצאות של השימוש ברובוט גלויות לי (הורדת רמות סטרס).	○	○	○	○	○	○	○
יכולתי לעשות שימוש באפליקציית הרובוט הנבחנת אם לא היה מישהו בסביבה שיגיד לי מה לעשות בזמן כשהשתמשתי ברובוט.	○	○	○	○	○	○	○

Q7

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל						מסכים/ה מאוד
	1	2	3	4	5	6	7
יכולתי לבדוק את האפליקציית הרובוט הנבחנת באמצעות הרובוט אם הרובוט היה מציע לי עזרה.	○	○	○	○	○	○	○
העבודה עם רובוט מלחיצה אותי.	○	○	○	○	○	○	○
רובוטים גורמים לי להרגיש לא בנוח.	○	○	○	○	○	○	○
רובוטים גורמים לי להרגיש אי שקט.	○	○	○	○	○	○	○

Q8

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל						מסכים/ה מאוד
	1	2	3	4	5	6	7
האם היית מתאר/ת את עצמך כספונטני/ת כאשר את/ה משתמש/ת ברובוט?	○	○	○	○	○	○	○
האם היית מתאר/ת את עצמך כיצירתי/ת כאשר את/ה משתמש/ת ברובוט?	○	○	○	○	○	○	○
האם היית מתאר/ת את עצמך כבעל/ת יכולת לשחק כאשר את/ה משתמש/ת ברובוט?	○	○	○	○	○	○	○
אני מוצא/ת את השימוש ברובוט כמהנה.	○	○	○	○	○	○	○

Q9

אנא ענה/י על השאלות הבאות, בהתייחס לממשק הרובוטי להורדת סטרס (עקה) שבחנת:

	לא מסכים/ה בכלל						מסכים/ה מאוד
	1	2	3	4	5	6	7
אני מוצא/ת את השימוש ברובוט כנעים.	○	○	○	○	○	○	○
אני נהנה/ נהנית להשתמש ברובוט.	○	○	○	○	○	○	○
השימוש ברובוט יכול לעזור לי בהפחתת סטרס (עקה).	○	○	○	○	○	○	○
השימוש ברובוט יכול לשפר את היעילות שלי בהפחתת סטרס (עקה).	○	○	○	○	○	○	○

Q10

אנא ענה/י על השאלות הבאות, בהתייחס לממשך הרובוטי להורדת סטרס (עקה) שבחנת:

	1 לא מסכים/ה בכלל	2	3	4	5	6	7 מסכים/ה מאוד
אני מוצא/ת שהרובוט יכול להיות שימושי להפחתת סטרס (עקה).	○	○	○	○	○	○	○
האינטראקציה שלי עם הרובוט הייתה ברורה ומובנת.	○	○	○	○	○	○	○
האינטראקציה עם הרובוט אינה דורשת מאמץ נפשי גדול.	○	○	○	○	○	○	○
אני מוצא/ת את הרובוט קל לשימוש.	○	○	○	○	○	○	○

Q11

אנא ענה/י על השאלות הבאות, בהתייחס לממשך הרובוטי להורדת סטרס (עקה) שבחנת:

	1 לא מסכים/ה בכלל	2	3	4	5	6	7 מסכים/ה מאוד
אני מוצא/ת שזה קל להכווין את הרובוט לעשות את מה שאני רוצה שיעשה.	○	○	○	○	○	○	○
בהנחה שהרובוט יהיה בשימוש קבוע במקום מגוריי, הייתי משתמש/ת ברובוט אם הוא יהיה נגיש לי.	○	○	○	○	○	○	○
בהנחה שהרובוט יהיה בשימוש קבוע, אני עשוי/ה להשתמש ברובוט אם הוא יהיה נגיש.	○	○	○	○	○	○	○
בהנחה שהרובוט יהיה בשימוש קבוע במקום מגוריי, הייתי מתכנן/ת להשתמש ברובוט בעתיד.	○	○	○	○	○	○	○

Appendix 6 – Co-design workshop sessions protocols

6.1 Co-design workshop first session protocol

ציוד:	**תפקידים:**
• מצלמת וידאו + מיקרופון + חצובה + כבל למצלמה • מדבקות עם שמות • טפסי הסכמה מדעת • פעילות תמונות רובוטים • מפת אמפתיה • ערכת ציוד codesign • דפי A4 • כיבוד + צלחות + מפיות • עטים	1. מנחה קבוצה (רעות) 2. תצפיתן – כתיבת פרוטוקול, הפעלת וידאו, צילום תמונות (איתי) 3. לוגיסטיקה – שולחן קפה וציוד (רעות) 4. סידור וארגון החדר – שולחן גדול, כיסאות סביב, פריסת ציוד צילום וציוד לסדנה (רעות)

זמן	**פעילות**	**הוראות**
0-15 דק'	התכנסות, קפה, פתיחה, חתימה על הסכמה מדעת והיכרות	- ציוד: מדבקות עם שם, כיבוד, הסכמה מדעת, עטים. - ברוכים הבאים ותודה שהסכמתם להשתתף בסדנת העיצוב המשותפת .אני רעות ,ואני אנחה את סדנת העיצוב .לפני שנתחיל לצלול לעומק ,אתחיל בהסבר כללי (לחלק טפסי הסכמה מדעת למשתתפים). - אני סטודנטית להנדסת תעשייה וניהול באוניברסיטת בן גוריון . במסגרת התואר אני עורכת מחקר ,במסגרתו אני עורכת השוואה בין עיצובים שונים של אפליקציות לרובוטים. - כחלק מהמחקר נעבור סדנה בת שלושה מפגשים ,כאשר אורך כל מפגש הוא שעה וחצי .מטרת הסדנה היא לעצב אפליקציה לרובוט טימי ,אותו נפגוש בהמשך. - ההשתתפות בסדנה הינה בהתנדבות ,והנתונים שאאסוף במהלך הסדנה חסויים ויהיו גלויים רק למנחים האקדמיים שלי ולי. - לאחר שתסכימו להשתתף בניסוי באמצעות חתימה על המסמכים שחילקתי לכם ,אקליט את הסדנאות באמצעות מצלמת וידאו, שמע ותמונה. ייתכן וארשום גם חלק מהדברים שתגידו ,מבלי להצביע על

		זהותכם .את ההקלטות אשמור בתיקייה המוגנת בסיסמה והן תהיינה חשופות רק לעורכי המחקר. - בכל שלב תוכלו לבחור להפסיק את השתתפותכם בסדנה .אם אתם מרגישים לא בנוח ,תוכלו לבקש ממני לעצור את השתתפותכם בסדנה. - בבקשה קראו את טפסי ההסכמה שלפניכם ,ובמידה ואתם מסמיכים עם הכתוב בהם חתמו עליהם. - במידה ויש לכם שאלות קראו לי ואגש אליכם. - נעשה עבשיו סבב היכרות קצר.
15-30 דק'	פעילות פתיחה – לא נפסיק לשיר	להתחיל להקליט כאן - אני רוצה שנתחיל בתחרות קטנה. אני אתן לכם מילה, למשל המילה "שלום" וכל אחד מכם יצטרך לחשוב על שיר שיש בו את המילה שאמרתי. מי שייתן את השיר ראשון יזכה בנקודה. מי שיזכה במירב הנקודות ינצח. נעשה סיבוב חימום, עבור המילה "שלום", איזה שיר אתם מכירים? החוקים ברורים? אוקיי, בואו נתחיל בתחרות. - מילים: שיר, שמש, חג, ירח, טוב. - איך הייתה לכם הפעילות ?מה הרגשתם? - שאלות מנחות: 1. האם הפעילות הייתה מהנה? 2. האם הפעילות הייתה מלחיצה? 3. האם הפעילות הייתה מביכה? 4. מה גרם לכם להרגיש ככה? 5. האם היה משהו שהתקשיתם לעשות ?מאיזו בחינה? - אז אחרי שקצת הכרנו ,בואו נתחיל .תרגישו חופשי לרשום הערות ומחשבות בדפים שחילקתי לכם כדי שתוכלו לעבוד בצורה טובה יותר במהלך הסדנה.
30-50 דק'	הצגת מטרת הסדנה	- מטרת הסדנה היא שנעצב ביחד אפליקציה רובוטית ,כמו האפליקציות שאתם משתמשים בהם בטלפונים שלכם ,לניהול רמות סטרס של מבוגרים. למעשה במקום להשתמש באפליקציה באמצעות טלפון או טאבלט ,השימוש יהיה על גבי מסך של רובוט. - בואו נפרק ביחד את המטרה.

		- מה זה סטרס ?הרגשתם פעם בסטרס ?מה הרגשתם ?מתי מרגישים סטרס? - סטרס , בעברית עקה, הוא תגובה טבעית שנועדה לעזור לנו כשאנחנו נמצאים במצב שהגוף חושב שיהיה לנו קשה להתמודד איתו. הסטרס בא לידי ביטוי בשורה של תגובות שכוללות שינויים בגוף (פיזיולוגיים) ושינויים בהתנהגות שלנו. המטרה של השינויים האלו היא לשפר את הפעילות שלנו במצב בו אנחנו נמצאים, וגם במצבים דומים בהם אנחנו עשויים להיתקל בעתיד. - למישהו יש רעיון למה חשוב לנהל סטרס ?למה סטרס יכול לגרום? - במקרים קלים סטרס יכול להוביל למגוון רגשות כמו דאגה ,מתח נפש, וחרדה. במקרים קשים יותר, בסטרס מתמשך, הסטרס עלול לגרום לבעיות פיזיות ונפשיות, למשל דיכאון, דיכוי מערכת החיסון או החמרה של מצב בריאותי אצל אנשים עם מחלות רקע. - למה דווקא להשתמש ברובוט ?מה יכולים להיות היתרונות של רובוט בטיפול באנשים ?מה יכולים להיות החסרונות של רובוט בטיפול באנשים? - לא תמיד המטפלים יכולים להעניק את הטיפול לו המטופלים זקוקים . מעבר לפגיעה במטופל ,מצב זה מעורר חוסר שביעות רצון בקרב המטפלים ומהווה גורם עיקרי התורם להתפטרות מעבודתם של מטפלים מבוגרים . - רובוטים יכולים לפקח על מבוגרים ולתמוך בפעילויות היומיומיות שלהם .מחקר שהציע לערב רובוטים בטיפול במבוגרים ,במיוחד כדי לטפל במחסור באנשי מקצוע בתחום הבריאות ,בין היתר ,מצא שהרובוט צריך לזהות ולהגיב בהתאם לצרכיו של האדם ולסייע לו , ולפעול לפי" חוקים אנושיים ,"כמו זיהוי האדם שמולו ,ציון דברים הנוגעים לאדם שהוא מסייע וכדומה .באופן כללי ,הרובוט נדרש להיות צפוי ,אמין ולא להוות איום על סביבתו. - בחינת הטמעת רובוטים בטיפול במבוגרים הראתה כי לשיטה זו יש השפעה בריאותית חיובית על משתמשי הבדיקה וכוללת הפחתת סטרס בקרב נבדקים.

		- מי יכול לדעתכם להרגיש סטרס? האם אתם מכירים מישהו שהרגיש סטרס? האם אתם הרגשתם סטרס? - לימור סיפרה לי שביחד איתכם בבית יונה גרים אנשים עם דמנציה. אתם מכירים מישהו שיש לו דמנציה מבית יונה? או בכלל? אתם חושבים שגם אדם עם דמנציה יכול להרגיש סטרס? מה אתם חושבים על זה שהרובוט ישמש את השכנים שלכם עם הדמנציה ממש כאן בבית יונה? הוא יכול לעזור להם לדעתכם? או שצריך לתת להם פתרון שונה למקרים בהם הם מרגישים סטרס? - כחלק מהמטרות שלנו אנחנו רוצים בהמשך במחקרים עתידיים, גם לערב אנשים עם דמנציה. - לפי ארגון הבריאות העולמי דמנציה מתייחסת למחלות המשפיעות , בין היתר ,על הזיכרון ועל יכולתו של החולה לבצע את שגרת יומו. סימפטום נפוץ נוסף בקרב אנשים עם דמנציה הוא קשיים בתחום השפה ,כמו כתיבה ,הבעה מילולית והבנה , אשר עלולים להוביל לקושי ספציפי בביטוי הרגשות והרצונות של הפרט .תסמינים הקשורים לשפה מתבטאים בדרך כלל בשלבים המוקדמים של דמנציה ומתפתחים באופן מהותי ככל שהמחלה מתקדמת .אנשים עם דמנציה עלולים לחוות תחושות שליליות ,כמו לחץ כתוצאה משינויים וקשיים גם בתחום השפה. - מחקרים ספציפיים על הטמעת רובוטים בטיפול במבוגרים עם דמנציה הראו שהשימוש ברובוטים דמוי אנוש סייע לשפר מדדים שנבדקו בקרב אנשים עם דמנציה ,ביניהם שיפור רגשי ושיפור ביכולתם של הנבדקים להתמודד עם לחץ .אחד המחקרים דיווח על אינטראקציות חיוביות בין משתמשי המבחן לבין הרובוטים ,שהובילו לשיפור ביכולותיהם החברתיות .מחקר זה מדגיש את החשיבות של העסקת רובוטים חברתיים לטיפול ארוך טווח בדמנציה. - עקב בעיות התנהגות והפרעות מצב רוח ,אנשים עם דמנציה נוטים לקבל ,בין היתר ,יותר תרופות הרגעה-מהפנטות ואנטי פסיכוטיות , שניתן להשתמש בהן לרעה או לשלבן בצורה בעייתית עם תרופות אחרות .שימוש לרעה בתרופות עלול להוביל לאשפוז וטעויות תרופתיות אצל אנשים עם דמנציה בסבירות גבוהה ,בהשוואה

		לאנשים ללא דמנציה .בנוסף ,השימוש בתרופות הרגעה-היפנוטיות אצל אנשים עם דמנציה נקשר לירידה קוגניטיבית מואצת ומוות בנוסף לאשפוזים . לכן, ננסה לטפל בדרכים אלטרנטיביות בסטרס אצל אנשים עם דמנציה, כמו הרובוט.
50-65 דק'	מה הם רובוטים מטפלים?	- ציוד: תמונות של סוגים שונים של רובוטים - כפעילות ראשונה שלנו, נרצה קודם כל להסתכל יחד על סוגים שונים של רובוטים שניתן להגדיר כרובוט מטפל. - הביטו בתמונות של רובוטים שונים הפזורים על השולחן. - בחרו תמונה שנראית כמו רובוט מטפל או מעניינת אותך. - הסבר לקבוצה מדוע בחרת בתמונה הזו? ענה על השאלות הכתובות בגב הכרטיס: ○ תאר/י את מאפייני הרובוט כפי שאת/ה חושב/ת או מרגיש/ה (ידידותי, אינטליגנטי, סמכותי וכו'). ○ אם היית צריך לייחס לרובוט מגדר, מה זה היה? (האם היית נותנ/ת לרובוט שם של גבר או אישה?) ○ מה את/ה אוהב/ת ברובוט הזה? ○ מה את/ה מתאר/ת לעצמך שהרובוט הזה יכול לעשות כרובוט מטפל באנשים שמרגישים סטרס?
65-85 דק'	מפת אמפתיה	- אני רוצה שנחשוב ביחד על דרך לעזור לאנשים עם דמנציה, ממש כמו השכנים שלכם כאן בבית יונה, שמרגישים סטרס לפעמים וננסה להיכנס למחשבות ולרגשות שלהם. מכיוון שאנחנו לא קהל היעד של האפליקציה שנתכנן ביחד, חשוב שנבין מה הצד של המשתמש מרגיש וחושב כשהוא נמצא בסטרס. - מה הם מרגישים כשהם בסטרס? איך הרובוט יכול לעזור להם? - מה הם רואים או שומעים כשהם מרגישים בסטרס? - מה הם אומרים כשהם מרגישים בסטרס?
85-90 דק'	סגירת המפגש ותזכורת לגבי המפגשים הבאים	- היום דיברנו בעצם על הבעייה שאנחנו רוצים לפתור. הגדרנו ביחד למה בכלל אנחנו רוצים לפתור את הבעייה (דיברנו על ההשלכות של סטרס), בעזרת מה אנחנו רוצים לפתור את הבעייה (בעזרת הרובוט), ועבור מי נרצה לפתור את הבעייה (עבור השכנים שלנו בבית יונה).

		- ביום חמישי הקרוב אנחנו ניפגש שוב ממש כאן בשעה 10:00. אני אתקשר אליכם להזכיר לכם על המפגש שלנו ביום רביעי וביום חמישי. - במפגש הבא נפגוש את טימי הרובוט, ונתחיל בעיצוב האפליקציה.

6.2 Co-design workshop second session protocol

ציוד:		**תפקידים:**
• מצלמת וידאו + מיקרופון + חצובה + כבל למצלמה • מדבקות עם שמות • שאלונים + עטים • מפת אמפתיה • ערכת ציוד codesign • דפי A4 • כיבוד + צלחות • דברים רכים – כרית, סוודר, סווטשירט, כדור רך, בובה רכה.		5. מנחה קבוצה (רעות) 6. תצפיתן – כתיבת פרוטוקול, הפעלת וידאו, צילום תמונות (איתי) 7. לוגיסטיקה – שולחן קפה וציוד (רעות) 8. סידור וארגון החדר – שולחן גדול, כיסאות סביב, פריסת ציוד צילום וציוד לסדנה (רעות)
זמן	**פעילות**	**הוראות**
0-15 דק'	התכנסות, קפה, פתיחה ומילוי שאלונים	- ציוד: מדבקות עם שם, כיבוד, שאלונים, עטים. - תודה שהגעתם למפגש היום. לפני שנתחיל בתזכורת קצרה למפגש הקודם, תמלאו בבקשה את השאלונים שלפניכם. - במפגש הקודם דיברנו על סטרס ,דמנציה ושימוש ברובוטים לטיפול . בנוסף , יצרנו מפת אמפתיה המתייחסת למבוגרים עם דמנציה. יש משהו נוסף שהייתם רוצים להוסיף למפה? יש מחשבות שעלו לכם במהלך השבוע ותרצו לשתף לפני שנמשיך? - הידע שרכשתם והניסיון לראות את העולם מנקודת המבט של המשתמש ,שהוא מבוגר עם דמנציה שחווה סטרס במקרה שלנו , יסייעו לנו בתכנון האפליקציה במפגש הזה. - עכשיו נכיר את טימי הרובוט: טימי מציג את עצמו - היי ,אני טימי ,איזה כיף לפגוש אתכם .אני הרובוט שאיתו תעבדו במהלך הסדנה. על גבי המסך שלי, שברגע מוצגות על גביו הפנים שלי, תוצג האפליקציה שתתכננו.

		- אז בעצם חוץ מזה שטימי יכול לדבר ,אפשר לראות על גביו דפי אינטרנט ,לצפות בסרטונים מיוטיוב ולראות תמונות.
15-30 דק'	איפיון האפליקציה	- ציוד: בלוק ציור, טושים, דברים רכים. - תסתכלו על מפת האמפתיה שהכנתם במפגש הקודם . תסתכלו על טימי .אני רוצה שתחשבו על האדם עם הדמנציה שחווה סטרס ורוצה להפסיק להרגיש סטרס. - לרשום ביחד איתם על הפלקט: ○ תכונות - במפגש הקודם אמרתם שאתם רוצים שהרובוט יהיה ידידותי, אינטליגנטי, האם יש תכונות נוספות שחשובות שיהיו לו? ○ מה רואים – שאלות מנחות: צבעים, צורות (עיגולים, ריבועים, קווים ישרים, קווים מעוגלים), פנים (אילו פנים, של אדם, רובוט, משהו אחר). ○ האם שומעים – שאלות מנחות: בפעם הקודמת הצעתם שהרובוט ידבר דברים טובים. מה הוא אומר? האם משמיע מוזיקה? אם מדבר באיזה טון? האם יש חשיבות לכך שיישמע כמו גבר או אישה? ○ מגע – דיברנו בפעם הקודמת על אפשרות של מגע, חיבוק. הבאתי כמה דברים רכים. משהו מהם נראה לכם מתאים? מה הכי הייתם רוצים שיהיה? קטן/גדול? באיזו צורה? משהו שיהיה כחלק מטימי / משהו שטימי מחזיק?
30-50 דק'	תכנון האפליקציה (אישי)	- אני מזכירה שהמטרה שלנו היא לתכנן אפליקציה שתסייע לאנשים מבוגרים עם דמנציה לנהל את רמות הסטרס שלהם ,כלומר תסייע להם להוריד את רמות שהם חווים כתחליף לטיפול תרופתי. בעצם אני רוצה שנתכנן משהו שנציג על גבי המסך של טימי שיעזור למי שמרגיש לחוץ / בסטרס להירגע. במפגש הקודם הזכרתם שסטרס יכול לגרום לכם להרגיש פחד, בושה, לקפוא במקום, חרדה, דיכאון, בדידות והדרכים שעוזרות לכם להתמודד עם סטרס זה להיות עם אנשים, לשמוע דברים טובים, לרקוד, לשחק, לדעת שיש מישהו שאפשר לסמוך עליו. אני רוצה שבעזרת כל מה שציינתם במפגש הקודם והיום נתחיל בתכנון אישי ראשוני של האפליקציה. אתם מוזמנים להשתמש

		בכל הציוד שלפניכם. אני רוצה שתציירו את מה שנראה באפליקציה. זה יכול להיות הפנים של הרובוט למשל, לכתוב את המילים שאתם רוצים שהוא יגיד, אולי הוא מציג כמה אפשרויות לפעילויות מרגיעות (דיברנו על כמה סוגים של דברים שיכולים להרגיע). אם יש כמה אפשרויות, האם רואים אותן במקביל (כמו למשל המסך שלנו בטלפון שאנחנו רואים את כל האפליקציות ואנחנו בוחרים את האפליקציה בה אנחנו רוצים להשתמש) או שהדברים מוצגים בסדר טורי, למשל קודם הרובוט מדבר ואח"כ משחקים משחק (במקרה הזה האם חייבים לשחק משחק? האם חייבים לדבר עם הרובוט? או שיש אפשרות להפסיק באמצע). אני כן רוצה שתחשבו על המאפיינים של הרובוט, אבל העיקר במשימה הזאת היא התובן, כלומר מה הרובוט עושה, אומר, איך עובדת האינטראקציה בינו לבין האדם, וכו'.
50-65 דק'	הצגת התכנון האישי	- כל אחד מציג מה הוא עשה ולמה הוא בחר את הבחירות שעשה.
65-85 דק'	תכנון האפליקציה (קבוצתי)	- אני רוצה שניקח את מה שציירתם ותכננתם, וביחד עם המאפיינים ומפת האמפתיה שנעצב ביחד את האפליקציה. זה יהיה אב טיפוס בשלב הזה, לכן זה בסדר אם תעלו רעיונות שגם אי אפשר ליישם אותם ובסוף הרובוט יהיה מסוגל לבצע רק חלק מהדברים. - (אם מתקדם טוב אולי לנסות כבר ממש ביחד איתם לתכנת את הרובוט).
85-90 דק'	סגירת המפגש ותזכורת לגבי המפגשים הבאים	- היום נכנסו כבר לעומקו של העיצוב של הממשק. אחרי המפגש אני אקח את כל הדברים שדיברתם עליהם ואנסה לתכנת אותם בטימי. בשבוע הבא ננסה להשתמש ביחד בממשק שעיצבתם היום. חשוב לי להדגיש שזה אב טיפוס בלבד, ויכול להיות שלא כל התכונות או הפעולות שביקשתם יבוצעו, אשתדל למצוא כמה שיותר פתרונות כדי שאצליח לתכנת את הרובוט לעשות את מה שביקשתם. - ביום חמישי הבא אנחנו ניפגש שוב ממש כאן בשעה 10:00. אני אתקשר אליכם להזכיר לכם על המפגש שלנו ביום חמישי.

6.3 Co-design workshop third session protocol

ציוד:	**תפקידים:**
	9. מנחה קבוצה (רעות)

• מצלמת וידאו + מיקרופון + חצובה + כבל למצלמה • מדבקות עם שמות • מפת אמפתיה • ציורי רובוט מהמפגש הקודם • ערכת ציוד codesign • דפי A4 • כיבוד + צלחות • דברים רכים – כרית, סוודר, סווטשירט, כדור רך, בובה רכה. • טימי + מטען	10. תצפיתן – כתיבת פרוטוקול, הפעלת וידאו, צילום תמונות (בר) 11. לוגיסטיקה – שולחן קפה וציוד (רעות) 12. סידור וארגון החדר – שולחן גדול, כיסאות סביב, פריסת ציוד צילום וציוד לסדנה (רעות)

זמן	פעילות	הוראות
0-15 דק'	התכנסות, קפה, פתיחה והתנסות בממשק	- ציוד: מדבקות עם שם, כיבוד, שאלונים, עטים. - תודה שהגעתם למפגש היום. נתחיל בתזכורת קצרה על המפגש הקודם. דיברנו על הפעילויות שאנחנו רוצים שיהיו בממשק שאנחנו מעצבים, קצת על מה הרובוט יגיד וגם קצת על העניין של החיבוק והמגע. - הכנתי את הממשק שעליו הסכמנו בסוף המפגש הקודם, שמורכב משיחה עם טימי ולאחריה בחירה של פעילות מרגיעה. אני רוצה שתנסו להשתמש בעצמכם בממשק ביחד. תדמיינו שאני לא כאן ושאתם מרגישים בלחץ. - אני מזכירה לכם שזה אב-טיפוס. עשיתי את כל המאמצים כדי שהוא יהיה דומה כמה שיותר למה שרציתם, אבל יכול להיות שחלק מהדברים לא יעבדו כמו שציפיתם.
15-25 דק'	ניתוח הרגשה לאחר השימוש	- רציתי לשאול איך הרגיש לכם השימוש בממשק? ○ האם אתם מרגישים רגועים? ○ האם אתם מרגישים לחוצים? ○ האם אתם מרגישים שמחים? ○ האם אתם מרגישים עצובים? ○ האם אתם מרגישים בעוסים? ○ האם אתם מרגישים פחד?

		○ האם השימוש בממשק היה קל או קשה? ○ האם נדרש לכם זמן רב ללמוד את השימוש בממשק? ○ האם לדעתכם צריך מישהו שיסביר על הממשק לפני שמשתמשים בו? למה?
25-65 דק'	בחינת הממשק וביצוע שינויים בהתאם לצורך	- ציוד: דף וטושים / עטים. - אני הולכת להציג לכם כמה קריטריונים לעיצוב הממשק שלנו להורדת לחץ. לכל קריטריון אציג כמה חלופות. אני רוצה שתבחרו את החלופה המועדפת עליכם ותרשמו אותה על גבי הדף. אחרי שכולם ירשמו את החלופה המועדפת, כל אחד יציג מה הוא מעדיף ולמה. - הפנים של טימי: **ולמה** ○ אפשרות 1: ברירת המחדל. ○ אפשרות 2: אנימציה שלי, הרבה פה מוארך (מופתע / מבוהל). ○ אפשרות 3: אנימציה שלי, הרבה פה רחב. ○ צבע הפנים של טימי – לבן / ורוד. - המלל שטימי אומר: **ולמה** ○ האם השיחה הייתה ארוכה / קצרה? ○ האם לאפשר לסיים את השיחה בכל שלב שרוצים? או שחייבים לדבר איתו ולענות על כל השאלות? ○ האם הייתם שואלים משהו אחר במקום אחת או חלק מהשאלות? ○ האם הייתם מוסיפים משהו לשיחה? - מסך ראשי: **ולמה** ○ בחירה מבין 3 אפשרויות של צבעים. ○ עם אייקונים, או בלי אייקונים. ○ כמות הכפתורים – לבחור בין 6 אפשרויות, 5 אפשרויות ו-4 אפשרויות. ○ האם אתם חושבים שכל הפעילויות מתאימות להרגעה? האם יש פעילויות שרוצים להוסיף / להוריד? - אפשרויות מוזיקה: **ולמה** ○ האם לאפשר לבחור בין האזנה למוזיקה, שירה וריקוד? ○ עם אייקונים או בלי? ○ בחירת השירים + הסרטונים.

		- תצוגת שירים: **ולמה** o לבחור בין 5/4/3 אפשרויות של שירים. o לבחור תצוגה. - התעמלות: **ולמה** o בחירת סרטון. o האם משנה השפה של הסרטון? o האם להציג תרגום? בטקסט? או בשמע? - סרטון מרגיע: **ולמה** o לבחור בין 4/3/2 אפשרויות לסרטונים. o עם תמונות / בלי תמונות? o עם אייקונים / בלי אייקונים? o בחירת סרטונים - הרצאות: **ולמה** o אילו הרצאות ירגיעו אתכם? o באיזה נושא? o מי המרצה? o האם המגדר של המרצה חשוב? o האם תינתן בחירה בין כמה אפשרויות? או שתוצג הרצאה אחת? o מה אורך ההרצאה? - סרטים: **ולמה** o איזה סגנון סרטים? o תנו דוגמאות לסרטים מרגיעים. o מה אורך הסרטים? o האם תינתן בחירה בין כמה אפשרויות? או שתוצג הרצאה אחת? - מגע: **ולמה** o משהו על טימי? (כמו סוודר) או משהו שהוא נושא איתו (כמו בדור) o לובש סוודר? או מונח עליו סוודר? o איפה נמצא הציוד שהוא נושא איתו? מקדימה או מאחורה?

		○ איזה ציוד הוא לוקח איתו? (בחירה מתמונות באינטרנט לפי השיחה). רעיונות: בובה, כרית, כדור רך, כרית עם אורז בריח נעים – לצייר. ○ איך טימי מציע לקחת ממנו את הדברים? אולי מציע לחבק אותו? אולי מציע ללטף אותו?
65-75 דק'	שימוש חוזר בממשק	- עושים שימוש חוזר בממשק לאחר העיצוב בשנית.
75-90 דק'	ניתוח הרגשה לאחר השימוש	- רציתי לשאול איך הרגיש לכם השימוש בממשק? ○ האם אתם מרגישים רגועים? ○ האם אתם מרגישים לחוצים? ○ האם אתם מרגישים שמחים? ○ האם אתם מרגישים עצובים? ○ האם אתם מרגישים כעוסים? ○ האם אתם מרגישים פחד? ○ האם השימוש בממשק היה קל או קשה? ○ האם נדרש לכם זמן רב ללמוד את השימוש בממשק? ○ האם לדעתכם צריך מישהו שיסביר על הממשק לפני שמשתמשים בו? למה? - תסתכלו על הדף שרשמתם בו את הקריטריונים לשינויים. האם אתם חושבים שנדרש לשנות משהו נוסף? למה?
90-95 דק'	סגירת המפגש	- תודה רבה שהשתתפתם בסדנה. אני ממש מעריכה את זה. - אני רוצה לתאם עם לימור הרצאה נוספת שאני או אחד מהמנחים שלי בפרויקט יעביר בשבועות הקרובים (יעל או איתי). כאות תודה על ההשתתפות שלכם, רציתי להציע שאתם תבחרו את הנושא של ההרצאה שתועבר. מה יכול לעניין אתכם? תרצו ללמוד יכולת חדשה? או לקבל מידע? - בנוסף, אני מגייסת משתתפים לניסוי, בו ישתמשו בממשק שעיצבנו ביחד כאן היום. אם יש לכם חברים מבית יונה שאתם חושבים שיכול לעניין אותם להשתמש בממשק שעיצבתם או שתרצו להראות להם את הממשק, אשמח שתקשרו בנינו. - תודה רבה לכם, ונתראה שוב בקרוב.

Appendix 7 – Stroop test

7.1 Stroop test example

7.2 Stroop test's timer html code for Qualtrics

7.2.1 Timer's code for the first question

```
<script type="text/javascript">
Qualtrics.SurveyEngine.addOnload(function() {
    var totalSurveyTime = 60;
    var startTime = Date.now();
    // Function to update the timer display
    function updateTimer() {
        var currentTime = Date.now();
        var elapsedTime = (currentTime - startTime) / 1000; // Elapsed time in seconds
        var timeLeft = Math.max(0, totalSurveyTime - elapsedTime); // Time left in seconds
        // Convert timeLeft to minutes and seconds
        var minutes = Math.floor(timeLeft / 60);
        var seconds = Math.floor(timeLeft % 60);
        // Format the time remaining
```

```
        var formattedTime = minutes.toString().padStart(2, '0') + ':' + seconds.toString().padStart(2, '0');
        // Update the timer display
        document.getElementById('timerDisplay').textContent = formattedTime;
        // Check if time is up
        if (timeLeft <= 0) {
            clearInterval(interval); // Stop the timer
            document.getElementById('timerDisplay').textContent = 'Time\'s up!';
            // Redirect or handle end of survey here
            window.location.href = "https://view.genially.com/667d1c1a1b7c540014e0b232/interactive-content-2"; // Replace with your destination URL
        }
    }
    // Update the timer every second
    var interval = setInterval(updateTimer, 1000);
    // Call updateTimer immediately to start the countdown
    updateTimer();
});
</script>
<div id="countdown_timer">
    <p style="text-align: center;">
        <span style="font-size: 37px;">
            <span id="timerDisplay">01:00</span>
        </span>
    </p>
</div>
```

7.2.2 Timer's code for all the questions but the first question

```
<script type="text/javascript">
Qualtrics.SurveyEngine.addOnload(function() {
    var totalSurveyTime = 60; // Total time in seconds for the entire survey
    //var startTime = parseInt("${e://Field/surveyStart}");
```

```
    // Function to update the timer display
    function updateTimer() {
        var currentTime = Date.now();
        var elapsedTime = (currentTime - startTime) / 1000; // Elapsed time in seconds
        var timeLeft = Math.max(0, totalSurveyTime - elapsedTime); // Time left in seconds
        // Convert timeLeft to minutes and seconds
        var minutes = Math.floor(timeLeft / 60);
        var seconds = Math.floor(timeLeft % 60);
        // Format the time remaining
        var formattedTime = minutes.toString().padStart(2, '0') + ':' + seconds.toString().padStart(2, '0');
        // Update the timer display
        document.getElementById('timerDisplay').textContent = formattedTime;
        // Check if time is up
        if (timeLeft <= 0) {
            clearInterval(interval); // Stop the timer
            document.getElementById('timerDisplay').textContent = 'Time\'s up!';
            // Redirect or handle end of survey here
            window.location.href = "https://view.genially.com/667d1c1a1b7c540014e0b232/interactive-content-2"; // Replace with your destination URL
        }
    }
    // Update the timer every second
    var interval = setInterval(updateTimer, 1000);
    // Call updateTimer immediately to start the countdown
    updateTimer();
});
</script>
<div id="countdown_timer">
    <p style="text-align: center;">
        <span style="font-size: 37px;">
```

```
          <span id="timerDisplay"></span>
        </span>
    </p>
</div>
```

Appendix 8 – Temi robot's sequences in the experiment

שלב	טקסט זבר	טקסט נקבה	תצוגת מסך	הערות
1	שָׁלוֹם אֲנִי טִימִי הָרוֹבּוֹט, נעים להכיר.	שָׁלוֹם אֲנִי טִימִי הָרוֹבּוֹט, נעים להכיר.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	הַנּסּוּי יִתְבַּצַּע בְּיַחַד אִתִּי, עַל גַּבֵּי הַמָּסָךְ שֶׁלִּי, שֶׁכָּרֶגַע הַפָּנִים שֶׁלִּי מֻקְרָנוֹת עַל גַּבָּיו.	הַנּסּוּי יִתְבַּצַּע בְּיַחַד אִתִּי, עַל גַּבֵּי הַמָּסָךְ שֶׁלִּי, שֶׁכָּרֶגַע הַפָּנִים שֶׁלִּי מֻקְרָנוֹת עַל גַּבָּיו.		
			פנים טימי מחייך (רק בעיצוב prototype A)	
2	מִיָּד אַצִּיג לָך סִרְטוֹן מַרְגִּיעַ, במטרה למדוד אֶת המדדים שלך בִּזְמַן רְגִיעָה.	מִיָּד אַצִּיג לָח סִרְטוֹן מַרְגִּיעַ, במטרה למדוד אֶת המדדים שֶׁלָּח בִּזְמַן רְגִיעָה.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	נַסֵּה לִנְשֹׁם בְּצוּרָה רְגִילָה וּלְהֵרָגַע.	נַסִּי לִנְשֹׁם בְּצוּרָה רְגִילָה וּלְהֵרָגַע.		
	כְּדֵי לְהַפְעִיל אֶת הסרטון, לחץ עַל שני כפתורי הַהַפְעָלָה, שיופיעו אחד אחרי השני בְּמֶרְכַּז הַמָּסָךְ שֶׁלִּי, אלו הם כפתורים בְּצוּרַת מְשֻׁלָּשׁ.	כְּדֵי לְהַפְעִיל אֶת הסרטון, לחצי עַל שני כפתורי הַהַפְעָלָה, שיופיעו אחד אחרי השני בְּמֶרְכַּז הַמָּסָךְ שֶׁלִּי, אלו הם כפתורים בְּצוּרַת מְשֻׁלָּשׁ.		
3	כָּעֵת תבצע מִבְחַן סְטְרוּפּ. לפניך יֵצְגוּ שֵׁמוֹת שֶׁל צְבָעִים. כל מילה כזו תהיה צבועה בצבע. עליך	כָּעֵת תֵּבַצְעִי מִבְחַן סְטְרוּפּ. לפנייך יֵצְגוּ שֵׁמוֹת שֶׁל צְבָעִים. כל מילה כזו תהיה צבועה בצבע. עלייך	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat

	יהיה לִבְחֹר בְּצֶבַע, בּוֹ המילה צְבוּעָה, מבין שני הצבעים, שיופיעו בתוך מלבנים, המוצגים על גבי המסך.	יהיה לִבְחֹר בְּצֶבַע, בּוֹ המילה צְבוּעָה, מבין שני הצבעים, שיופיעו בתוך מלבנים, המוצגים על גבי המסך.		
	כך ייראה המסך במבחן. בחלקו העליון של המסך, יוצג טיימר המציג, את הזמן הנותר, להשלמת המבחן. במבחן, תצטרך לַעֲנוֹת, עַל כַּמָּה שְׁאֵלוֹת, בְּזְמַן מֻגְבָּל שֶׁל דקה. כְּדֵי לַעֲנוֹת עַל שְׁאֵלָה, לחץ עַל המלבן, שאתה חושב, שמכיל את התשובה הַנְּכוֹנָה. לאחר מכן, יש ללחוץ עַל כפתור הַבָּא, שֶׁבְּתַחְתִּית הַמָּסָךְ בְּצַד יָמִין, הַצָּבוּעַ בְּצֶבַע שחור, כדי להמשיך לשאלה הבאה. עליך לבחור בצבע, בו המילה צבועה. במקרה זה התשובה הנכונה היא אדום,	כך ייראה המסך במבחן. בחלקו העליון של המסך, יוצג טיימר המציג, את הזמן הנותר, להשלמת המבחן. במבחן, תצטרכי לַעֲנוֹת, עַל כַּמָּה שְׁאֵלוֹת, בְּזְמַן מֻגְבָּל שֶׁל דקה. כְּדֵי לַעֲנוֹת עַל שְׁאֵלָה, לִיחְצִי עַל המלבן, שעת חושבת, שמכיל את התשובה הַנְּכוֹנָה. לאחר מכן, יש ללחוץ עַל כפתור הַבָּא, שֶׁבְּתַחְתִּית הַמָּסָךְ בְּצַד יָמִין, הַצָּבוּעַ בְּצֶבַע שחור, כדי להמשיך לשאלה הבאה. עלייך לבחור בצבע, בו המילה צבועה. במקרה זה התשובה הנכונה היא אדום,		תצוגת התמונה במצב repeat

	מכיוון שהמילה צבועה בצבע אדום. נעבור לדוגמה.	מכיוון שהמילה צבועה בצבע אדום. נעבור לדוגמה.		
	אָנָּא אֱמֹר בְּקוֹל אֶת התשובה שאתה חושב שהיא הַנְּכוֹנָה, אדום או כחול?	אָנָּא אימרי בְּקוֹל אֶת התשובה שעת חושבת שהיא הַנְּכוֹנָה, אדום או כחול?		זמן תצוגה 8 שניות
	הַתְּשׁוּבָה הַנְּכוֹנָה הִיא כָּחֹל, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע כָּחֹל. בַּמִּבְחָן, תצטרך לִבְחֹר, אֶת המלבן הַכָּחֹל.	הַתְּשׁוּבָה הַנְּכוֹנָה הִיא כָּחֹל, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע כָּחֹל. בַּמִּבְחָן, תצטרכי לִבְחֹר, אֶת המלבן הַכָּחֹל.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	נַעֲבֹר לְדוגמה אַחֶרוֹנָה. אָנָּא אֱמֹר בְּקוֹל, אֶת התשובה שאתה, חושב שהיא הַנְּכוֹנָה.	נַעֲבֹר לְדוגמה אַחֶרוֹנָה. אָנָּא אימרי בְּקוֹל, אֶת התשובה שעת, חושבת שהיא הַנְּכוֹנָה.		זמן תצוגה 9 שניות
	התשובה הַנְּכוֹנָה הִיא אדום, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע אדום.	התשובה הַנְּכוֹנָה הִיא אדום, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע אדום.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	לֹא נִתָּן לַחֲזֹר אָחוֹרָה לאחר לחיצה על כפתור הבא. בְּהַצְלָחָה!	לֹא נִתָּן לַחֲזֹר אָחוֹרָה לאחר לחיצה על כפתור הבא. בְּהַצְלָחָה!		
4	הַזְּמַן נגמר. מִבְחַן סְטָרוּפ הושלם. כָּעֵת נַעֲבֹר לאפליקציה,	הַזְּמַן נגמר. מִבְחַן סְטָרוּפ הושלם. כָּעֵת נַעֲבֹר לאפליקציה,	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat

	שתצטרך לִבְחֹן בְּמִסְגֶּרֶת הַנִּסּוּי,. בסוף הניסוי, תידרש לענות על שאלות אודות האפליקציה, אנא בדוק אותה בקפידה.	שתצטרכי לִבְחֹן בְּמִסְגֶּרֶת הַנִּסּוּי,. בסוף הניסוי, תידרשי לענות על שאלות אודות האפליקציה, אנא בידקי אותה בקפידה.		
	הנך מועבר לאפליקציה	**הנך מועברת לאפליקציה**	תמונה עם הכיתוב הנך מועבר/ת לאפקליציה	זמן תצוגה 5 שניות
	טקסט בהתאם לעיצוב	טקסט בהתאם לעיצוב	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
			פנים טימי מחייך אחרי כל שאלה בזמן שממתין לתשובה (רק עבור עיצוב prototype A)	
5	כָּעֵת תבצע מִבְחַן סְטְרוּפּ נוסף. לפניך יְצָגוּ שֵׁמוֹת שֶׁל צְבָעִים. כל מילה כזו תהיה צבועה בצבע. עליך יהיה לִבְחֹר בְּצֶבַע, בּוֹ המילה צְבוּעָה, מבין שני הצבעים, שיופיעו בתוך מלבנים, המוצגים על גבי המסך.	כָּעֵת תְּבַצְּעִי מִבְחַן סְטְרוּפּ נוסף. לפנייך יְצָגוּ שֵׁמוֹת שֶׁל צְבָעִים. כל מילה כזו תהיה צבועה בצבע. עלייך יהיה לִבְחֹר בְּצֶבַע, בּוֹ המילה צְבוּעָה, מבין שני הצבעים, שיופיעו בתוך מלבנים, המוצגים על גבי המסך.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	הנה דוגמה לתזכורת קצרה. אָנָּא אִמֹּר בְּקוֹל אֶת	הנה דוגמה לתזכורת קצרה. אָנָּא אימרי בְּקוֹל אֶת		זמן תצוגה 10 שניות

	התשובה שאתה חושב שהיא הַנְּכוֹנָה, אדום או כחול?	התשובה שעת חושבת שהיא הַנְּכוֹנָה, אדום או כחול?		
	הַתְּשׁוּבָה הַנְּכוֹנָה הִיא כָּחֹל, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע כָּחֹל. במבחן, תצטרך לִבְחֹר, אֶת המלבן הַכָּחֹל.	הַתְּשׁוּבָה הַנְּכוֹנָה הִיא כָּחֹל, מִכֵּיוָן שהמילה, צְבוּעָה בְּצֶבַע כָּחֹל. במבחן, תצטרכי לִבְחֹר, אֶת המלבן הַכָּחֹל.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
	לֹא נִתָּן לַחֲזֹר אָחוֹרָה לאחר לחיצה על כפתור הבא. בְּהַצְלָחָה!	לֹא נִתָּן לַחֲזֹר אָחוֹרָה לאחר לחיצה על כפתור הבא. בְּהַצְלָחָה!		
6	הַזְּמַן נגמר. מבחן סְטְרוּפּ הושלם. כָּעֵת נַעֲבֹר לִשְׁאֵלוֹן הַסִּיּוּם.	הַזְּמַן נגמר. מבחן סְטְרוּפּ הושלם. כָּעֵת נַעֲבֹר לִשְׁאֵלוֹן הַסִּיּוּם.	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
7	הניסוי הסתיים. תודה ולהתראות	הניסוי הסתיים. תודה ולהתראות	פנים טימי מדבר	תצוגת הפנים של טימי במצב repeat
			פנים טימי מחייך (רק בעיצוב prototype A)	

Appendix 9 – Experiment checklist

<u>הכנות לניסוי:</u>

- חיישן:
  - ☐ הטענת החיישן.
  - ☐ סידור הרצועות.
  - ☐ פתיחת תוכנת oscilloscope מהמחשב.
  - ☐ חיבור המחשב לרשת האינטרנט של הפלאפון.
  - ☐ הדלקת החיישן.
- טימי (רובוט):
  - ☐ הטענת הרובוט.
  - ☐ הדלקת הרובוט.
  - ☐ חיבור לרשת אלחוטית.
  - ☐ הרצת הניסוי לבדיקת עבודה תקינה של כלל הקישורים.
  - ☐ במידה והממשק הנבחן הוא 2 – הוספת סל אביזרים לטימי.
- סביבת הנסיין:
  - ☐ לקיחת טופס ההסכמה המדעת של המשתתף הקודם.
  - ☐ הנחת טופס הסכמה מדעת חדש.
  - ☐ כתיבת מספר הנבדק על גבי הלוח המחיק.
- וידאו:
  - ☐ טעינת מצלמת הוידאו.
  - ☐ הצבת החצובה.
  - ☐ מיקום המצלמה על גבי החצובה.

<u>הפעלת הניסוי:</u>

- ☐ לבקש להניח תיק בצד, לשים בתוכו את הטלפון הנייד על מצב שקט.
- ☐ להסביר על הניסוי.
- ☐ חתימה על הסכמה מדעת.
- ☐ ענידת החיישן למשתתפ/ת על היד שאינה דומיננטית.
- ☐ הפעלת מצלמת הוידאו.
- ☐ מענה על שאלוני רקע (https://bgu.qualtrics.com/jfe/form/SV_8ivbOHpRfr2igUC).
- ☐ הפעלת תרחיש 2 (לאחריו יגיע סרטון מרגיע https://youtu.be/oflmKyMGm5k).
- ☐ הפעלת תרחיש 3 (לאחריו המשתתף עונה על מבחן סטרופ 1 https://bgu.qualtrics.com/jfe/form/SV_5irCylpAdLLgFsG).
- ☐ הפעלת תרחיש 4.
- ☐ הפעלת תרחיש 5.
- ☐ הפעלת תרחיש 6 (לאחריו יופיע הממשק הנבחן:

ממשק 1: https://view.genially.com/66648f42f01fdd001450212c/interactive-content--

ממשק 2: https://view.genially.com/6660e61f8400e100144fd965/interactive-content-3-).

- ☐ הפעלת תרחיש 7 (לאחריו המשתתף יענה על מבחן סטרופ 2 https://bgu.qualtrics.com/jfe/form/SV_aYktbRVyrqmwdq6).
- ☐ הפעלת תרחיש 8 (לאחריו שאלון סיום: https://bgu.qualtrics.com/jfe/form/SV_5b9StsnmA4gSZaS).
- ☐ הפעלת תרחיש 9.
- ☐ אני – תודה שהשתתפת בניסוי. יש לך שאלות? הצעות לשיפור?

Appendix 10 – Older adults invitation for participating in co-design workshop and experiment

Appendix 11 – Data analysis code

11.1 Emotibit data analysis

11.1.1 Timestamps converter + merge notes and data

```
import pandas as pd
from datetime import datetime
import numpy as np
def convert_timestamp(timestamp):
    try:
        # Convert Unix timestamp to datetime
        dt = datetime.fromtimestamp(float(timestamp))
        # Format the datetime as requested
        return dt.strftime('%d-%m-%y %H:%M:%S')
    except Exception as e:
        print(f"Error converting timestamp {timestamp}: {e}")
        return None
def find_closest_timestamp(target, timestamps, direction='after'):
    if direction == 'after':
```

```
        return min((ts for ts in timestamps if ts >= target), default=None)
    else:  # 'before'
        return max((ts for ts in timestamps if ts <= target), default=None)
def safe_to_datetime(ts):
    try:
        return pd.to_datetime(ts, unit='s' if ts.isdigit() else None)
    except:
        return pd.NaT
# Load the BI.csv file
bi_data = pd.read_csv('C:/Users/Owner/Desktop/Emotibit data/102/2024-07-08_12-42-16-956568_BI.csv')  # Replace with your actual file name
un_df = pd.read_csv('C:/Users/Owner/Desktop/Emotibit data/102/2024-07-08_12-42-16-956568_UN.csv')
# Convert LocalTimestamp to the requested format
bi_data['FormattedTime'] = bi_data['LocalTimestamp'].apply(convert_timestamp)
# Reorder columns to put FormattedTime at the beginning
columns = ['FormattedTime'] + [col for col in bi_data.columns if col != 'FormattedTime']
bi_data = bi_data[columns]
# Convert LocalTimestamp to datetime
bi_data['LocalTimestamp_dt'] = bi_data['LocalTimestamp'].apply(safe_to_datetime)
un_df['LocalTimestamp_dt'] = un_df['LocalTimestamp'].apply(safe_to_datetime)
# If conversion failed, use numeric sorting
if bi_data['LocalTimestamp_dt'].isna().all() or un_df['LocalTimestamp_dt'].isna().all():
    bi_data['LocalTimestamp_dt'] = pd.to_numeric(bi_data['LocalTimestamp'], errors='coerce')
    un_df['LocalTimestamp_dt'] = pd.to_numeric(un_df['LocalTimestamp'], errors='coerce')
# Sort both dataframes by LocalTimestamp
bi_data = bi_data.sort_values('LocalTimestamp')
un_df = un_df.sort_values('LocalTimestamp')
# Create a copy of bi_data and add a new 'UN' column
merged_df = bi_data.copy()
merged_df['UN'] = np.nan
# Create a dictionary for faster lookup
```

```
bi_dict = dict(zip(bi_data['LocalTimestamp'], bi_data.index))
# Iterate through UN dataframe
for _, un_row in un_df.iterrows():
    un_timestamp = un_row['LocalTimestamp']
    un_data = un_row['UN']
    if un_timestamp in bi_dict:
        # Exact match found
        merged_df.at[bi_dict[un_timestamp], 'UN'] = un_data
    else:
        if str(un_data).startswith('end'):
            # Look for closest timestamp before
            closest_ts = find_closest_timestamp(un_timestamp, bi_data['LocalTimestamp'],
'before')
        else:
            # Look for closest timestamp after
            closest_ts = find_closest_timestamp(un_timestamp, bi_data['LocalTimestamp'],
'after')
        if closest_ts is not None:
            merged_df.at[bi_dict[closest_ts], 'UN'] = un_data
# Remove LocalTimestamp_dt from columns if it exists
if 'LocalTimestamp_dt' in columns:
    columns.remove('LocalTimestamp_dt')
# Calculate squared difference between consecutive rows in the 'BI' column
merged_df['diff^2'] = (merged_df['BI'].diff() ** 2).fillna(0)
# Save the merged dataframe to a new CSV file
merged_df.to_csv('BI_time_notes_102.csv', index=False)
```

11.1.2 RMSSD calculator

```
import pandas as pd
import numpy as np
from datetime import datetime
# Read the CSV file
df = pd.read_csv('C:/Users/Owner/Desktop/Emotibit data/102/BI_time_notes_102.csv')
```

```
def convert_timestamp(timestamp):
    try:
        # Convert Unix timestamp to datetime
        dt = datetime.fromtimestamp(float(timestamp))
        # Format the datetime as requested
        return dt.strftime('%d-%m-%y %H:%M:%S')
    except Exception as e:
        print(f"Error converting timestamp {timestamp}: {e}")
        return None
def safe_to_datetime(ts):
    try:
        return pd.to_datetime(ts, unit='s' if ts.isdigit() else None)
    except:
        return pd.NaT
# Convert and format the 'LocalTimestamp' column
df['FormattedTimeNew'] = df['LocalTimestamp'].apply(convert_timestamp)
df['FormattedTimeNew'] = df['FormattedTimeNew'].apply(safe_to_datetime)
# Define a function to calculate time differences
def calculate_time_difference(start_label, end_label):
    start_times = df.loc[df['UN'] == start_label, 'FormattedTimeNew']
    end_times = df.loc[df['UN'] == end_label, 'FormattedTimeNew']
    if not start_times.empty and not end_times.empty:
        start_time = start_times.iloc[0]
        end_time = end_times.iloc[0]
        # Calculate the difference in seconds
        return (end_time - start_time).total_seconds()
    else:
        return None
# Calculate the time differences
time_differences = {
    'relaxing video': calculate_time_difference('relaxing video', 'end of relaxing video'),
    'stroop1': calculate_time_difference('stroop1', 'end of stroop1'),
```

```
    'app using': calculate_time_difference('app using', 'end of app using'),
    'stroop2': calculate_time_difference('stroop2', 'end of stroop2')
}
# Convert time differences to hh:mm:ss format
time_differences_formatted = {key: pd.to_timedelta(value, unit='s') for key, value in time_differences.items() if value is not None}
# Create a DataFrame to store the time differences
time_diff_df = pd.DataFrame(list(time_differences_formatted.items()), columns=['Activity', 'Time Difference'])
# Format the 'Time Difference' column to hh:mm:ss
time_diff_df['Time Difference'] = time_diff_df['Time Difference'].apply(lambda x: str(x).split()[-1])
# Define the ranges based on the "UN" column
ranges = {
    "relaxing video": ("relaxing video", "end of relaxing video"),
    "stroop1": ("stroop1", "end of stroop1"),
    "app using": ("app using", "end of app using"),
    "stroop2": ("stroop2", "end of stroop2")
}
# Initialize a list to store the average values
avg_diff2_values = []
# Calculate the averages for each range
for key, (start, end) in ranges.items():
    start_index = df[df['UN'] == start].index[0] + 1
    end_index = df[df['UN'] == end].index[0]
    # Calculate the average of "diff^2" for the given range
    avg_diff2 = df.loc[start_index:end_index, 'diff^2'].mean()
    avg_diff2_values.append(avg_diff2)
# Add the calculated averages to the new column "avg(diff^2)"
time_diff_df['avg(diff^2)'] = avg_diff2_values
# Calculate the square root of each value in "avg(diff^2)" and add it to "sqrt(avg)"
time_diff_df['sqrt(avg)'] = np.sqrt(time_diff_df['avg(diff^2)'])
```

```
# Merge the original DataFrame with the new calculated columns
result_df = pd.concat([df, time_diff_df], axis=1)
# Save the modified DataFrame to a new CSV file
output_file_path = 'calc_time_102.csv'
result_df.to_csv(output_file_path, index=False)
```

11.2 PSS score calculation

```
import pandas as pd
# Function to reverse score specific items
def reverse_score(value):
    return 6 - value  # Since your scale is 1-5, reverse scoring is 6 - original score
# Function to interpret the total score
def interpret_score(total_score):
    if total_score <= 23:
        return "Low Stress"
    elif total_score <= 36:
        return "Moderate Stress"
    else:
        return "High Stress"
# Load the Excel file
input_file = 'C:/Users/Owner/Desktop/PSS/PSS data_No invalids.xlsx'  # Replace with your input file name
output_file = 'PSS_scoring_No invalids.xlsx'  # Replace with your desired output file name
# Read the Excel file
df = pd.read_excel(input_file)
# Strip whitespace from column names
df.columns = df.columns.str.strip()
# Reverse score the necessary columns and store in new columns
df['reverse_statement4'] = df['statement4'].apply(reverse_score)
df['reverse_statement5'] = df['statement5'].apply(reverse_score)
df['reverse_statement7'] = df['statement7'].apply(reverse_score)
df['reverse_statement8'] = df['statement8'].apply(reverse_score)
# Calculate the total score using the new reverse-scored columns
```

```
df['total score'] = (df['statement1'] + df['statement2'] + df['statement3'] + df['reverse_statement4'] + df['reverse_statement5'] + df['statement6'] + df['reverse_statement7'] + df['reverse_statement8'] + df['statement9'] + df['statement10'])
# Interpret the total score
df['Interpretation'] = df['total score'].apply(interpret_score)
# Save the results to a new Excel file, including both original and reversed scores
df.to_excel(output_file, index=False)
print(f"Results saved to {output_file}")
```

11.3 TAM Mann-Whitney U test code

```
library(readxl)
library(dplyr)
library(tidyr)
library(stats)
# Read the Excel file
data <- read_excel("C:/Users/Owner/Desktop/TAM/All data.xlsx")
dataset <- data[-c(43, 44, 45, 46, 47), ]
pu_cols <- grep("^TAM_PU", colnames(dataset), value = TRUE)
peou_cols <- grep("^TAM_PEOU", colnames(dataset), value = TRUE)
bi_cols <- grep("^TAM_BI", colnames(dataset), value = TRUE)
# Print identified columns
print("Identified PU columns:")
print(pu_cols)
print("Identified PEOU columns:")
print(peou_cols)
print("Identified BI columns:")
print(bi_cols)
# Convert all relevant columns to numeric
dataset <- dataset %>%
  mutate(across(c(all_of(pu_cols), all_of(peou_cols), all_of(bi_cols)), as.numeric))
# Gather the data for each construct
data_long <- dataset %>%
  pivot_longer(
```

```
  cols = c(all_of(pu_cols), all_of(peou_cols), all_of(bi_cols)),
  names_to = "variable",
  values_to = "score"
 ) %>%
 mutate(construct = case_when(
  startsWith(variable, "TAM_PU") ~ "PU",
  startsWith(variable, "TAM_PEOU") ~ "PEOU",
  startsWith(variable, "TAM_BI") ~ "BI"
 ))
# Function to perform Mann-Whitney U test safely
safe_wilcox_test <- function(formula, data) {
 tryCatch({
  wilcox.test(formula, data = data)
 }, error = function(e) {
  message("Error in wilcox.test: ", e$message)
  return(NULL)
 })
}
# Perform Mann-Whitney U test for each construct
pu_test <- wilcox.test(score ~ Prototype, data = filter(data_long, construct == "PU"))
peou_test <- safe_wilcox_test(score ~ Prototype, data = filter(data_long, construct == "PEOU"))
bi_test <- safe_wilcox_test(score ~ Prototype, data = filter(data_long, construct == "BI"))
# Function to create a formatted output
format_results <- function(test, construct) {
 cat("\nMann-Whitney U Test Results for", construct, "\n")
 if (!is.null(test)) {
  cat("W statistic:", test$statistic, "\n")
  cat("p-value:", test$p.value, "\n")
  cat("Significance:", ifelse(test$p.value < 0.05, "Significant", "Not significant"), "\n")
 } else {
  cat("Test could not be performed. Check if there are exactly two groups.\n")
```

```
  }
}
# Print results
format_results(pu_test, "Perceived Usefulness (PU)")
format_results(peou_test, "Perceived Ease of Use (PEOU)")
format_results(bi_test, "Behavioral Intention (BI)")

# Calculate and print medians and means for each group
group_summary <- data_long %>%
  group_by(Prototype, construct) %>%
  summarise(
    median_score = median(score, na.rm = TRUE),
    mean_score = mean(score, na.rm = TRUE)
  ) %>%
  pivot_wider(names_from = construct,
              values_from = c(median_score, mean_score))
print(group_summary)
```

Appendix 12 – GitHub link

https://github.com/ReutAl/Final-project

Includes:

- Emotibit case Solidworks files
- Stroop test code
- Emotibit data analysis
- PSS score calculator
- TAM Mann-Whitney U test code

Appendix 13 - Perceived Stress Scale (PSS) questionnaire score scale calculation

Usually, the score of PSS questionnaire is from 0-4. In this research it was chosen to use a score scale of 1-5.

The results interpretation that is usually used, for a score scale of 0-4 is (Torales et al., 2020):

- Low stress: ≤ 13 points
- Medium stress: 14-26 points
- High stress: ≥ 27 points

The proportion of sections is:

- Low stress: 34.15% (14 scores of 41 possible scores)
- Medium stress: 31.7% (13 scores of 41 possible scores)
- High stress: 34.15% (14 scores of 41 possible scores)

To keep the proportion in the chosen scale, the range of each category is:

- Low stress: ≤ 23 points (14 scores of 41 possible scores)
- Medium stress: 24-36 points (13 scores of 41 possible scores)
- High stress: ≥ 37 points (14 scores of 41 possible scores)

Appendix 14 - A list of insights from the researcher's observation during the experiment

- יש בעייה בתצוגת הסוללה שנותרה בחיישן.
- חלק מהמשתתפים שאלו את טימי שאלות בחזרה בממשק של המבוגרים, אך הוא לא ענה להם.
- חלק מהמשתתפים הצעירים שבחנו את הממשק של המבוגרים נשמעו מופתעים מהשאלה האם הם לוקחים כדורים.
- חלק מהמשתתפים ניסו ללחוץ על המסך של טימי בהסבר על מבחן סטרופ (תמונה בלבד).
- אולי כדאי שבכל הסרטונים יהיה קליפ וידאו, אולי משעמם לשבת מול מסך סטטי.
- לעשות רק את הממשק הנבחן על הרובוט כי זה מבלבל את המשתתפים לגבי מה הם צריכים לענות בשאלון הסיום .
- בממשק של המבוגרים, אנשים לא מבינים את השאלה של האם לקחת כדורים.
- לתחושבתי, הרבה מבוגרים לא הבינו את מבחן סטרופ ומה הם מתבקשים לעשות בו.
- לא תמיד התשובות במבחן סטרופ נשמרו.
- אולי היה כדאי לשים תמונה של המסך הראשי בתחילת שאלון הסיום.
- להמליץ בניסויים הבאים לנתח את הסטרס בצורה נוספת.