

MAUU5900
MASTER THESIS
in
Universal Design of ICT

May 2020

**Investigation of personalizing persuasive
system design model in fitness apps to
reduce prolonged sitting behavior among
the elderly: A qualitative experiment**

<Atia Batool>

Department of Computer Science
Faculty of Technology, Art and Design

OSLOMET

Preface

I would like to thank my parents (Syed Hakim Ali Shah and Syeda Habib Fatima) and my siblings for understanding that conducting this research sometimes required me to be quiet to get stuff done. Sorry that it stole some of our together time. Special thanks to my friend Muhammad Nadeem for being always there for me when I needed you.

Many thanks to my advisor, Frode Eika Sandnes. I can certainly say that there was some luck involved when you accepted my request to be my advisor. Your systematic approach helped me to complete this work on time, and without it, this work would never have finished at the scheduled time.

Abstract

The advancement in technologies for transportation, communication, workplace environment, and entertainment has changed the physical, economic, and social environment all around the globe and is still evolving rapidly. Due to these technologically advanced environments, the prevalence of sedentary lifestyle and physical inactivity has increased and caused countless non-communicable diseases. The mobile health and fitness applications aiming at sedentary behavior change and increasing physical activity levels are becoming increasingly popular. However, the major user group of such applications is less than 60 years old. On the other hand, the Elderly are the main affected group of this emerging risk to health, which has become the leading cause of mortality among the elderly. This study addressed how can the personalization of the Persuasive System Design (PSD) model in mobile health and fitness applications assist elders in reducing prolonged sitting behavior. A qualitative experiment designed to investigate the perceived inspiration, usefulness, and effectiveness of personalized PSD categories. The interaction effect between personalization and PSD categories for perceived effectiveness was moderate ($p = .012$), while for perceived usefulness and perceived inspiration was not significant, ($p = .073$) and ($p = .337$) respectively. All assumptions for the parametric statistical test were not met; there were outliers in each group. However, the elderly liked to have simplified and personalized system features, which would make the application learning process fast and easy for them. Further, they preferred to receive promotive and encouraging messages (content) over preventive messages. The qualitative results indicated that adopting new behavior is easier for the elderly instead of changing the existing one.

Abbreviations

Abbreviation	Phrase
PSD	Persuasive System Design
PSPs	Persuasive System Principles
PTS	Primary Task Support
DS	Dialogue Support
SS	Social Support
SP	Strongly Personalized
CP	Contra Personalized
ProM	Promotive Messages
PreM	Preventive Messages
StP	Susceptibility to Persuasion
METs	multiples of the basal metabolic rate

Terms Description

Strong Personalization: Participants will get intervening PSPs messages from the same PSD category for which (s)he is susceptible. For example, if participant is susceptible to PTS, (s)he will receive intervening messages from PTS category.

Contra Personalization: Participants will get PSPs messages from the PSD category for which (s)he is not susceptibility. For example, if participant is susceptible to PTS, (s)he will receive intervening messages either from DS category or from SS category.

Table of Contents

Chapter 1 Introduction9

Chapter 2 Literature.....16

 Norwegian older demography.....16

 Life Expectancy17

 Health.....18

 Lifestyle Habits.....18

 Employment.....19

 Digital Agenda for Norway.....20

 Technology and the elderly21

 Recommendations22

 Recommendations by WHO.....22

 Persuasive systems23

Chapter 3 Methodology.....28

 Experimental Design28

 Research Method.....28

 Research designs.....30

 Initial research design30

 Final research design31

 Unique identity for participants33

 Change in research design34

 Equipment.....34

 Participants35

 Pilot study36

 Refined Research design.....36

Task	37
Ethical issues	38
Procedure.....	40
Analysis	42
Chapter 4 Results	43
Perceived inspiration	44
Perceived usefulness.....	47
Perceived effectiveness	50
Perceived preference over message types	53
Persuasive System Design Categories.....	54
Strongly personalized primary task support.....	55
Strongly personalized dialogue support	57
Strongly personalized social support	59
Contra personalized dialogue support	61
Contra personalized social support	63
Contra personalized primary task support	65
Contra personalized primary task support	67
A typical day.....	68
Self-reported active routines	68
Self-reported sedentary routines	69
Data integrity	70
Boxplots	73
Chapter 5 Discussion.....	76
Limitations.....	80
Cultural background balance	81

Few participants.....	81
Unfamiliarity with apps.....	81
Experiment language	81
Cultural context	81
Experimental design shortcomings.....	82
Language issues and terminology.....	82
Experiment duration.....	82
Susceptibility to persuasion scale statements.....	83
Persuasive system design principle as messages	83
Promotive versus preventive message types	84
Video scene choice	84
Direct versus indirect persuasion route.....	85
Chapter 6 Conclusion	86

List of figures

Figure 2.2: Survey report on sit time 10 hours or more on weekdays, sit or stand during day time activities, and exercise routines for both genders aged 67 years or above; the total number of interviews 1451 (742 males and 749 females)	19
Figure 2.3: Percentage of people aged 65 to 74 in the labor force in 1972, 2000, and 2018.	20
Figure 4.1: Perceived inspiration for strong- and contra- personalized PTS with promotive and ProM (susceptibility to persuasion scale of contra personalization: DS)	44
Figure 4.2: Perceived inspiration for strong- and contra- personalized PTS with promotive and ProM (susceptibility to persuasion scale of contra personalization: SS).....	44
Figure 4.3: Perceived inspiration for strong- and contra- personalized DS with promotive and ProM (susceptibility to persuasion scale of contra personalization: PTS).....	45
Figure 4.4: Perceived inspiration for strong- and contra- personalized SS with promotive and ProM (susceptibility to persuasion scale of contra personalization: PTS).....	45
Figure 4.5: Perceived usefulness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: DS) ...	47
Figure 4.6: Perceived usefulness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: SS)....	47
Figure 4.7: Perceived usefulness for strong- and contra- personalized DS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)	48
Figure 4.8: Perceived usefulness for strong- and contra- personalized SS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)	48
Figure 4.9: Perceived effectiveness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: DS) ...	50
Figure 4.10: Perceived effectiveness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: SS)....	50
Figure 4.11: Perceived effectiveness for strong- and contra- personalized DS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)..	51

Figure 4.12: Perceived effectiveness for strong- and contra- personalized SS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)..	51
Figure 4.13: Perceived preference over message type	53
Figure 4.14: SP PTS (suggestion and reminder principles) with promotive, preventive, and control messages	55
Figure 4.15: SP DS (suggestion and reminder principles) with promotive, preventive, and control messages	57
Figure 4.16: SP SS (normative influence and social learning principles) with promotive, preventive, and control messages	59
Figure 4.17: CP DS with PTS susceptibility (suggestion and reminder principles) with promotive, preventive, and control messages	61
Figure 4.18: CP SS with PTS susceptibility (normative influence and social learning principles) with promotive, preventive, and control messages	63
Figure 4.19: CP PTS with DS susceptibility (self-monitoring and reduction principles) with promotive, preventive, and control messages	65
Figure 4.20: CP PTS with SS susceptibility (self-monitoring and reduction principles) with promotive, preventive, and control messages	67
Figure 4.21: Self-reported sitting/reclining time on a typical day	71
Figure 4.22: Box plot for self-monitoring, suggestion, and normative influence consisting of promotive and preventive messages.....	73
Figure 4.23: Box plot for self-monitoring, suggestion, and normative influence consisting of promotive and preventive messages.....	74

List of tables

Table 3.1: List of selected Principles from PSPs.....32

Table 3.2: Question set and Subject-Generated Identification Code.....33

Chapter 1 Introduction

This study addressed how can the personalization of the Persuasive System Design (PSD) model in mobile health and fitness applications assist elders in reducing prolonged sitting behavior. The advancement in technologies for transportation, communication, workplace environment, and entertainment has changed the physical, economic, and social environment all around the globe and is still evolving rapidly. Due to these technologically advanced environments, people need only low energy consuming physical activities to perform routine tasks (Lorraine Lanningham-Foster, 2003). This close-to-equal inactivity has associated with reduced energy-consumption than the recommended in physical activity recommendations by WHO. On the other hand, moderate-effort physical activities for at least 30 minutes for 5 days a week are recommended (WILLIAM L. HASKEL, 2007).

Two factors characterize prolonged sitting/reclining time, namely posture (sitting and reclining), and energy-consumption of some 1.0-1.5 METs (multiples of the basal metabolic rate). In contrast, moderate-to-high physical activities are those where the energy consumption is at least 3.0 METs (Ainsworth BE, 2011). It means that light- intensity activities such as routine home tasks, social events, work duties, and others have an energy-consumption of some 1.0-2.9 METs (David W. Dunstan, 2012).

Although sedentary behavior and low-effort activities share an overlapping energy-consumption range of 1.0-1.5METs, still prolonged sitting is being considered as a distinct risk to health impacts now. The low-effort routines were essential factors of daily energy-consumption (William Ta Donahoo, 2004). Technological advancement and social and environmental changes have reduced people's level of activity and increased the time they are sitting (Neville Owen, 2010). Older people are more exposed to sedentary behavior and have higher sedentary time compared to younger age groups. That demonstrated by U.S. and European studies that objectively measured sitting time in 50 years older (Charles E. Matthews, 2008) and 65 years older (MARK G. DAVIS, Objectively measured physical activity in a diverse sample of older urban UK adults, 2001), respectively. These studies also found that the elderly (aged 60 years and more) spend approximately 80% of the time other than night sleep time on activities involving energy-consumptions below 1.5 METs. The time spent on sedentary activities (sedentary energy-consumption) comprises of 8 to 12 hours

on a typical day (Charles E. Matthews, 2008; MARK G. DAVIS, 2001; W. McLennan, 1998). The findings of a study conducted in more than 60 countries by Hallal et al. also supported the highest prevalence of sedentary time (minimum 4 hours on a typical day) among the elderly (Pedro C Hallal, 2012).

Reducing physical inactivity and sitting time and increasing physical activity among older people has become a crucial concern for the health sectors and governments. In Europe, the "Active Ageing" agenda has been developed to promote a healthy lifestyle among its inhabitants overall and elderly specifically to decrease the risk of all-cause mortality.

Older people spend approximately 95% of the time of a typical day in a sedentary mode, which increases the risk of all-cause mortality (E. Gorman, 2014; Barbara J Jefferis T. J.-M., 2018; Barbara J Jefferis C. S.-M., 2014). For example, this age group has a higher risk of getting type 2 diabetes (Ajao, 2019) and an increased prevalence of stroke and dementia (Valery L Feigin, 2017) because of sedentary behaviors.

Adverse effects of prolonged sitting (sedentary behavior) on brain health are also empirically evident from the literature (Ryan S Falck, 2017; Prabha Siddarth, 2018). A healthy brain needs delivery of oxygen and necessary nutrients to maintain adequate cerebral blood flow in older adults, which is possible with moderate amounts of exercise along with reduced/interrupted sedentary behavior (Micheal J. Wheeler, 2019). Also, an investigation on interrupting sitting time with intermittent physical activities have shown beneficial impacts on different aspects of brain health such as blood pressure (Dharini M Bhammar, 2017; Paddy C. Dempsey, 2016), sympathetic function (Paddy C. Dempsey, 2016), and vascular function (Rachel E. Climie, 2018; Robert M. Restaino, 2015; Saurabh S. Thosar, 2015).

Chances of becoming disabled or being affected by non-communicable diseases may also increase with age. More than two-thirds of annual deaths around the world are results of non-communicable diseases, which closely linked to lifestyle risk behaviors such as physical inactivity, sedentary behavior, extensive use of drugs, smoking, unhealthy sleep patterns. When these modifiable risk behaviors are combined (such as a combination of physical inactivity, sedentary behavior, and prolonged sleep time), there are higher health risks and a higher chance of all-cause mortality (Ding Ding, 2015).

Physical and mental health has a direct relation to the well-being of the elderly. So, both physical and mental health are equally important, and both could be affected by the sedentary time. Psychological well-being is a crucial part of health according to the WHO definition of health, namely "Health is state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1946). A broader definition of psychological well-being by (Huppert, 2009) is "the combination of feeling good and functioning effectively."

Different measures have been devised to discourage prolonged sitting behavior, e.g., adjustable desk heights for working people, social group activities by communities, short breaks during long lectures in academic settings. Such measures could only be effective when people decide on abandoning the sedentary behavior. To minimize/cease sedentary behavior, researchers worked on behavioral theories and produced empirical evidence on intervening behaviors or attitudes or both through persuasion. In-person instructional formats, "Tele-Health," and other mediated approaches to intervene and promote regular physical activity were in practice. However, these approaches suffered due to constraints such as staff time, low intervention fidelity, transport, and venue cost, reduced personalization in groups format (King A. B., 2013). The advent of computers, and later mobile technology, has suppressed those constraints and facilitated to overcome time_ and context-based issues in collecting and delivering health information. (King A. B., 2013)

In the current era, mobile usage is growing exponentially. The ubiquitous attribute of mobile technology has empowered people to use it anywhere and anytime, as well as has given access to a broader segment of the population across the globe. Health-related mobile applications have inundated the industry with fervor using its power of being ubiquitous (Sarkar, et al., 2016). Still, only a few applications have features and functionalities based on theories and theoretical principles.

However, a positive link between exercise and the elderly's health has been demonstrated empirically; exercise can promote health and delay or reverse functional decline (Patricia A. Boyle, 2007; MARION E. T. MCMURDO, 1995; MIRIAM C. MOREY, 1998; Marja H. Westhoff, 2000). A longitudinal study by Rakowski and Mor (W. Rakowski, 1992) proved an inverse relationship between exercise and risk of mortality. A study by (Miriam C. Morey, 2002) on exercise and chronically ill older adults also proved that the elderly could experience

increased longevity by participating in exercise programs. Gillespie's research findings also support that exercise can benefit older adults by reducing the risk of common chronic diseases and falling (Lesley D Gillespie, 2012; Singh, 20002). The health benefits of exercise for the elderly such as increased longevity, reduced risk of chronic diseases, and avoiding falls can enhance the capability of the elderly to function effectively in social, volunteer, and occupational activities (Paul Stoleea, 2012). It ultimately improves the psychological well-being of the elderly.

In light of scientific evidence, updated health recommendations suggest cutting sedentary time alongside moderate-to-vigorous intensity exercise (Health A. G., 2014; Health D. o., 2011). In the United States, the scientific report that informed the 2018 Physical Activity Guidelines for Americans highlighted a need for future studies to investigate different patterns of physical activity and sedentary behavior on brain health outcomes. To control health risk factors, the Norwegian government has also revitalized the public health sector. Currently, the overall impression of the health status of all ages in Norway is a healthy population.

The researchers, organizations, and policymakers from different countries are paying considerable attention to active aging studies because the elderly proportion of the population and related health issues are increasing rapidly worldwide. An increase in the population's life expectancy is one of humanity's triumphs, as well as one of the biggest challenges. In the 21st century, it puts challenging health, social and environmental demands on all countries, especially low-GDP-per-capita countries. At the same time, Older people are precious and valuable and often an ignored part of society. It is necessary to take measures to help older people remain healthy and active as they grow older. The World Health Organization has given many recommendations to improve health and decrease the burden of lifestyle diseases among the elderly.

According to World Health Organization (WHO), sedentary behavior is the fourth significant risk of mortality around the globe and the primary cause of the prevalence of non-communicable diseases (NCDs) specifically and overall population health generally (Organization, 2010). However, the recommendations related to physical inactivity were general because of less research evidence on this newly emerging health risk factor at the time of recommendations were proposed. In contrast, over the last ten years, the evidence

on the health impact of sedentary behavior and physical activity has increased massively. The WHO has given priority to review the evidence and updated the 2010 recommendations on physical activity and sedentary behavior in "Global action plan on physical activity 2018-2030 (GAPPA)" on the request of member countries (Organization, Public consultation on the draft WHO Guidelines on physical activity and sedentary behaviour for children and adolescents, adults and older adults 2020, 2020).

With the advent of mobile technology and its ubiquitous nature, it became easier to motivate people to adopt new health behaviors and implement recommendations to reduce sedentary behavior and lower the burden of NCDs, useful and effective. In information communication technologies (ICT), different psychology theories have been implemented to modify existing or to adopt new behaviors. The transformation of theories to software functionalities and qualities was a big challenge. Different frameworks introduced to overcome this challenge over time. Fogg has worked extensively on designing interactive information technology to modify people's (user's) behaviors, attitudes, or both, namely persuasive technology (Fogg B. , 2003). Oinas-Kukkonen and Harjumma extended Fogg's theoretic work and suggested a framework for Persuasive System Design (PSD) with 28 design principles for persuasive system features categorized in four categories, namely primary task support (PTS), dialogues support (DS), social support (SS), and system credibility support (SCS) (Harri Oinas-Kukkonen, 2009). Primary task support (PTS) category includes principles that provide support to user for completing a process or making the process/task easy to do. In Dialogue support (DS), there are principles to implement computer-human dialogue support in form of feedback, rewards, suggestions, reminders, etc. via verbal, visual, or vibration. Social support (SS) category is based on Fogg's principles of mobility and connectivity (Harri Oinas-Kukkonen, 2009). Persuasive systems are intentionally designed to change persons' behavior.

The technologies may not be attractive to the elderly. The use of technology decreases with the age increase as the internet reported a 34% decrease in use among the elderly over the age of 75 (Kathryn Zickuhr, 2012) despite the extensive work on improvement of interface and interaction design. Gabriela Villalobos-Zúñiga and Mauro Cherubini proposed techniques that might nudge the elderly to adopt and adhere to the technology using Self-

Determinant Theory and Persuasive System Design (PSD) framework (Gabriela Villalobos-Zúñiga, 2017).

However, to the best of author's knowledge and by the time of writing this work, there is no evidence to support whether personalization of persuasive system principles based on user's susceptibility to persuasive system principles (PSPs) categories would perceive more useful and effective to reduce the sitting time, during day time. It is also no evidence to support whether promotive messages are perceived as more inspiring compare to preventive messages among the elderly. The aim of this study was, therefore, to assess perceived inspiration, perceived effectiveness, and perceived usefulness of personalization of Persuasive System Principles categories based on susceptibility to persuasion, with promotive and preventive message types, on reducing sedentary behavior in the elderly. We hypothesized that a strong personalization of PSPs categories based on susceptibility to persuasion would inspire the elderly and perceive useful and effective in reducing sedentary behavior, relative to contra (opposite) personalization of PSPs to the susceptibility of persuasion. In addition, we hypothesized that promotive messages (contents) are perceived as more motivating to discourage sedentary behavior relative to preventive messages (contents).

Chapter 2 Literature

This chapter discusses the current state of the art of Norwegian older demography and its projection for coming decades, health impacts of non-communicable diseases and all-cause mortality among the elderly due to sedentary behavior, recommendations by World Health Organization and Norwegian authorities for physical activity (frequency, intensity, and duration) and sedentary behavior, persuasive systems for physical activity and sedentary behavior.

Norwegian older demography

The current proportion of population aged 66+ in Norway is 15.1% that will increase to 21.4% by 2040 according to population projection by Statistics Norway (<https://www.ssb.no>). Due to a fast increase in older population percentage, enacting implications of measures for physical activity and sedentary behavior has become crucial for the Norwegian government, policymakers, organizations, and civil society. "Active Ageing" term was used for plans and policies propagating healthy and active lifestyles in the population. During 1994 to 2003, Norwegian government took different initiative concerning active aging policy such as NOU 1994:2 (on work and retirement), 1997 White Paper (Action plan for Care of Elderly), NOU 1998:19 (On flexible Retirement), NOU 2000:27 (Working life including), 2002 Competence Reform, 2003 Government proposal on the disability pension, 2001 pension commission, 2002 Commission on labor law revision. NOU 1994:2 and NOU 1994:19 were vetoed (HRISTENSEN, 2003).

An increase in sedentary behavior is observed during and after transitioning periods from the second age group (approximately <60 years) to the third age group (approximately > 60 years). That may be the time when system software can assist the elderly (more precisely young adults) to adopt or maintain an active lifestyle and avoid sedentary periods for their well-being.

Heaven et al. (2015) define life transitioning periods are when "individuals may be making normative lifestyle changes, thus presenting opportunities to intervene and promote healthier behavior" (Ben Heaven, 2015). Lars Bauger (Lars Bauger, 2016) conducted phenomenological interviews (a qualitative study) to get an in-depth understanding of well-

being from the first-hand experiences of older people after retirement (they considered third age group) and based on the experiences of 9 elderly participants. They constructed a general meaning structure based on four interrelated constituents to assess and promote well-being in elderly; "(1) awareness and gratitude for a healthy and functioning body, (2) a new experience of time presenting possibilities for action, (3) a heightened sense of agency, and (4) being-in-place in relationships." In the report, Interviewees' data showed that concerns relevant to the security of functioning of the body eliminated by physical activities. Furthermore, a sense of strong and able body coming after the accomplishment of a physically exhausting task gives good feelings, interviewees revealed while talking about the gratitude of the functioning body. The study found that after retirement, people have more free time and a sense of agency to do new ventures and spend their time according to one's priorities that result in the sense of achievement and good feeling on accomplishing their set goals or activities.

Further, they have time to be present with their relations, friends, and family, to enjoy the present moment as well. Insinuating predictions of this study could be that lifestyle diseases have less influence on an active lifestyle. However, the study reported only on exhausting physical activities and interviewees' intentions to keep themselves busy in retirement life. It did not consider the periods evolving sedentary energy-consumption activities, which constitute a large proportion of the day-time activities.

Life Expectancy

Due to reforms and revitalization of the health sector, general health has been improved overall among all age groups in Norway. Epidemic and infectious diseases, which were a major cause of large-scale deaths in previous millenniums, are now controlled in all parts of the world except sub-Saharan Africa, where AIDS is still the leading problem (Organization, 2002). In the current millennium, major health risks are lifestyle diseases (non-communicable diseases). Despite the high mortality rate caused by NCDs, over the years, good healthcare facilities have resulted in increased life expectancy, 81 and 84.5 years in males and females, respectively. Other factors, such as luxury lifestyle, prosperity, decreased accidental deaths, and others, have also played a vital role in an overall increase in expected remaining life years of individuals.

Further, future projections show that the proportion of people aged 65 years and above will increase faster compare to other age groups. Insinuating meanings of that are people will live longer in the coming decades. Another factor of an increased proportion of older population projection might be decreasing fertility rate in general or increased death rate at an early age.

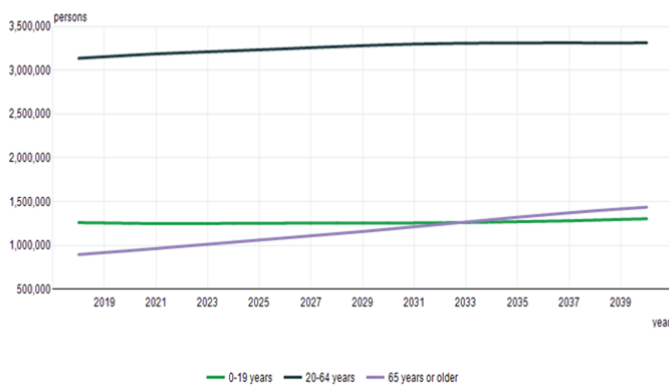


Figure 2.1: Population projection over a period from 2019 to 204

Health

According to a survey conducted in 2015, less than 1% of people reported poor health in general, and 3.8% reported very good health (this percentage is taken on total respondents 2128) (Norway, 2015). Statistics show that almost 33% of the elderly population (older than 80 years) require more nursing services (Norway, 2015).

Lifestyle Habits

Norwegians are healthy in general. However, statistics on physical activities are surprising. In a survey on Living conditions, conducted under Statistics Norway in 2015, people from different age groups were interviewed. In this study, we considered four factors from the survey report for both genders aged 67 years and above, namely "sits still 10 hours or more on weekdays (school, work or leisure time)", "mostly sit or stand during day time activities (school, work or at home)", "exercise weekly or more often," and "never exercises." Figure 2.4 shows the results of four selected factors in the form of a bar chart. More than 65% of participants in the survey reported that they exercise weekly or more often. In contrast,

almost 25% of people reported no exercise at all. More than 40% of people aged 67 years or above reported that they perform their day time activities mostly sitting or standing, while almost 10% of the elderly still sit 10 hours or more. The fact that more than 65% of the elderly are exercising weekly or more often is impressive and shows a good sign towards the reduction of all-cause mortality in the elderly. However, the collective impacts of the other three factors could be disturbing.

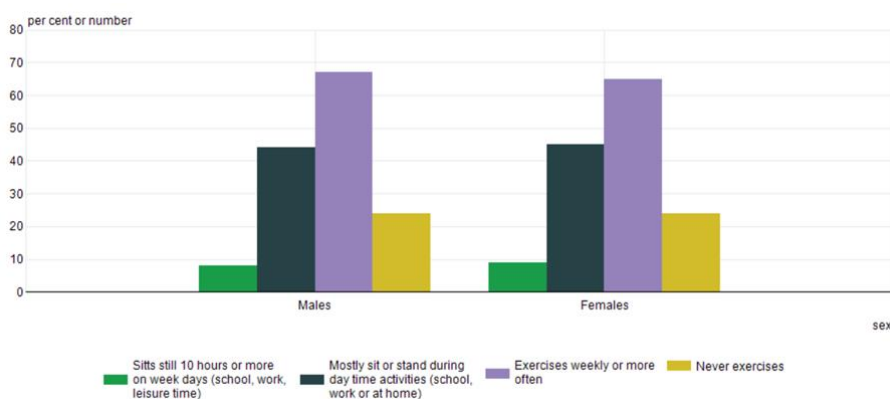


Figure 2.2: Survey report on sit time 10 hours or more on weekdays, sit or stand during day time activities, and exercise routines for both genders aged 67 years or above; the total number of interviews 1451 (742 males and 749 females)

In the same survey, 2% male and 3% of females have reported difficulty with a social relationship in the age group 67 and the older, and the same pattern is also evident in the 45-64 age group. However, none of the groups has shown a reduction in work capacity (employed persons) and difficulty in participating in organization or leisure activities (Norway, 2015).

Employment

One of the challenges of achieving 2030 Agenda, what worries Norwegian authorities, is "Reducing the proportion of young people not in employment, education or training" (Norway's follow-up of Agenda 2030 and the Sustainable Development Goals, 2016). Current statistics of Norway reveals that the majority of people aged above 66 resides out of the sphere of working labor. Both facts (less youngster and older) affect the total labor available in the market negatively. Decreased labor force means more burden of work on available labor, which ultimately affects not only the labor health but also the economy

overall. In Norway, despite good health, only 22.8% males aged 65 to 74 are working, and for females, the percentage is 14.8%, which is 1972, were 42.6%, and 16.5% for males and females respectively (Labour force survey, 2018).

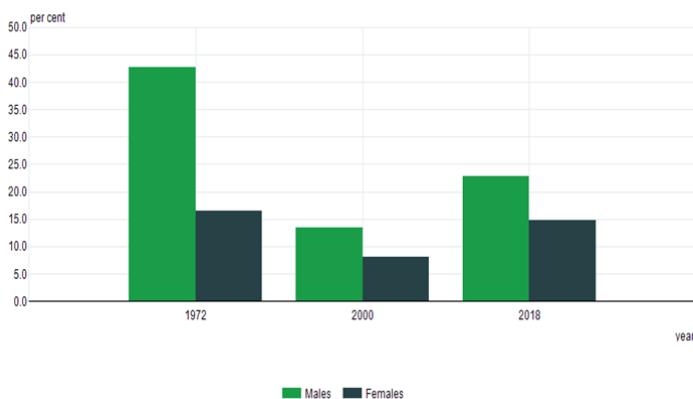


Figure 2.3: Percentage of people aged 65 to 74 in the labor force in 1972, 2000, and 2018

In contrast, the statistics in figure 2.5 shows a positive trend after 2000. Since the start of the 21st century, the trend of remain in paid work in the 65-74 age group has been uplifted by 9.4% in males and 6.7% in females within almost two decades. A sharp decline of older workers in the labor force is evident in Figure 2.5 between 1972 and 2000. A positive trend of working longer after 2000 may be the result of the promotion of active aging agenda—this hypothesis supported by the literature. Gewolb (Gewolb, 2015) reported in her investigation of a successful retirement and aging that older people who are still in the workforce are concerned about becoming senile and decline of the functioning body due to regular inactivity—further confirmed by people who are not in the labor force that successful aging is possible with keeping themselves busy and active regularly (Gewolb, 2015).

Digital Agenda for Norway

(St., 2015-2016) presented a brief report to Storting (white paper) on the Digital Agenda for Norway. Authorities have categorized digital key priorities under five heads, namely "A user-centric focus," "ICT constitutes a significant input for innovation and productivity," "Strengthened digital competence and inclusion," "Effective digitization of the public

sector," and "Sound data protection and information security." These heads cover maximum aspects of the digitalization of the market and society, and all age groups were considered. Users are the central focus in all five categories. The study will copy heading titles from reference to avoid confusion. Steps are being taken towards digitizing Norway and the inclusion of all age groups. The Elderly is the demography that exhibits slower adaptation of advanced technology, and measures are taken to their inclusion. For example, for senior Norwegians, training was/are/will be arranged to make them part of the digitized society. Advanced ICT degrees and subjects have been introduced in educational institutes to produce competent ICT experts and to increase knowledge of ICT for the development of accessible systems. It will also benefit Norway in another way that young brains are coming up with new ideas to utilize ICT to strengthen societal and economic productivity.

Technology and the elderly

Technology has entered in our daily routines through its ubiquitous nature. The usage of technology has increased in Norwegian elderly and has become part of their lives (Kathryn Zickuhr, 2012). They are using the internet for different purposes such as watching TV, playing games, using social media (Facebook, LinkedIn, etc.), Skype, document reading, paying bills, banking, email, and so on. Some people using it extensively in all aspects of routine life to fully benefit from technology. The increase in elderly users of technology might be the result of the promotion of the Norwegian government agenda "everyone on the internet." Still, there is a big group of elderly who are shy of learning new technologies, perhaps due to a decrease in memory and learning capability. Appearing as a novice could be another reason for staying away from learning and exploring technology. However, institutes such as NAV and SeniorNet are offering training on the use of gadgets and IT systems to the elderly. However, Kathryn's report shows that once the elderly are on the internet, they spent most of the time on it (Kathryn, 2012) and remain active longer than other age groups (Kathryn Zickuhr, 2012) which might result in less physical activity and an invitation to lifestyle diseases. A study also shows that excessive use of technology, specifically social media, becomes a cause of social isolation (Archana Singh, 2009). Thus, the purposeful use of the internet and ICT, in the elderly, is true because physical inactivity has bad impacts on health, and social isolation and loneliness cause depression and mental health issues.

Recommendations

Recommendation on physical activity (frequency, intensity, and duration) by Norwegian authorities are the same as given by WHO (Helsedirektoratet, 2019); therefore, the study includes the recommendation by WHO.

Recommendations by WHO

Physical activity is considered the primary prevention of NCDs at the population level. Therefore, the WHO (Organization, Global Strategy on Diet, Physical Activity and Health, 2011) has given recommendations on physical activities (frequency, intensity, and duration) for all age groups to prevent all-cause mortality and NCDs. The available recommendations are not the latest and were given in 2011. At that time, there was not enough evidence of health impacts due to sedentary behavior, and recommendations were general. There is extensive development of evidence on sedentary behavior being considered an emerging health risk. WHO is reviewing the evidence and will update its recommendations on physical activity and sedentary behavior.

The age group for physical activity recommendations at the website of the World Health Organization is 5-17 years, 18-64 years, and 65 and above. This study considered recommendations for the age group 65 and above. WHO clarified that physical activity is not just exercise; more clearly, exercise is a subpart of physical activities. Further physical activities consist of leisure time, transportation, occupational (if the individual is still working), household chores, sports, and exercise in the context of everyday life activities.

The recommended frequency, intensity, and duration of physical activities to reduce the risk cardiorespiratory and muscular fitness issues, bone and functional health issues, NCDs, depression, and cognitive decline are:

At least 150 minutes of moderate-intensity or 75 minutes vigorous-intensity or an equivalent combination of moderate-vigorous intensity aerobic physical activities 7 days a week

Bouts of 10 minutes duration for aerobic activity are recommended

To achieve additional health benefits, increase activity level to 150 minutes of moderate-intensity or 75 minutes vigorous-intensity or an equivalent combination of moderate-vigorous intensity activities per week

For improvement in mobility, physical activities should be performed 3 or more days a week to improve balance and reduce the risk of falls.

For strengthening major groups of muscles, the activities should be performed twice or more per week

If an individual (elderly) is not capable of fulfilling the recommendations, (s)he should do physical activities according to his/her abilities.

Persuasive systems

Preventive and proactive approaches are being adopted in contrast to the traditional reactive approach toward health-related problems using mobile technologies, where ubiquitous nature of mobile technologies is helping to reach out vast majority of users. The purpose of adopting such approaches is to counteract health impacts caused by physical inactivity and sedentary behavior. Implications of behavioral change (BC) theories in mobile technology empower individuals to self-manage their health (Ryan, 2009) by monitoring physical activities and levels of energy consumption. The exponential growth of technology usage among the elderly (however, the mobile usage decreases with the increase in age of older people) has made possible the prevalence of behavioral change interventions at individuals levels. Advancement in hardware and software technologies has empowered users to track, monitor, and reflect on their physical activity levels (Gabrielle M Turner-McGrievy, 2013). The inclusion of persuasive interventions in applications has empowered individuals to self-manage their attitudes and behaviors to meet physical activity levels (Gary Hsieh, 2014) recommended by WHO or by health institutes.

A large number of health and fitness applications are available on app stores. However, most applications have neither theoretical base of intervening content nor developed and evaluated systematically (Harri Oinas-Kukkonen K. T., 2009) and consequently could bring its user to unintended harmful results (Agnis Stibe, 2016). Moreover, a large number of applications are unable to develop intervention adherence among its user over a period of

time pertaining to the issues regarding security and privacy, application designs, and persuasion (Duwaraka Yoganathan, 2015). A proper framework is needed to systematically transform persuasive principles and theories to application features.

Fogg worked on persuasion technologies and introduced principles for persuasion based behavioral theories in the psychology field. Implementation of persuasion principles in software systems created an opportunity to affect the behaviors or attitudes or both systematically of a wide population (Fogg, 2003). However, this model has some loopholes as it did not explain how to transform such principles to system requirements and later in system features. Harri Oinas-Kukkonen (Harri Oinas-Kukkonen M. H., 2009) extended the Fogg's work on design principles for persuasive technology. He took the existing model and worked on its weaknesses and explain the transformation of design principles into software requirements and, ultimately, system features. First, he described seven postulates related to the user of the persuasive system, persuasive strategies, and system features to develop and evaluate persuasive systems. Next, he adopted and modified the design principles from the existing model and added some new ones. Finally, he got a total of 28 design principles and assigned these to four categories, namely Primary Task support, Dialogue support, System Credibility support, and Social Support.

King et al. developed three behavioral change (BC) apps based on behavioral science theories to promote physical activity and decrease sedentary behavior among the elderly. For the three applications, they developed three motivational frameworks, namely "analytic," "social," and "affective." Each framework consisted of some BC technique. The BC techniques used in the "analytic" motivational framework were personalization, quantified goal-setting, problem-solving around behavioral change barriers, feedback, and suggestions. The techniques used in the "social" motivational framework for BC were normative feedback, social support, group competition and collaboration, social learning. Among the BC techniques used in the "affective" motivational framework were positive reinforcement, real-time feedback using visual-model, game-like feedback, and "jackpot" rewards. The motivational frameworks were based on theories and behavioral change principles. After 8-weeks intervening period, the participants reported a significant increase in moderate-to-vigorous intensity physical activity level and a significant decrease in sedentary time. Further, there was no significant difference between groups for both

physical activity and sedentary time (Abbey C. King, 2013). The motivational framework concept developed in this research is similar to the Persuasive System Design (PSD) model given by (Harri Oinas-Kukkonen K. T., 2009).

Many studies have used the persuasive system design (PSD) model for the development and evaluation of persuasion systems. John Matthews used the PSD model to evaluate the current state of the art of mobile applications promoting physical activity, and the "review identified and confirmed the effectiveness of persuasive features in physical activity studies" (John Matthews, 2106). Therefore, they recommended the developers to incorporate persuasive features in health and fitness applications. However, there were some limitations of this review, such as only English articles were considered, formative persuasive technologies were excluded, included articles generally used mobile text messages technology for behavioral modification. Further, this review has included only the PSD model, and therefore, persuasive studies based on other models and theories were not considered.

Bartlett et al. developed and evaluated three prototypes for mobile apps based on PSD categories (Primary task support, Dialogue support, Social support) to support and encourage physical activity among people with chronic obstructive pulmonary disease (PwCOPD). And results showed a positive acceptance of the prototypes by PwCOPD (Yvonne Kiera Bartlett, 2017). The application was only for PwCOPD patients.

Micallef et al. (Nicholas Micallef, 2016) Aide-Memoire Stroke (AIMS) App to facilitate the stroke patients remember to do exercise more frequently. As reminder was the main element of the app, so they developed different reminder modalities (audio, visual, speech, vibration, etc.), and the user had a facility to set a combination of modalities and duration of reminder. Alongside the reminder, different feedback modalities (visualization and frequency) developed as well. The user feedback during the evaluation of the AIMS app was positive, which indicates that personalized system features are more preferred by the user instead of having irrelevant functionalities. Micallef et al. study included only two persuasion elements (reminder, feedback) and was self-customizable. The population was the study was all stroke patients in the rehabilitation process. The elderly population could react differently towards the reminder and feedback modalities.

Lars Bauger (Lars Bauger, 2016) conducted phenomenological interviews (a qualitative study) to get an in-depth understanding of well-being from the firsthand experiences of older adults older age (they considered third age group) and based on the experiences of 9 elderly participants. They constructed a general meaning structure, based on four interrelated constituents to assess and promote well-being in elderly: "(1) awareness and gratitude for a healthy and functioning body, (2) a new experience of time presenting possibilities for action, (3) a heightened sense of agency, and (4) being-in-place in relationships." In the report, Interviewees' data showed that concerns relevant to the security of the functioning of a body eliminated by physical activities. Furthermore, a sense of healthy and able body coming after the accomplishment of physically exhausting tasks gives good feelings, interviewees revealed while talking about the gratitude of the functioning body.

When the active aging concept drills down, one of its pillars is reducing sedentary time or discouraging prolonged sitting behavior. Researches in the medical field have shown a close link between mental and physical health and sedentary time. Based on empirical findings, researchers have been suggesting interventions to sedentary behavior and increase in physical activities since reduced activity level, causing diseases and decreased life expectancy.

To our best knowledge no fitness application provide complete personalization of application features for elderly. Some completely personalized applications are developed by researcher but only for a specific group of user (mostly for patient of a specific disease). An application that could be personalized based on user's susceptibility to persuasion category could benefit common elderly without any specific disease or need. The keep the content simple and easy to understand, indirect route messages could attract the elderly user. (McGuire, 1973) and (Petty, 1986) believed that, in many cases, a direct route for persuasion proved to be more enduring. However, in the current era of information overflow, people have to deal with the abundance of information, so people with low Need for Cognition (NfC) prefer to use simple cues and stereotypes for information processing (Harri Oinas-Kukkonen M. H., 2009). As the population of this study was elderly, so to keep the content easy to understand, simple cues (indirect route) was used.

(McGuire, 1973) and (Petty, 1986) believed that, in many cases, a direct route for persuasion proved to be more enduring. However, in the current era of information overflow, people have to deal with the abundance of information, so people with low Need for Cognition (NfC) prefer to use simple cues and stereotypes for information processing (Harri Oinas-Kukkonen M. H., 2009). As the population of this study was elderly, so to keep the content easy to understand, simple cues (indirect route) was used.

Chapter 3 Methodology

In this chapter, the author wrote on research design and its refinement process, and procedure of conducting the research experiment. This chapter is comprises of experimental design, research design, unique identity for participants, change in design, equipment, participants, pilot study, refined research design, task, ethical issues, procedure, and analysis subheading.

Experimental Design

A mixed-method between- and within-group experimental design was chosen with personalization, PSD Categories, and message type as independent variables and perceived inspiration (5-items Likert Scale), perceived usefulness (5-items Likert Scale), perceived effectiveness (5-items Likert Scale), and perceived preference of message type as dependent variables. The personalization factor has two levels, namely strong personalization and contra personalization. PSD categories factor has three levels, namely Primary Task Support (PTS), Dialogue Support (DS), and Social Support (SS). Message type has two levels, namely promotive messages (ProM) and preventive messages (PreM).

Research Method

The primary purpose of this research was measuring whether the personalization of PSD (PSD) categories perceived as more inspiring, useful and effective to reduce sitting time. In addition, the researcher also wanted to explore what type of messages (promotive/preventive) was preferred by elderly. The study was looking for, do the elderly perceive strong personalization of PSPs effective to discourage prolonged sitting behavior or sedentary behavior? And does strong personalization cause an increase in perceived inspiration, perceived usefulness and perceived effectiveness of Persuasive System Principles (PSPs) when compared to contra personalization?

This study also explored whether ProM encourages/motivates elderly to reduce prolonged sitting in their daily routine or PreM? This experiment was confirmatory as well as exploratory. The study looked for what are the activities elderly do on a typical day? Also under which personalization condition, elderly perceived the PSD categories more inspiring, useful and effective. To answer the research questions and confirm or reject the hypothesis,

this study needed an mixed-method investigation to measure perceived usefulness and perceived effectiveness of personalized PSD categories and user preference over message types as well as their routine activities before experiment and feedback after experiment. The research needed a controlled experiment alongside exploring participant's routine activities and their thoughts after experiment. Qualitative experiment considered suitable for this kind of research because some other researchers also chose mixed-method qualitative experiment for exploratory research under controlled conditions (Sue Robinson, 2012). This study involved examining sedentary behavior (prolonged sitting behavior) in older people, an age group that has higher physical and emotional vulnerability due to age factor and experience with technology. Some older people have impairments, such as reduced vision, reduced hearing, reduced mobility, or reduced cognition. Organizing experiment in settings where older people felt more comfortable, resolved environmental comfortability and mobility issues of the participants. The presence of the researcher, during experiment, was beneficial for the participants when they felt difficulty understanding the question(s) or message(s). Organizing experiments at participants' settings proved a right choice instead of controlled lab-based experiment. First, it would have been difficult to recruit participants for lab-based experiments. Second, total calculated time for the questionnaires and the experiment was different from pilot tests which were completed by young students. Some participants who chose settings other than their home could not complete experiments in one sitting. In contrast, participants who called at their homes, selected a time slot (mostly evening or weekend) when they could give extra time if needed and completed experiments in one sitting. The researcher kept full control over the experiment in her hands. This field experiment was feasible because the author needed a quiet place, a laptop, and a comfortable and accessible sitting place for the participants to conduct the whole experiment. Among the other reasons for performing the field experiment were getting more realistic settings, performing in participants' comfort zone.

A quantitative research experiment was useful for collecting well-defined, computable, and analyzable data to measure the effectiveness and usefulness of personalization. Experiments and surveys are two commonly used methods in the quantitative approach. These structured data collection methods give measurements to formulate facts and

statistical and numerical analysis of collected data. A comparison of results from two groups (SP, CP) described what kind of PSPs perceived more effective and useful for this specific demographic. The qualitative part gave a chance to have insight on physically active and sedentary routines of elderly on a typical day. The researcher was also able to have participants thoughts in form of feedback.

Thus, the author decided to conduct a mixed-method qualitative experiment research; experiment with a two-factor design with random assignment and qualitative part with semi-structured questionnaires. The first factor is personalization, which has two levels, namely strong personalization, and contra personalization. The second factor was PSD categories, which have three levels, namely Primary Task Support (PTS), Dialogue Support (DS), and Social Support (SS). The two factors, personalization, and PSD categories, were between-subject while message type was the within-subject independent variable. The participants assigned randomly to the groups. There were two reasons for choosing randomization. The first was to minimize the chances of researcher's favoritism. The second was to get unbiased data for each group.

Research designs

Initially, two experiments were designed. Both experiments were developed around design principles of persuasion given by (Harri Oinas-Kukkonen M. H., 2009).

Initial research design

The initial experiment was a mixed-method (between and within) design where 2x5 between-subjects design developed with personalized tunneling and drives of sedentary time as independent variables along with a within-subject independent variable, namely route. Personalization of tunneling had two factors, namely strong personalized tunneling and random tunneling. The five main drives of sedentary time were supposed to identify in the first step through a survey. The route had two factors, namely, direct and indirect. The idea was, in the first step, to identify main drives/reasons of sedentary time in the elderly and then made two main groups SP tunneling and random tunneling. The researcher found that fieldwork and research design are dependent on each other and could result in a deadlock. This initial research design was discarded owing to its problems. This initial research design work discussed in detail in discussion chapter.

Final research design

In the second research design, a mixed-method between- and within-group experiment designed and initially intended to be conducted in two levels to assess the perceived inspiration, usefulness and effectiveness of personalized PSD categories, and perceived preference of message type among elderly. The initially experiment design developed and evaluated with pilot tests. Initially it was designed to conduct research into two part. In the first part, the researcher requested participants to fill a questionnaire, to measure the Susceptibility to Persuasion (StP). After collecting all responses to first questionnaire, the second part of experiment performed with a gap of 2 days; 2 days gap kept for StP calculations. Then, participants randomly assigned to groups (SP and CP) based on independent variable personalization; next in each personalized group, participants further assigned PSD categories based on their susceptibility to persuasion. PSD categories are the second independent variable with three levels; PTS, DS, and SS. Then a video watching activity performed where participants watched two videos, in agreement or disagreement with their susceptibility to persuasion. Each video intervened with two persuasive (one promotive and one preventive) and one control message. The participants asked for their feedback on a questionnaire presented at the end of the video-watching activity. There was an open-ended question on feedback form along with three Likert-scale based questions, to have participants' thoughts and also to identify reasons for outliers if there are any. Message type (promotive, preventive) was the other independent variable of this design. The rationale behind using ProM was motivating the participant to adapt and learn a new behavior without touching the existing ones. The new behavior (increased mobility) would be healthier and gradually overlap the existing one (prolonged sitting behavior). On the other hand, the rationale behind PreM was showing the drawback of current practice to the user and suggest that they should eradicate it from their daily routines. This design included a third type of message called a control message. The control messages were not based on the PSPs; these were simply a piece of general and irrelevant information. A purpose of introducing control message was to check whether feedback on messages were real or emotionally influenced. In a critical examination of this research design, it found that it was not causing any deadlock alike initial research design. Hence this, the second research

design, found feasible in the context of master thesis time and scope, thus approved for conducting the research.

The persuasive system principles (PSPs) for this experiment were taken from (Harri Oinas-Kukkonen M. H., 2009). For the sake of simplicity and to avoid misunderstandings, the author used the same categories and principles names as given in original work (Harri Oinas-Kukkonen M. H., 2009). The author decided to pick up three categories (PTS, DS, and SS) and two principles from the mentioned categories. The motives behind these decisions were; first to adjust the scope of research work within given time limits; second to keep the experiment relevant and simple. It was challenging to recruit a large number of participants and conduct experiments on their settings within the limited time-frame of this master thesis.

Category	Principle
PTS	Reduction
PTS	Self-monitoring
DS	Reminders
DS	Suggestion
SS	Social learning
SS	Normative influence

Table 3.1: List of selected Principles from PSPs

Another obstacle was to determine how many principles to include and how to choose the principles? To answer "how many principles" from selected categories, the author decided to take the most representative principles of that category and commonly available in health and fitness applications. The author chose two principles from each group due to thesis time scope. The next question was "how to select principles," a strategy made to answer this question. That was to select principles that somehow already exist in the form of system features in some well-known and highly user rated mobile applications for health and fitness applications. A query "health and fitness applications" made on the Android play store on Huawei P10 mobile. Eight top user rated applications were selected and checked

features from the given feature list. The author believed that the rating provided on the play store was by users and accurate. All other information were taken from the descriptions that were given with each application on the play store. Special consideration was also paid on the relevance of features (principles) for elderly.

Unique identity for participants

This study did not need any personal information of participants. The researcher, therefore, avoided to take any personal data that could be used for participants' identification in future. Hence, there was no need of General Data Protection Regulations (GDPR) process. However, a unique identity needed for every participant because experiments supposed to be conducted in two different time frames. In each sitting, there was at least one questionnaire. To link the data collected in two sittings for same participant needed to be linked through a unique code. Name and phone numbers were noted on separate paper to contact the participants for second sitting and discarded after completion of experiment. To create unique code for each participant, a formula given by (Leo A. Yurek, 2008) followed for identity creation.

At the start of each experiment, the author created a unique identity for the participant. This study used the same questionnaire from the original study (Leo A. Yurek, 2008) and asked following four questions to participants for creation of identity codes.

Question	Example Answer	Code Element	SGIC
First letter of mother's first name?	M-Mary	M	
Number of older brothers (living or deceased)?	01-one	01	
Number representing the month you were born?	05-May	05	
First letter of middle name (if none, use X)	A-Ann	A	
Subject-Generated Identification Code			M0105A

Table 3.2: Question set and Subject-Generated Identification Code

Random allocation of participants to the groups was a way to minimize the risk of the author's favoritism or biases towards participants. An honest and effective random

distribution, undoubtedly, has a positive influence on risk management. In questionnaire for susceptibility to persuasion, the eighteen statements for six principles randomized using a Microsoft excel.

Change in research design

After the Corona virus outbreak in March 2020, the Norwegian government locked down all institutes and societies and asked people to maintain social distance to control the spread of the virus. The Corona was a new virus, and there was no medication for it invented yet. So to save herself (the researcher) and others (potential participants), it was necessary to halt the data collecting. During that break, the author thought of and looked for other alternatives to conduct experiments and collect data. As participants were supposed to answer questions, watch videos, and give feedback on messages, so it was feasible to conduct this experiment online by using a video calling application and sharing the screen with participants. The author took inspiration from the online method and conducted 21 experiments out of 60 online. Because of the loss of time after the coronavirus outbreak, the author was left with less time to complete the study and therefore decided to stop data collection with 60 participants.

Equipment

Both questionnaires, one for identity, demographic, and susceptibility to persuasion scale questions and second for identity and dependent variables, were paper-based and written in English. Norwegian translation using google translator was provided on demand to make understanding of participants clearer. Most participants were Pakistani, and some of them needed Urdu translation as the author is a native Urdu speaker, so these participants were given explanations in Urdu. The author asked questions to the participants and filled out answers on questionnaires. Two offline videos with intervened messages showed on Microsoft Surface Book 3 with a 15-inch display and Windows 10 Home. The Windows media player application was used to show the videos. The author set up the whole experiment and dealt with unexpected problems. The participants did not operate the machine. All other notifications were disabled to keep the experiment uninterrupted. During the corona outbreak, the experiments were conducted using Skype version 8.59.

Participants

Approximately 200 people were contacted for participation. Out of the 60 people, 25 women and 35 men, gave a positive response and participated in the research. Data collection conducted in two phases; In person; and Online. During the first phase, the author was present and filled the questionnaires and performed the experiment. During the first 39 experiments out of 60, the author was present in person. After the corona virus outbreak, data collection shifted to online mode. During the corona virus outbreak, the data collection process was suspended for a period to analyze the situation. It was impossible to conduct experiments in person while following the social distancing instructions given by the government to control the spread of the virus. In the second phase, 21 experiments conducted online using skype with a screen sharing feature.

Potential participants were contacted in public places, libraries, Oslo Metropolitan University, old homes, and religious places such as mosques and churches. Respondents were recruited using random and snowball sampling (also called chain sampling, chain-referral sampling, or referral sampling)[add reference]. At first, the author spread the words at her workplace and talked to her contact to search for potential participants as well as contacting the Senior Centre at Oslo Metropolitan University for recruiting retired faculty. The author also went in person to public places such as cafes, subway stations, public libraries, and religious places such as mosques. Participants who were recruited through personal references and public places became the first subjects in further snowball and referral sampling. Old homes were also contacted for potential participants, but the response was not positive, or in some cases, the author did not get a response—most of the referral sampling was made at mosques.

Out of 60, two participants completed the first questionnaire and refused to continue and claimed that the experiment is taking more time than expected. Two experiments were for the random personalized group that later excluded. The remaining 56 participants completed their experiments for strong and CP groups. Twenty four out of 56 complete experiments were for strong personalized group and 32 for CP group. The experiments were conducted at the participants' settings at the end of winter and start of spring seasons when usually mobility is low in Oslo, Norway. The inclusion criteria of this study was all genders aged greater than 60 from different nationalities, religions, physical activity levels, and

educational and occupational backgrounds.. Experiment language was English, and participants were supposed to have mid to high command on English. As the participants are elderly and living in Oslo, it was expected that they have a high command of the Norwegian language. To facilitate the author and participants with language and to take notes at the experiment, an option considered was to hire a person who had high command on both Norwegian and English. However, it was ensured that the helper did not affect the experiment in any way. During the experiments, no participant was in extreme need of translation help, and therefore, the author handled all experiments herself without any helper. Participants asked about prior experience with mobile applications for physical activity.

Pilot study

Five pilot tests were conducted. All five pilot participants were master students of Universal Design of ICT. Pilot participants were asked to fill out susceptibility to persuasion scale questionnaire, watch videos, and fill out feedback questionnaires. The researcher noted the time for each activity. After the pilot tests, the researcher asked the participants for their feedback. Each participant reported that there were too many questions in the susceptibility to persuasion questionnaire. There should not be more than 20-25. Initially, this questionnaire had 56 questions. All messages and questions are clear and easy to understand. The chosen video (The good place) is interesting but a bit too long. They liked the idea of intervening in messages in videos. The total experiment time taken by pilot participants was from 25 to 35 minutes. After modification, another pilot test round was completed with two participants. The major problem that were identified during the first and second round of pilot tests was experimenting two sittings at different times. All pilot test participants agreed to complete tests in one sitting, and they claimed that it is hard to take time out on different days for the experiment.

Refined Research design

Based on the feedback from the pilot participants and researchers' discussions, the number of questions in the susceptibility to persuasion questionnaire was reduced to twenty-four. The video time was reduced from 6 to 3-4 minutes for each video, including the messages time. The new calculated time to complete the experiment was 30-35 minutes. However,

most of the real experiments took double the time estimated based on pilot tests. In a few cases, the time was close to calculated time, and in other few cases, total time exceeded twice the calculated time.

A way out was formulated to conduct the whole experiment in one sitting. Participants were supposed to be recruited using the snowball method. So, 24 experiments, 8 for each PSD category group, would be SP. Next, 32 experiments would be CP. In contra personalization, there were four groups and 8 participants for each group. The random personalized group was supposed to be done after strong and contra personalization and would have 24 participants. The identity creation process was not removed, and the choice was given to participants to finish video watching activity in the first sitting or at some other time.

Task

The experiment was divided into two steps. The division was devised to measure susceptibility to the persuasion scale in the first step that leads to the creation of messages for strong and CP groups in the second step.

In the first step, the participant answered a questionnaire, and the researcher filled out their answers. The questionnaire had three parts. The first part included four questions to establish an identity of the participant for establishing a link between data being gathered at the first and second steps for the same participant. The second part comprised demographic questions and questions regarding day-to-day life. The questions in the third part were related to the PSPs.

For the second step, a video watching activity with intervened messages was devised, followed by a final questionnaire completion activity. There were two groups (strong personalized, CP); the strong personalized group had 24 participants, and CP group had 32 participants. Each participant watched two videos of 8 minutes and completed a questionnaire. The first message appeared after the completion of the first scene of the video, followed by the second message after the second scene of the video, and last, the third message appeared after the third scene of the video. Participants watched the final scene after the third message. Each scene lasted approximately 30 to 45 seconds. Each message lasted for 20 seconds with colored background and music. The minimum time of the video was three minutes and nine-second (03:09), and the maximum time was four

minutes and twenty-two seconds (4:22). The max time limit, however, did not exceed 8 minutes. After each video, the participants were presented feedback questionnaires. The questionnaire had four pages, and the first page had a field to write the participant's identity code. The rest of the pages have questions to measure dependent variables after video watching activity with intervened messages. The participants watched the first video, followed by answering the respective questionnaire, and the same goes for the second video. The sequence of videos was random for each participant. The sequence of types of messages within each video was random as well. After each video, the questionnaire completion activity was set to reduce the complexity and cognitive burden for the elderly. The author tried to keep the messages easy to understand.

Ethical issues

Before conducting the research experiment, taking care of ethical issues was of immense importance because it involved humans, therefore, paying attention to their autonomy, privacy, dignity, and security from risk was the responsibility of the authors of the research. Participants were treated with kindness, and respect was given to their decisions and thoughts. The Norwegian National Committee for Research Ethics in Science and Technology, which has established to make sure the implementation of the Research Ethics Act, has provided guidelines for research ethics (Guidelines for research ethics in science and technology, 2016). The purpose of these guidelines is not only to promote good scientific practices but also to explain to the researchers their duty of honesty towards their research and responsibilities towards peers, society, other people, and the environment (Guidelines for research ethics in science and technology, 2016). There is another institute that handles the misconduct cases related to research, called the National Commission for the Investigation of Research Misconduct. The definition of misconduct in the Research Ethics Act is "falsification, fabrication and plagiarism, and other serious breaches of good scientific practice" (The National Commission for the Investigation of Research Misconduct, n.d.). A willful act of falsification or overall gross negligence can lead to misconduct in research.

Experiment and questionnaire filling activities were conducted in participants' settings. Neither audio nor camera recording was made. Any data that could be used to recognize the participants in the future did not take.

The author operated the machine that used to run videos for the participant, so there is no need for prior participant's experience with laptops usage.

During the corona virus outbreak, however, experiments were conducted online. Before the online setup, the potential participants were called and asked if they can set up a skype call, or is there any family member who can help to set up a skype call. So, online experiments were conducted where participants had experience with skype use or arrangements to set up an online call.

The author wrote/filled-out the questionnaires for the participants based on their oral responses to the questions..

The other problem was about reduced vision, hearing, cognitive abilities. So, the participant might not understand things correctly and sharply. They might take more time than usual to understand writings or ideas. To overcome this issue, the author made documents such as the consent form, intervening messages, and questionnaires in possible simple language and paper-based forms accessible. The accessibility of materials was ensure and double-checked before approaching the participants. The investigator also explained verbally using simple and easy words and with examples when participants needed more information regarding the project and questions.

Before the questionnaire filling and performing the experiment, participants were informed about:

1. Purpose of the research: The primary purpose of this study is to measure the effectiveness and usefulness of strong personalization of PSPs and whether ProM are perceived more motivational and preferred over preventives by elderly demography or not.
2. Willingness to participate: Participants have the right to decline to participate, refuse to answer any question, or to withdraw at any level of experiment.
3. Potential risks: If any potential risks are identified that might affect the user, it communicated to participants.
4. Incentives/rewards: the participation will be voluntary, and there will be no gifts or incentives in any form for the participants.

5. Benefits of research: the study will confirm that how the elderly perceive personalization of the application's qualities and persuasive message intended to abandon/modify prolonged sitting behavior.
6. Publicity of Information: participants informed that all information collected to contact participants would be used only for the research. All participants will remain anonymous for the public or audience of this research.
7. Destroy Information: Participants informed that their contact information destroyed after completion of the data collection and any other information at the end of the study by the 30th of June 2020.
8. An informed consent form was given to the participants. These were not signed to preserve the anonymity of the participants. Participants were only asked for their verbal consent.
9. Possible efforts put to justify equal gender participation of the targeted population in research.
10. A concise information sheet read for the participant that briefly informs about the research.

Procedure

At first, participants were contacted in person or by phone and were informed about the study. Their questions were answered. Most people asked about the study, such as how the results of the study will be beneficial for common people? Will study or university identify them? How much time will it take? We don't have experience with technology, could we be of any help for you? Some other people declined the invitation to participate.

The people who agreed to participate were next asked for the date and time of their availability. A list in Microsoft word was created to note down the name, phone number, response at the first call, response at second call, meeting place (address), and decided date and time for the experiment. The sheet was destroyed after data collection. The author went to the decided places on time to meet participants and conduct the experiment. The places of experiments were, usually, the home of the participant; however, six experiments completed at mosques, one experiment made at OsloMet University, and one in a café.

After arriving at the decided place, the conversation started with ice-breaking questions such as Hi (Smile) My name is [NAME], how are you, a short dialogue on ongoing whether condition. All of the Pakistani participants, who invited the researcher at their home, offered tea with some snacks. Some of them insisted on having a meal with their family. They showed this gratitude because they were taking the researcher as their guest, and offering tea or food to guests is a tradition in Pakistani culture. After ice-breaking, the researcher requested the participants to have a seat at their favorite and comfortable sitting place, remove any distractions, for example, switching off TV or muting noisy objects. The researcher made the laptop ready and assembled the paper documents and questionnaires in order. The researcher asked the participants if they need headphones or they want to listen to videos from the speakers. The speakers on the author's laptop had clear audio quality. Then participants were asked if they are comfortable starting a formal experiment.

First, the participants were given a piece of oral consent information informing them about research purpose, their rights to withdraw at any time, the anonymity of the participant and his/her responses, and different parts of the experiment such as creating the identity, age, question on daily routines, questions on susceptibility to persuasion scale, video watching activity and final feedback questions. After taking the verbal consent of participants, the author started the experiment. The author asked the questions to the participants and filled the forms in by herself. The forms were visible to the participants while the author was entering responses. During the experiment, the first participants were asked four questions to create their unique id-code, and that id-code was written on all forms. In the next step, demographics questions were filled out where age was asked to participants, and gender and geography (location) were filled out based on observation. Next, questions related to susceptibility to PSPs were asked to participants. These questions had Likert-scale values ranging from strongly disagree to agree strongly (strongly disagree-disagree-neutral-agree-strongly agree). A 5 minutes pause was taken after completing susceptibility to a persuasive scale questionnaire to compute the relevant category of the participants based on answers given in this questionnaire. Liker-scale ordinal categories were given numeric values as strongly disagree = -2, disagree = -1, neutral = 0, agree = 1, and strongly agree = 2 for sake of making susceptibility computation easy and fast. The decision question was also included in each category to find susceptibility in case of a tie.

Numeric values of all answers for each category were added up to compute the susceptibility of the persuasion scale for the participant. The category that got the highest score was considered as susceptible to that participant. In case two categories got the same score, then the decision was made based on answers given for decision questions. After computing the relevant category of susceptibility to persuasion, the participant asked to watch two videos one by one. The feedback questions asked to the participant and given answers filled out after each video, respectively. Three out of four feedback questions for each message had Likert-scales value ranging from 1 to 5, where at Likert-scale value 1 was lowest, and value 5 was the highest.

In contrast, the fourth question was an open-ended question, where participants were asked about their favorite part of the message. While responding to the open-ended question, Participants also gave their thoughts. Data were collected during the end of winter and start of spring 2020. Any personal data that could be used for the identification of participants were not collected. Therefore, the General Data Protection Regulation (GDPR) rules were not violated.

Analysis

All collected data for both questionnaires and feedback forms were manually converted to spreadsheets, and the transformation was also manual. Statistical analysis of data was performed using JASP 0.11.1.0. Data were analyzed using a parametric two-way MANOVA test, which allows investigating interaction effects. Contingency test and descriptive statistics also used to interpret data. Correlation Matrix used to test data integrity. Feedback and questionnaire data were visualized using diverging stacked bar charts, as suggested by Robbins and Heiberger (N. B. Robbins, 2011).

Chapter 4 Results

Figures 4.1-4.12 shows the 56 responses to the feedback questionnaire of the video watching activity. Blue and orange are used to indicate ProM, and green and yellow are representing the PreM. The intensity of the colors indicates strong- and contra-personalization. Interaction effects between personalization and PSD categories on dependent variables (perceived inspiration, perceived usefulness, and perceived effectiveness) were measured using Two-way MANOVA.

Perceived inspiration

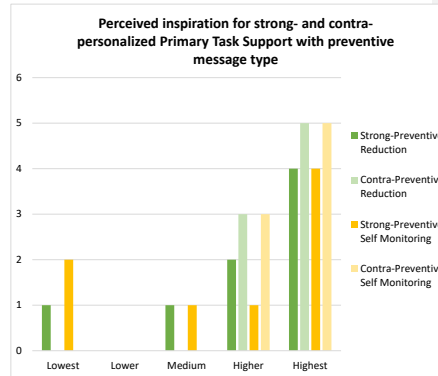
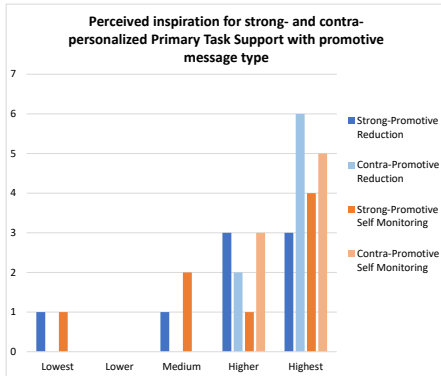


Figure 4.1: Perceived inspiration for strong- and contra- personalized PTS with promotive and ProM (susceptibility to persuasion scale of contra personalization: DS)

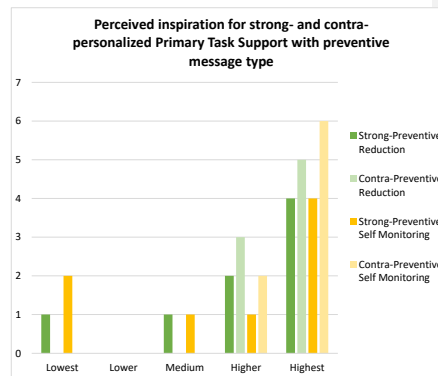
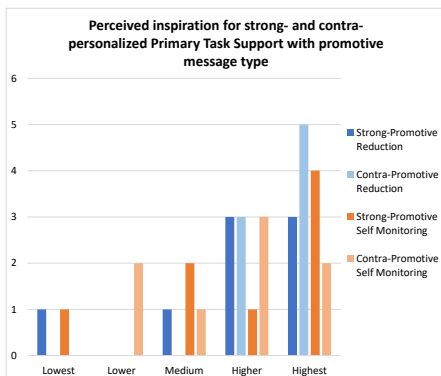


Figure 4.2: Perceived inspiration for strong- and contra- personalized PTS with promotive and ProM (susceptibility to persuasion scale of contra personalization: SS)

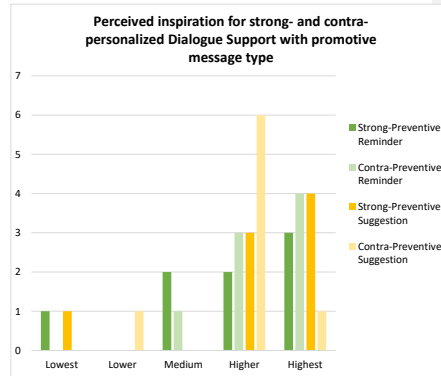
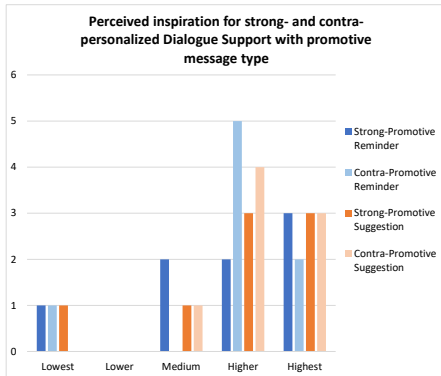


Figure 4.3: Perceived inspiration for strong- and contra- personalized DS with promotive and ProM (susceptibility to persuasion scale of contra personalization: PTS)

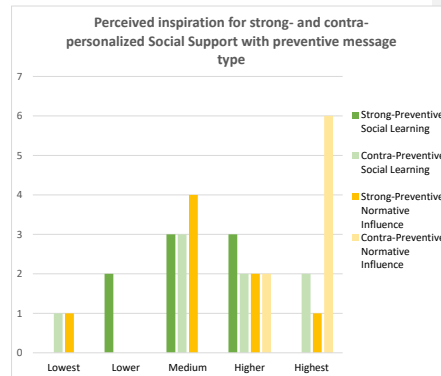
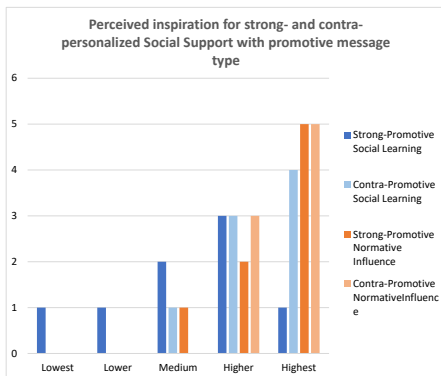


Figure 4.4: Perceived inspiration for strong- and contra- personalized SS with promotive and ProM (susceptibility to persuasion scale of contra personalization: PTS)

Figures 4.1-4.4 show the responses to perceived inspiration for SP PSD categories versus CP PSD categories. For contra personalization, susceptibilities to persuasion scale are; PTS with DS susceptibility and SS susceptibility; DS with PTS susceptibility, and SS with PTS susceptibility.

All three PSD categories perceived as highly inspiring when CP with DS closer to medium inspiring for the ProM. The PTS and DS are perceived as more inspiring for PreM as well when CP. In contrast, SS perceived medium inspiring for the same message type in contra personalization. The contra personalization of all three categories perceived moderate-to-high inspiring compare to strong personalization. There was a small effect of personalization ($F(1,50) = 2.983, p = .028$; Pillai's Trace = 0.202) and PSD categories ($F(1,50) = 2.304, p =$

.026; Pillai's Trace = 0.322); however, there was no significant interaction effect between the personalization and the PSD categories ($F(2,50) = 1.150, p = .337$).

Perceived usefulness

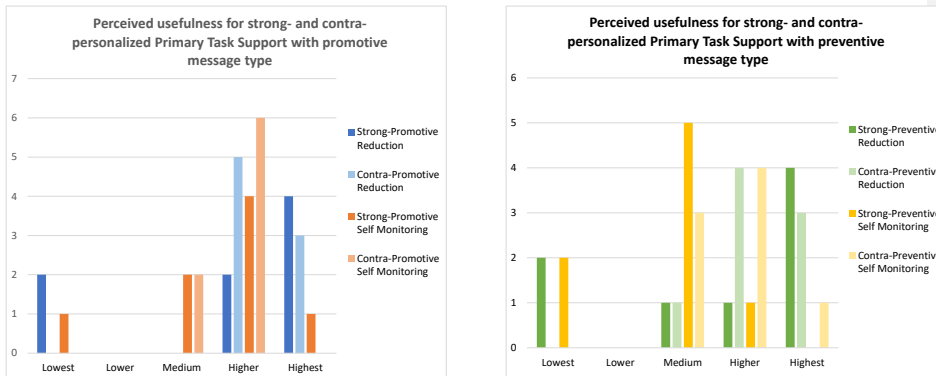


Figure 4.5: Perceived usefulness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: DS)

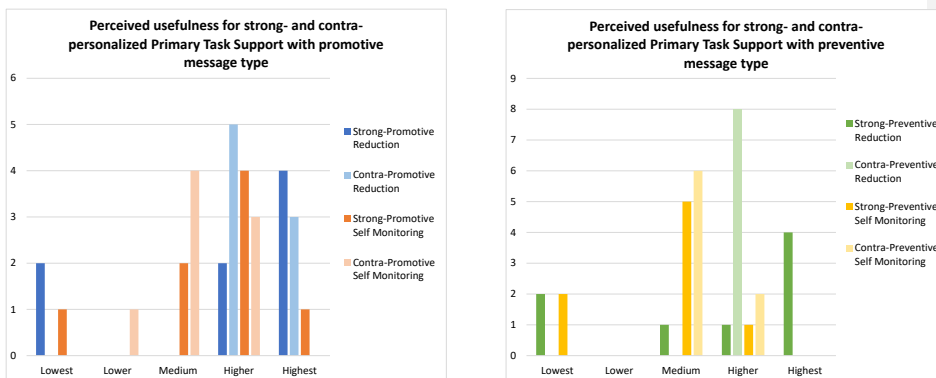


Figure 4.6: Perceived usefulness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: SS)

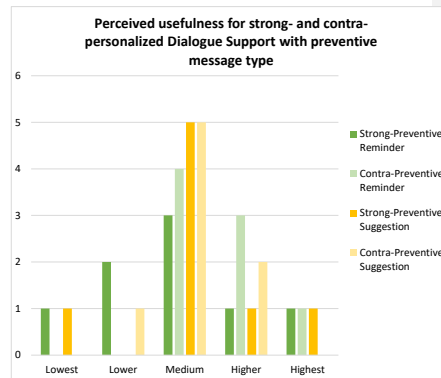
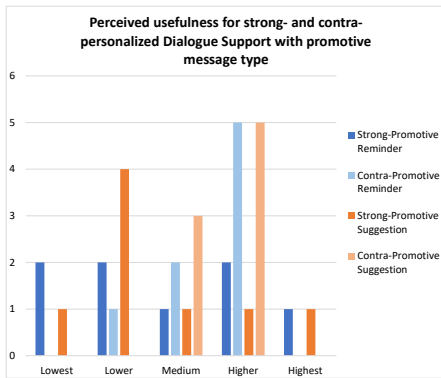


Figure 4.7: Perceived usefulness for strong- and contra- personalized DS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)

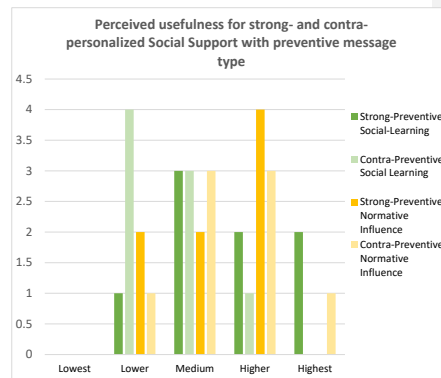
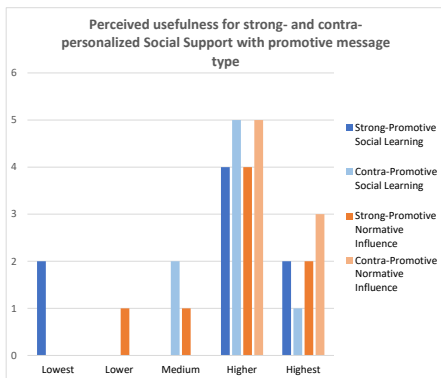


Figure 4.8: Perceived usefulness for strong- and contra- personalized SS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)

Figures 4.5-4.8 show the responses to perceived usefulness for SP PSD categories versus CP PSD categories. For contra personalization, susceptibilities to persuasion scale are; PTS with DS susceptibility and SS susceptibility; DS with PTS susceptibility, and SS with PTS susceptibility.

SP PTS category perceived highly useful for the ProM. In contrast, contra personalization of PTS to DS and SS perceived medium to medium-high useful. With PreM, PTS tended to higher useful when SP against contra personalization to DS. On the other hand, contra personalization perceived more useful SS susceptibility and PreM. CP DS is more useful with ProM and medium useful for both strong and contra personalization with the PreM. Personalized (either strong or contra) SS category perceived moderate-to-high useful.

However, the category perceived more useful when CP with promotive message contents, while SP SS perceived more useful with the PreM. There was no effect of personalization ($F(1,50) = 1.284, p = .290$; Pillai's Trace = 0.098) and there was a small effect of PSD categories ($F(1,50) = 2.715, p = .010$; Pillai's Trace = 0.369); however, there was no significant interaction effect between the personalization and the PSD categories ($F(2,50) = 1.875, p = .073$).

Perceived effectiveness

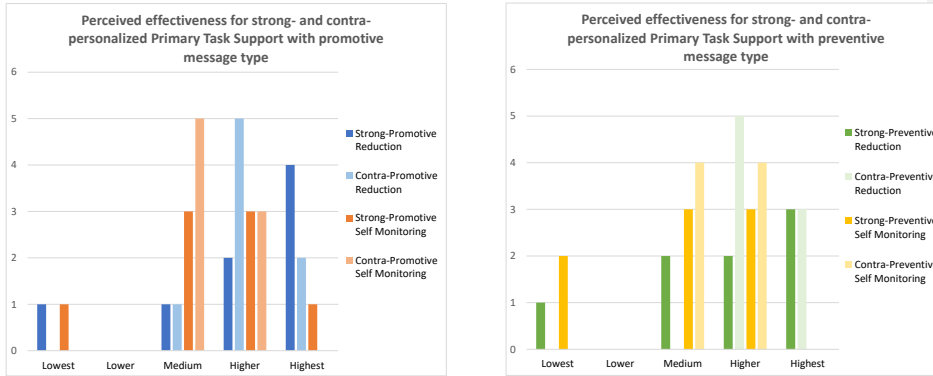


Figure 4.9: Perceived effectiveness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: DS)

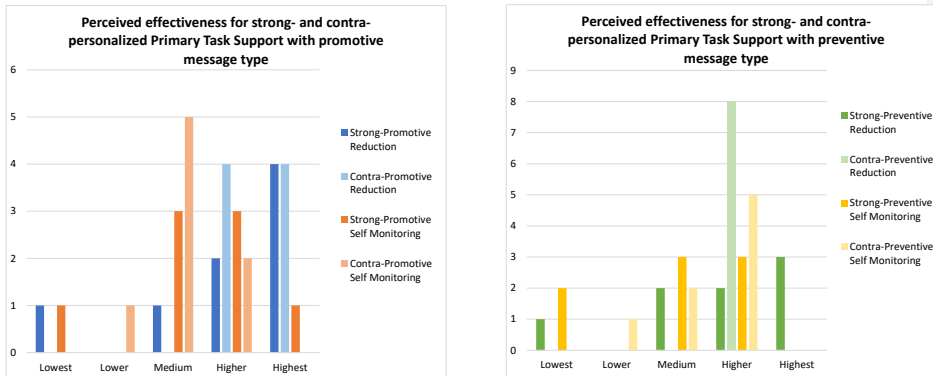


Figure 4.10: Perceived effectiveness for strong- and contra- personalized PTS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: SS)

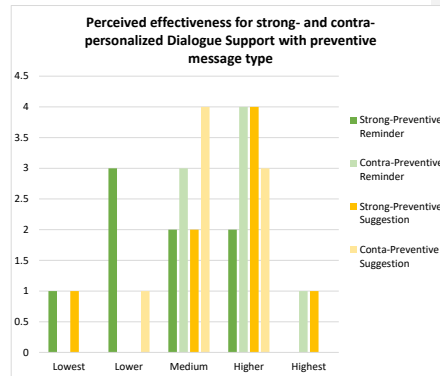
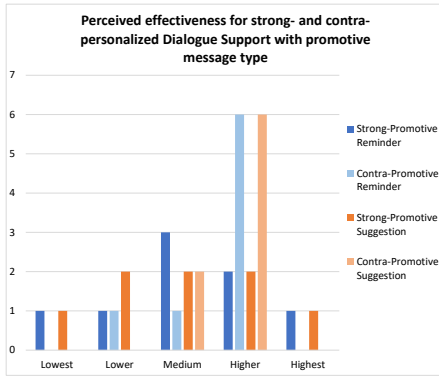


Figure 4.11: Perceived effectiveness for strong- and contra- personalized DS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)

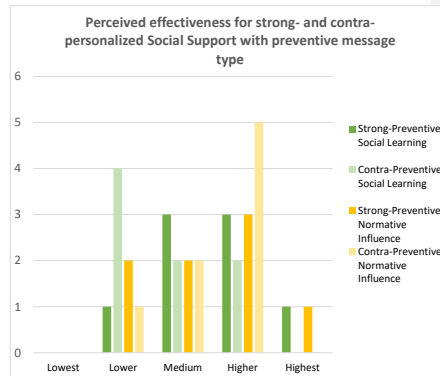
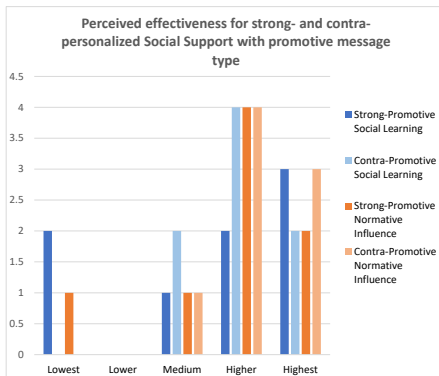


Figure 4.12: Perceived effectiveness for strong- and contra- personalized SS with message types (ProM and PreM) (susceptibility to persuasion scale of contra personalization: PTS)

Figures 4.9-4.12 show the responses to the perceived effectiveness for SP PSD categories versus CP PSD categories. For contra personalization, susceptibilities to persuasion scale are; PTS with DS susceptibility and SS susceptibility; DS with PTS susceptibility, and SS with PTS susceptibility.

The reduction principle (from PTS category) perceived more effective when SP. In contrast, the self-monitoring principle perceived effective when CP and with the ProM. With PreM, the CP PTS category perceived more effective with either DS or SS susceptibility. CP DS perceived highly effective with promotive content, while the SP suggestion principle perceived more effective with the PreM. Personalization (either strong and contra) perceived as equally effective for normative influence principles, while the social learning

principle perceived effective when CP with the ProM. With PreM, CP normative influence principle and SP social learning principle perceived effective in the SS category. Overall social learning and normative influence principles with PreM and normative influence principle with ProM perceived more effective when CP. In contrast, the social learning principle is perceived as more effective when SP with the ProM. There was no effect of personalization ($F(1,50) = 1.420$, $p = .242$; Pillai's Trace = 0.108) and there was a significant effect of PSD categories ($F(1,50) = 3.830$, $p < .001$; Pillai's Trace = 0.484). Furthermore, there was a small interaction effect between the personalization and the PSD categories ($F(2,50) = 2.634$, $p = .012$).

Perceived preference over message types

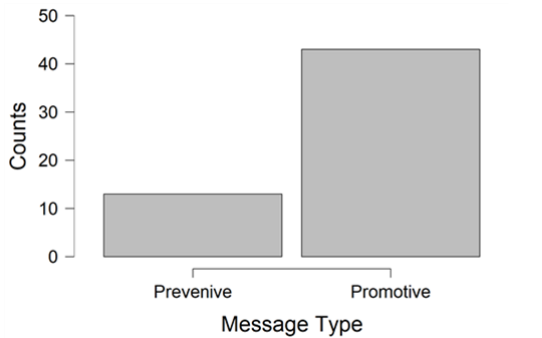


Figure 4.13: Perceived preference over message type

Figure 4.13 shows the distribution of participants' perceived preference on the message types (ProM and PreM). From the graph, it is clear that most participants like to have promotive or encouraging messages. It also reveals that encouraging a new behavior through motivational content is comparatively more acceptable among the elderly. The message content asking participants to change or abandoned an existing practice without guiding them why do they need it and where they could spend spared time, perhaps would not motivate the elderly. However, they found the messages motivational, and some of them showed gratitude to remind them of reducing sedentary time in their daily routine.

The independent variable message type was dichotomic. The perceived preference concluded from the open-ended question, "What is your favorite part in this message?" where the researcher felt that the participants got distracted and failed to show their preferences or was unable to give the right answer, the participants were, therefore, asked follow-up questions to identify their perceived choice. The researcher took steps to remain neutral and not influence the participants' responses. The yes/no and closed-ended questions were avoided for follow up questions. Examples were given where participants needed an explanation of the susceptibility to persuasion items.

Persuasive System Design Categories

Diverging stacked bar graphs under the following subheadings are the summary of all the 56 respondents. Orange and blue are used to indicate preference on one of the sides. Further, the intensity of colors refers to the preference level. Each diverging stacked bar graph shows the perceived values of dependent variables (inspiration, usefulness, and effectiveness) for two principles in each category and three types of messages (promotive, preventive, and control).

From an overall view of the graphs (under following subheadings), responses to dependent variables on control messages are mostly on the lower value side of the graph, which indicates that mood and understanding did not affect the responses. A trend towards higher value on (Lowest-Highest Likert-scale and) diverging stacked bar graph observed for perceived inspiration for control messages; it caused by control message selection and personal affiliation of the participants towards that message.

Strongly personalized primary task support

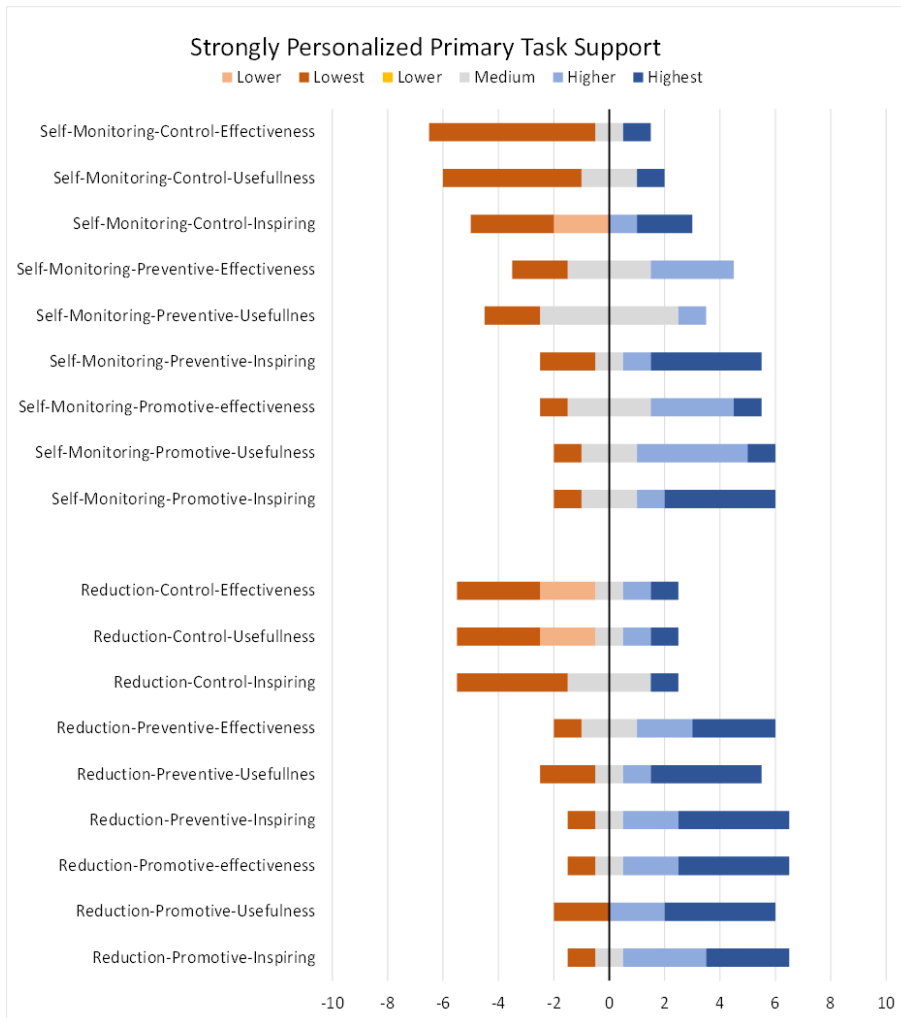


Figure 4.14: SP PTS (suggestion and reminder principles) with promotive, preventive, and control messages

Figure 4.14 shows 8 responses on perceived inspiration, perceived usefulness, and perceived effectiveness of the SP PTS category for promotive, preventive, and control messages.

Self-Monitoring Principle: Both promotive and preventive messages perceived as almost equally inspiring by the participants. While perceived usefulness of promotive messages is

stronger compare to perceived usefulness of preventive messages. Similarly, perceived effectiveness for ProM was given preference over perceived effectiveness for preventive messages.

Reduction Principle: Perceived preference for usefulness and effectiveness is minimal when compared for promotive and preventive messages, respectively. Perceived values for ProM are slightly more preferred than the PreM. However, perceived inspiration is the same for both message types.

Strongly personalized dialogue support

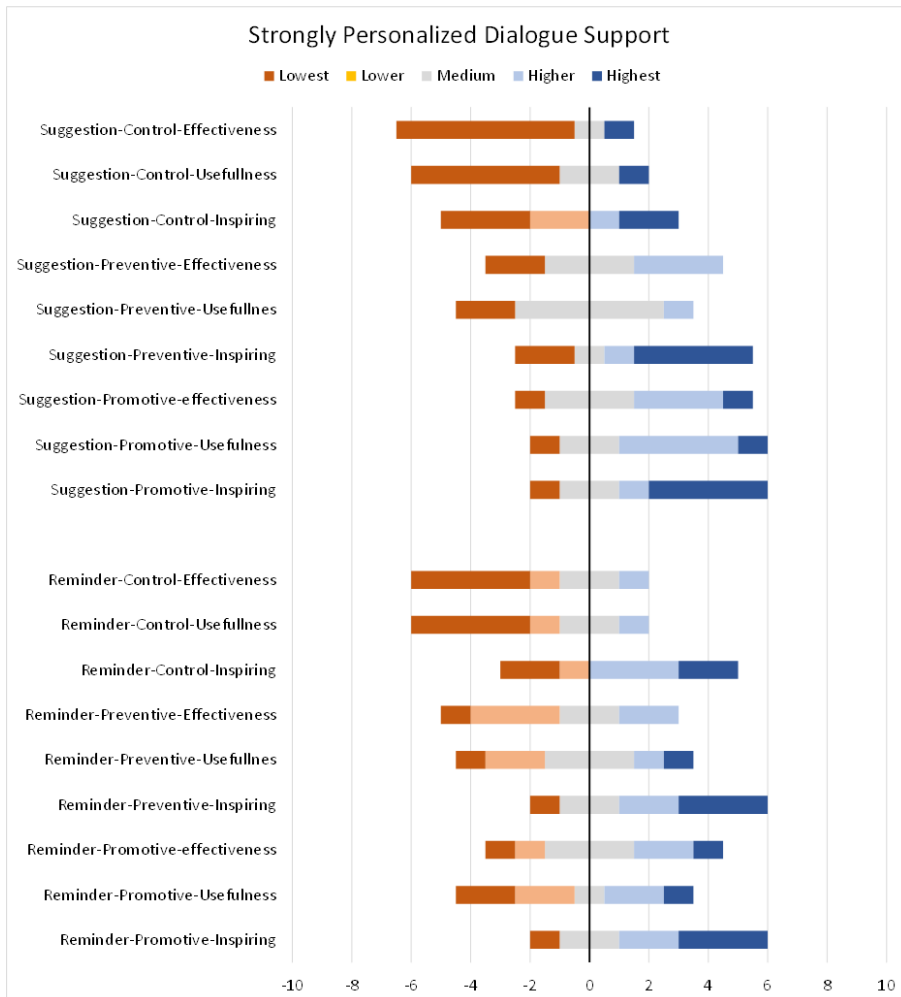


Figure 4.15: SP DS (suggestion and reminder principles) with promotive, preventive, and control messages

Figure 4.15 shows 8 responses to the perceived inspiration, perceived usefulness, and perceived effectiveness of the SP DS category for promotive, preventive, and control messages.

Suggestion Principle: Both promotive and preventive messages perceived as almost equally inspiring by the participants. More than half of the respondents rated perceived usefulness of PreM either neutral or lower compared to perceived usefulness for the promotive

message, which was mostly rated higher. While perceived effectiveness for promotive messages was slightly preferred over perceived effectiveness for preventive messages.

Reminder Principle: Perceived preference for usefulness for promotive and ProM are the same; however, the number of neutral responses for the PreM is higher compared to that of the ProM. Perceived effectiveness for the ProM is preferred over the PreM. However, the perceived inspiration was being rated equally for the two message types and indicated a mostly positive trend.

Strongly personalized social support

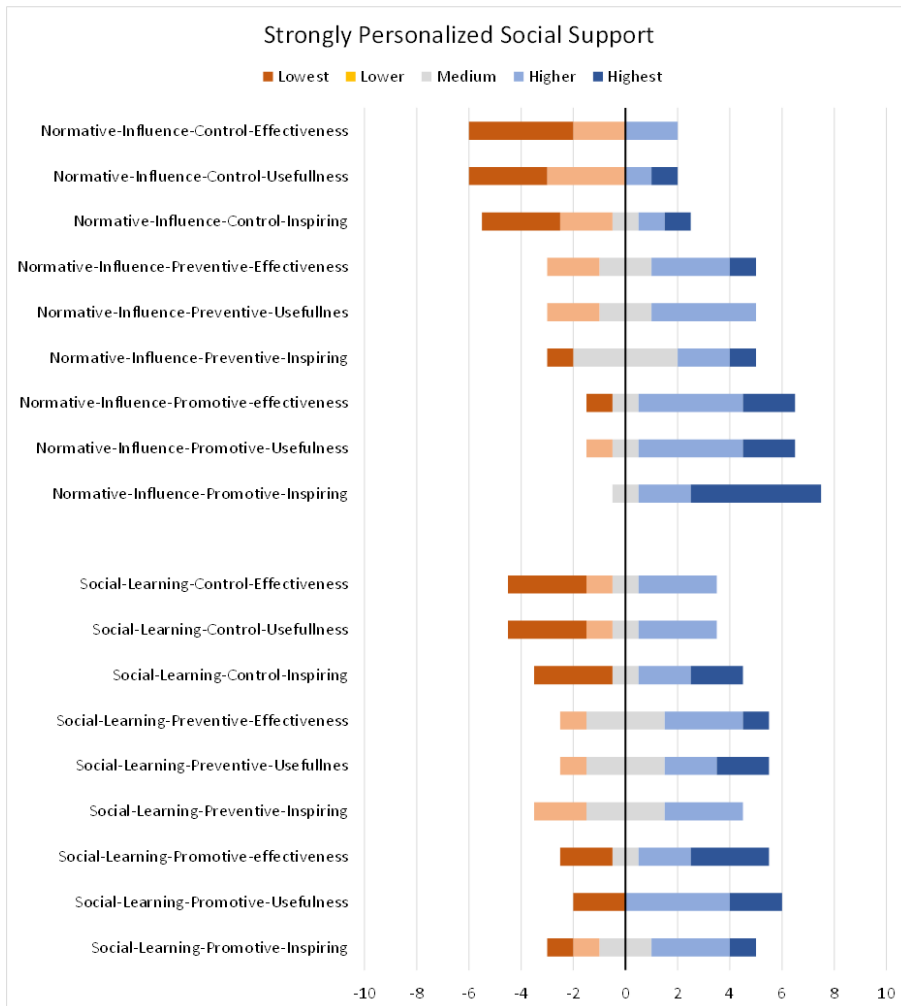


Figure 4.16: SP SS (normative influence and social learning principles) with promotive, preventive, and control messages

Figure 4.16 shows eight responses to the perceived inspiration, perceived usefulness, and perceived effectiveness of the SP SS category for promotive, preventive, and control messages.

Normative Influence Principle: ProM for normative influence principle (in SS) is perceived as more inspiring by the participants compared to the PreM. Similarly, perceived usefulness

and perceived effectiveness for ProM are given higher preference over preventive messages, respectively.

Social Learning Principle: It is perceived as high usefulness and effectiveness with ProM. Most of the respondents perceived it as moderately useful and effective with PreM. However, the perceived inspiration for the two message types shows the same number of responses on both sides of the graph; yet a closer inspection revealed a difference in intensity level that social learning principle perceived highly inspiring with ProM while with PreM it perceived moderate-to-high inspiring.

Contra personalized dialogue support

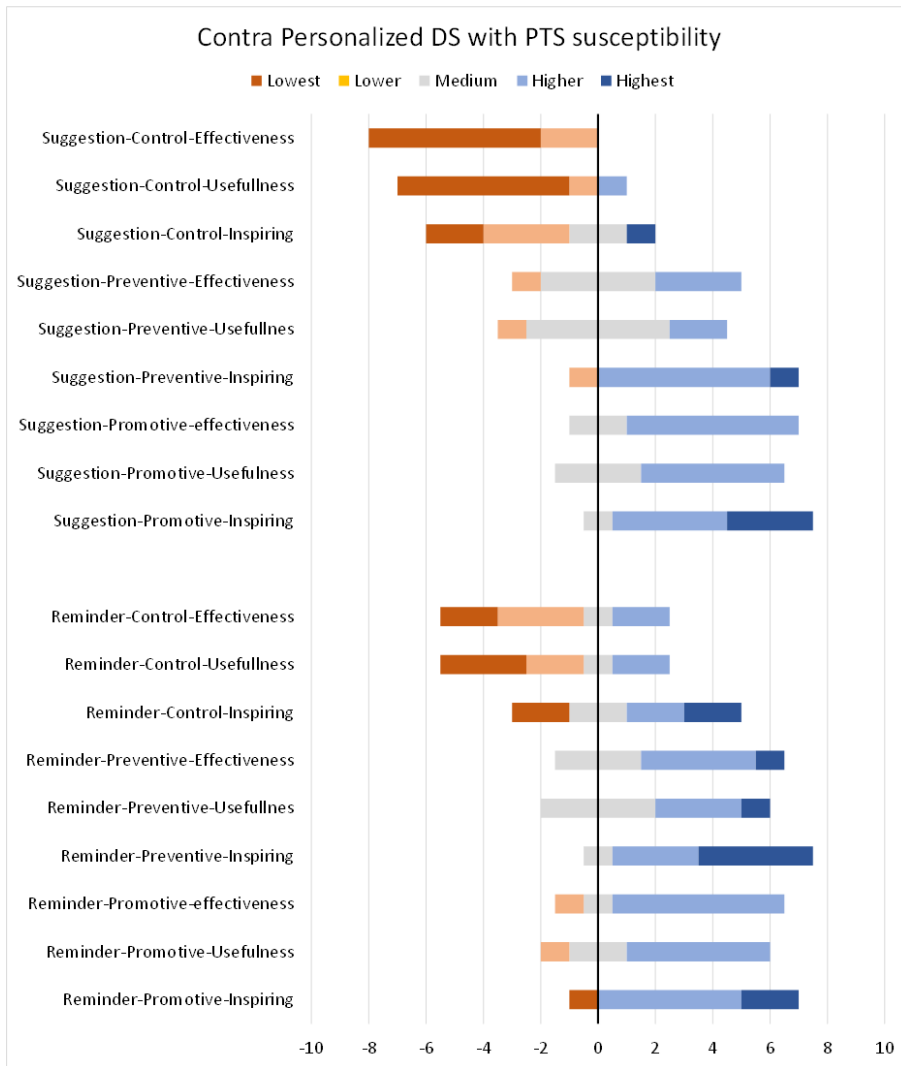


Figure 4.17: CP DS with PTS susceptibility (suggestion and reminder principles) with promotive, preventive, and control messages

Figure 4.17 shows eight responses related to perceived inspiration, perceived usefulness, and perceived effectiveness of CP DS to PTS susceptibility for promotive, preventive, and control messages.

Suggestion Principle: The intensity level of the perceived inspiration for the ProM indicates a higher preference over perceived inspiration for the PreM. Similarly, perceived usefulness and perceived effectiveness for ProM are given a higher preference over preventive messages, respectively.

Reminder Principle: Perceived usefulness and perceived effectiveness for the ProM are mostly preferred when looking down on the intensity level of the two message types. The number of neutral or average rating responses are higher in preventive messages for the two perceived values. The intensity level on the perceived inspiration for PreM indicates a higher preference over perceived inspiration for ProM.

Contra personalized social support

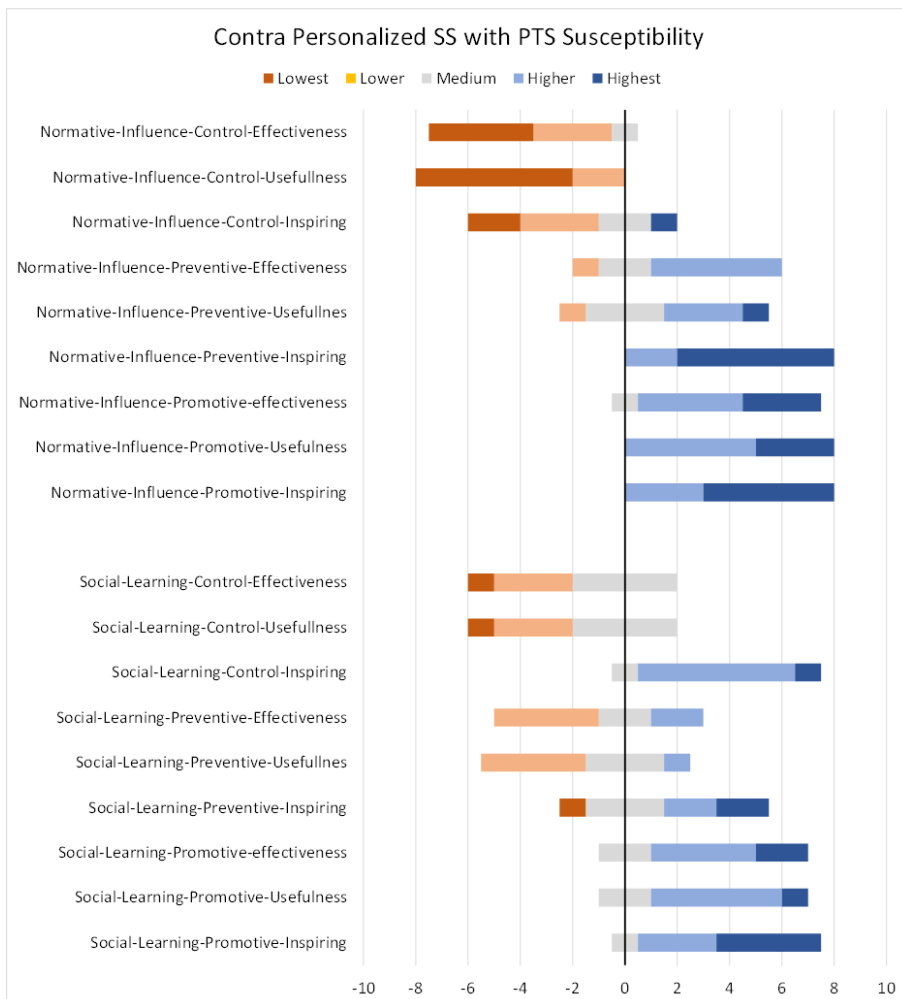


Figure 4.18: CP SS with PTS susceptibility (normative influence and social learning principles) with promotive, preventive, and control messages

Figure 4.18 shows eight responses related to perceived inspiration, perceived usefulness, and perceived effectiveness of CP SS to PTS susceptibility for promotive, preventive, and control messages.

Normative Influence Principle: The intensity level of the perceived inspiration for Message types (ProM and PreM) indicates an almost close-to-equal preference level. Perceived

usefulness and perceived effectiveness for the ProM do not have any neutral and negative indication compared to the two values for the preventive messages, which shows some neutral and lower than the neutral trend in preferences.

Social Learning Principle: All three perceived values (inspiration, usefulness, and effectiveness) for the social learning principle shows mostly neutral-to-negative trend for preventive messages and from neutral to favorable preference without any negative value for promotive messages. It strongly indicates that promotive messages are more motivational compare to preventive messages.

Contra personalized primary task support

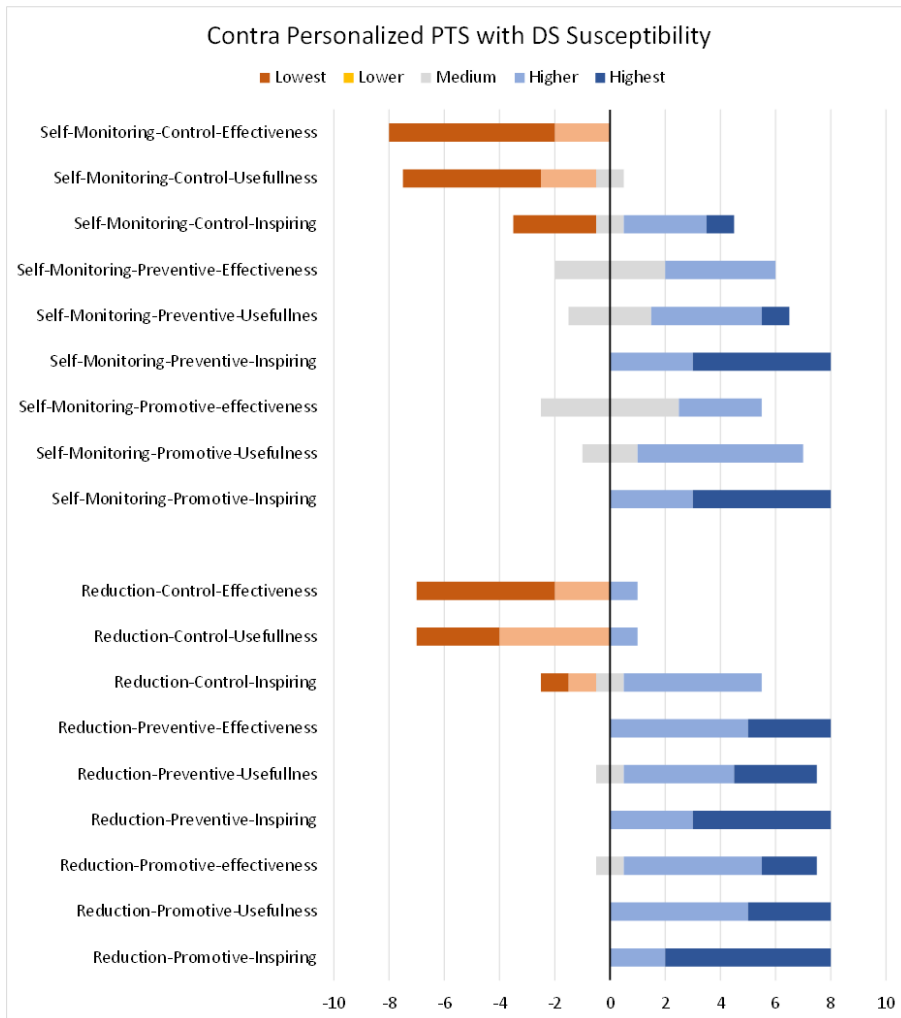


Figure 4.19: CP PTS with DS susceptibility (self-monitoring and reduction principles) with promotive, preventive, and control messages

Figure 4.19 shows eight responses to perceived inspiration, perceived usefulness, and perceived effectiveness of CP PTS (with DS susceptibility) for promotive, preventive, and control messages.

Self-Monitoring Principle: All three dependent variables show an almost similar trend for promotive and ProM for this principle, except the difference in the selection of preference

levels. A neutral trend in the responses to the perceived effectiveness of both messages is prominent.

Reduction Principle: Here, the promotive and preventive messages perceived close-to-equal useful and effective. All three dependent variable values are on the positive side of the scale, which means that the motivation level will not be affected by the content/message type.

Contra personalized primary task support

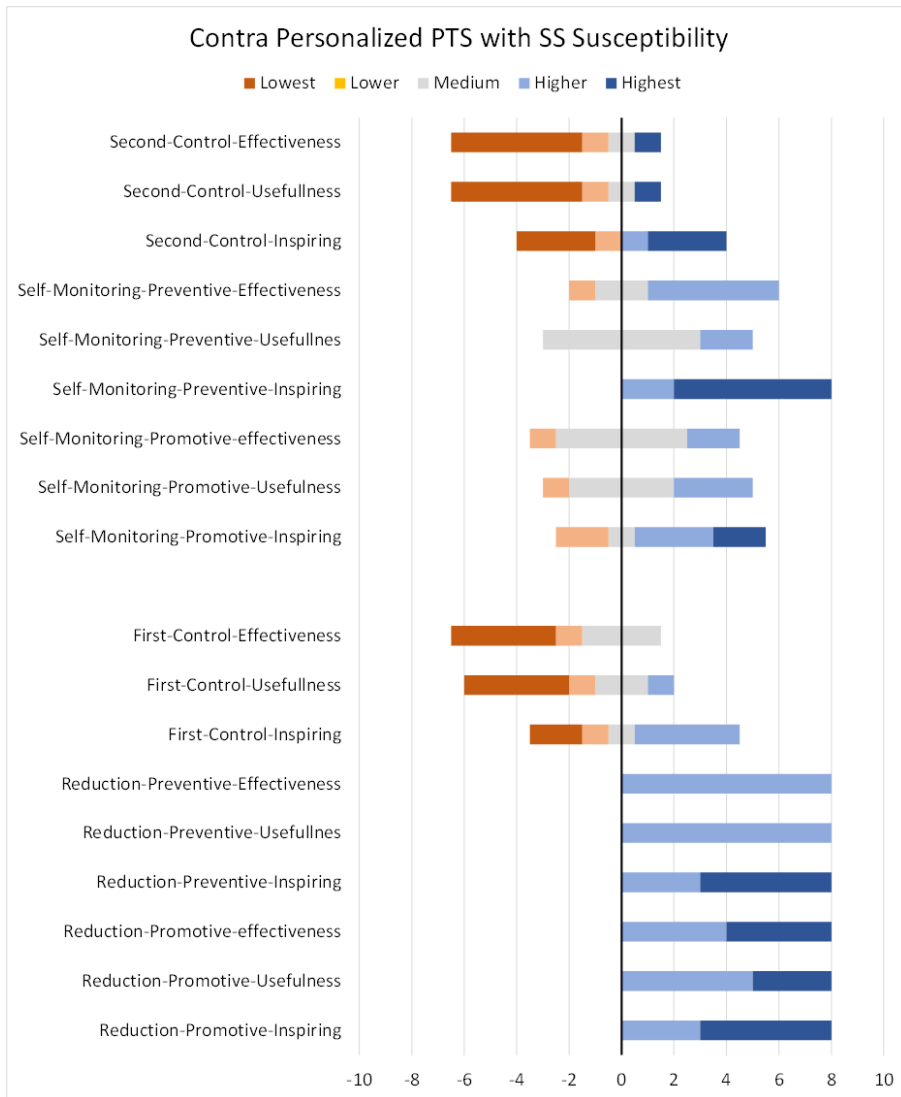


Figure 4.20: CP PTS with SS susceptibility (self-monitoring and reduction principles) with promotive, preventive, and control messages

Figure 4.20 shows eight responses to perceived inspiration, perceived usefulness, and perceived effectiveness of CP PTS with SS susceptibility for promotive, preventive, and control messages.

Self-Monitoring Principle: The perceived inspiration for PreM is showing an all positive trend while the perceived inspiration for the ProM, showing a mixed trend from lowest to highest. The preference of perceived usefulness and perceived effectiveness for both message types does not show a strong trend. Most of the responses for the two perceived values are neutral, which indicates that the respondents did not find it motivational for changing/abandoning the prolonged sitting behavior.

Reduction Principle: Similar to results of reduction principle in PTS with DS susceptibility, the two message types, promotive and preventive, do not experience a difference on the sides of the graph. All three dependent variable values are on the positive side of the scale, which means that the motivation level will not be affected by the content/message type. Here, there are no neutral nor negative responses; all responses are on the positive side of the scale.

A typical day

The following sections explain which routines on a typical day cause the elderly to sit longer while others keep them active. Respondents reported these routines while answering an open-end question, "How would you describe your day?" in the first questionnaire.

Self-reported active routines

Walk/training time

In the first questionnaire, the participants, while answering the question "How would you describe your day?" mentioned whether they do walk/training or not. If the participant did not indicate a walk/training, they were asked about it specifically in the follow-up question.

The categorical walk/training time (hours/week) data were transformed to ordinal data with 5 hours gap. The Walk/training time categories after data transformation were; 1 = 1-5 hours, 2 = 6-10 hours, 3 = 11-15 hours, and 4 = 16-20 hours. After data transformation analysis was run using contingency tests to find the association between walk/training time and gender in JASP. The contingency test has two assumptions stated in (Sampson, 2018) namely, "the two variables must be categorical data (nominal or ordinal)"; and second, "Each variable should comprise two or more independent categorical groups." The data transformation conducted to meet the assumption of the contingency test.

Self-reported walk/training time shows that men are more active and do walk/training 5-15 hours per week compared to women who train/walk 1 to 5 hours per week. Self-reported walk/training time also revealed that almost half of the respondents reported zero physical activity levels in the context of walk/training. There was no significant difference in physically inactive respondents based on gender. There was a small association between gender and walk/training time ($\chi^2 (4) = 10.850, p = .028$).

Prayers

Females tend to participate comparatively more in religious activities. There was a minor association between gender and prayers ($\chi^2 (1) = 4.000, p = .046$).

Most of the participants in this study were Muslims. Muslims worship their God five times a day and collectively spend almost one-hour and ten minutes (1:10:00) on it. Muslims' prayers are a kind of exercise where they stand up for a few minutes, bow down on their knees, bow down on the earth, and sitting straight. It helps to stretch their body and play a role in keeping them active. Therefore, an association between gender and prayer can help to understand the trend towards activity level among the elderly. As religion is a sensitive topic, so the researcher did not ask any follow-up question on prayer and noted down the daily routine of the participant and guessed whether participants do pray or not. The researcher's guess was based on the usual answers from other Muslim participants. If a participant did not mention whether (s)he pray or not and did not mention any other religious activity and association to holy places, then the answer was mentioned as NO. While preparing the datasheets, however, answers to prayer were noted as yes/no answers. The study analyzes the association between prayer and gender. A Contingency test is conducted to find an association between prayer and gender.

Self-reported sedentary routines

Sedentary time

In the first questionnaire, one question was about participants' self-reported sitting or reclining time during a typical day. Sitting/reclining time (hours/day) data were transformed to categorical data with 3 hours gap. The sitting/reclining time categories after transformation is; 1 = 1-3 hours, 2 = 4-6 hours, 3 = 7-9 hours, and 4 = 10-12 hours. After data

transformation analysis ran using the contingency test in JASP—the contingency test conducted to find a relation between sitting and reclining time and gender.

The men tend to sit longer 7-9 hours on a typical day than the women 4-6 hours on a casual day. A small association between gender and sitting/reclining time also supported by the contingency test, χ^2 statistic ($\chi^2 (3) = 9.277, p = .026$).

There is a smaller group in the sample as well, who sit either less than 4 hours or more than 9 hours.

Social media and reading

Social media and reading habits did not show any significant association between gender and social media ($\chi^2 (1) = .380, p = .538$), and gender and reading habit ($\chi^2 (1) = 1.403, p = .236$).

Participants were asked whether they spend time on social media or not in follow up questions if they did no mentioned themselves. The researcher noted down the name of the application the participant usually use on mobile phones. While preparing the datasheets, however, answers to the use of social media questions were noted as yes/no answers.

Participants were also asked about reading habits in follow up questions. The researcher noted down whether the participant spends time reading a newspaper or a book. While preparing the datasheets, however, answers to reading habit questions were noted as yes/no answers. The study analyzes the association between reading habits and gender. A Contingency test is conducted to find an association between social media and gender and reading habits and gender.

Data integrity

Participants' selection and exclusion bias were controlled during research design and data collection. All contacts that were received in snowballing contacted and asked for volunteer participation in the study. The potential participants who agreed to participate were called for the experiment. Questions for susceptibility to persuasion scale were randomized to control researcher bias towards answers and computation of category based on susceptibility to persuasion scale. No participant was excluded from the study by the researcher.

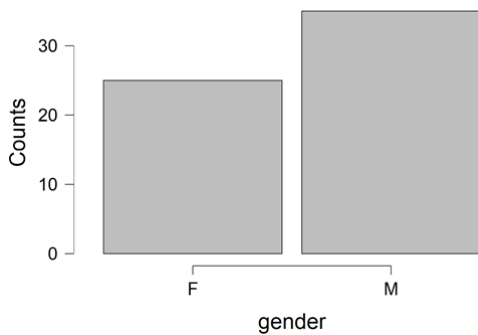


Figure 4.21: Self-reported sitting/reclining time on a typical day

Figure 4.21 shows that there was no big difference in gender balance.

As this study is based on sample statistics and sample data is used to estimate parameters of population, so the correctness of data is crucial. This study has three independent variables personalization, which has two groups, namely strong personalization and contra personalization, categories which have three groups, namely PTS, DS, and SS, and message type, which has two levels, namely, promotive messages and preventive messages. Personalization and categories are between-group independent variables, while message type is a within-group independent variable. Two-way MANOVA is suitable to test understanding the interaction between the two between-group independent variables over the three dependent variables (perceived inspiring, perceived usefulness, and perceived effectiveness). JASP did not explain MANOVA in their manuals until today. The author, therefore, checked other sources to look into assumptions for MANOVA. Laerd Statistics (Two-way MANOVA in SPSS Statistics, n.d.) stated nine assumptions for the two-way MANOVA test. Statistics Solutions (MANOVA, n.d.) also mentioned assumptions for MANOVA with the reference of "Using multivariate statistics" (6th ed.) book by Tabachnick, B. G. & Fidell, L. S. but for One-way MANOVA.

The assumptions from (Two-way MANOVA in SPSS Statistics, n.d.) are:

1. "Your two or more dependent variables should be measured at the interval or ratio level."
2. "Your two independent variables should consist of two or more categorical, independent groups."

3. "You should have independence of observations, which means that there is no relationship between the observations in each group or between the groups themselves."
4. "You should have an adequate sample size. Although the larger your sample size, the better; for MANOVA."
5. "There are no univariate or multivariate outliers."
6. "There is multivariate normality."
7. "There is a linear relationship between each pair of dependent variables for all combinations of groups of your two independent variables."
8. "There is homogeneity of variance-covariance matrices."
9. "There is no multicollinearity."

The first four assumptions were met in experiment design. Some statistical tests are conducted to testify for the rest of the assumptions.

Boxplots

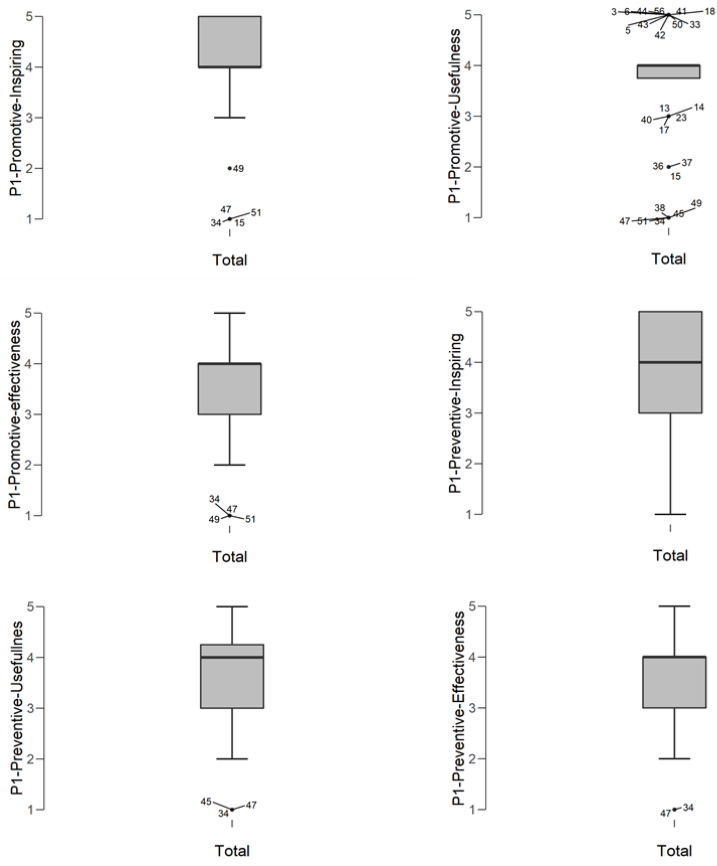


Figure 4.22: Box plot for self-monitoring, suggestion, and normative influence consisting of promotive and preventive messages

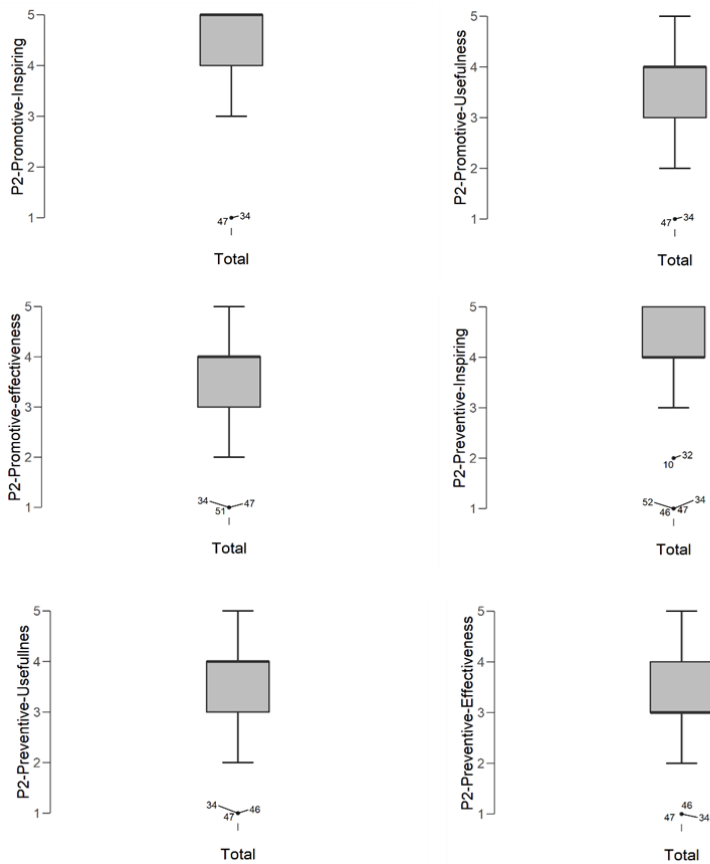


Figure 4.23: Box plot for self-monitoring, suggestion, and normative influence consisting of promotive and preventive messages

First, to check the univariate outliers, Boxplots are drawn for all dependent variables. From the Boxplots (figure 4.22 and 4.23), it is pretty clear that all dependent variables have univariate outliers. Box's M-test was conducted to test multivariate outliers or homogeneity of covariance across the matrices. The test has shown that the covariance across all the matrices is moderately different, $p = 0.007$.

The Shapiro-Wilk test for normality was conducted to test the multivariate normality, and results for all variables showed that variables are not normally distributed ($p < 0.001$).

A linear relationship was checked by drawing scatter plots for each pair of dependent variables. Scatter plots can be referred to in the appendix, namely correlation plots.

Multicollinearity (also collinearity) in data is problematic for the MANOVA test and therefore needs to be corrected. Multicollinearity is described by Laerd Statistics (Two-way MANOVA in SPSS Statistics, n.d.) as “Multicollinearity is a state of very high intercorrelations or inter-association among the independent variables. It is, therefore, a type of disturbance in the data, and if present in the data, the statistical inferences made about the data may not be reliable.”

Multicollinearity assumption was checked by drawing a correlation matrix for each pair and by checking Pearson's r and p values for each pair. Results from the correlation matrix table interpreted that there was a significant correlation among 26 pairs out of 66, a moderate correlation among 12 pairs, a small correlation among 13 pairs, and no correlation among 19 pairs. For details, refer to the Pearson correlation table in the appendix.

All assumptions for MANOVA, although, did not prove true. The researcher continued with MANOVA because a non-parametric test equivalent to MANOVA is not introduced in JASP 0.11.1 yet. Some other tools are providing a non-parametric analysis; however, the researcher was short of time to explore and use different tools.

Chapter 5 Discussion

This chapter, first, discusses the overall results of all three categories of persuasive system design principles with personalization and message types. After an overview, each category discussed in turn. Perceived preference on message type presented next to categories followed by a discussion on drives (causes/reasons) of prolonged sitting time and short sitting time. Respondents' employment status (both paid and unpaid are included with different working hours) is discussed in the last. The results of the experiments were quite interesting. At the start of the research, the researcher was expecting, perhaps most senior people would fall into one category, but they did not.

Overall, personalization (either strong or contra) of PTS is perceived as inspiring and moderate-to-high useful and effective to motivate the elderly for self-interrupting prolonged sitting time. The effect of message type on results is neutral. However, the acceptance of PTS principles is higher among the elderly who are susceptible to either DS or SS compare to the elderly with susceptibility to PTS. Strong personalized DS perceived moderately inspiring. Further, the elderly perceived DS messages least useful when the message content was promotive, and the perceived effectiveness decreased for preventive message contents among the elderly. While contra personalized DS shows stronger acceptance and perceived more useful and effective despite the message type. The elderly in contra personalized SS group perceived messages moderate-to-high inspiring with encourage content while preventive message contents perceived more inspiring by strongly personalized group of the elderly. The usefulness and effectiveness of principles (in form of messages) perceived moderate-to-high by the groups, respectively. Normative influence principle perceived more useful and effective than the social learning principle by the contra personalized group. One explanation for strong personalization being lesser inspiring, useful, and effective is the presence of outliers in this group. There were three leading causes of outliers; first the design and content of the susceptibility to persuasion statements and message types; second participants who evaluated messages information critically, rated the messages with lowest values on the Likert-scale; and third participants who worked or were working in health and health-related institutions, rejected the messages information based on credibility (source of messages did not provide during experiment

intervention) and rated it the lowest on the Likert-scale. Design flaws in the susceptibility to persuasion statements and messages content caused by the researcher's limited knowledge of Norwegian cultural and social lifestyle.

In terms of inspiration, the dimensions associated with contra personalization of persuasive system design principles categories, namely PTS with DS susceptibility, PTS with SS susceptibility, DS with PTS, and SS with PTS, showed a similar pattern for the ProM. That is contra personalized principles were perceived as highly inspiring. The strong personalization of principles was also perceived as inspiring with ProM but to a lesser degree than with contra personalization. In contrast with PreM, a similar pattern was observed, that is contra personalization was viewed as more inspiring compared to strong personalization, for the PTS and DS categories. However, the normative influence principle in SS was perceived as highly inspiring when contra personalized, while contra personalized social learning principle was perceived moderate inspiring. Similarly, strong personalization of both principles (normative influence and social learning) were perceived as moderately inspiring. One possible explanation for the perceived inspiration being rated high was that the information given in ProM and PreM were unfamiliar to most of the participants. Unfamiliar information was more interesting to the participants and, consequently, was rated higher. Another factor that contributed towards the high rating of inspiration was the common concept between existing stereotypes in the society (mentioned by respondents) about health and the information such as a to take a walk after dinner keeps one healthy, prolonged sitting freezes the knees, sitting longer cause increase in abdomen fats, etc.

In terms of the usefulness of persuasive system design principle categories, the results are divided into personalization and message types. Personalized (either strong or contra) PTS and SS perceived more useful when the message type was promotive. Further, contra personalization perceived more useful compare to strong personalization for the two categories. However, the pattern for DS was different, namely strong personalization of principles perceived lesser useful while contra personalization showed higher perceived usefulness. All three categories (PTS, DS, and SS) indicated different patterns when the message type was preventive. The strongly personalized PTS was considered more useful compare to contra personalized PTS with DS susceptibility. On the other hand, contra personalized PTS viewed as more useful when the susceptibility was SS. Personalized (either

strong or contra) DS with susceptibility to PTS perceived moderate useful with preventive message contents. Strongly personalized SS perceived moderate-to-high useful compare to contra personalized SS. The social learning principle perceived least useful in both strong and contra personalization. One explanation for this zig-zag pattern of perceived usefulness is the unfamiliarity of participants with real implementations of the principles in real applications. The perception of participants was based on message contents that could make different sense to different participants. On the other hand, the functionality and quality of real implementation will be the same for all. The usefulness of principles could be assessed truly based on firsthand experience.

In terms of the effectiveness of persuasive system design principle categories with ProM, both strong and contra personalization were perceived effective. However, strong personalization perceived less effective by all respective groups. In contrast, effectiveness was perceived differently for different categories with the PreM. Both strong and contra personalization of PTS category perceived more effective with strong personalization being lesser effective. The DS perceived moderately effective when contra personalized. Strong personalization of principles in DS categories lied on two opposite ends; suggestions principles perceived effective above moderate and reminder being below moderate. Strong personalized SS was moderately effective while contra personalization perceived effective above moderate for normative influence and below moderate for social learning. The explanation for this is that the persuasive system design principles were unfamiliar to the participants, and they did not have any experience with fitness applications. The results were thus purely based on the participant's critical evaluation of information and their thoughts.

There was an interesting observation of contra personalization where participants with PTS susceptibility perceived reminder principle from DS and social learning principle from SS least useful and least effective. In contrast, participants with DS and SS susceptibility perceived both reduction and self-monitoring principles (of PTS) highly inspiring and moderate to highly useful and effective. This was perhaps because of their lifestyle here in Norway; less communication and more self-dependency among people were observed, which at some point also causes loneliness. In that case, people need clear guidance to perform some action (reduction principle provide this) and a mechanism to monitor their

performance (self-monitoring principle serve the purpose). It supported by participants' comments. Participants who have their plans and like to be punctual disliked the idea of adding people in their workout and walk plans. As one participant said, "...I have my routines and don't need anyone" while responding to social learning principles with the preventive message content.

It is interesting that the responses received during the in-person experiment on the video watching activity feedback questionnaire were different from the responses received during the online experiments. The researcher observed that the icebreaking process was more comfortable and smooth with elderly participants when meeting in-person compared to online meetings. Perhaps this is due to the elderly's comfortability level with technology. They probably, feel more relaxed and safe in the in-person meetings because they are used to for such kinds of settings. Most of the experiments for contra personalization group were conducted online, and this is the one which gets least or almost no outliers. Most responses during online experiments were rated medium to high for both message types.

In terms of perceived preference over message types, the ProM was given significant preference over PreM. However, most of the participants could not differentiate between promotive and preventive message contents in the videos and showed their preference in follow up questions. There could be three reasons; imperfect message content (cues in intervened messages failed to catch participant's attention); participant's unfamiliarity with fitness application and their qualities (persuasive system design principles); or less critical thinking on messages contents (failed to differentiate message contents). Potentially imperfect message content was possibly due to the researcher's limited knowledge of the Norwegian society. The Liker-scale responses reflected how the participants interpreted the message contents. Both ProM and PreM were rated in the same manner when the participants were unable to differentiate between the promotive and preventive cues in intervened message contents.

In terms of drives (reasons/causes) of prolonged sitting time and short sitting time, self-reported walk and training time increased their physical activity level, and prayers (religious activity in Muslim community) were creating an interruption in sitting on five different times on a day. The drives (reasons/causes) were self-reported in response of an open-ended question "How would you describe your day?" In contrast, the use of social media, reading

habits, and relaxing with family and friends were self-reported drivers of prolonged sitting time. Almost half of the participants, mostly men, were aware and motivated to increase their physical activity level during and after transformation from the second age group to the third age group to stay healthy. This awareness was reported as that it is due to the promotions of active aging by the Norwegian institutions.

Respondents who were still working were noted as more active and had less sitting time. However, it depends on the nature of work; for example, respondents who are taxi drivers or were working in an office sit longer compare to teachers, business owners, and welfare workers. Respondents in their 60s and early 60s were working regular jobs. While some others were working twice or thrice in a week to keep themselves active and they think they still can return to society. The work included both paid and unpaid. A few respondents had their businesses (which now were being run by the heirs), and they go there 2-3 hours daily. Some retired Pakistani-Norwegians, mostly men and few women, were managing social welfare work. Either they had their organizations or working for other organizations.

Most of the participants were Pakistani-Norwegian, and they had similar cultural and social values. Their difference points were around the educational and occupational background and social connectivity. Participants with higher qualifications and who have more social contacts were more aware and concerned about their health at an older age.

The process followed to create participant's identity was not very useful in Norwegian and Pakistani naming culture. One question out of four was, "First letter of middle name (if none, use X) (e.g., A from Ann)?" Most people did not have a middle name. Out of 56 complete experiments, there were two pairs of similar identity code. The probability of multiple same identity codes will increase with the increase in the number of participants. Hence, it indicated less suitability of this identity creation questionnaire in Norwegian and Pakistani culture, or it required improvements to fit-in in these two cultures.

Limitations

Some of the limitations of this study include cultural background balance, a small number of participants for this kind of study (quantitative), participants unfamiliar with fitness applications, the language of the experiment.

Cultural background balance

All participants belonged to two cultures Norwegian and Pakistani, with a leading number of Pakistani-Norwegians. There was no balance; the number of Norwegian participants was small. There should be more and balanced number of participants from both cultures.

Few participants

Overall, 60 elderly participated in the study. Fifty-six out of 60 experiments were considered correct and complete. There were two groups for DS and SS categories and three groups in the PTA category. That means there were 8 participants for each group and 16 for each category except PTA, which had three groups. Perhaps, sixteen participants are not enough to represent the whole population for that category. A bigger population sample needed to generalize the results.

Unfamiliarity with apps

None of the participants had any experience with fitness applications. The novice factor of persuasive system design principles (in the form of messages) affected the results that most of the participants rated the perceived inspiration of messages highest despite the message types. What participants perceived useful and effective from the information given could prove misleading (least useful and effective) for individuals in real life. Perhaps working prototypes of persuasive system design principles served better, but developing prototypes demanded more time that was not possible given the limitation of this master project.

Experiment language

The language used in the experiment was English. Most participants believed that they know the English language, but reading and understanding took longer; perhaps, because of being out of practice. The study language was a hurdle in the recruitment process and conducting experiments. For older adults, picking English was hard, and older immigrants were not fluent in Norwegian either. It was a hindrance to recruiting immigrants from other cultures as well.

Cultural context

Differences in the cultural context of the researcher and the experimental setting may have affected the results. The importance of the understanding of culture, social values, living

style in the region where the study being conducted noticed during the research. It is specifically relevant when the research needs interaction with humans and required their perception of variables being studied.

Some of the susceptibility to persuasion statements did not fit the living style in Norway. Norwegian lifestyle is mostly independent, which also affects their behaviors in routine life. To live independently, people learn decision making and do not look at others for help. So questions such as "I often rely on other people to know what I should do?" and "When I am in a new situation, I look at others to see what I should do?" were observed mismatching with Norwegian lifestyle by some participants.

Experimental design shortcomings

The researcher identified some experimental design shortcomings while conducting the experiments and interacting with the participants. These are discussed in the following sections.

Language issues and terminology

One participant highlighted that some of the English words used in certain statements are used in different contexts in Norway compared to the Asian region.

It was observed that participants who worked or currently working in public institutions rejected the information given in messages because it did not come from a credible source of authority. Although all ProM and PreM were taken from research results of different papers but the information was not verified from trustworthy organizations, e.g., the World Health Organization or Norwegian health institutions.

Experiment duration

Older adults take more time while reading and understanding questions or statements compare to youngsters and young adults. During the experiments, the elderly took more time to think, understand, and again think and respond to each item. Normally, interviews were taking twice the estimated time, and especially people above 70 took more than twice the estimated time. The total time was estimated based on the pilot study, and the pilot study participants were young master students. These time estimates did not match the times needed for the real experiments with the elderly. It was observed that the older the

participant was, the longer each trial took. Experiment duration also correlated with the experiment language. Participants who were not active English speakers took more time to understand the statements.

Susceptibility to persuasion scale statements

"It is important to me to fit in." was the least understood statement. This statement was written in the context of normative influence (peer pressure) in social gatherings. Some participants were unable to understand that what does it mean, while others asked about specific use context and examples. All other statements were not difficult to understand; however, some participants asked for examples or answers were not clear, so follow up questions were asked.

Regarding the statement "Before going to sleep, I review all activities which I performed during the day," one participant commented that it is pessimistic, and he is an optimistic person. Hence, he thinks about tomorrow, not about the day that had gone. This statement was looking for self-monitoring routines of the participants. However, the participants' reviews indicated that there could be two ways; one is setting goals for tomorrow and achieving them; second is setting goals and retrospectively reviewing the day to assess what has achieved.

Three other statements were mismatched with Norwegian cultural and social norms.

Persuasive system design principle as messages

Three messages in approximately 3 minutes of videos were seen as too many. One participant disliked having three messages in such a short video and expressed his/her thoughts, "it was a bombardment of messages." Generic statements were more problematic for the elderly. They said that they behave/respond differently in different contexts, so questions should be about a specific context and must have an example.

A few participants expressed thoughts such as "Oh, this message is totally ineffective" or "I don't believe this information is false." Others needed more clarifications and made statements such as "I didn't understand." However, there were also participants who perhaps did not understand the statement or question but hesitated to ask for further clarification; here, the researcher asked the follow-up questions.

There was a mishandling while selecting the control messages by the researcher. Control messages related to games (ski and chess) were considered real messages as the ski is relevant to intensive physical activity while chess is related to low or no physical activity. The control messages should have been selected carefully, and messages related to physical activities should have been excluded.

Promotive versus preventive message types

About 95% of the participants could not understand the difference between ProM and PreM from the messages. While answering the follow-up question on the message type, most of the participants chose ProM. It seemed that most of participants were not evaluating the practicality of the messages for real life. Most of the participants said that it was easy to understand the messages and questions on feedback questionnaires, and mostly they chose ProM over preventive. But the Likert-scale rating for ProM and PreM does not show this trend. There could be two reasons. First, participants could not differentiate between the cues in the messages and hence, could not rate the messages correctly on 5-item Likert-scale. That means intervened messages were not good enough to serve the purpose. The reason could be the participants' unfamiliarity with health and fitness applications. None of the participants was using any fitness mobile application. The information was new for most of the participants; therefore, evaluating and differentiating between the message type and principles became somewhat hard for them. This was also observed during susceptibility to persuasion scale questions and answers to feedback questionnaires during contra personalization.

Video scene choice

The researcher chose an English drama "The good place" and took 6 video clips (2-3 minutes each) from 2 episodes of the first season. Those six video clips (two for each category) were intervened with promotive, preventive, and control messages. Selecting six different video clips was observed as an unsuccessful idea. When a video started on a scene, participants got curious about what happened before that scene. Perhaps, one video clip for all categories could have served better.

Direct versus indirect persuasion route

The research observations also revealed that it was hard for the participants to get the clue given in the message to trigger the heuristics. The persuasive system design principle messages were developed on possible simple cues, so the elderly do not need a high Need for Cognition to evaluate the content of the messages. Participants from health and related sectors rejected indirect route messages and thus, became outliers in the data by giving low Likert ratings on the Feedback questionnaire.

Chapter 6 Conclusion

This study was looking for does the personalization of persuasive features in mobile fitness application perceive inspiring, useful, and effective among Norwegian elderly. In addition, do the elderly perceive ProM more preferable over PreM.

This study has several contributions. First, our participants liked to have personalized features (persuasive system principles) in health and fitness mobile applications. They agreed that a technological intervention (reminder, suggestions, normative influence) would help them to reduce prolonged sitting time by increasing physical activity frequency. Further, they commented that a simple application (with a smaller number of features) would be easy to learn and use. They argued that a simple application would be more useful for us and would prove effective in reducing prolonged sitting time. Second, our participants perceived strong and contra personalization equally acceptable; however, the author suggests a future work with working personalized prototypes based on susceptibility to the persuasion of users. Third, our participants perceived that ProM are motivational and encouraging rather than PreM that felt discouraging. Most participants argued that encouraging and guiding messages are useful and easy to follow. While PreM prohibited you from sitting longer but did not guide on how to self-interrupt prolonged sitting or how to fill up the free time, this indicates that guiding the elderly on building new behavior is more acceptable rather changing the existing behavior. Also, we found that the suggestions principle perceived more useful and effective compare to reminders. It shows a simple reminder is not motivating enough to interrupt the sitting state. A message that tells them benefit or cause of stopping sitting would perceive motivating, and suggestion principle could serve the purpose. Similarly, we also found that normative influence perceived more effective and useful than social learning. Our participants perceived that having a plan (e.g., walk plan) with peers gave you a sense of responsibility and encouraged you to continue over a period. Also, we found that self-monitoring and reduction (guiding through the process) are very useful and effective in a social environment where the elderly do not like to compromise their independence.

Chapter 7 References

- Abbey C. King, E. B. (2013). Harnessing Different Motivational Frames via Mobile Phone to Promote Daily Physical Activity and Reduce Sedentary Behavior in Aging Adults. *PLOS One*.
- Agnis Stibe, B. C. (2016). Persuasive Backfiring: When Behavior Change Interventions Trigger Unintended Negative Outcomes. *International Conference on Persuasive Technology* (pp. 65-77). Springer.
- Ainsworth BE, H. W.-L.-G. (2011). 2011 Compendium of Physical Activities: a second update of codes and MET values. *Medicine & Science in Sports & Exercise*, 1575-1581.
- Ajao, T. (2019). Prevalence of Obesity and Type 2 Diabetes with Sedentary Behaviors and Their Association Across Age Groups in Canada. *ProQuest*.
- Archana Singh, N. M. (2009). Loneliness, depression and sociability in old age. *Industrial Psychiatry Journal*, 51-55.
- Barbara J Jefferis, C. S.-M. (2014). Adherence to physical activity guidelines in older adults, using objectively measured physical activity in a population-based study. *BMC Public Health*.
- Barbara J Jefferis, T. J.-M. (2018). . Objectively measured physical activity, sedentary behaviour and all-cause mortality in older men: does volume of activity matter more than pattern of accumulation? *British Journal of Sports Medicine*.
- Ben Heaven, P. N. (2015). Mobilizing Resources for Well-being: Implications for Developing Interventions in the Retirement Transition. *The Gerontologist*, 615-629.
- Charles E. Matthews, K. Y. (2008). Amount of time spent in sedentary behaviors in the United States. *American Journal of Epidemiology*, 875-881.
- David W. Dunstan, B. H. (2012). Too much sitting – A health hazard. *Elsevier*, 368-376.
- Dharini M Bhammar, B. J. (2017). Breaks in sitting time: effects on continuously monitored glucose and blood pressure. *Medicine & Science in Sports & Exercise*, 2119-2130.

- Ding Ding, K. R. (2015). Traditional and Emerging Lifestyle Risk Behaviors and All-Cause Mortality in Middle-Aged and Older Adults: Evidence from a Large Population-Based Australian Cohort. *PLOS Medicine*.
- Duwaraka Yoganathan, K. S. (2015). Designing fitness apps using persuasive technology: A text mining approach. *Pacific Asia Conference on Information Systems*. Association of Information Systems.
- E. Gorman, H. M.-A. (2014). Accelerometry analysis of physical activity and sedentary behavior in older adults: a systematic review and data analysis. *European Review of Aging and Physical Activity*, 35-49.
- Fogg, B. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do*. San Francisco: Morgan Kaufmann Publishers.
- Fogg, B. J. (2003). *Persuasive Technology: Using Computers to change What We Think and Do*. *Morgan Kaufmann Publishers*.
- Gabriela Villalobos-Zúñiga, M. C. (2017). Not a Technology Person: Motivating Older Adults Toward the Use of Mobile Technology. *ResearchGate*.
- Gabrielle M Turner-McGrievy, M. W.-A. (2013). Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mHealth weight loss program. *Journal of the American Medical Informatics Association*, 513-518.
- Gary Hsieh, H. O.-K. (2014). Personalizing Behavior Change Technologies. *Extended abstracts of the 32nd annual ACM conference on Human factors in Computing Systems - CHI 2014*, (pp. 107-110). Tronto.
- Gewolb, S. J. (2015). Working towards successful retirement: older workers and retirees speaking about ageing, change and later life. *Working with Older People*, 25-32.
- Goss-Sampson, M. A. (2018). *Statistical Analysis in JASP: A Guide for Students*.
- Guidelines for research ethics in science and technology*. (2016, 06 28). Retrieved from The Norwegian National Research Ethics Committees:

<https://www.etikkom.no/en/ethical-guidelines-for-research/guidelines-for-research-ethics-in-science-and-technology/>

- Harri Oinas-Kukkonen, K. T. (2009). Persuasive System Design: State of the Art and Future Directions. *Proceedings of 4th International Conference on Persuasive Technology* (pp. 1-8). California: Association for Computing Machinery.
- Harri Oinas-Kukkonen, M. H. (2009). Persuasive Systems Design: Key Issues, Process Model, and System features. *Communications of the Association for Information Systems*.
- Harri Oinas-Kukkonen, M. H. (2009). Persuasive Systems Design: Key Issues, Process Model, and System Features. *ResearchGate*.
- Health, A. G. (2014). *Australia's Physical Activity and Sedentary Behaviour Guidelines for Adults (18–64 years) (Government Report)*. Canberra: Department of Health.
- Health, D. o. (2011). *Start Active, Stay Active: a Report on Physical Activity for Health from the Four Home Countries' Chief Medical Officers (Government Report)*. London: Department of Health.
- Helsedirektoratet. (2019, 04 29). *Physical activity for children, young people, adults, elderly and pregnant women*. Retrieved from Helsedirektoratet: <https://www.helsedirektoratet.no/faglige-rad/fysisk-aktivitet-for-barn-unge-voksne-eldre-og-gravide/fysisk-aktivitet-for-voksne-og-eldre>
- Huppert, F. A. (2009). Psychological Well-being: Evidence Regarding its Causes and Consequences. *International Association of Applied Psychology*, 137-164.
- James A Levine, S. J. (2000). Energy expenditure of nonexercise activity. *American Journal of Clinical Nutrition*, 1451-1454.
- John Matthews, K. T.-K. (2106). Persuasive Technology in Mobile Applications Promoting Physical Activity: a Systematic Review. *Journal of Medical Systems*.
- Kathryn Zickuhr, M. M. (2012). *Older adults and internet use*. Pew Research Center Social and Demographic Trends.
- Kathryn Zickuhr, M. M. (2012). Older adults and internet use: for the first time half of adults ages 65 and older are online. *Pew Internet & American Life Project*.

- Labour force survey*. (2018). Retrieved from Statistics Norway:
<https://www.ssb.no/en/statbank/table/03781/tableViewLayout1/>
- Lars Bauger, P. s. (2016). The lived experience of well-being in retirement: A phenomenological study. *International Journal of Qualitative Studies on Health and Well-being*.
- Leo A. Yurek, J. V. (2008). The Use of Self-Generated Identification Codes in Longitudinal Research. *Sage Publications*.
- Lesley D Gillespie, M. C. (2012). Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews*.
- Lorraine Lanningham-Foster, L. J. (2003). Labor saved, calories lost: the energetic impact of domestic labor-saving devices. *Obesity research*, 1178-1181.
- MANOVA*. (n.d.). Retrieved from Statics Solutions: using multivariate statistics 6th edition by tabachnick and fidell
- MARION E. T. MCMURDO, R. J. (1995). A randomized controlled trial of a home exercise programme for elderly people with poor mobility. *Age Ageing* 24, 425-528.
- Marja H. Westhoff, L. S. (2000). Effects of a low-intensity strength-training program on knee-extensor strength and functional ability of frail older people. *Journal of Aging and Physical Activity*, 325-342.
- MARK G. DAVIS, K. R. (2001). Objectively measured physical activity in a diverse sample of older urban UK adults. *Medicine & Science in Sports & Exercise*, 647-654.
- MARK G. DAVIS, K. R. (2001). Objectively measured physical activity in a diverse sample of older urban UK adults. *Medicine & Science in Sports & Exercise*, 647-654.
- McGuire, W. J. (1973). Communication, Language, and Meaning Psychological Perspectives. *New York: Basic Books*, 242-255.
- Micheal J. Wheeler, D. W. (2019). Morning exercise mitigates the impact of prolonged sitting on cerebral blood flow in older adults. *Journal of Applied Physiology*, 1049-1055.

- Miriam C. Morey, C. F.-B. (2002). Exercise adherence and 10-year mortality in chronically ill older adults. *Journal of the American Geriatrics Society*, 1929-1933.
- MIRIAM C. MOREY, C. F.-H. (1998). Physical fitness and functional limitations in community-dwelling older adults. *Medicine & Science in Sports & Exercise*, 715-723.
- N Owen, A. B. (2009). Too much sitting: a novel and important predictor of chronic disease risk? *British Journal of Sports Medicine*.
- Naomi B. Robbins, R. M. (2011). Plotting likert and other rating scales. *Joint Statistical Meeting*, (pp. 1058-1066).
- Neville Owen, P. B. (2010). Sedentary behavior: emerging evidence for a new health risk. *Mayo Clinic Proceedings*, 1138-1141.
- Nicholas Micallef, L. B. (2016). Time to Exercise! An Aide-Memoire Stroke App for PostStroke Arm Rehabilitation. *Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services* (pp. 112-123). Florence: ACM.
- Norway, S. (2015). *Health, care and social relations, survey on living conditions*. Retrieved from Statistics Norway: <https://www.ssb.no/en/>
- (2016). *Norway's follow-up of Agenda 2030 and the Sustainable Development Goals*. NEW YORK: Sustainable Development Goals.
- Organization, W. H. (2002, 4 4). *Physical inactivity a leading cause of disease and disability, warns WHO*. Retrieved from World Health Organization: <https://www.who.int/mediacentre/news/releases/release23/en/>
- Organization, W. H. (2010, 11 30). *Global recommendations on physical activity for health*. Retrieved from World Health Organization: <https://www.who.int/publications-detail/global-recommendations-on-physical-activity-for-health>
- Organization, W. H. (2011). *Global Strategy on Diet, Physical Activity and Health*. Retrieved from World Health Organization: <https://www.who.int/dietphysicalactivity/pa/en/>
- Organization, W. H. (2020, 3 31). *Public consultation on the draft WHO Guidelines on physical activity and sedentary behaviour for children and adolescents, adults and*

older adults 2020. Retrieved from World Health Organization:
<https://www.who.int/news-room/articles-detail/public-consultation-on-the-draft-who-guidelines-on-physical-activity-and-sedentary-behaviour-for-children-and-adolescents-adults-and-older-adults-2020>

- Paddy C. Dempsey, J. W. (2016). Interrupting prolonged sitting with brief bouts of light walking or simple resistance activities reduces resting blood pressure and plasma noradrenaline in type 2 diabetes. *Journal of Hypertension*, 2376-2382.
- Patricia A. Boyle, A. S. (2007). Physical activity is associated with incident disability in community-based older persons. *Journal of the American Geriatrics Society*, 195-201.
- Paul Stoleea, C. Z. (2012). Evaluation of a volunteer-led in-home exercise program for home-bound older adults. *Journal Of Prevention Assessment & Rehabilitation*, 339-354.
- Pedro C Hallal, L. B. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet*, 247-257.
- Petty, R. E. (1986). *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*. New York: Springer-Verlag.
- Prabha Siddarth, A. C. (2018). Sedentary behavior associated with reduced medial temporal lobe thickness in middle-aged and older adults. *PLOS ONE*.
- Rachel E. Climie, M. J. (2018). Simple intermittent resistance activity mitigates the detrimental effect of prolonged unbroken sitting on arterial function in overweight and obese adults. *Journal of Applied Physiology*, 1787-1794.
- Robert M. Restaino, S. W. (2015). Impact of prolonged sitting on lower and upper limb micro- and macrovascular dilator function. *Experimental Physiology*, 829-838.
- Ryan S Falck, J. C.-A. (2017). What is the association between sedentary behaviour and cognitive function? A systematic review. *British Journal of Sports Medicine*, 800-811.
- Ryan, P. (2009). Integrated theory of health behavior change: Background and intervention development. *Clinical Nurse Specialist*, 161-172.
- Sampson, M. A. (2018). *Statistical Analysis in JASP: A Guide for Students*.

- Sandnes, F. E. (n.d.). Statistical toolbox with measurement instruments: Part 2: Experiments.
- Saurabh S. Thosar, S. L. (2015). Effect of prolonged sitting and breaks in sitting time on endothelial function. *Medicine & Science in Sports & Exercise*, 843-849.
- Singh, M. (20002). Exercise to prevent and treat functional disability. *Clinics in Geriatric Medicine*, 431-462.
- St., M. (2015-2016). *Digital agenda for Norway in brief*. Norwegian Ministry of Local Government and Modernisation.
- Sue Robinson, A. L. (2012). A Qualitative Experiment: Research on Mediated Meaning Construction Using a Hybrid Approach. *Journal of Mixed Methods Research*, 332-347.
- Tracey E Howe, L. R. (2007). Exercise for improving balance in older people. *Cochrane Database of Systematic Reviews*.
- Two-way MANOVA in SPSS Statistics*. (n.d.). Retrieved from Laerd Statistics: <https://statistics.laerd.com/spss-tutorials/two-way-manova-using-spss-statistics.php>
- Valery L Feigin, A. A.-A. (2017). Global, regional, and national burden of neurological disorders during 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet Neurology*, 877-897.
- W. McLennan, A. P. (1998). *National nutrition survey users' guide*. Canberra: Australian Bureau of Statistics.
- W. Rakowski, V. M. (1992). The association of physical activity with mortality among older adults in the Longitudinal Study of Aging (1984–1988). *Journal of Gerontology*, 122-129.
- WHO. (1946). Preamble to the Constitution of WHO as adopted by the International Health Conference, New York. *Official Records of WHO*, (p. 100). New York.
- WILLIAM L. HASKEL, I.-M. L. (2007). Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Medicine & Science in Sports & Exercise*, 1423-1434.

William Ta Donahoo, J. A. (2004). Variability in energy expenditure and its components. *Current Opinion in Clinical Nutrition and Metabolic Care*, 599-605.

Yvonne Kiera Bartlett, T. L. (2017). Using Persuasive Technology to Increase Physical Activity in People With Chronic Obstructive Pulmonary Disease by Encouraging Regular Walking: A Mixed-Method Study Exploring Opinions and Preferences. *Journal of Medical Internet Research*.

Perceived Usefulness and Effectiveness of Persuasive System Designs (PSD) Principles

Identification Code

Following four questions will be used to create an unique code for the participant that will be helpful to match the data collected in two sessions.

1. **First letter of mother's first name (e.g. M-Mary)?**

2. **Number of older brothers (living or deceased) (e.g. 01-one)?**

3. **Number representing the month you were born (e.g. 05-May)?**

4. **First letter of middle name (if none, use X) (e.g. A-Ann)?**

5. **ID-Code**

Powered by
 Google Forms

Figure 8.1: Identity codes form

Perceived Usefulness and Effectiveness of Persuasive System Designs (PSD) Principles

1. Id-Code

2. what is your gender?

Mark only one oval.

Male

Female

Other: _____

3. Where do you live?

Mark only one oval.

Oslo

Other: _____

4. How old are you?

Mark only one oval.

60 - 70

71 - 80

81 - 90

91 - Above

Prolonged sitting time

5. How would you describe your day? For example, what do you do in morning, in afternoon, in evening, and/or before going to the bed?

6. What do you do in the times you get after finishing your routine tasks? (Followup question)

7. On a typical day, how much time do you usually spend sitting or reclining? (Followup question)

Section 01

Susceptibility to Persuasion Scale

8. I often forget where I have placed my belongings (e.g. key-chain, glasses, wrist watch, etc.).

Mark only one oval per row.

Strongly disagree Disagree Neutral Agree Strongly agree

9. I act/react more carefully in front of children as they learn from their elder.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

10. I feel bad when see my friends/others are taking care of their health while I am not.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

11. I prefer to consult a clerk when handling financial, tax, insurance or legal issues instead of filling out application forms myself.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

12. I, usually, use paper/digital reminders.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

13. Looking at what other has achieved, encourage me.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

Section 02

Susceptibility to Persuasion Scale

14. I strictly follow the schedule I set.

Mark only one oval per row.

Strongly Disagree Disagree Neutral Agree Strongly Agree

15. I usually accept suggestions for healthy food.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. I often rely on other people to know what I should do.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. Whenever I commit to an appointment I always follow through.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. When I am in a new situation, I look at others to see what I should do.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. I, usually, follow the social norms of the society where I live.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 03

Susceptibility to Persuasion Scale

20. I trust that someone in family help me to remind me about my commitments.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. I prefer to use applications that really reduce my intellectual efforts.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. I look for health and fitness suggestions from people I trust.

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. **It is important to me to fit in.**

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. **Before going to asleep, I review all activities which I performed during the day.**

Mark only one oval per row.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

25. **I get ideas for my free time by looking at what others are doing.**

Mark only one oval per row.

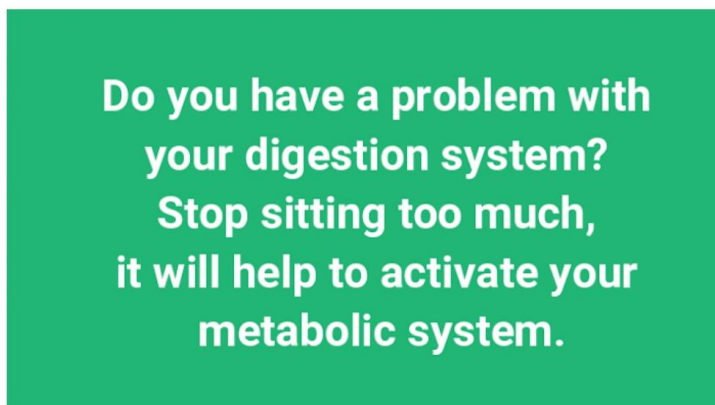
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video

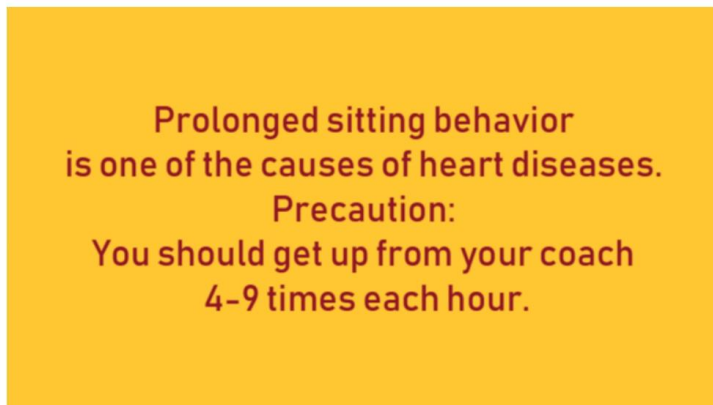


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video

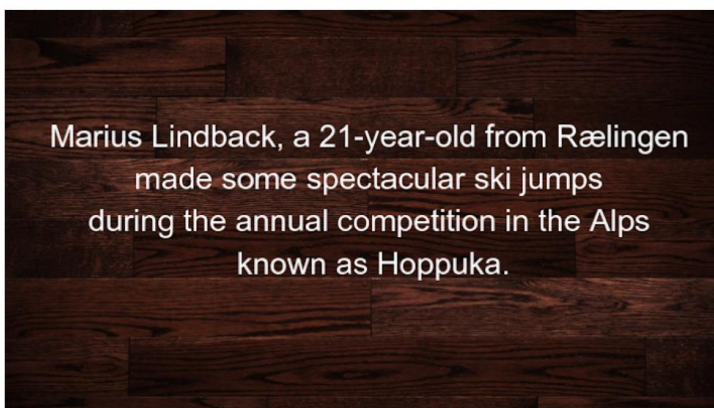


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

Google Forms

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video

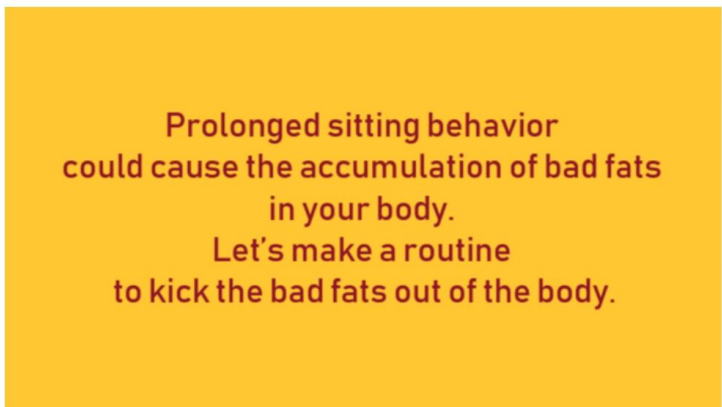


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

Google Forms

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video

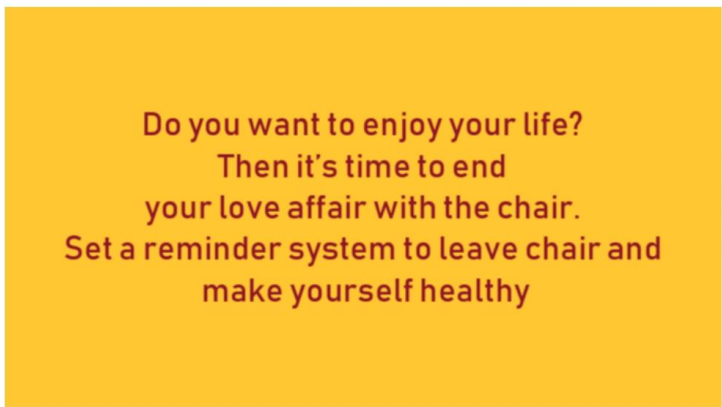


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

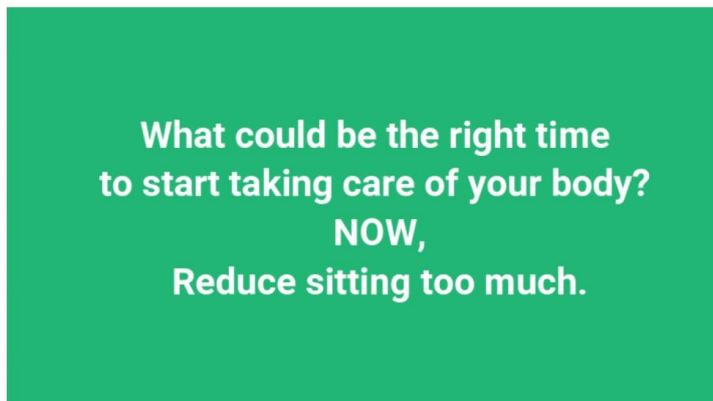
Google Forms

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video

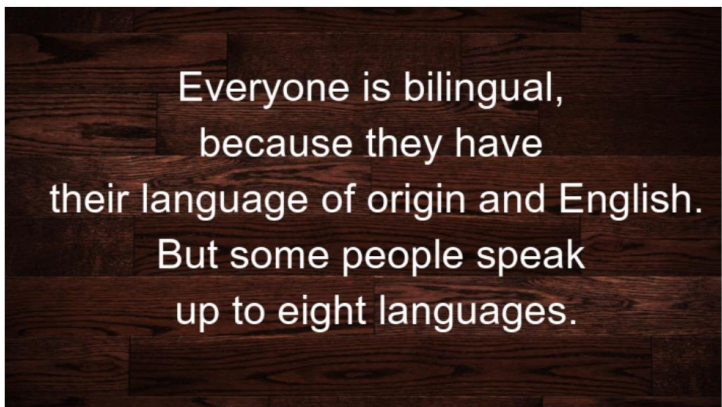


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

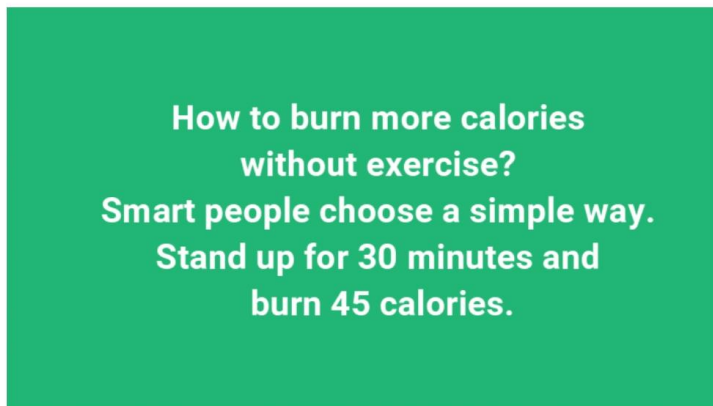
Google Forms

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

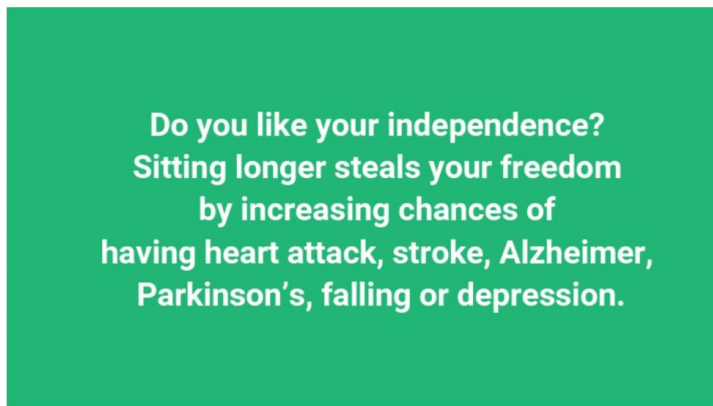
Google Forms

Video Watching Activity: Opinion on Messages

In this form, the research seeks your opinion on the messages you have observed in the video.

1. Id-code

2. Look at the following message from the video

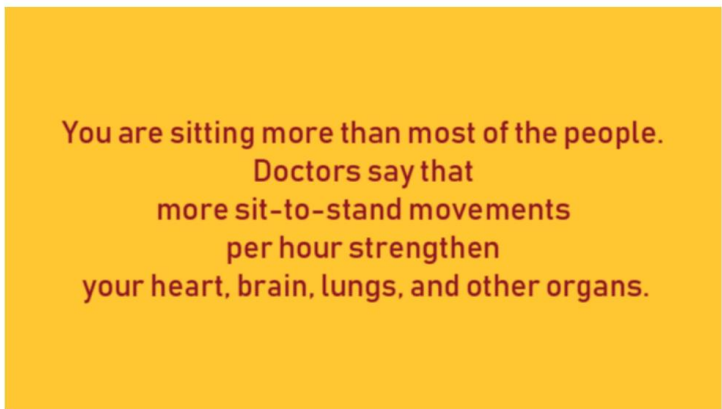


Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. What is your favorite part in this message?

4. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. What is your favourite part in this message?

6. Look at the following message from the video



Mark only one oval per row.

	1 (Lowest)	2	3	4	5 (Highest)
How inspiring did you find this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How effective is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How useful is this message?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. What is your favourite part in this message?

This content is neither created nor endorsed by Google.

Google Forms

Descriptive Statistics of Message Type

	Message Type
Valid	56
Missing	4
Mean	1.232
Std. Deviation	0.426

Contingency Tables for walk/training time

walk/training (hours/week) range		gender		Total
		F	M	
0	Count	11.000	12.000	23.000
	Expected count	9.583	13.417	23.000
	% within column	44.000 %	34.286 %	38.333 %
	% of total	18.333 %	20.000 %	38.333 %
1	Count	13.000	9.000	22.000
	Expected count	9.167	12.833	22.000
	% within column	52.000 %	25.714 %	36.667 %

walk/training (hours/week) range	gender			
	F	M	Total	
2	% of total	21.667 %	15.000 %	36.667 %
	Count	1.000	8.000	9.000
	Expected count	3.750	5.250	9.000
	% within column	4.000 %	22.857 %	15.000 %
3	% of total	1.667 %	13.333 %	15.000 %
	Count	0.000	4.000	4.000
	Expected count	1.667	2.333	4.000
	% within column	0.000 %	11.429 %	6.667 %
4	% of total	0.000 %	6.667 %	6.667 %
	Count	0.000	2.000	2.000
	Expected count	0.833	1.167	2.000
	% within column	0.000 %	5.714 %	3.333 %
Total	% of total	0.000 %	3.333 %	3.333 %
	Count	25.000	35.000	60.000
	Expected count	25.000	35.000	60.000
	% within column	100.000 %	100.000 %	100.000 %

walk/training (hours/week) range	gender		Total
	F	M	
% of total	41.667 %	58.333 %	100.000 %
Chi-Squared Tests			
	Value	df	p
X ²	10.850	4	0.028
X ² continuity correction	10.850	4	0.028
N	60		

Contingency Tables for prayers

Contingency Tables

Prayers	gender		Total
	F	M	
Count	4.000	14.000	18.000
Expected count	7.500	10.500	18.000
N	% within row	77.778 %	100.000 %
	% within column	40.000 %	30.000 %
	% of total	23.333 %	30.000 %

Contingency Tables

		gender		Total
		F	M	
Y	Count	21.000	21.000	42.000
	Expected count	17.500	24.500	42.000
	% within row	50.000 %	50.000 %	100.000 %
	% within column	84.000 %	60.000 %	70.000 %
	% of total	35.000 %	35.000 %	70.000 %
Total	Count	25.000	35.000	60.000
	Expected count	25.000	35.000	60.000
	% within row	41.667 %	58.333 %	100.000 %
	% within column	100.000 %	100.000 %	100.000 %
	% of total	41.667 %	58.333 %	100.000 %

Chi-Squared Tests

	Value	df	p
X ²	4.000	1	0.046
X ² continuity correction	2.939	1	0.086
N	60		

Contingency Tables for work frequency

gender

Contingency Tables

		gender		
		F	M	Total
frequently	Count	5.000	14.000	19.000
	Expected count	7.917	11.083	19.000
	% within row	26.316 %	73.684 %	100.000 %
	% within column	20.000 %	40.000 %	31.667 %
	% of total	8.333 %	23.333 %	31.667 %
never	Count	18.000	16.000	34.000
	Expected count	14.167	19.833	34.000
	% within row	52.941 %	47.059 %	100.000 %
	% within column	72.000 %	45.714 %	56.667 %
	% of total	30.000 %	26.667 %	56.667 %
sometimes	Count	2.000	5.000	7.000
	Expected count	2.917	4.083	7.000
	% within row	28.571 %	71.429 %	100.000 %
	% within column	8.000 %	14.286 %	11.667 %

Contingency Tables

		gender		Total
		F	M	
work frequency	% of total	3.333 %	8.333 %	11.667 %
	Count	25.000	35.000	60.000
	Expected count	25.000	35.000	60.000
Total	% within row	41.667 %	58.333 %	100.000 %
	% within column	100.000 %	100.000 %	100.000 %
	% of total	41.667 %	58.333 %	100.000 %

Chi-Squared Tests

	Value	df	p
χ^2	4.114	2	0.128
χ^2 continuity correction	4.114	2	0.128
N		60	

Contingency Tables for social media

Contingency Tables

		gender		Total
		F	M	
social media				
N	Count	12.000	14.000	26.000
	Expected count	10.833	15.167	26.000
	% within row	46.154 %	53.846 %	100.000 %
	% within column	48.000 %	40.000 %	43.333 %
	% of total	20.000 %	23.333 %	43.333 %
Y	Count	13.000	21.000	34.000
	Expected count	14.167	19.833	34.000
	% within row	38.235 %	61.765 %	100.000 %
	% within column	52.000 %	60.000 %	56.667 %
	% of total	21.667 %	35.000 %	56.667 %
Total	Count	25.000	35.000	60.000
	Expected count	25.000	35.000	60.000
	% within row	41.667 %	58.333 %	100.000 %
	% within column	100.000 %	100.000 %	100.000 %
	% of total	41.667 %	58.333 %	100.000 %

Contingency Tables

social media	gender		Total
	F	M	

Chi-Squared Tests

	Value	df	p
X ²	0.380	1	0.538
X ² continuity correction	0.124	1	0.725
N	60		

Contingency tables for reading

Contingency Tables

reading	gender		Total
	F	M	
Count	16.000	17.000	33.000
Expected count	13.750	19.250	33.000
N			
% within row	48.485 %	51.515 %	100.000 %
% within column	64.000 %	48.571 %	55.000 %
% of total	26.667 %	28.333 %	55.000 %

Contingency Tables

		gender		Total
		F	M	
Y	Count	9.000	18.000	27.000
	Expected count	11.250	15.750	27.000
	% within row	33.333 %	66.667 %	100.000 %
	% within column	36.000 %	51.429 %	45.000 %
	% of total	15.000 %	30.000 %	45.000 %
Total	Count	25.000	35.000	60.000
	Expected count	25.000	35.000	60.000
	% within row	41.667 %	58.333 %	100.000 %
	% within column	100.000 %	100.000 %	100.000 %
	% of total	41.667 %	58.333 %	100.000 %

Chi-Squared Tests

	Value	df	p
χ^2	1.403	1	0.236
χ^2 continuity correction	0.848	1	0.357
N	60		

Descriptive Statistics

	P1- Promotive- Inspiring	P1- Promotive- Usefulness	P1- Promotive- effectiveness	P1- Preventive- Inspiring	P1- Preventive- Usefullnes	P1- Preventive- Effectiveness
Valid	56	56	56	56	56	56
Missing	0	0	0	0	0	0
Mean	4.071	3.679	3.768	4.000	3.571	3.607
Std. Deviation	1.126	1.177	1.062	1.112	1.158	1.090
Shapiro-Wilk	0.753	0.770	0.803	0.807	0.893	0.886
P-value of Shapiro-Wilk	< .001	< .001	< .001	< .001	< .001	< .001

Descriptive Statistics

	P2- Promotive- Inspiring	P2- Promotive- Usefulness	P2- Promotive- effectiveness	P2- Preventive- Inspiring	P2- Preventive- Usefullnes	P2- Preventive- Effectiveness
Valid	56	56	56	56	56	56
Missing	0	0	0	0	0	0
Mean	4.339	3.661	3.589	4.071	3.446	3.375
Std. Deviation	0.940	0.959	0.987	1.158	1.025	1.019
Shapiro-Wilk	0.702	0.838	0.856	0.751	0.887	0.898
P-value of Shapiro-Wilk	< .001	< .001	< .001	< .001	< .001	< .001

Table 3: Pearson correlations

Pearson Correlations			Pearson's r	p
P1-Promotive-Usefulness	-	P1-Promotive-effectiveness	0.9 ***	< .001
P2-Preventive-Usefullnes	-	P2-Preventive-Effectiveness	0.874 ***	< .001
P2-Promotive-effectiveness	-	P2-Promotive-Usefulness	0.873 ***	< .001
P1-Preventive-Usefullnes	-	P1-Preventive-Effectiveness	0.82 ***	< .001
P1-Promotive-Inspiring	-	P1-Promotive-effectiveness	0.709 ***	< .001

P2-Preventive-Inspiring	-	P2-Preventive-Usefullnes	0.703	***	< .001
P1-Promotive-Inspiring	-	P1-Promotive-Usefulness	0.64		< .001
P2-Preventive-Inspiring	-	P2-Preventive-Effectiveness	0.626	***	< .001
P1-Promotive-Inspiring	-	P1-Preventive-Inspiring	0.595	***	< .001
P1-Preventive-Inspiring	-	P1-Preventive-Effectiveness	0.59	***	< .001
P1-Promotive-Inspiring	-	P2-Preventive-Inspiring	0.589	***	< .001
P1-Preventive-Inspiring	-	P1-Preventive-Usefullnes	0.559	***	< .001
P1-Promotive-Usefulness	-	P1-Preventive-Effectiveness	0.555	***	< .001
P1-Promotive-Usefulness	-	P1-Preventive-Usefullnes	0.536	***	< .001
P2-Promotive-effectiveness	-	P2-Promotive-Inspiring	0.51	***	< .001
P1-Promotive-effectiveness	-	P1-Preventive-Inspiring	0.502	***	< .001
P2-Promotive-Inspiring	-	P2-Promotive-Usefulness	0.475	***	< .001
P1-Preventive-Inspiring	-	P2-Preventive-Inspiring	0.461	***	< .001
P1-Promotive-Usefulness	-	P1-Preventive-Inspiring	0.458	***	< .001
P1-Promotive-effectiveness	-	P2-Preventive-Inspiring	0.438	***	< .001
P1-Promotive-Inspiring	-	P2-Preventive-Effectiveness	0.43	***	< .001
P1-Promotive-effectiveness	-	P1-Preventive-Effectiveness	0.429	***	< .001
P1-Promotive-effectiveness	-	P2-Preventive-Usefullnes	0.426	**	0.001
P1-Promotive-Inspiring	-	P2-Promotive-Inspiring	0.424	**	0.001

P1-Promotive-Inspiring	-	P2-Preventive-Usefulness	0.419	**	0.001
P1-Promotive-Usefulness	-	P2-Preventive-Inspiring	0.411	**	0.002
P1-Preventive-Inspiring	-	P2-Preventive-Usefulness	0.405	**	0.002
P1-Preventive-Usefulness	-	P2-Preventive-Usefulness	0.398	**	0.002
P1-Promotive-effectiveness	-	P1-Preventive-Usefulness	0.379	**	0.004
P1-Promotive-Usefulness	-	P2-Preventive-Usefulness	0.371	**	0.005
P1-Promotive-Inspiring	-	P1-Preventive-Effectiveness	0.36	**	0.006
P1-Preventive-Inspiring	-	P2-Preventive-Effectiveness	0.355	**	0.007
P1-Preventive-Effectiveness	-	P2-Promotive-Usefulness	0.347	**	0.009
P1-Promotive-Inspiring	-	P2-Promotive-effectiveness	0.343	**	0.01
P1-Promotive-Inspiring	-	P1-Preventive-Usefulness	0.333	*	0.012
P1-Preventive-Inspiring	-	P2-Promotive-Inspiring	0.317	*	0.017
P1-Promotive-Inspiring	-	P2-Promotive-Usefulness	0.307	*	0.022
P1-Preventive-Usefulness	-	P2-Preventive-Inspiring	0.301	*	0.024
P2-Preventive-Usefulness	-	P2-Promotive-Inspiring	0.296	*	0.027
P1-Promotive-effectiveness	-	P2-Preventive-Effectiveness	0.294	*	0.028
P1-Preventive-Usefulness	-	P2-Preventive-Effectiveness	0.294	*	0.028
P1-Preventive-Effectiveness	-	P2-Preventive-Inspiring	0.292	*	0.029
P1-Promotive-Usefulness	-	P2-Promotive-Usefulness	0.277	*	0.039

P2-Promotive-effectiveness	-	P2-Preventive-Effectiveness	0.276 *	0.039
P1-Promotive-effectiveness	-	P2-Promotive-Inspiring	0.267 *	0.047
P1-Preventive-Effectiveness	-	P2-Preventive-Usefullnes	0.265 *	0.049
P1-Promotive-effectiveness	-	P2-Promotive-Usefulness	0.265 *	0.048
P1-Promotive-Usefulness	-	P2-Promotive-Inspiring	0.261	0.052
P1-Promotive-effectiveness	-	P2-Promotive-effectiveness	0.254	0.059
P2-Preventive-Inspiring	-	P2-Promotive-Inspiring	0.248	0.065
P2-Preventive-Effectiveness	-	P2-Promotive-Inspiring	0.237	0.079
P2-Preventive-Effectiveness	-	P2-Promotive-Usefulness	0.228	0.091
P1-Promotive-Usefulness	-	P2-Preventive-Effectiveness	0.222	0.1
P1-Preventive-Usefullnes	-	P2-Promotive-Usefulness	0.214	0.113
P1-Preventive-Effectiveness	-	P2-Promotive-effectiveness	0.206	0.127
P1-Promotive-Usefulness	-	P2-Promotive-effectiveness	0.2	0.139
P1-Preventive-Usefullnes	-	P2-Promotive-Inspiring	0.194	0.152
P2-Promotive-effectiveness	-	P2-Preventive-Usefullnes	0.19	0.16
P1-Preventive-Usefullnes	-	P2-Promotive-effectiveness	0.182	0.18
P1-Preventive-Effectiveness	-	P2-Preventive-Effectiveness	0.177	0.191
P2-Preventive-Usefullnes	-	P2-Promotive-Usefulness	0.175	0.197
P1-Preventive-Effectiveness	-	P2-Promotive-Inspiring	0.162	0.232

P2-Preventive-Inspiring	-	P2-Promotive-Usefulness	0.155	0.254
P1-Preventive-Inspiring	-	P2-Promotive-effectiveness	0.149	0.275
P1-Preventive-Inspiring	-	P2-Promotive-Usefulness	0.149	0.274
P2-Promotive-effectiveness	-	P2-Preventive-Inspiring	0.115	0.397
* p < .05, ** p < .01, *** p < .001				

Correlation Plots

Kommentert [FES1]: Do you find that these plots helps comprehension? I do not get much from these plots. I would therefore consider not including them. What do you think? Some of the descriptions of correlation below could still be included.

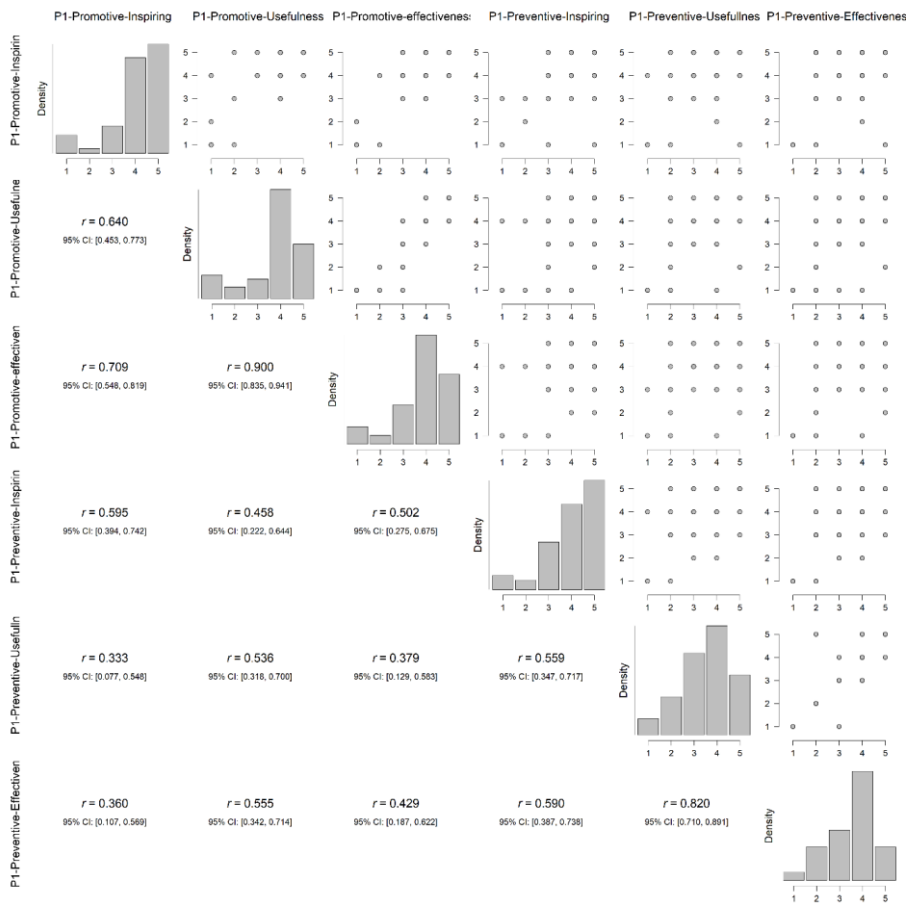


Figure 8.2: scatter plots for each pair of perceived inspiration, perceived usefulness, and perceived effectiveness for reduction, reminder, and social learning with pro-motive, preventive, and control message types

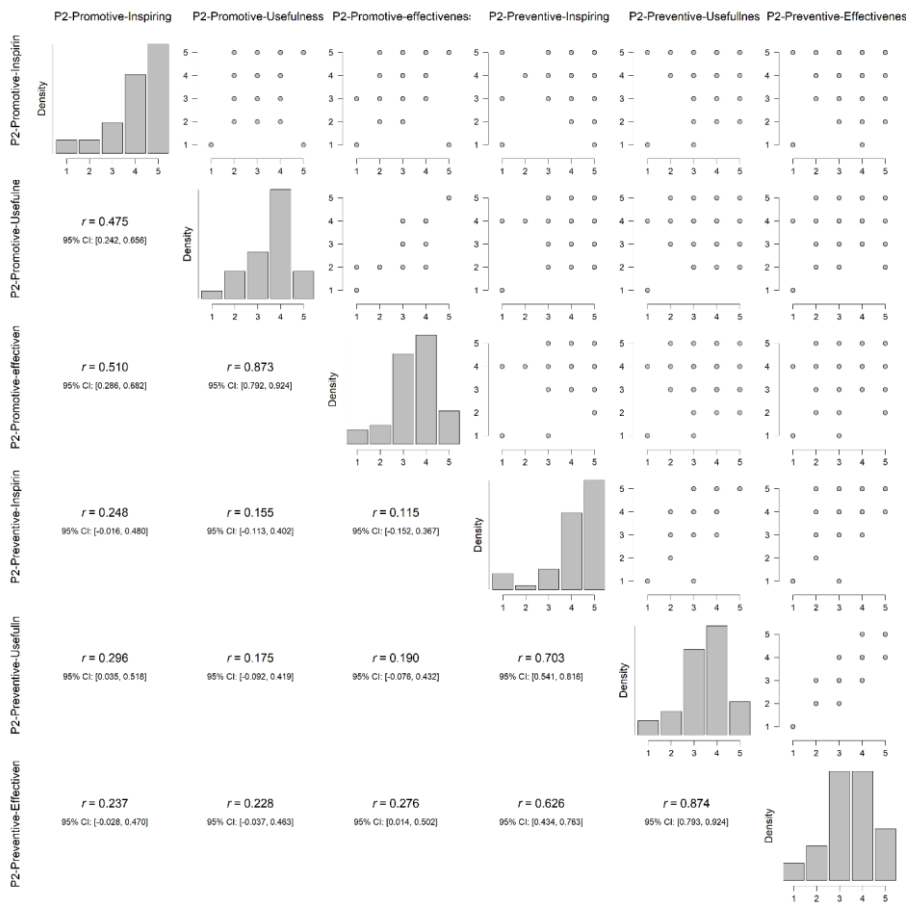


Figure 8.3: scatter plots for each pair of perceived inspiration, perceived usefulness, and perceived effectiveness for self-monitoring, suggestion, and normative influence with pro-motive, preventive, and control message types