Developing Persuasive Health Messages for a Behaviour-Change-Support-System That Promotes Physical Activity

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Abstract. This paper describes the first of three experiments conducted to investigate the efficacy of a proposed persuasive mHealth messaging intervention that motivates individuals to become more physically active. In order to develop a set of persuasive health messages that can be used in the principal experiment, which examines a particular message tailoring strategy, we conducted an online survey through Amazon Mechanical Turk. In this online study participants rated a series of health messages to indicate each message's level of persuasiveness, as well as message's focus. This study was particularly essential, as disagreements exist on how to frame persuasive health messages in the context of promoting physical activity. Among the proposed 57 messages, 14 messages that rated as most persuasive were selected for the principal experiment.

Keywords: Persuasive systems; behaviour-change support systems; text-based interventions; message tailoring; health communication; Higgins' Regulatory Fit theory; consumer psychology, promoting leisure-time physical activity; e-health; m-health; Amazon Mechanical Turk

1 Introduction

Encouraging people to perform regular leisure-time physical activity has proven challenging. Many interventions have tried to address this problem by employing theories that model behaviour change. These technologies, also known as behaviour-change or persuasive systems, utilize a variety of strategies to influence users' attitudes and behaviours. One commonly used strategy involves tailoring the persuasive communication between the system and its users. Many researchers have indicated that different individuals may react to the same persuasive message differently (Batra, Keller, & Strecher, 2010; Khaled, Barr, Noble, Fischer, & Biddle, 2006; Kaptein, 2012) and believe that in order to increase the efficacy of behaviour change support systems, persuasive communication should be adjusted to individuals' psychological characteristics (Noar, Harrington, & Aldrich 2009; Kaipainen, Payne, & Wansink, 2012). Although the importance of tailoring has been highlighted in the literature, insufficient guidance exists on how to employ this technique in the design of persuasive systems. This research was design to investigate a specific tailoring mechanism based on Higgins' Regulatory Fit Theory (2000) in an effort to address this problem.

2 Background

Scholars in the field of public health have been investigating the effects of tailoring messages for decades and verified that tailoring increases the impact of persuasive health messages (Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008). Their findings demonstrated that participants considered tailored messages more engaging and relevant (Vries, Kremers, Smeets, Brug, & Eijmael, 2008; Noar, Benac, Harris, 2007).

Persuasive systems designed to support forming healthy habits can tailor the communications with their users in two different ways, either tailoring the messages based on users' physiological or psychological characteristics. The number of studies that employed user psychological characteristics for tailoring is relatively small. Some examples of tailoring in design of persuasive health communication include the work of Halko and Kientz (2010) in which the tailoring was based on Big Five personality traits to design a system that promotes exercising, or the work Orji and colleagues (2013), in which tailoring was based on Bartle's taxonomy of gamers in an effort to design a persuasive game that encouraged participants to consume a healthy diet.

One of the most systematic works in tailoring is the research of Kaptein, Markopoulos, de Ruyter, and Aarts (2009). These researchers developed a Susceptibility to Persuasion Scale that measures individuals' susceptibility to six different influence strategies such as commitment, scarcity, authority, and consensus.

Even though those researchers employed the tailoring technique according to well-accepted psychological theories, the validity and efficacy of their proposed interventions are still to be determined.

3 Approach

Considering the lack of guidelines in the literature on how to utilize tailoring as a persuasive mechanism in the design of behaviour change support systems, by drawing on the public health communication and social psychology literature, we decided to examine the efficacy of Higgins' Regulatory Fit Theory (2000) in influencing individuals' attitude and behaviour.

3.1 Regulatory Fit Theory

Regulatory Focus Theory, introduced in the late 1990s by Tory Higgins, describes two different self-regulatory mechanisms that individuals employ while pursuing their goals: promotion-orientation and prevention-orientation. Individuals with promotion-orientation employ a motivational strategy that focuses on accomplishment and potential gains, whereas individuals with prevention-orientation employ a motivational strategy that focuses on safety and security, preventing potential losses.

Higgins also introduced the Regulatory Fit theory (2000), which argues that when individuals' self-regulatory orientation matches their goal-pursuit strategy, they are more engaged in the process of pursuing their goals, and he referred to this phenomenon as Regulatory Fit.

Since the introduction of Higgins' theory, many studies, which aimed to promote healthy habits, have examined the efficacy of this approach. In these studies, participants were presented with health-related content framed to either match or not match their regulatory orientation. After exposure to the health-related contents, the

researchers examined whether participants perceived messages that matched their regulatory orientation, as being more persuasive. Although the findings partially confirmed the theory, there is still no conclusive answer, and some scholars have attributed this inconclusiveness to the way the health messages were framed.

3.2 Ambiguity in Best Approach to Frame Persuasive Messages

Over the last few decades, health communication scientists have employed different psychological models to frame health messages for educating the public and promoting healthy behaviours. One of the most-used theories has been Prospect Theory (Kahneman, 1979). O'Keefe and Jensen (2006) conducted a meta-analysis of 165 studies, in which Prospect Theory and two psychological phenomena (negativity bias and loss aversion) were used to frame persuasive health messages. These two constructs were employed to design (either loss-framed or gain-framed) health messages, and the empirical findings showed that loss-framed messages have a stronger impact than gain-framed ones in persuading individuals (regardless of their psychological characteristics) (2011b). However, these researchers pointed out that the observed difference between the effect sizes of these two types of framing—although statistically significant—was very small (O'Keefe & Jensen, 2006; O'Keefe, 2011b; Gallagher & Updegraff, 2012; O'Keefe, 2015), and that small size might be attributed to moderating factors such as type of behaviour, or more importantly individuals' differences in perceiving potential risks or benefits associated with performing or not performing that behaviour (Updegraff, Rothman, & Salovey, 2012).

However since then, and after the introduction of Higgins' theory, other researchers such as Lee and Aaker (2004) introduced the idea of pairing a gain-/loss-framed message with someone's regulatory orientation and therefore, accounting for individuals' differences. Consequently, a lot of research has been conducted to determine whether message framing and tailoring based on this approach were effective in promoting healthier living. Ludolph and Schulz (2015) performed a systematic review, in which they examined 30 out of 2127 published studies and concluded that tailoring based on regulatory fit theory may be an effective strategy in delivering persuasive communication.

4 Objective

The goal of our research was to investigate efficacy of Higgins' theory in design of persuasive systems. In order to prevent risks to the validity of our research, the first step was to identify the best approach to frame health messages for our principal experiment.

Previous research has demonstrated that there is a consensus on how to frame promotion-oriented messages. Promotion-oriented messages, which highlight the benefits of physical activity, are framed so they describe how a desirable state (being healthy or maintaining one's health) can be achieved by adhering to the promoted behaviour (i.e., by performing regular physical activity). In the other words their structure follows a gain-framed messages structure.

However, there is no general agreement on how to frame prevention-oriented messages. Prevention-oriented messages can be framed so they either highlight the risks of not adhering to target behaviour, or to stress how those potential risks can be avoided by adherence.

In some earlier studies (e.g., the work of Latimer and colleagues (2008)), in which the efficacy of tailoring based on regulatory focus theory was examined, a loss-framed message structure was used to develop prevention-oriented messages. Those messages followed a structure where each message highlighted the consequences of not performing regular leisure-time physical activity (i.e., messages focused on how an undesirable state might be attained, if individuals do not adhere to the target behaviour). On the other hand, in some other studies (including the work of Pfeffer (2012)), messages were framed in a way that instead of highlighting the risks non-adherence, they emphasized how those risks (i.e., undesirable states) can be prevented, if individuals adhere to the behaviour. However, the results of those studies did not lead to a general conclusion on determining the best approach to frame messages.

Therefore, we decided to first create a set of health messages whose persuasiveness could be evaluated in a study prior to our principal experiment by a group of individuals whose characteristics would match of those of our principal experiment.

5 Method

The messages were adapted from those used in similar studies, which investigated the effect of message framing to promote physical activity (Rebecca, Pfeffer, Latimer).

In this study, which was conducted through Amazon Mechanical Turk, we recruited 130 individuals with a sedentary lifestyle and between 18 and 30 years of age (Mean age: 25.69, SD: 3.5, 45 females).

To be eligible for our study, potential participants were required to indicate whether they regularly performed at least 150 minutes of moderate- to vigorous-intensity leisure-time physical activity per week. Only those who answered ‘NO’, but expressed that they intend to do so, were admitted.

Then participants were presented with two groups of messages: prevention- and promotion-messages. All the participants were presented 31 promotion-messages (messages that promoted the benefits of performing regular physical activity) and 26 prevention-messages. However, for prevention-messages, half of the participants read only one type of prevention messages (Prevention-messages Type 1) and the other half read only the other type of prevention messages (Prevention-messages Type 2). The two types of prevention messages conveyed the same health-related contents, but were formulated in different structures. Prevention-messages Type 1 stressed the risks and consequences of not engaging in regular activity, whereas prevention-messages Type 2 highlighted those health risks that can be avoided by performing regular activity (Figure 1.). An example of each message category is shown in Table 1.

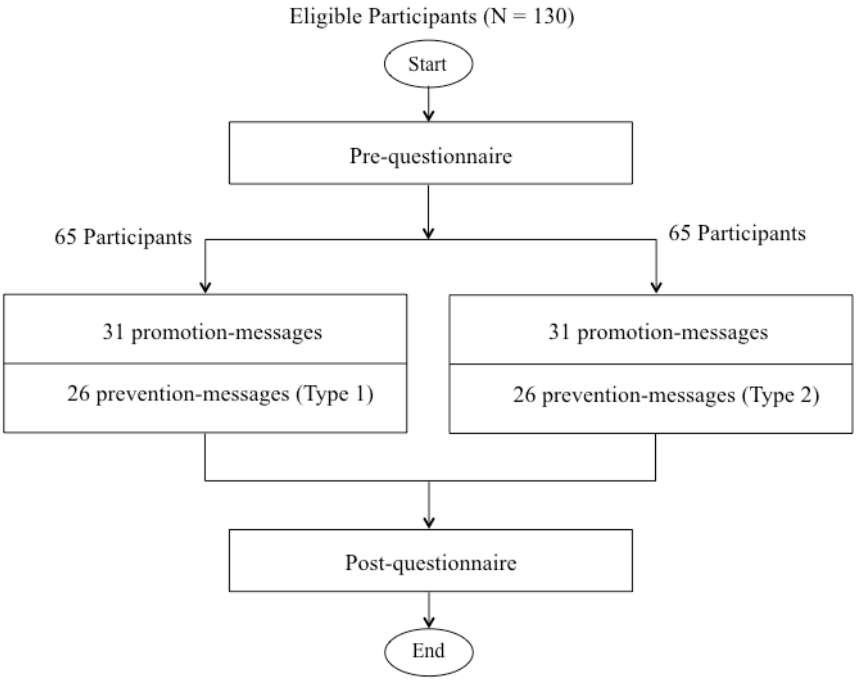


Figure 1. Study procedure

After reading messages, participants were asked to rate them in terms of *message focus* and *message persuasiveness*. For each message, participants indicated whether the message focused on the consequences of physical inactivity or benefits of physical activity (1: *This message focuses heavily on the risks of physical inactivity* to 5: *This messages focuses heavily on the benefits of physical activity*). Also, on a scale of 0 to 100, participants rated messages' perceived persuasiveness, indicating to what extend they thought each message could persuade someone to become more physically active.

Category	Content
Promotion-message	People who participate in aerobic activities such as jogging, swimming, and basketball are more likely to improve their cardiovascular fitness.
Prevention-message Type 1	Physical inactivity can increase the symptoms and effects of diseases, such as high blood pressure, diabetes, and heart disease.
Prevention-message Type 2	Physical activity can alleviate the symptoms and effects of disease, such as high blood pressure, diabetes, and heart disease.

Table 1. Examples of each message category

In addition to the message-rating task, we asked participants to answer questions about their motivation, intention, feelings with respect to performing regular physical activity (i.e., affect), and measured their response efficacy (how effective—they believe—performing regular physical activity might be) and physical-activity-related self-efficacy (using Haas' Physical Activity Self-efficacy Scale (2010)), so we could asses the correlation between each of those measures and how they perceived each message in terms of its persuasiveness.

Participants were also required to complete Higgins' (2001) and Lockwood's (2002) regulatory focus questionnaires so their regulatory orientation could be identified.

The study followed a mixed experimental design with message focus being the within-subject variable and message structure (of prevention messages) being the between-subject variable.

6 Results

Before we ran the analysis, we first calculated the deviance scores of participants' perceptions of the promotion- and prevention-messages (Type 1 and Type 2). Higher ratings implied that participants perceived the message focusing more on the benefits of regular physical activity; lower ratings implied that participants perceived the message focusing more on the risks of inactivity. We calculated the average ratings of the promotion- and prevention-messages for each participant respectively. Then we created the deviance scores by subtracting the average ratings of the prevention-messages from the averages ratings of the promotion-messages. Bigger deviance scores suggested that participants perceived the prevention-messages more differently from the promotion-messages. Given that the negative deviance scores may imply that participants did not pay attention to the messages by giving opposite ratings, we excluded the participants whose deviance scores were smaller than zero (8.46%). Additionally, we excluded answers of those individuals who did not complete the regulatory focus scales or their age was beyond 30 years old. The descriptive statistics of perceptions and perceived persuasiveness of the promotion and prevention messages were summarized in Table 2.

	Condition 1*		**Condition 2****	
	Prevention Messages Type 1	**Promotion Messages**	**Prevention Messages Type 2**	**Promotion Messages**
Perceived Focus	1.99 (0.69)	4.15 (0.37)	3.33 (0.79)	4.18 (0.43)
Perceived Persuasiveness (%)	51.96 (15.96)	61.61 (14.84)	58.39 (14.43)	63.04 (15.84)

* In Condition 1, participants received messages that highlighted the risks of not performing regular physical activity.
** In Condition 2, participants received messages that highlighted health risks that can be avoided by performing regular physical activity.

Table 2. Descriptive statistics of focus and perceived persuasiveness of the messages

5.1 Effects of Condition on Perception of Two Different Types of Prevention Messages

The first research question was to examine how participants' perception differs when provided with messages that contain the same health-related content, but in two different message structures. This step was necessary as a sort of manipulation check to verify if our independent variables way we intended. The prevention-messages Type 1 highlighted the negative consequences of physical inactivity on individuals' health, whereas prevention-messages Type 2 described how regular physical activity could prevent those negative consequences.

We first examined the effects of different conditions of prevention-messages (Type 1 vs. Type 2) on their deviance scores of the perceptions. Results showed that deviance scores between prevention-messages Type 1 and promotion-messages (M=2.16, SE=0.13) were significantly larger than those between prevention-messages Type 2 and promotion-messages (M=0.85, SE=0.13) ($t(94)=7.08$, $p<.001$), suggesting that participants perceived prevention-messages Type 2 closer to the promotion-messages than prevention-messages Type 1, in terms of stressing the effects of physical activity.

5.2 Effects of Condition on Perceived Persuasiveness

We then examined the effects of message type (promotion vs. prevention) and condition (Type 1 vs. Type 2) on the ratings of perceived persuasiveness of the messages. The results showed that the perceived persuasiveness of promotion-messages (M=0.62, SE=0.02) was higher than the perceived persuasiveness of prevention-messages (M=0.55, SE=0.02) regardless of the condition ($F(1,94)=56.98$, $p<.001$). This result was consistent with findings in similar studies (XXXX, XXX). As shown in Figure 2, there was also an interaction of messages type and condition on the ratings of perceived persuasiveness of messages ($F(1,94)=6.97$, $p<.01$) suggesting that participants rated the prevention-messages Type 2 (M=0.58, SE=0.02) as more persuasive than the prevention-messages Type 1 (M=0.52, SE=0.02) (Post-hoc test, $t(94)=-2.07$, $p<.05$). Since both groups of participants read the same set of promotion-messages, there was no differences in the ratings of perceived persuasiveness of promotion-messages (Post-hoc test, $t(94)=-0.46$, $p=0.65$).

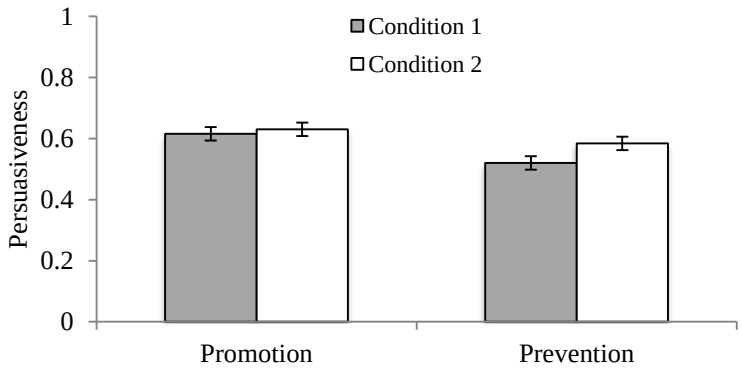


Figure 2. Effects of message type and condition on the perceived persuasiveness of the messages. In Condition 1, participants were presented with prevention-messages Type 1 and in Condition 2, participants were presented with prevention-messages Type 2. Promotion-messages in both conditions were identical (rated by different group of participants, though).

In summary, our findings demonstrated that, among the three different message categories we examined, messages that promoted the benefits of performing regular physical activity (promotion-messages) were perceived to be the most persuasive (which was consistent with previous findings in the literature)[XX, XX]. Then the second most persuasive category of messages were prevention-messages Type 2 (messages that highlighted physical and mental health problems that can be avoided by performing regular activity). The least persuasive category of messages among these three groups were prevention-messages Type 1 (those that stressed the risks and consequences of not engaging in regular activity).

With respect to the other measures, there was a correlation between promotion-messages' persuasiveness and the affect, meaning that those participants who had stronger positive feelings about performing regular physical activity perceived promotion-messages more persuasive. This was also the case for motivation, intention and response efficacy—meaning that those individuals who had higher motivation and intention to perform regular activity and also rated the response efficacy measure higher, perceived promotion-messages more persuasive.

Similarly, there was a correlation between Type 2 prevention-messages' persuasiveness and the affect, meaning prevention-messages Type 2 were perceived more persuasive by the participants who had stronger positive feelings about performing regular activity. This was also the case, also for motivation (but not intention) and response efficacy—meaning those who had higher motivation to perform regular activity and also rated the response efficacy measure higher, perceived prevention-messages Type 2 more persuasive.

Regarding physical-activity-related self-efficacy measure, there was a correlation between self-efficacy and Type 2 prevention-messages' persuasiveness, meaning that participants with higher self-efficacy, intent to perceive prevention-messages Type 2 more persuasive.

With resect to regulatory focus, a medium correlation between Lockwood's regulatory scale and Higgins' scales was observed ($r = 0.33$). Additionally, there was a medium to strong correlation between Lockwood promotion scores and intention 0.38

Finally, as one can expect, there was a strong correlation between motivation to perform regular activity and intention to become physically active.

7 Discussion and future work

This study was the first of three experiments the authors designed to investigate the efficacy of tailoring the persuasive communication between a system that promotes physical activity and its users, when tailoring is grounded on regulatory fit theory. The goal of this study was to develop a set of validated health messages for the principal experiment in which the effects of tailored health messages on individuals' behaviour and intention to become more physically active would be—objectively—investigated. Based on the findings of this study a number of promotion and prevention messages that found to be most persuasive were chosen for the second and

third experiments. In the second experiment participants will be presented with daily health messages over a 2-week period and effects of those selected messages would be subjectively investigated (through self-report measures). Then in the final experiment, whose design is similar to the second experiment, the effects of those messages would be measured objectively through motion sensors.

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