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Susceptibility to social influence strategies and persuasive system design: exploring the relationship

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ABSTRACT

Cialdini's six principles of influence are commercially used but less common to encourage healthy behaviors. This study examines how these influence strategies relate to the persuasive systems design (PSD) model constructs implemented in commercial mobile fitness applications. Our research questions address whether susceptibility to influence strategies strengthen the relationships between persuasive constructs and, if so, which strategies and software features are promising to leverage the persuasive effects of systems designed to change health behaviors. This study presents results from a survey of system users (N=147) and their self-reported susceptibility to the six principles. All PSD model constructs showed significantly unequal distribution for some influence strategy, indicating that susceptibility to these strategies affects how users evaluate systems. The commitment principle correlated positively with all persuasive constructs, while reciprocation, scarcity and liking all significantly affected system evaluations. Susceptibility to influence strategies also moderated the relationships between PSD model constructs, but the moderation was often negative with small effect sizes. Our preliminary results indicate that practitioners could benefit from utilizing these influence strategies, especially susceptibility to commitment and reciprocation, which are stable and often high. However, the interaction between these strategies and persuasive systems is not straightforward and would benefit from further research.

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Persuasive design; social influence; influence strategies; persuadability; persuasion profiling

1. Introduction

Interactive digital applications used to support aspirations for better health, time management or financial state are the most prominent examples of persuasive technology. Persuasive technology refers to any 'interactive computing system designed to change people's attitudes or behaviours' (Fogg 2003). The core assumption of persuasive technology is that humans will communicate with computers, e.g. mobile applications, as they do with other humans (Nass et al. 1995). When humans communicate, they use persuasion to influence others' thoughts, feelings and behaviors (Simons, Morreale, and Gronbeck 2001), and similar techniques can be used in human-computer interaction. In the context of persuasive technology, persuasiveness is measured by a system's ability to generate persuasive effects. The actual mechanisms that might induce changes in attitudes and behaviors are derived from many different theories and psychological processes.

One source of these mechanisms is the study of social influence strategies, which were introduced by Robert E. Cialdini (2001). Cialdini categorized a vast number of studies into six principles of influence: reciprocation, commitment and consistency, social proof (consensus), liking, authority and scarcity. These principles are widely used in marketing and sales to spur customers toward making buying decisions. In the scientific community, the most relevant work has been done in the field of persuasion profiling, which refers to methods of utilizing individual susceptibility to persuasive strategies (see, e.g. Kaptein et al. 2015). Studies on susceptibility to persuasion have indicated that using the principles to which a user is most susceptible increases compliance with message requests (Kaptein et al. 2012; Kaptein and Van Halteren 2013). Susceptibility to certain principles is considered a stable trait and comparatively independent from the actual target behavior (Kaptein and Eckles 2010).

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In terms of adapting persuasive change mechanisms to interactive digital systems, the most comprehensive framework is presented by the persuasive systems design (PSD) model (Oinas-Kukkonen and Harjumaa 2009), a collection of mechanisms capable of persuasive effects. The model categorizes principles into four groups based on their target effects on the system design. The essence of the model is that the persuasiveness of the system is based upon the design of the system itself, although some of the principles are more focused on the contents, such as personalization, tailoring and praise (Oinas-Kukkonen and Harjumaa 2009). The PSD model has been used to both design (Karppinen et al. 2016; Teeriniemi et al. 2018) and evaluate (Halttu and Oinas-Kukkonen 2017; Lehto, Oinas-Kukkonen, and Drozd 2012; Meedya et al. 2019; Shevchuk and Oinas-Kukkonen 2019) systems that incorporate intentional behavior change. In terms of PSD model categories, most physical activity support systems implement principles of primary task support (self-monitoring) and dialogue support (e.g. praise, rewards, reminders). Due to tracking and data collection capabilities, they often also employ credibility support features (e.g. trustworthiness, expertise, authority).

While persuasion strategies are considered useful in, for example, marketing, they have not been extensively used to support health-related behavioral change support. There is also a lack of understanding regarding the overlaps and interactions between different strategies in interactive systems, as sources for influence principles are numerous (Kaptein et al. 2015). In this study, we have surveyed regular users of physical activity support systems and measured how they evaluate the following features of their self-selected systems: primary task support, dialogue support and perceived credibility. We also assess the correlation between PSD model constructs and susceptibility measures. The system evaluations are then further explored based on the moderating effect of susceptibility to Cialdini's persuasion strategies. The aim of this study is to understand the similarities shared by the persuasion mechanisms and to ascertain if susceptibility to persuasion strategies strengthen system persuasiveness.

Our research questions are the following:

RQ: How does susceptibility to social influence strategies relate to evaluation of persuasive design features?

Sub-RQ: Which strategies and software features are most likely to leverage the persuasiveness of systems?

Our paper continues with theoretical background, focusing on introduction of Cialdini's six principles

and recent studies that update his theories. We also outline how personality factors have been connected with susceptibility to persuasion and with the research on persuasion profiling. After describing our research model and methodology, we present our results and discuss both previous research and our contributions to the literature.

2. Related work

2.1. Cialdini's six influence strategies

Robert B. Cialdini studied the psychology of compliance and the psychological principles that increase the tendency to comply with requests. His work consisted of observing 'compliance professionals,' like salespeople and advertisers, and he organized thousands of observed behavioral tactics into six categories (Cialdini 2001). These psychological principles are described by Cialdini as capable of producing mindless compliance, a 'willingness to say yes without thinking first' (Cialdini 2001). In the following, we briefly present these principles and extend the ideas of the original work to encompass more recent contributions from several disciplines.

Reciprocation refers to our obligation to repay others for what they have given us. It is considered a very strong influence strategy, partially because of its universal presence in human cultures (Cialdini 2001, 19). It is so strong that some people feel anxious in situations requiring reciprocation (Xiong et al. 2018). However, reciprocation works well in many contexts, including that of verbal communication, as is demonstrated by the case of the UK's National Health Service Organ Donor Registrations (Sallis, Harper, and Sanders 2018). In that quasi-randomized, controlled trial case, persuasive messages with an embedded reciprocation strategy tied with loss-framed messaging were the most effective tactic for increasing organ donor registration. In digital services, reciprocation can be implemented by offering free trials or free parts of a service.

Gift-giving, in this context, serves as a favor that obliges repayment through purchase or continuing use of the service. In health and wellness applications and communication, it is possible to use this strategy to create a sense that the system has already done the heavy work for the user (creating insights, summaries, etc.) and to give the user an easy way to reciprocate (e.g. giving supportive information, evaluating the insight, etc.).

Scarcity utilizes the common human tendency to desire things more if they are scarce. Messages implying limited quantity (product scarcity) or time (resource scarcity) are used widely in marketing campaigns to

drive consumer conversion (Hamilton et al. 2019). According to Cialdini (2001), products that are difficult to obtain are valued more highly because scarce availability indicates that the product is of good quality and in high demand. Scarcity also restricts our freedom to choose, prompting us to try to retain that freedom by increasing our desire for the limited product, as explained by the reactance theory (for an overview, see, e.g. Miron and Brehm 2006). Research has also shown that consumers want products more when they have limited information about them (Cialdini 2001). Recent study of the effects of scarcity on decision-making in various parts of the journey the customer interacts with the service indicate that resource scarcity enhances elaboration of varying solution alternatives, while exposure to product scarcity mainly narrows product considerations. Therefore, prolonged exposure to resource scarcity may have more long-term effects on how people think and behave, such as on their willingness to delay gratification (Hamilton et al. 2019). The effects of either type of limitation vary according to the type of product under evaluation. For conspicuous products, limited quantity indicates a uniqueness that can also be achieved by limited editions (Jang et al. 2015). Both Hamilton et al. (2019) and Jang et al. (2015) show that the effects of scarcity are not straightforward and that its use in health behavior persuasion should be carefully considered.

The presence of scarcity induces feelings of arousal that hinder an individual's capacity to engage in information processing tasks. Cialdini (2001) originally suggested that this evoked heuristic, automatic, rule-of-thumb responses to scarcity appeals; however, more recent studies have reported that, in response to scarcity tactics, devotion of cognitive resources to message evaluation is moderated by the individuals' motivation to elaborate. If the initial motivation to evaluate, for example, a product offer is initially low, scarcity increases the degree of attention given to task-relevant cues, making the evaluation process more systematic and thorough. Individuals also tend to focus on resources that are scarce; therefore, short-term goals relating to such resources may be considered more salient (Hamilton et al. 2019). Extended exposure to resource scarcity, such as limited capital in families with a low socioeconomic status, increases awareness and monitoring of the social environment. Like reciprocity, a preference for scarce items also appears to be culturally driven (Diesendruck et al. 2019). In marketing communication, the indicated scarcity might be in time (e.g. a 24-hour special offer), in amount ('only a few items left in stock') or in availability (offer presented 'only to a select few').

Authority refers to our tendency to comply with orders given by authority figures. Often, individuals who possess high levels of knowledge, wisdom or power are also true authorities whose advice we should follow. However, symbols of authority can also serve as cues for obedience, even without any other evidence of the presumed status. This effect is one example of cognitive shorthand (Simons, Morreale, and Gronbeck 2001). Other examples include recommendations by experts in product advertisements and the use of logos of organizations with good reputations. Systems may also deliver information related to scientific studies or medical doctors and base the feedback they give on collected measures and tracking data. Many mobile tracker applications have names or marketing messages that position themselves as 'personal trainers,' 'coaches,' or 'health experts.' This suggests that, in addition to or instead of merely referring to authorities, they position themselves as an authority on the topic. This is also an example of computers, as social actors, creating relationships with users in order to persuade them (Fogg 2003).

The **commitment** principle, often presented together with or as **consistency**, is based on our need to craft a stable worldview in which we think and act consistently. This is particularly manifested through the alignment of current actions and behaviors with what we have said and done in the past; we prefer to do as we said we would do. This principle is among the few that are usually useful; being consistent makes us more liked and predictable, and being aligned with our own thoughts and actions makes us feel good about ourselves. Consistency with previous actions decreases the cognitive load needed to process information presented by similar subsequent events. Individuals differ remarkably in their preference for consistency (PfC), as demonstrated by the scale developed to measure it (Cialdini, Trost, and Newsom 1995). Individuals with high PfC are more consistent in their behaviors and experience strong unpleasant feelings when their attitudinal inconsistency is made accessible and more salient (Newby-Clark, McGregor, and Zanna 2002). PfC is also associated with emotion regulation, and it seems to increase with age, perhaps due to motivation to reduce emotional upset (Brown, Asher, and Cialdini 2005). A recent study in which robots performed foot-in-the-door sequential requests on humans (Lee and Liang 2018) demonstrated that this technique has a strong effect. More interestingly, the effect was not dependent on the robot's performance or perceived credibility. This suggests that preference for consistency moderates attitudes, beliefs and behaviors at the source-independent level. People tend to support their previous

commitments with new justifications, and commitments often survive longer than their initial purpose (Cialdini 2001). The commitment principle can be utilized by allowing users to share their application or product preferences with others, which encourages them not to deviate from their previous actions and to keep using the products.

Consensus is often referred to as social proof. We use the term ‘consensus’ in this paper, following the original measurement items developed by Kaptein et al. (2009). Consensus implies that we decide how to act or think based, in some part, on how other people are acting and thinking. This tendency is especially strong in situations in which we are very uncertain or among similar people. Consensus is an informational strategy, and, as information comes from other people, it is strongly affected by cultural differences. Logically, individuals who consider their own knowledge to be superior to that of others are not highly susceptible to influence by behaviors of a given group. Traditional implementations of the consensus principle show consumers what other people have purchased. The effect is further strengthened when a consumer looks at certain products and is told what other people who looked at the same product ultimately purchased. Like scarcity, consensus speeds up decision-making (Cialdini 2001) and is, therefore, often used in marketing communication.

Liking is a principle that relies on the persuasive power of considering someone or something likable. Cialdini (2001) lists physical attractiveness, similarity and familiarity as reasons that an individual might acquiesce to a request from a person they like. In addition, we like people who co-operate with us, who share similar values and who give us compliments. Studies suggest that why we like something is based on mere exposure to it; when we encounter similar stimuli repeatedly, processing the related information grows easier (Zajonc 2001). Recent research has questioned whether the fluency of processing might be a key factor, or if liking is based upon matching a stimulus to similar extant representations (Montoya et al. 2017). Regardless, it is clear that exposure alone can positively influence attitudes. Using a series of four studies, Garner (2005) investigated how similarity in names influenced liking and compliance. The findings indicate that name similarity itself is a strong influencer, is not dependent on familiarity, and led to more careful and compliant processing.

Liking is a principle that can have long-term effects on customer retention and on health behavior. As the importance of exposure suggests, being familiar and recognizable to the user strengthens the ability to influence their behaviors. A feeling of co-operation might

also support persuasive powers. For digital interactions, however, physical attractiveness is probably the closest match. This impact can be explained by the halo effect—we assign good qualities to things that signal positive characteristics, even when there is no logical reason for the association. Recently, a study of dominant and submissive interaction styles indicated that persuasion might be more effective when users do not like the system and that the users preferred systems that were similar to their interaction style (Ruijten 2021). Although this finding seems to contradict with liking principle, it is not clear whether this effect is sustained in longer relationships with the system, such as in self-monitoring or health behavior change systems that are designed to be used for extended periods.

Cialdini’s social influence mechanisms are not entirely free of contextual interference. There are several moderators of information processing activities that impact whether an attempt to influence triggers a direct or peripheral route. One of the most studied and established moderators is a trait called need for cognition (NfC). Cacioppo et al. (1986) argued that people with a high NfC are more likely to think intensively about incoming messages than people with a low NfC. While NfC and the elaboration likelihood model (ELM) focus on attitudes, high NfC also predicts stronger attitudinal and behavioral consistency. In a study by Whittler and Manolis (2015), NfC moderated persuasive expression based on scarcity and authority in different ways. The use of authority increased message elaboration, and strong arguments led to more favorable product evaluations. When the scarcity principle was used, argument strength did not have any effect; however, high-NfC individuals had more negative thoughts about the product. Overall, feelings of product scarcity increase arousal. This, however, can make message elaboration more difficult (high NfC) or increase attention (low NfC), leading to a more elaborate processing of task-relevant cues (Hamilton et al. 2019). These findings indicate that persuasion is not independent of context of use but is highly sensitive to the effects of other traits and argument qualities. This further implies that the use of persuasion strategies in system design should focus on strong arguments, which tend to be more effective and are more often processed via a direct route.

2.2. Persuasion and personality

The relationship between persuasiveness, a person’s overall susceptibility to being persuaded, and other personality characteristics has been examined in several studies. Alkiş and Taşkaya Temizel (2015) studied the link between personality traits and susceptibility to

influence strategies by collecting survey data from Turkish university students. Though their study was not explicitly connected to health applications or activity tracking (sample was taken from general student population), it is useful to this examination because it mapped the Big Five personality traits to specific influence principles. Individuals with high agreeableness were the most susceptible to persuasion strategies, with significant causal relationships between agreeableness and authority, reciprocity, commitment, consensus and liking. All of these principles indicate sensitivity toward other people's opinions and actions. Scarcity, on the other hand, was linked only to extraversion and neuroticism and seemed to differ from other strategies. Oyibo et al. (2018), in a study with Canadian participants, also concluded that none of the Big Five personality traits predicted scarcity. In a recent study assessing the relationship between personality profiles and susceptibility to persuasion, Wall et al. (2019) found that 'Fearful' individuals who reported high neuroticism, social inhibition and negative affectivity were likely to obey authority and were generally susceptible to strategies oriented towards other people (reciprocity and consensus). A 'socially apt' profile high in extraversion, agreeableness and conscientiousness was highly susceptible to commitment, indicating preference for consistency with previous behaviors. 'Malevolent' profiles that scored high in extraversion and negative affectivity also manifested so-called dark triad traits and were susceptible to scarcity (Wall et al. 2019). The importance of culture to the creation of susceptibility to scarcity is supported by a recent study that concluded that scarcity is unique to humans and is learned when children develop their cognitive skills in social interaction (John et al. 2018).

In terms of cultural difference and its effect on influence strategies, Orji et al. (2019) demonstrated that individualist and collectivist dimensions, which 'account for most of the variance in global differences,' have statistically different levels of susceptibility to four out of six strategies. Collectivists performed higher in authority, reciprocity, liking and consensus, while individualists were persuaded most by scarcity. For collectivists, commitment and reciprocity were strongest; for individualists, commitment. Cialdini et al. (1999) also reported cultural differences in the comparative influence of commitment and social proof (consensus) strategies.

2.3. Persuasion profiling

Persuasion profiling refers to the methodologies used to personalize persuasive messages based on users' susceptibility to different persuasion strategies. Tailored

messages or other textual content is the most popular approach to the personalization of interactive systems. According to the elaboration likelihood model (ELM), a prominent dual-process theory of attitude change (Petty, Barden, and Wheeler 2009), any influence strategy based on message content is dependent upon the user's motivation and ability to process the information contained in the message. The effectiveness of tailoring is suggested to be grounded in the resulting increase in personal relevance, which is among the most important variables affecting motivation to process information (81; Petty and Cacioppo 1986). Accordingly, increasing relevance is considered effective at improving the persuasiveness of systems (Orji et al. 2019).

Profiles can be created based on questionnaires or an accumulated understanding of user context; the latter is based on the average effects of segments or target behaviors. Profiles may also be based on users' responses to actual messages (e.g. monitoring their susceptibility in operation). These operative measures out-performed (self-reported) meta-judgment and are, therefore, considered to be the most effective alternative. However, they may also introduce ethical dilemmas through potential threats to user privacy (Kaptein 2018). The present paper focuses on susceptibility to persuasion, which, in this context, refers to the scale created by Kaptein et al. (2009). The scale is based on six persuasion principles (Cialdini 2001), and the questions used in this study are presented in the Appendix. The scale has previously been used in the context of the health domain (Kaptein, Lacroix, and Saini 2010) but not in the context of health or fitness users. In this study, a basic version of the questionnaire developed by Kaptein et al. (2009), not explicitly referencing to health behaviors, was presented to health-tracking individuals. In the following, we will briefly discuss how susceptibility to Cialdini's persuasion strategies have been studied in relation to personalization and targeting and will note any relevant implications.

Most published studies in this field focus on text messages. For example, de Vries et al. (2017) identified persuasive messages and studied their perceived levels of motivation. In a study of the use of Persuasive text messages to reduce snacking, results indicated that the most important factor to the design of persuasive communication is the avoidance of wrong principles. The study demonstrated a low success rate with contra-tailored messages (Kaptein et al. 2012).

Kaptein, Duplinsky, and Markopoulos (2011) explained the reducing effect of disclosure of attempts at persuasion through a dual-process model, arguing that information about the persuasion attempt encourages elaboration, reduces peripheral processing

and, therefore, strengthens influence via a direct route. Kaptein, Duplinsky, and Markopoulos (2011) also argued that multiple strategies engendered feelings of skepticism and a lack of trust, rendering them non-effective. Allowing users to choose which strategy to use increased compliance, as did perception of free choice. Finally, when persuasion attempts were adapted to users' responses and the system learned on the go, effectiveness decreased at a slower rate than did that of fixed profiles (Kaptein et al. 2015). Susceptibility is highly variable among individual users (Kaptein and Eckles 2010), making it difficult to build models based on averages that also allow for personalization.

Compared to the many other ways to create personalized profiles for customers or system users, persuasion profiles focus on means instead of ends (Kaptein and Eckles 2010). In other words, they personalize tactics rather than final behaviors or outcomes. The desired behaviors can be anything: less flying, more savings, eating more vegetables, etc. This makes them extremely useful for domains in which persuasion would otherwise narrow desired behaviors (Brynjarsdóttir et al. 2012). It is noteworthy, however, that ELM states that any variable the user evaluates may serve either as argument or as peripheral cue (Petty and Cacioppo 1986). This so-called multiple role postulate posits that simple cues of social influence principles, such as scarcity, can serve as triggers for peripheral processing or entice the attention for a higher degree of conscious elaboration (Petty and Wegener 1999). Hence, one can influence the effectiveness of social persuasion strategies by persuading the user to further elaborate upon their preferences. This increased attention, however, may not lead to compliance with subsequent requests.

2.4. PSD model

The PSD model is a conceptual framework for developing and evaluating persuasive behavior change technologies (Oinas-Kukkonen and Harjuma 2009). The design model is three-phased and begins with postulates outlining some of the key concepts underlying each persuasive system. The second phase guides the decision-making process related to, for example, target behaviors, relevant factors of the problem domain or suitable strategies for communicating persuasive messages. Actual system features are selected in the third phase. These features are grouped into four categories: primary task support, dialogue support, system credibility, and social support. Primary task support includes all features that support the user in completion of the task most relevant to

the target behavior. Various features from the dialogue support category, such as feedback, rewarding or reminding, are included within primary task support, as are extensively-utilized self-monitoring, reduction and tunneling. Counting steps is an example of scaling down a complex target (in this case, a goal to be more physically active) into simple and easily-monitored steps. In tunneling, the user is guided through a series of questions and tasks that facilitate focus on essential aspects (Matthews et al. 2016). Elements of dialogue support are naturally intertwined with primary tasks, but this is especially true for self-monitoring, which gives feedback, praise and rewards and uses reminders to keep the user appraised of their progress. System credibility features illustrate how the persuasive powers of credibility can be leveraged in system design: a carefully-crafted appearance and the adoption of certain behaviors can enhance credibility (surface credibility) as can the inclusion of definitive information that exhibits expertise. Finally, features of social support focus on the effects of social influence (Oinas-Kukkonen and Harjuma 2009).

Mobile applications that track physical activity typically implement primary task support self-monitoring functions. If a wearable, such as a heart rate monitor is not being worn, the application can utilize smartphone sensors to track distance and pace. Many applications also use maps to illustrate progress, and those that track activity in terms of steps, which is the case for most applications designed for wearable devices, also implement the primary task support principle of reduction. All applications generate summaries of the data they collect and present it to the user as different kinds of statistics or visualizations. Statistics are a part of the reflection-on-action type of feedback (Ploderer et al. 2014), which is delivered after the activity is complete. Feedback is also provided during the exercise or activity through updates that show progress and other relevant data, such as page and distance. These feedback functionalities implement dialogue support features of the PSD model, which may take the form of praise, rewards or reminders.

3. Research model and hypotheses

Our research model is based on the work of Lehto and Oinas-Kukkonen (Lehto and Oinas-Kukkonen 2015; Lehto, Oinas-Kukkonen, and Drozd 2012; Lehto et al. 2012), who developed measurement items and basic models for quantitative research approaches. Figure 1 illustrates the research model. All of the relationships among the constructs, represented by arrows, are assumed to be positive.

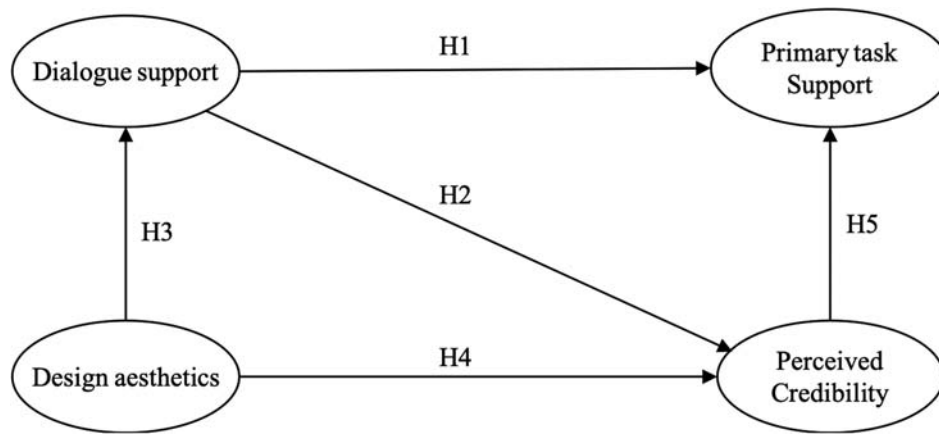


Figure 1. Research model and the hypotheses.

These constructs were chosen to model how persuasive systems function at a general level. All of this study's measurement items are existing constructs, and the relationships between the selected constructs have been validated with various studies and data sets (Halttu and Oinas-Kukkonen 2017; Lehto and Oinas-Kukkonen 2015; Lehto, Oinas-Kukkonen, and Drozd 2012; Lehto et al. 2012). We slightly modified the original wording of the questions to match our study's focus. The original source of each construct and the exact wording used in the study questionnaire are available in Appendix A. Table 1 defines the constructs and hypotheses for this study and presents prior research that confirms these paths. In addition to confirmatory hypothesis testing of PSD model relationships, we explored the moderating effects of susceptibility to persuasion strategies by running moderator analysis for all six strategies and for all five paths of the research model.

4. Research methodology

4.1. Data collection and respondent characteristics

An email invitation letter containing the link to the Webropol survey was sent to 18,605 students and employees of the University of Oulu. The introductory text indicated that survey respondents should be regular users of a health or well-being service. The measurement items for collecting data for research model presented in Figure 1 is available in Appendix A. All the measurement items consisted of seven-point Likert scale items ranging from strongly disagree (1) to strongly agree (7). The participants were first asked to list the applications and services that they used. Then they were asked to select one main service to serve as the evaluation object in subsequent questions.

Some 176 responses were received (a sample rate of 0.95%). After checking the validity of the responses, any response with low or unclear use of a relevant application or a response from user of a service or application not considered to be a health or wellness application were removed from the data set. The final sample contained 147 valid responses, of which Table 2 presents the basic demographics. The respondents were primarily women under 30 years old and educated at the undergraduate level. A bit less than half of the respondents (44.9% when part-time employees and entrepreneurs were included) were employees, while over half (51.7%) were university students.

4.2. Mobile application characteristics

The most commonly-used service was Sports Tracker (21 women, 15 men), followed by the Polar Flow and Beat applications (altogether 19 women, 11 men) and by HeiaHeia (10 women, 2 men). The biggest group, 'others,' (25 women, 19 men) included 30 different applications and services, each of which was used by one to four respondents. A Pearson chi-square test revealed no significant differences between men and women, although some services seemed to attract one gender more than the other. Figure 2 illustrates screens from this study's three most-used mobile applications.

Sports Tracker and HeiaHeia are mobile apps that can be used without any additional wearable tracker, but both can be complemented by such a device. Polar Flow is a mobile application that complements the use of Polar heart rate monitors and wrist-worn sports watches. All of these apps are based on self-monitoring functionality, though Polar Flow also implements the reduction principle, as it shows physical activity as

Table 1. This study's constructs and hypotheses.

Hypothesis	Description	Related Studies
H1: Dialogue support is positively related to primary task support	Features in the category of dialogue support facilitate interaction between the user and the system. In the context of self-monitoring tools, this category contains the essence of the tool—feedback that enables the user to see their own behavior and evaluate progress towards goals or targets. Dialogue support is often the most prominent feature of the system, and its impact on the users' experiences and acceptance of the system is significant. The interactive features support the user when they are completing important and essential tasks (i.e. primary tasks). A well-designed system offers the right kind of support at the right time, thus increasing the user's potential to meet the desired goal(s). In the context of self-monitoring tools, the self-regulatory process is built upon constant feedback that facilitates corrective actions and confirmation of completed actions. Therefore, in persuasive systems, dialogue support features should positively influence primary task support.	Lehto and Oinas-Kukkonen (2015); Lehto, Oinas-Kukkonen, and Drozd (2012); Lehto et al. (2012)
H2: Dialogue support is positively related to perceived credibility	Due to the prominent nature of feedback and other dialogue support features, like rewards and praise, these elements have the potential to either support or damage the credibility of the overall system and the services it provides. While trust in a service provider is a somewhat larger phenomenon than the influence perceived via dialogue support, recent contributions in the field of health information systems indicate that the credibility of the system transforms into trust over prolonged use (Shin, Lee, and Hwang 2017). When the dialogue features provide feedback that the user finds reasonable and useful, the perceived trustworthiness and reliability of the information source are enhanced. Credibility can also be formed through interaction with the system or service (Wathen and Burkell 2002). Previous studies have implied that dialogue support is among the strongest contributors to perceived credibility.	Lehto and Oinas-Kukkonen (2015); Lehto, Oinas-Kukkonen, and Drozd (2012); Lehto et al. (2012)
H3: Design aesthetics are positively related to dialogue support	Design aesthetics address visual experience, the attractiveness of the visuals on the screen, and the general appearance of the service. According to Fogg (2003), systems that are more attractive are more persuasive. Our ability to determine the aesthetic quality of an object is highly effective, and evaluations form fast, implying a natural tendency of our visual system that is relevant to success (Dou et al. 2019). One of the elements of aesthetics is the user impression of visual complexity (Reinecke et al. 2013). Regarding the feedback given through self-monitoring tools, unnecessary complexity decreases evaluations of aesthetic qualities and, therefore, diminishes overall perceptions of dialogue support.	Lehto, Oinas-Kukkonen, and Drozd (2012)
H4: Design aesthetics are positively related to perceived credibility	Experimental studies have demonstrated in the context of web pages that more refined aesthetics decisions increase perceived levels of credibility (Robins and Holmes 2008). Robins and Holmes further suggest that this amelioration effect relies on visceral judgement and diminishes when cognitive evaluation is complete. Design quality, another of the components of aesthetics, enhances feelings of trust in online transactions and is an also important contributor to usability and system performance (Sonderegger and Sauer 2012). The role of design aesthetics in usability, however, seems to diminish if the product is used for a long period of time (Sonderegger et al. 2012).	Lehto, Oinas-Kukkonen, and Drozd (2012)
H5: Perceived credibility is positively related to primary task support	A belief in the trustworthiness and reliability of a service facilitates user achievement of primary tasks. If users trust the service, they are more likely to follow its recommendations and believe that the service is helping them reach their desired goals. Hong (2006) showed that trust and expertise predicted intentions to visit health-related websites, and Fogg (2003) found that trustworthiness leverages the system's persuasive power, especially regarding persuasion delivered via the primary task support category features.	Halttu and Oinas-Kukkonen (2017)

steps. The most prominent dialogue support feature among the applications is feedback, which is delivered both in and on action (Ploderer et al. 2014). Depending on the features selected by the user, applications may also remind, praise or reward user actions. The credibility support category is mainly represented by surface

credibility evaluations of the overall reliability of the system. Polar, on their website, also makes references to their own research center. However, this information is not readily visible in the mobile application, making it difficult to assess if the application benefits from the trustworthiness and expertise principles of the

Table 2. Demographics.

		Frequency	Percent (%)
Gender	Female	88	59.9
	Male	59	40.1
Age	19–29	82	55.8
	30–39	40	27.2
	40–63	25	17.0
Service use time	novice users	42	28.6
	6–11 months	29	19.7
	12–24 months	37	25.2
	over 2 years	39	26.5
Employment status	Employee	66	44.9
	Student	76	51.7
	Other	5	3.4
	Licentiate	3	2.0
Highest completed education	Secondary school	27	18.4
	Polytechnic	7	4.8
	Bachelor's degree	44	29.9
	Master's degree	50	34.0
	Doctor's degree	16	10.9
	Licentiate	3	2.0

credibility category. All of the most-used applications have social support features, but all of them are fully functional without any social features.

In terms of persuasion strategies, all applications except for Polar Flow, which requires a wearable to function, implement reciprocation in the form of a free trial or entirely free service with an option to buy professional versions of the software. If the user chooses to utilize training plans, the applications present pre-prepared trainings and implement a form of time

scarcity by indicating that the trainings should be completed within a certain timeframe. All of the applications use expert recommendations in the form of famous sports experts in their marketing communication or in social media and therefore implement the authority principle. Also, each of the three implement the commitment strategy by offering a simple and easy-to-use way to inform others that they are using the application. If the user finds the application aesthetically pleasing and a good fit for their style, the liking principle is also in effect.

5. Data analysis and results

5.1. Descriptive statistics for susceptibility measures

All susceptibility scores showed a non-normal distribution when tested using Kolmogorov–Smirnov and Shapiro–Wilk tests of normality. The descriptive statistics of the susceptibility scores indicate that reciprocation and commitment had the highest values (Table 3).

Females rated higher in all principles. The scores also varied according to age group; in general, younger people had higher scores than older people across all principles. Significantly different distributions were detected for reciprocation, scarcity, and commitment (Kruskall-Wallis $X^2(2) = 7.386$, $p = 0.025$; $X^2(2) = 10.983$, $p = 0.004$; $X^2(2) = 9.348$, $p = 0.009$, respectively). For all of these principles, pairwise comparisons

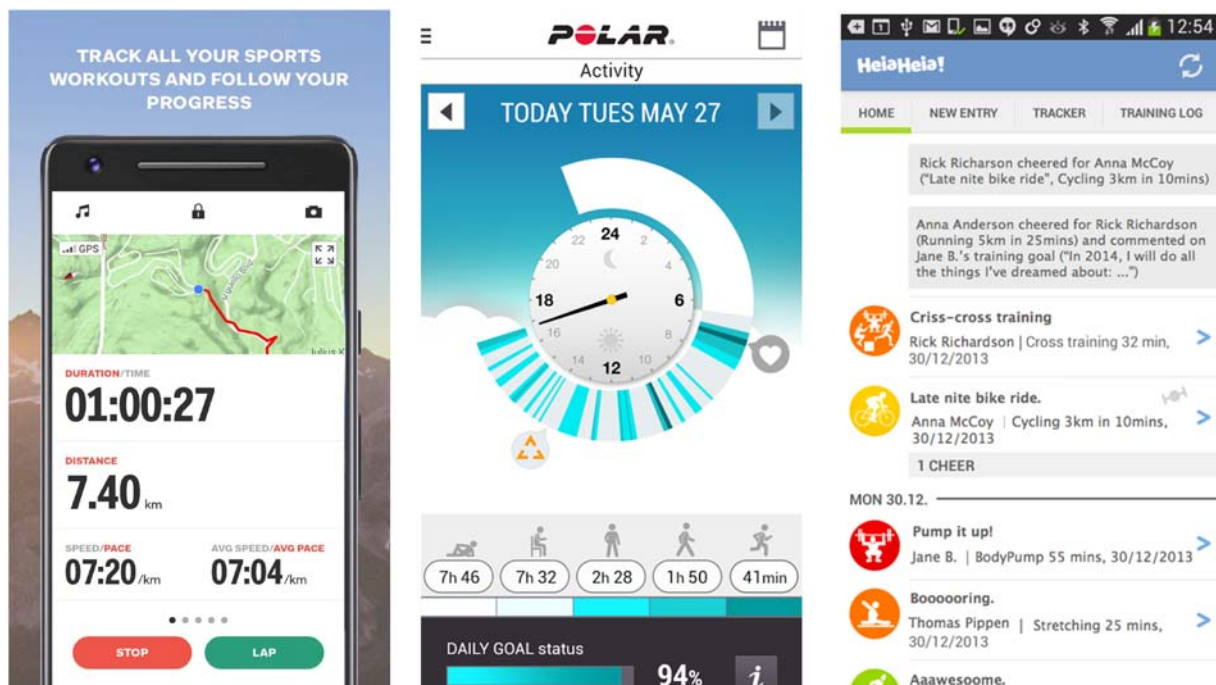


Figure 2. Screen captures from interfaces of Sports Tracker, Polar Flow and HeiaHeia.

Table 3. Overall susceptibility to persuasion strategies for the full sample, genders and age groups.

Group	Persuasion strategy					
	Reciprocation	Scarcity	Authority	Commitment	Consensus	Liking
Full	5.66	4.91	4.14	5.83	4.65	5.07
Female	5.80	5.01	4.20	5.88	4.83	5.21
Male	5.47	4.75	4.06	5.78	4.36	4.85
Use time	5.47	5.11	4.56	5.67	5.04	5.32
novice users	5.60	4.88	4.14	6.03	4.59	4.91
6–11 months	5.80	4.80	3.81	5.74	4.68	4.93
12–24 months	5.79	4.82	4.01	5.96	4.24	5.04
over 2 years	5.80	5.20	4.37	6.03	4.79	5.21
Age	5.69	4.81	4.06	5.76	4.61	5.05
–29	5.18	4.12	3.52	5.32	4.24	4.64
30–39						
40 -						

between the youngest and oldest groups were also significant. There were no differences in strategies based on length of use.

When respondents were assigned to groups according to the type of persuasion they rated the highest, 26% of all respondents were assigned to commitment, 16% to reciprocation and 12% had equally high scores for both reciprocation and commitment. For comparison, the most commonly implemented strategies—authority, consensus and scarcity—had the lowest scores, with 0.7%, 1.4% and 4.8% of the sample, respectively. To summarize, 54% of respondents self-reported high susceptibility to either reciprocation or commitment strategies.

Table 4. Correlations among susceptibility scores and PSD model constructs. From top to bottom of each cell: first full sample, then female and male.

	1.	2.	3.	4.	5.	6.
1. Reciprocation		.29**	.13	.47**	.26**	.26**
		.25*	.06	.44**	.15	.12
		.32*	.20	.51**	.36**	.45**
2. Scarcity			.36**	.16	.25**	.27**
			.41**	.05	.09	.32**
			.31*	.31*	.44**	.19
3. Authority				.21**	.34**	.32**
				.14	.28**	.25*
				.28*	.42**	.41**
4. Commitment					.18*	.31**
					.20	.31**
					.15	.31*
5. Consensus						.50**
						.43**
						.59**
6. Liking						
7. Design aesthetics	.08	.18*	.20*	.25**	.05	.17*
	-.09	.11	.07	.13	.00	.18
	.31*	.40**	.35**	.43**	.18	.15
8. Dialogue support	.18*	.08	-.02	.19*	.02	.13
	.25*	.05	-.16	.28**	.00	.12
	.05	.14	.20	.05	.02	.12
9. Perceived credibility	.36**	.17*	.09	.38**	0.12	.19*
	.33**	.07	.09	.43**	0.14	.29*
	.40**	.30*	.12	.31*	0.10	.05
10. Primary task support	0.32**	0.25**	.06	.26**	.16	.23**
	0.36**	0.27*	.02	.22*	.27*	.40**
	0.20	0.23	.06	.31*	-.05	-.05

Significant correlations are indicated with asterisks. (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$)

There were significant correlations between susceptibility scores and persuasive features of systems (Table 4). Reciprocation and commitment, scarcity and authority, and consensus and liking were strongly correlated, but liking and consensus were the only strategies that correlated with all others. Commitment strategy correlated with all PSD model constructs, authority correlated only with design aesthetics, and consensus did not correlate with any of the constructs. Of the studied features, dialogue support correlated only with reciprocation and commitment. Design aesthetics showed gender-specific differences regarding correlation with reciprocation, scarcity, authority and commitment. In all cases, males scored significant correlations and females did not.

The sample was divided, using visual binning function of SPSS software, into three groups that incorporated upper limit values. Note that this group formation is different from that used in the health promotion study that compared only the lowest- and highest-scoring quartiles and grouped all the principles under one general persuadability score (Kaptein, Lacroix, and Saini 2010). We used three equal-sized groups to ensure that each was sufficient size. Independent assessment of each persuasion strategy gives more practical relevance to design considerations and more theoretical relevance to the causes of differences.

Evaluations of several persuasive features were distributed unequally between persuadability groups. Each feature had higher scores than expected for the high persuadability group, meaning that persons who scored high in persuasive features often also scored high in persuadability. Table 5 presents the results of the Kruskal–Wallis test that was used to determine statistically significant differences between the three susceptibility groups (low, moderate, high) in the distribution of persuasive features. Perceived credibility and primary task support were most often unequally distributed, and reciprocation and commitment

Table 5. Kruskal-Wallis test results on distribution of persuasive features among three susceptibility groups (low, moderate, high) of persuasion strategies. The number is Kruskal-Wallis χ^2 value. Significantly different distributions among subgroups are indicated with asterisks (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).

Group	Persuasion strategy					
	Reciprocation	Scarcity	Authority	Commitment	Consensus	Liking
Design aesthetics				6.603*		
Dialogue support	6.104*					
Perceived credibility	17.356***			15.032**		6.986*
Primary task support	11.825**	9.147*		6.423*		

seemed to be most sensitive to persuasive features, as both were unequally distributed amongst four persuasive features.

5.2. Analysis of susceptibility among persuasive features

To understand in more detail if the differences in distribution among susceptibility groups are relevant to the design and evaluation of persuasive features in general, we used the research model presented in Figure 1 as a framework. The research model was analyzed using structural equation modelling with partial least squares (PLS-SEM), following the guidelines by Hair et al. (2014), and analyzed using SmartPLS software version 3.2.8 (Ringle, Wende, and Becker 2015). PLS-SEM analysis has two steps. First, the measurement model is analyzed by assessing the relationship of each indicator with its corresponding construct. Second, the hypothesized relationships between the constructs are evaluated.

5.3. Measurement model

Table 6 presents internal consistency values for the constructs in the measurement model. Internal consistency reliability was measured using composite reliability (CR) according to the recommendation of Hair et al. (2014). Composite reliability varies between 0 and 1; higher values indicate higher levels of reliability. Values

of 0.60–0.70 are acceptable in exploratory research, while, in the more advanced stages of research, values between 0.70 and 0.90 are generally regarded as satisfactory (Nunnally and Bernstein 1994). In our data, composite reliability values were acceptable for all constructs at the level of exploratory research, but we decided to remove consensus because, in addition to low CR, it had a low average variance extracted (AVE), which signals a low level of explained variance of its indicators (Hair et al. 2014). The discriminant validity of the constructs was assessed using a cross-loading matrix (available in Appendix B) and Fornell-Larcker analysis (Table 5). All of the indicators loaded onto their associated constructs.

5.4. Structural model and hypotheses testing

The research model was tested by defining the path coefficients and explained variances, and the predictive relevance of the constructs was also assessed. We used the complete bootstrapping method with 5,000 resamples and parallel processing with no sign changes. The confidence interval method was the two-tailed bias-corrected and accelerated (BCa) bootstrap (default setting). As suggested by previous research, all of the paths are statistically significant in a full sample without a moderator. The results of basic structural model evaluation are presented in the context of moderation analysis (see Table 6).

Table 6. Assessment of the constructs' internal consistency reliability using composite reliability (CR) and Cronbach's alpha (CA). Convergent reliability is demonstrated by average variance extracted (AVE). Fornell-Larcker analysis provides support for discriminant validity. The bolded values show the square roots of AVE and inter-construct correlations. CRED = Perceived credibility, DEA = Design aesthetics, DIAL = Dialogue support, PRIM = Primary task support.

	CR	AVE	1	2	3	4	5	6	7	8	9	10
1. CRED	0.897	0.686	0.829									
2. DEA	0.963	0.896	0.428	0.947								
3. DIAL	0.858	0.603	0.392	0.306	0.777							
4. PRIM	0.915	0.782	0.480	0.369	0.541	0.885						
5. authority	0.886	0.798	0.088	0.209	0.034	0.156	0.894					
6. commitment	0.861	0.758	0.382	0.261	0.204	0.294	0.210	0.878				
7. consensus	0.649	0.543	−0.002	−0.123	−0.087	−0.085	−0.072	0.036	0.630			
8. liking	0.826	0.703	0.230	0.258	0.175	0.297	0.373	0.371	0.094	0.839		
9. reciprocation	0.887	0.798	0.324	0.109	0.212	0.298	0.169	0.469	0.119	0.337	0.897	
10. scarcity	0.786	0.648	0.161	0.223	0.068	0.256	0.398	0.182	−0.028	0.302	0.269	0.805

5.4.1. Moderation analysis

We ran moderator tests with the full response scale as a continuous variable for all paths and persuasion strategies and used a product indicator approach with mean-centered product term generation. Table 7 presents all of the relevant measures of the structural model, including without any moderators and with each moderator. All except for one path of the research model was moderated by one or two strategies. Five out of six persuasion strategies had a statistically significant moderation effect with meaningful effect size, but effect sizes were always small. These interaction effects are presented as slope graphs in Appendix C. The majority of the moderation effects, whether significant or not, were negative, which means that susceptibility to a given strategy is detrimental to the basic relationship between the features of persuasive system design.

6. Discussion

The purpose of this study was to explore how Cialdini's six principles of social influence relate to constructs defined by the PSD model, a framework for building persuasiveness into software systems. As an outcome of that analysis, we hoped to understand which

principles, if any, show promise for leveraging the persuasiveness of these systems.

We found preliminary indications of variation in how individuals, who are susceptible to certain strategies, evaluate systems. Our targeted sample of mobile health and wellness application users presented self-reported susceptibility for influence strategies similar to those reported in previous research with more general samples, indicating that strategies are indeed highly generalizable in different populations. In the following, we further detail our analysis and discuss the results.

6.1. Susceptibility to influence strategies in the Finnish university sample

Our self-reported susceptibility scores for different social influence strategies are similar to those reported in other studies. For example, in a recent study by Oyibo et al. (2018) that used a different questionnaire, commitment and reciprocation were also the two highest scores for both the Nigerian and Canadian samples. The same was true of a Turkish sample (Alkiş and Taşkaya Temizel 2015), of a sample obtained by Mechanical Turk (Orji, Mandryk, and Vassileva 2015), and of an Austrian/German sample of participants suffering

Table 7. Results from hypothesis testing with structural equation modelling. Significant paths are indicated with asterisks (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Ns = non-significant. Effect sizes below 0.02 are considered too weak for theoretical or practical relevance. Effect size above 0.02 is considered small, above 0.15 medium and above 0.35 large effect. CRED = Perceived credibility, DEA = Design aesthetics, DIAL = Dialogue support, PRIM = Primary task support.

Hypothesis	Moderator	Path	<i>t</i> statistics	<i>f</i> ²	Hypothesis supported
H1: DIAL-PRIM	None	0.415***	4.514	0.232	Yes
	reciprocation	-0.064ns	0.835	0.032	
	scarcity	-0.051ns	1.373	0.042	
	authority	-0.079*	2.556	0.083	
	commitment	-0.055ns	0.743	0.031	
H2: DIAL-CRED	liking	-0.062ns	0.923	0.037	Yes
	none	0.293***	3.749	0.105	
	reciprocation	-0.032ns	0.517	0.006	
	scarcity	-0.041ns	0.673	0.021	
	authority	-0.038ns	0.66	0.016	
H3: DEA-DIAL	commitment	-0.075ns	0.935	0.038	Yes
	liking	0.05ns	0.684	0.019	
	none	0.307**	3.239	0.104	
	reciprocation	-0.073ns	1.089	0.017	
	scarcity	-0.033ns	0.417	0.006	
H4: DEA -> CRED	authority	-0.043ns	0.687	0.008	Yes
	commitment	-0.091ns	0.690	0.039	
	liking	-0.10*	2.091	0.039	
	none	0.34***	4.656	0.142	
	reciprocation	-0.016ns	0.211	0.001	
H5: CRED -> PRIM	scarcity	0.029ns	0.516	0.006	Yes
	authority	0.105*	2.172	0.06	
	commitment	0.047ns	0.711	0.011	
	liking	0.058ns	0.935	0.016	
	none	0.316***	4.137	0.135	
	reciprocation	-0.043ns	0.491	0.007	Yes
	scarcity	-0.081**	2.777	0.055	
	authority	-0.089ns	0.945	0.066	
	commitment	-0.132**	2.678	0.085	
	liking	-0.096ns	1.702	0.051	

from chronic obstructive pulmonary disease (COPD; Wais-Zechmann et al. 2018). Liking is the third strategy in all but the Nigerian sample, in which authority was third. Our sample contained mainly Finnish respondents, but, as we did not ask about nationality or ethnic background, we can only speculate based on the health and fitness services used (mainly Finnish companies) and on the names in the email addresses (collected to deliver a prize from a lottery).

Our results support previous studies in that self-reported susceptibility to influence strategies is highest for commitment and reciprocity. Further, excepting the Nigerian sample, liking was the third-highest susceptibility in all studies. Therefore, these are the three most stable strategies, and they might serve as excellent starting points when sketching persuasion profiles; using these will most likely not result in contra-tailored persuasive strategies that have low effectivity (Kaptein et al. 2012). The remaining three—scarcity, consensus and authority—exhibit more fluctuation in terms of self-reporting between the various studied samples. Scarcity and consensus both aim to spur users' decision-making: scarcity in terms of time or quantity limitations and consensus by prompting faster action through evaluation of peer behavior. These strategies need more fine-tuning but are probably influential when they fit the user's preferences and context.

The only existing study that reported gender and age differences in susceptibility scores is that of Orji, Mandryk, and Vassileva (2015), who found significantly different scores for reciprocity, commitment and consensus. Although the questions were the same as in our study, only scores for consensus and liking were statistically different between genders (Table 2). Further, in our sample, there were statistically significant differences among age groups; in general, persuadability scores tended to decrease with age. This finding contradicts previous results reported by Brown, Asher, and Cialdini (2005). However, it is worth remembering that our sample consisted of regular users of mobile health and fitness applications. Also, our sample was collected in a university setting. Both of these characteristics may have influenced our results in several ways. For example, the second question, which concerns authority, refers to a professor as a reliable source of information. While our sample was likely in the right context for that wording, it is possible that the question could also trigger a bias against the authority principle or against authority figures in general.

Our results on correlations between different influence strategies were somewhat similar to other studies that have reported results on Cialdini's strategies. Reciprocity and commitment had the strongest

correlation in our sample. Past studies have reported similar results (Alkiş and Taşkaya Temizel 2015; Wall et al. 2019), but our sample did not find a correlation between reciprocity and authority, which was comparatively strong in both of the studies mentioned above. However, similar to our results, a strong positive correlation between consensus and liking has been previously reported (Wall et al. 2019). Interestingly, statistically significant correlations were more often found among men. It is noteworthy that we used a smaller set of susceptibility questions than did the studies of Alkiş and Taşkaya Temizel (2015) and Wall et al. (2019), and instead of a general university sample, we have targeted our sampling towards users of mobile health and wellness apps. Either or both of these factors might explain the scoring differences.

6.2. Implications for persuasive systems design model

Preliminary correlation analysis comparing influence strategies to persuasive features implied that high susceptibility to social influence strategies also results in high scores for PSD model constructs. Similarly, there were significantly different distributions of all PSD constructs when they were analyzed against susceptibility groups. However, moderation analysis implied that susceptibility to influence strategies had adverse effects on some of the relationships between basic persuasive features, suggesting that the model itself represents, at least partly, a different type of persuasive feature than that manifested by social influence strategies. Perceived persuasiveness, as defined by Lehto, Oinas-Kukkonen, and Drozd (2012), is operationalized as favorable impressions towards the system. It is, therefore, considered to be an attitudinal construct. Persuadability, the 'tendency to comply with implementations of persuasive strategies' (Kaptein, Lacroix, and Saini 2010), primarily refers to behavioral outcomes (complying with a request, etc.). In this study, however, we treat susceptibility to influence strategies merely as traits that moderate how individuals evaluate the persuasive features of their systems and their systems overall.

Commitment strategy was positively correlated with all persuasive features of self-monitoring systems. This suggests that systems with self-monitoring functions that employ behavioral regulation approaches might be preferred by high-commitment individuals. However, commitment is the strongest susceptibility type in all studies, confirming that it is at the very least high among individuals who respond to research surveys similar to ours. Also, the tendency to comply with their past actions (to consider the system they

have selected still as a good choice) might also have an effect on evaluations of self-selected systems. Alternatively, selection of these self-help tools might itself be an indication of commitments and motivational levels; individuals that are not ready to make those commitments will not buy or use these types of tools.

All except for one path of our research model were moderated by at least one strategy. In general, however, the effect sizes were small, and our results should therefore be considered exploratory. Our results indicate that the relationships between PSD model constructs interact with susceptibility to influence strategies and that, as the path coefficients are negative, these variables usually weaken the strength of the relationship. Although our study setting is artificial and it evaluates each moderating variable separately, this result indicates that the basic relationships within the PSD model are, indeed, theoretical averages of the sample population. For example, the susceptibility to authority moderated two paths but, depending on the path, it either weakened (DIAL-PRIM) or strengthened (DEA-CRED) the relationship.

6.3. Implications for practice

Our results suggest that persuasive software features are experienced differently and with varying levels of susceptibility to influence strategies. Differing from previous research that has focused mainly on the strategies of scarcity, authority and consensus, we suggest that reciprocation and commitment could be utilized in health behavior change support systems. New ways to utilize these two correlating strategies could focus on creating interactions that twine together both of these strategies, the need to keep consistent with previous actions and the need to engage with the service in a reciprocating way. The functionality could be implemented, for example, with a combination of software features (e.g. reminders and suggestions) and content that frames the expected action as returning a favor or asking a favor.

Our results also imply that, on average, susceptibility to some strategies increase and some decrease the impact of persuasive features. Practitioners should pay attention to which strategies they employ: persuasion strategies can cause repulsion and, as our explorative results imply, some strategies decrease the relationships between persuasive features. Based on our results, the effects are small. Negative effects can sometimes happen when a system, through implementation of an influence strategy that triggers user elaboration, draws attention to something that is not aligned with the user's worldview or attitudes

and induces strong elaboration that may or may not end favorably for the system. The same applies to incorrect information and to weak arguments that threaten the credibility of the system. We suggest that influence strategies might be effective at drawing attention to messages in low-motivation situations. In these conditions, a well-placed influence strategy might be able to improve the total persuasiveness of the system.

As reciprocation and commitment are generally rather high in studied populations and seem to cause differences in how users evaluate system features, we suggest that those strategies are the most likely to leverage the persuasiveness of systems designed to facilitate health behavior change. In terms of other influence strategies, our findings are not as significant.

6.4. Limitations of the study

We collected our sample from users of several different physical-activity-related self-monitoring systems, which makes our study conceptual and the results explorative at best. Those results, overall, show small effect sizes, especially in moderation hypotheses, which is probably partly caused by system variance. We hypothesize that results would be stronger if the sample contained only one system. Our study also used constructs that measured the categories of the PSD model instead of developing constructs that would focus directly on specific principles, such as self-monitoring or reminders. This is another limitation in our data that might have introduced heterogeneity to responses and therefore decreased effect sizes.

While both of aforementioned issues are limitations, they also support our belief that the phenomena under study are robust and have implications for actual system design: by using system-specific measurement items with wordings that identify specific design principles, we expect more concrete and wider implications. However, both self-selected systems and self-selection to participate in this study introduce self-selection bias. Therefore, generalizability of our findings is restricted to similar contexts, i.e. the voluntary use of these systems. We anticipate that self-selection has influenced our results toward more positive experiences with the systems.

Our study is based on self-reported values; this is another limitation. There is some evidence that people behave rather consistently in terms of self-reported values related to persuasive principles (Kaptein et al. 2009, 2010). Therefore, we consider our self-reported results to be an adequate baseline for our purpose. Kaptein (2018) reported that operative measures

outperformed meta-judgmental measures in an online shopping context, and we want to emphasize that our results are, indeed, based on self-reported scores and that operative measures should be collected to evaluate the real practical value of our findings. It is worthwhile to note that most of the research on persuasion strategies has addressed compliance with marketing messages. It is not known how effectively these mechanisms might leverage influence in terms of healthy behaviors and long-term engagement.

Finally, the actual implementations of persuasion strategies are rare in current commercial systems. Therefore, it is difficult to evaluate if the user has actually used the functionality and exposed to relevant messages repeatedly. Our research approach aimed to explore if there are synergies between susceptibility to strategies as a general trait and different persuasive features often implemented in self-tracking systems as these concepts of persuasion are somewhat different.

6.5. Future research

This study is our first attempt to understand how the susceptibility to influence strategies organized by Cialdini might affect the persuasive features of systems and services. Future studies should more deeply investigate the features of persuasive systems (for example, dialogue support) as well as how and for whom different strategies (e.g. praise, feedback, goal setting and messaging) work in real products and with users with different persuasion profiles. As aforementioned, specific features are vectors for persuasive attempts. They provide insights into how systems are perceived in real-life settings.

We measured persuasive features at a level that is too general for the creation of specific design guidelines. For example, the dialogue support measurement items refer to praise (encouragement), rewards, feedback and reminders. From an application point of view, all of these should be measured individually to track which software features generate a given response. Instead of one dialogue support question, therefore, surveys should include full constructs for feedback through data visualizations, verbal encouragement and reminder characteristics. It is likely that these elements will have different effects; thus, to target the correct features, one must be able to track them individually. Additionally, commercial products often have several concurrent implementations that make it difficult to identify which actually caused the reaction (Kaptein et al. 2015). Due to these reasons, we have provided only high-level suggestions on how to derive relevant and practical implications from our work.

Any implementation of persuasion strategies in health and fitness applications should carefully monitor how the users interact with persuasion strategies by, for example, monitoring application logs. By collecting data on real-life systems, it is possible to understand in which contexts responses to persuasion attempts are somewhat consistent between users, which allows us to begin to recognize highly variable patterns. All of this information contributes to our understanding of contexts in which users elaborate on messages and those in which they are more distracted or otherwise unmotivated. Future studies on this topic will contribute to research on both dual-process theories and persuasion strategies.

Consumers are known to develop practices to avoid advertising (Fransen et al. 2015) and to recognize phishing emails (Parsons et al. 2019). Similarly, it is also probable that users of self-selected health behavior change support systems tend to create tactics to avoid and neglect messages and interactions that they feel are too obtrusive, cognitively challenging, dismissive or unsupportive in other ways. While systems should always be designed to avoid all of the aforementioned characteristics, it is possible that some influence mechanisms, in some contexts, might be considered coercion. Therefore, it is very important to understand which mechanisms are strongly influential and therefore prone to causing unintended negative consequences. Self-help tools have a high abandonment rate, and it is probable that negative experiences with influence tactics are at least partially responsible. Systems that utilize these powerful influential and persuasive elements must be carefully designed to also address ethics and the consumer experience.

7. Conclusions

This study contributes to the understanding of how susceptibility to social influence strategies interact with PSD model constructs that represent elements of persuasive systems. Influence strategies manifest both a strong level of consistency across studied populations and variation in evaluation of persuasive systems. These promising results imply that the strategies need to be studied at the level of specific system features and as operative measures in order to chart the ways that actual behaviors are affected by these strategies. However, interactions with system features were not straightforward. Due to their potential to support health behaviors, these strategies and their interactions deserve further study.

Declarations of interest

None.

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

- Alkiş, N., and T. Taşkaya Temizel. 2015. "The Impact of Individual Differences on Influence Strategies." *Personality and Individual Differences* 87: 147–152. doi:10.1016/j.paid.2015.07.037.
- Brown, S. L., T. Asher, and R. B. Cialdini. 2005. "Evidence of a Positive Relationship Between age and Preference for Consistency." *Journal of Research in Personality* 39 (5): 517–533. doi:10.1016/j.jrp.2004.07.001.
- Brynjarsdottir, H., M. Håkansson, J. Pierce, E. Baumer, C. DiSalvo, and P. Sengers. 2012, May. "Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 947–956. doi:10.1145/2207676.2208539.
- Cacioppo, J. T., R. E. Petty, F. K. Chuan, and R. Rodriguez. 1986. "Central and Peripheral Routes to Persuasion. An Individual Difference Perspective." *Journal of Personality and Social Psychology* 51: 1032–1043. doi:10.1037/0022-3514.51.5.1032.
- Cialdini, R. B. 2001. *Influence: Science and Practice*. 4th ed. Boston, MA: Allyn and Bacon.
- Cialdini, R. B., M. R. Trost, and J. T. Newsom. 1995. "Preference for Consistency: The Development of a Valid Measure and the Discovery of Surprising Behavioral Implications." *Journal of Personality and Social Psychology* 69 (2): 318–328. doi:10.1037/0022-3514.69.2.318.
- Cialdini, R. B., W. Wosinska, D. W. Barrett, J. Butner, and M. Gornik-Durose. 1999. "Compliance with a Request in two Cultures: The Differential Influence of Social Proof and Commitment/Consistency on Collectivists and Individualists." *Personality and Social Psychology Bulletin* 25 (10): 1242–1253. doi:10.1177/0146167299258006.
- de Vries, R. A. J., K. P. Truong, C. Zaga, J. Li, and V. Evers. 2017. "A Word of Advice: how to Tailor Motivational Text Messages Based on Behavior Change Theory to Personality and Gender." *Personal and Ubiquitous Computing* 21 (4): 675–687. doi:10.1007/s00779-017-1025-1.
- Diesendruck, G., W. C. Chiang, M. Ferera, and A. Benozio. 2019. "Cultural Differences in the Development of a Preference for Scarce Objects." *Developmental Psychology* 55 (1): 89–95. doi:10.1037/dev0000620.
- Dou, Q., X. S. Zheng, T. Sun, and P. A. Heng. 2019. "Webthetics: Quantifying Webpage Aesthetics with Deep Learning." *International Journal of Human Computer Studies* 124: 56–66. doi:10.1016/j.ijhcs.2018.11.006.
- Fogg, B. J. 2003. *Persuasive Technology: Using Computers to Change What we Think and do*. Amsterdam: Morgan Kaufmann Publishers.
- Fransen, M. L., P. W. J. Verlegh, A. Kirmani, and E. G. Smit. 2015. "A Typology of Consumer Strategies for Resisting Advertising, and a Review of Mechanisms for Countering Them." *International Journal of Advertising* 34 (1): 6–16. doi:10.1080/02650487.2014.995284.
- Garner, R. 2005. "What's in a Name? Persuasion Perhaps." *Journal of Consumer Psychology* 15 (2): 108–116.
- Hair, J. F., G. T. M. Hult, C. M. Ringle, and M. Sarstedt. 2014. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 1st ed. Thousand Oaks: Sage.
- Halttu, K., and H. Oinas-Kukkonen. 2017. "Persuading to Reflect: Role of Reflection and Insight in Persuasive Systems Design for Physical Health." *Human-Computer Interaction* 32 (5–6): 381–412. doi:10.1080/07370024.2017.1283227.
- Hamilton, R., D. Thompson, S. Bone, L. N. Chaplin, V. Griskevicius, K. Goldsmith, R. Hill, et al. 2019. "The Effects of Scarcity on Consumer Decision Journeys." *Journal of the Academy of Marketing Science* 47: 532–550. doi:10.1007/s11747-018-0604-7.
- Hong, T. 2006. "Contributing Factors to the use of Health-Related Websites." *Journal of Health Communication* 11 (2): 149–165. doi:10.1080/10810730500526679.
- Jang, W. E., Y. J. Ko, J. D. Morris, and Y. Chang. 2015. "Scarcity Message Effects on Consumption Behavior: Limited Edition Product Considerations." *Psychology and Marketing* 32 (10): 989–1001. doi:10.1002/mar.20836.
- John, M., A. P. Melis, D. Read, F. Rossano, and M. Tomasello. 2018. "The Preference for Scarcity: A Developmental and Comparative Perspective." *Psychology and Marketing* 35 (8): 603–615. doi:10.1002/mar.21109.
- Kaptein, M. 2018. "Customizing Persuasive Messages; the Value of Operative Measures." *Journal of Consumer Marketing* 35 (2): 208–217. doi:10.1108/JCM-11-2016-1996.
- Kaptein, M., B. De Ruyter, P. Markopoulos, and E. Aarts. 2012. "Adaptive Persuasive Systems: A Study of Tailored Persuasive Text Messages to Reduce Snacking." *ACM Transactions on Interactive Intelligent Systems* 2 (2): 1–25. doi:10.1145/2209310.2209313.
- Kaptein, M., S. Duplinsky, and P. Markopoulos. 2011, May. "Means Based Adaptive Persuasive Systems." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 335–344. doi:10.1145/1978942.1978990.
- Kaptein, M., and D. Eckles. 2010, June. "Selecting Effective Means to Any End: Futures and Ethics of Persuasion Profiling." In *Persuasive Technology*. PERSUASIVE 2010. Lecture Notes in Computer Science, Vol. 6137, edited by T. Ploug, P. Hasle, and H. Oinas-Kukkonen, 82–93. Berlin: Springer. doi:10.1007/978-3-642-13226-1_10.
- Kaptein, M., J. Lacroix, and P. Saini. 2010. "Individual Differences in Persuadability in the Health Promotion Domain." In *Persuasive Technology*. PERSUASIVE 2010. Lecture Notes in Computer Science, Vol. 6137, edited by T. Ploug, P. Hasle, and H. Oinas-Kukkonen, 94–105. Berlin: Springer. doi:10.1007/978-3-642-13226-1_11.
- Kaptein, M., P. Markopoulos, B. De Ruyter, and E. Aarts. 2009. "Can You Be Persuaded? Individual Differences in Susceptibility to Persuasion." In *Human-Computer Interaction*. INTERACT 2009. Lecture Notes in Computer Science, Vol. 5726, edited by T. Gross, J. Gulliksen, P. Kotzé, L. Oestreicher, P. Palanque, R. O. Prates, and M. Winckler, 115–118. Berlin: Springer. doi:10.1007/978-3-642-03655-2_13.
- Kaptein, M., P. Markopoulos, B. De Ruyter, and E. Aarts. 2015. "Personalizing Persuasive Technologies: Explicit and Implicit Personalization Using Persuasion Profiles." *International Journal of Human Computer Studies* 77: 38–51. doi:10.1016/j.ijhcs.2015.01.004.

- Kaptein, M., and A. Van Halteren. 2013. "Adaptive Persuasive Messaging to Increase Service Retention: Using Persuasion Profiles to Increase the Effectiveness of Email Reminders." *Personal and Ubiquitous Computing* 17: 1173–1185.
- Karppinen, P., H. Oinas-Kukkonen, T. Alahäivälä, T. Jokelainen, A. M. Keränen, T. Salonurmi, and M. Savolainen. 2016. "Persuasive User Experiences of a Health Behavior Change Support System: A 12-Month Study for Prevention of Metabolic Syndrome." *International Journal of Medical Informatics* 96: 51–61. doi:10.1016/j.ijmedinf.2016.02.005.
- Lee, S. A., and Y. (Jake) Liang. 2018. "Robotic Foot-in-the-Door: Using Sequential-Request Persuasive Strategies in Human-Robot Interaction." *Computers in Human Behavior* 90: 351–356. doi:10.1016/j.chb.2018.08.026.
- Lehto, T., and H. Oinas-Kukkonen. 2015. "Explaining and Predicting Perceived Effectiveness and use Continuance Intention of a Behaviour Change Support System for Weight Loss." *Behaviour and Information Technology* 34 (2): 176–189. doi:10.1080/0144929X.2013.866162.
- Lehto, T., H. Oinas-Kukkonen, and F. Drozd. 2012. "Factors Affecting Perceived Persuasiveness of a Behavior Change Support System." 33rd International Conference on Information Systems, Orlando, 1926–1939.
- Lehto, T., H. Oinas-Kukkonen, T. Pätäilä, and O. Saarelna. 2012. "Consumers' Perceptions of a Virtual Health Check: An Empirical Investigation." ECIS 2012 - Proceedings of the 20th European Conference on Information Systems. <https://aisel.aisnet.org/ecis2012/154>.
- Matthews, J., K. T. Win, H. Oinas-Kukkonen, and M. Freeman. 2016. "Persuasive Technology in Mobile Applications Promoting Physical Activity: A Systematic Review." *Journal of Medical Systems* 40 (3): 1–13. doi:10.1007/s10916-015-0425-x.
- Meedya, S., M. K. Sheikh, K. T. Win, and E. Halcomb. 2019. "Evaluation of Breastfeeding Mobile Health Applications Based on the Persuasive System Design Model." In *Persuasive Technology: Development of Persuasive and Behavior Change Support Systems*. PERSUASIVE 2019. Lecture Notes in Computer Science, Vol. 11433, edited by H. Oinas-Kukkonen, K. Win, E. Karapanos, P. Karppinen, and E. Kyza, 189–201. Cham: Springer. doi:10.1007/978-3-030-17287-9_16.
- Miron, A. M., and J. W. Brehm. 2006. "Reactance Theory - 40 Years Later." *Zeitschrift Für Sozialpsychologie* 37 (1): 9–18. doi:10.1024/0044-3514.37.1.9.
- Montoya, R. M., R. S. Horton, J. L. Vevea, M. Citkowitz, and E. A. Lauber. 2017. "A re-Examination of the Mere Exposure Effect: The Influence of Repeated Exposure on Recognition, Familiarity, and Liking." *Psychological Bulletin* 143 (5): 459–498. doi:10.1037/bul0000085.
- Nass, C., Y. Moon, B. J. Fogg, B. Reeves, and D. C. Dryer. 1995. "Can Computer Personalities be Human Personalities?" *International Journal of Human-Computer Studies* 43 (2): 223–239.
- Newby-Clark, I. R., I. McGregor, and M. P. Zanna. 2002. "Thinking and Caring About Cognitive Inconsistency: When and for Whom Does Attitudinal Ambivalence Feel Uncomfortable?" *Journal of Personality and Social Psychology* 82 (2): 157–166. doi:10.1037/0022-3514.82.2.157.
- Nunnally, J. C., and I. H. Bernstein. 1994. *Psychometric Theory*. 3rd ed. New York, NY: McGraw-Hill.
- Oinas-Kukkonen, H., and M. Harjumaa. 2009. "Persuasive Systems Design: Key Issues, Process Model, and System Features." *Communications of the Association for Information Systems* 24 (1): 485–500. doi:10.17705/1cais.02428.
- Orji, R., D. Reilly, K. Oyibo, and F. A. Orji. 2019. "Deconstructing Persuasiveness of Strategies in Behaviour Change Systems Using the ARCS Model of Motivation." *Behaviour and Information Technology* 38 (4): 319–335. doi:10.1080/0144929X.2018.1520302.
- Orji, R., R. L. Mandryk, and J. Vassileva. 2015, June. "Gender, Age, and Responsiveness to Cialdini's Persuasion Strategies." In *Persuasive Technology*. PERSUASIVE 2015. Lecture Notes in Computer Science, Vol. 9072, edited by T. MacTavish and S. Basapur, 147–159. Cham: Springer. doi:10.1007/978-3-319-20306-5_14.
- Oyibo, K., I. Adaji, R. Orji, and J. Vassileva. 2018. "What Drives the Perceived Credibility of Mobile Websites: Classical or Expressive Aesthetics?" In *Human-Computer Interaction. Interaction in Context*. HCI 2018. Lecture Notes in Computer Science, Vol. 10902, edited by M. Kurosu, 576–594. Cham: Springer. doi:10.1007/978-3-319-91244-8_45.
- Parsons, K., M. Butavicius, P. Delfabbro, and M. Lillie. 2019. "Predicting Susceptibility to Social Influence in Phishing Emails." *International Journal of Human Computer Studies* 128 (July 2018): 17–26. doi:10.1016/j.ijhcs.2019.02.007.
- Petty, R. E., J. Barden, and S. C. Wheeler. 2009. "The Elaboration Likelihood Model of Persuasion: Developing Health Promotions for Sustained Behavioral Change." In *Emerging Theories in Health Promotion Practice and Research*. 2nd ed., edited by R. J. DiClemente, R. A. Crosby, and M. Kegler, 185–214. San Francisco, CA: Jossey-Bass.
- Petty, R. E., and J. T. Cacioppo. 1986. *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*. 1st ed. New York, NY: Springer-Verlag.
- Petty, R. E., and D. T. Wegener. 1999. "The Elaboration Likelihood Model: Current Status and Controversies." In *Dual-Process Theories in Social Psychology*, edited by S. Chaiken and Y. Trope, 37–72. New York, NY: Guilford Press.
- Ploderer, B., W. Reitberger, H. Oinas-Kukkonen, and J. van Gemert-Pijnen. 2014. "Social Interaction and Reflection for Behaviour Change." *Personal and Ubiquitous Computing* 18 (7): 1667–1676. doi:10.1007/s00779-014-0779-y.
- Reinecke, K., T. Yeh, L. Miratrix, R. Mardiko, Y. Zhao, J. Liu, and K. Z. Gajos. 2013. "Predicting Users' First Impressions of Website Aesthetics With A Quantification of Perceived Visual Complexity And Colorfulness." In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI 13, 2049. <https://doi.org/10.1145/2470654.2481281>.
- Ringle, C. M., S. Wende, and J.-M. Becker. 2015. *SmartPLS Release: 3*. Boenningstedt: SmartPLS GmbH.
- Robins, D., and J. Holmes. 2008. "Aesthetics and Credibility in web Site Design." *Information Processing and Management* 44 (1): 386–399. doi:10.1016/j.ipm.2007.02.003.

- Ruijten, P. A. M. 2021. “The Similarity-Attraction Paradigm in Persuasive Technology: Effects of System and User Personality on Evaluations and Persuasiveness of an Interactive System.” *Behaviour and Information Technology* 40 (8): 734–746. doi:10.1080/0144929X.2020.1723701.
- Sallis, A., H. Harper, and M. Sanders. 2018. “Effect of Persuasive Messages on National Health Service Organ Donor Registrations: a Pragmatic Quasi-Randomised Controlled Trial with one Million UK Road Taxpayers.” *Trials* 19 (1): 1–10. doi:10.1186/s13063-018-2855-5.
- Shevchuk, N., and H. Oinas-Kukkonen. 2019. “Influence on Intention to Adopt Green IS: Boosting Endogenous Motivations with Persuasive Systems Design.” *Proceedings of the 52nd Hawaii International Conference on System Sciences* 6: 2055–2064. doi:10.24251/hicss.2019.249.
- Shin, D. H., S. Lee, and Y. Hwang. 2017. “How do Credibility and Utility Play in the User Experience of Health Informatics Services?” *Computers in Human Behavior* 67: 292–302. doi:10.1016/j.chb.2016.11.007.
- Simons, H. W., J. Morreale, and B. E. Gronbeck. 2001. *Persuasion in Society*. Thousand Oaks, CA: Sage Publications.
- Sonderregger, A., G. Zbinden, A. Uebelbacher, and J. Sauer. 2012. “The Influence of Product Aesthetics and Usability Over the Course of Time: A Longitudinal Field Experiment.” *Ergonomics* 55 (7): 713–730. doi:10.1080/00140139.2012.672658.
- Teerinemi, A. M., T. Salonurmi, T. Jokelainen, H. Vähänikkilä, T. Alahäivälä, P. Karppinen, H. Enwald, et al. 2018. “A Randomized Clinical Trial of the Effectiveness of a Web-Based Health Behaviour Change Support System and Group Lifestyle Counselling on Body Weight Loss in Overweight and Obese Subjects: 2-Year Outcomes.” *Journal of Internal Medicine* 284 (5): 534–545. doi:10.1111/joim.12802.
- Wais-Zechmann, B., V. Gattol, K. Neureiter, R. Orji, and M. Tscheligi. 2018, April. “Persuasive Technology to Support Chronic Health Conditions: Investigating the Optimal Persuasive Strategies for Persons with COPD.” In *Persuasive Technology*. PERSUASIVE 2018. Lecture Notes in Computer Science, Vol. 10809, edited by J. Ham, E. Karapanos, P. Morita, and C. Burns, 255–266. Cham: Springer. doi:10.1007/978-3-319-78978-1_21.
- Wall, H. J., C. C. Campbell, L. K. Kaye, A. Levy, and N. Bhullar. 2019. “Personality Profiles and Persuasion: An Exploratory Study Investigating the Role of the Big-5, Type D Personality and the Dark Triad on Susceptibility to Persuasion.” *Personality and Individual Differences* 139 (November 2018): 69–76. doi:10.1016/j.paid.2018.11.003.
- Wathen, C. N., and J. Burkell. 2002. “Believe it or not: Factors Influencing Credibility on the Web.” *Journal of the American Society for Information Science and Technology* 53 (2): 134–144. doi:10.1002/asi.10016.
- Whittler, T. E., and C. Manolis. 2015. “Toward Understanding Persuasion Expressions: The Activation of Attitudes.” *Psychology and Marketing* 32 (8): 874–890. doi:10.1002/mar.20824.
- Xiong, X., S. Guo, L. Gu, R. Huang, and X. Zhou. 2018. “Reciprocity Anxiety: Individual Differences in Feeling Discomfort in Reciprocity Situations.” *Journal of Economic Psychology* 67 (August 2017): 149–161. doi:10.1016/j.joep.2018.05.007.
- Zajonc, R. B. 2001. “Mere Exposure: A Gateway to the Subliminal.” *Current Directions in Psychological Science* 10 (6): 224–228. doi:10.1111/1467-8721.00154.

Appendices

Appendix A. Measurement items for constructs used in this study and their original sources

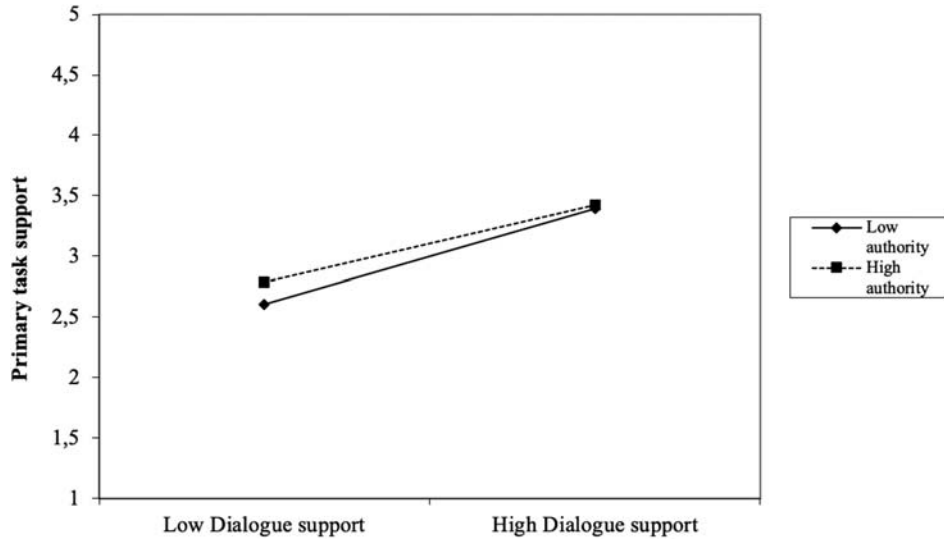
Constructs	Items	Source
Design aesthetics	The screen in the service (i.e. colors, layout, presenters, etc.) is attractive The general appearance of the service is appealing	Lehto, Oinas-Kukkonen, and Drozd (2012)
Dialogue support	The service provides a nice visual experience The service encourages me The service rewards me The service provides me with appropriate feedback The service provides me with reminders for reaching my personal goals	Lehto and Oinas-Kukkonen (2015)
Perceived credibility	The service is trustworthy The service is reliable The service shows expertise The service instills confidence in me	Lehto, Oinas-Kukkonen, and Drozd (2012)
Primary task support	The service makes it easier for me to reach my goals The service helps me in reaching my goals gradually The service helps me in keeping track of my progress	Lehto, Oinas-Kukkonen, and Drozd (2012)

Reciprocation	When a family member does me a favor, I am very inclined to return this favor	Kaptein et al. (2009)
Scarcity	I always pay back a favor I believe rare products are more valuable than mass products When my favorite shop is about to close, I would visit it since it is my last chance	
Authority	I always follow advice from my general practitioner	
Commitment	When a professor tells me something I believe it is true Whenever I commit to an appointment I do as I told	
Consensus/Social proof	I try to do everything I have promised to do If someone from my social network notifies me about a good book, I tend to read it	
Liking	When I am in a new situation I look at others to see what I should do I accept advice from my social network When I like someone, I am more inclined to believe him or her	

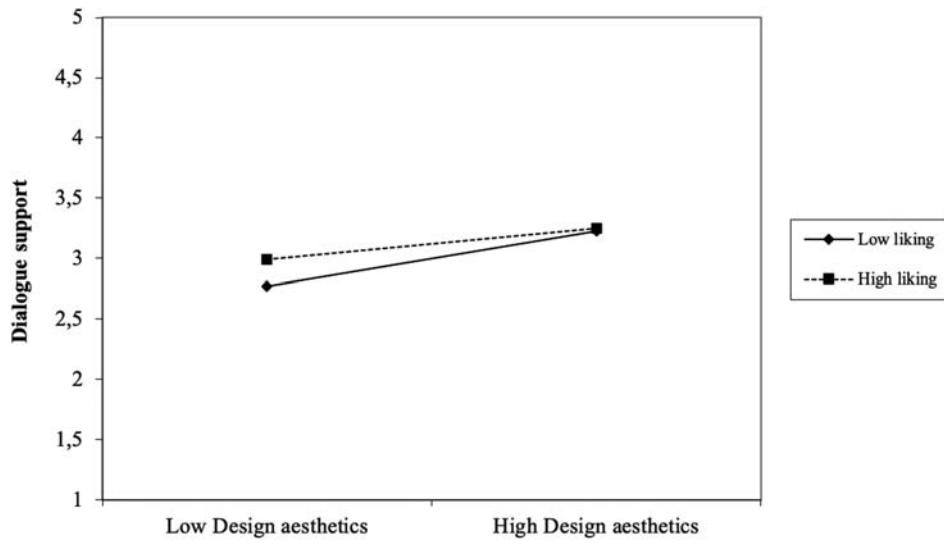
Appendix B. Cross-loadings for measurement items

	CRED	DEA	DIAL	PRIM	authority	commitment	consensus	liking	reciprocation	scarcity
CRED1	0.838	0.341	0.219	0.410	0.052	0.304	-0.001	0.191	0.267	0.151
CRED2	0.840	0.280	0.162	0.383	0.081	0.297	0.046	0.122	0.223	0.128
CRED3	0.827	0.355	0.399	0.359	0.008	0.301	0.052	0.138	0.325	0.123
CRED4	0.812	0.420	0.467	0.430	0.140	0.324	-0.083	0.285	0.254	0.132
DEA1	0.394	0.940	0.247	0.371	0.221	0.172	-0.107	0.230	0.065	0.225
DEA2	0.438	0.962	0.288	0.352	0.183	0.286	-0.133	0.265	0.148	0.216
DEA3	0.382	0.938	0.333	0.327	0.190	0.278	-0.107	0.236	0.091	0.194
DIAL1	0.386	0.333	0.830	0.591	0.023	0.251	-0.066	0.206	0.229	0.093
DIAL2	0.229	0.240	0.804	0.331	0.233	0.139	-0.088	0.223	0.127	0.084
DIAL3	0.289	0.169	0.757	0.361	-0.082	0.133	-0.074	0.065	0.167	-0.049
DIAL4	0.271	0.152	0.711	0.293	-0.068	0.048	-0.046	0.002	0.090	0.067
PRIM1	0.393	0.338	0.504	0.893	0.147	0.231	-0.138	0.288	0.244	0.242
PRIM2	0.413	0.329	0.512	0.931	0.132	0.234	-0.062	0.280	0.223	0.175
PRIM3	0.471	0.311	0.414	0.826	0.135	0.321	-0.021	0.217	0.330	0.266
Auth1	0.099	0.206	0.062	0.170	0.982	0.226	-0.104	0.361	0.177	0.374
Auth2	0.031	0.164	-0.065	0.068	0.795	0.103	0.049	0.316	0.097	0.372
Com1	0.296	0.297	0.246	0.322	0.255	0.849	-0.093	0.306	0.364	0.129
Com2	0.369	0.177	0.127	0.209	0.129	0.906	0.133	0.342	0.453	0.185
Cons1	0.084	0.139	0.043	0.152	0.374	0.148	-0.406	0.427	0.182	0.259
Cons2	0.054	-0.038	-0.064	0.011	0.173	0.137	0.793	0.384	0.248	0.143
Lik1	0.133	0.144	0.035	0.220	0.316	0.267	0.174	0.800	0.226	0.192
Lik2	0.242	0.276	0.238	0.274	0.313	0.348	0.003	0.876	0.330	0.304
Rec1	0.285	0.075	0.213	0.290	0.096	0.350	0.100	0.367	0.926	0.221
Rec2	0.301	0.128	0.161	0.240	0.225	0.518	0.116	0.220	0.867	0.270
Scar1	0.140	0.165	0.062	0.239	0.270	0.117	-0.010	0.194	0.204	0.771
Scar2	0.122	0.193	0.048	0.179	0.365	0.172	-0.033	0.286	0.228	0.838

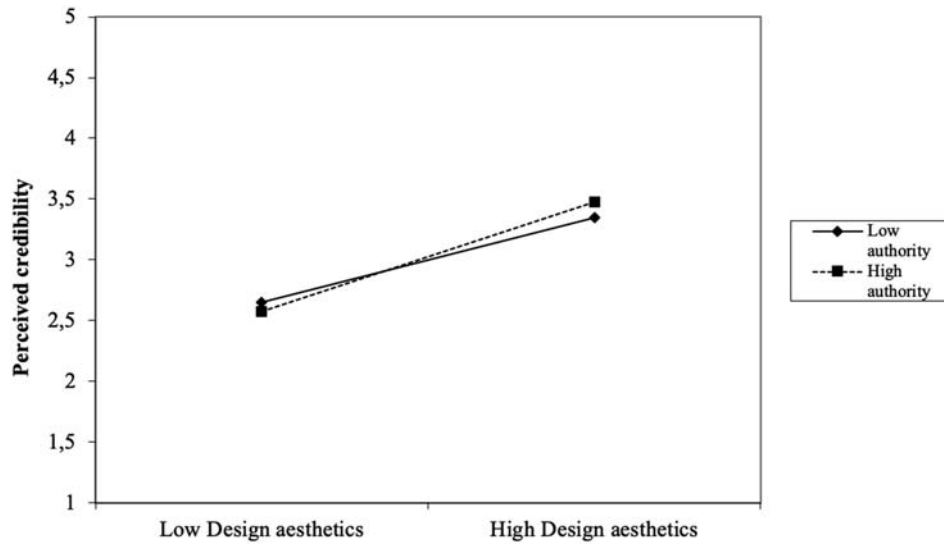
Appendix C. Interaction effects presented as simple slopes



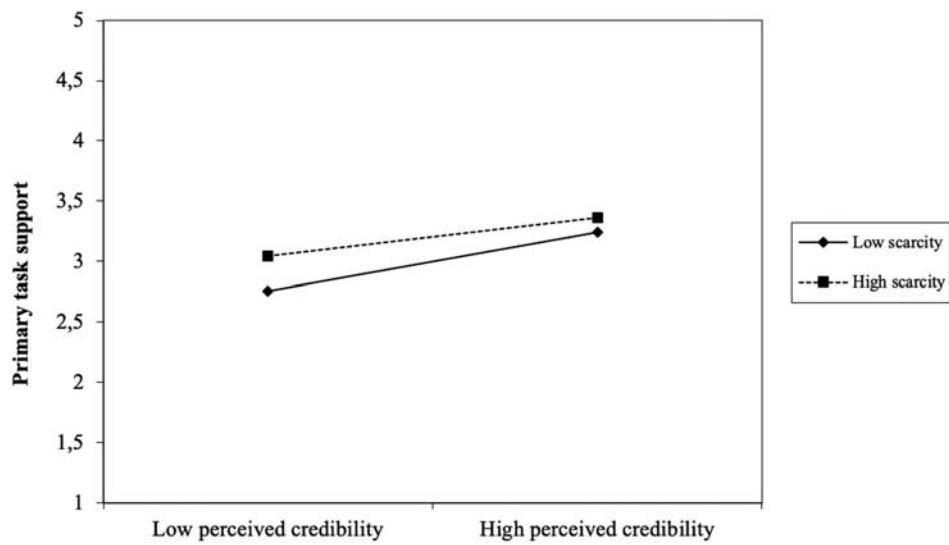
Dialogue supports effect to primary task support moderated by authority strategy.



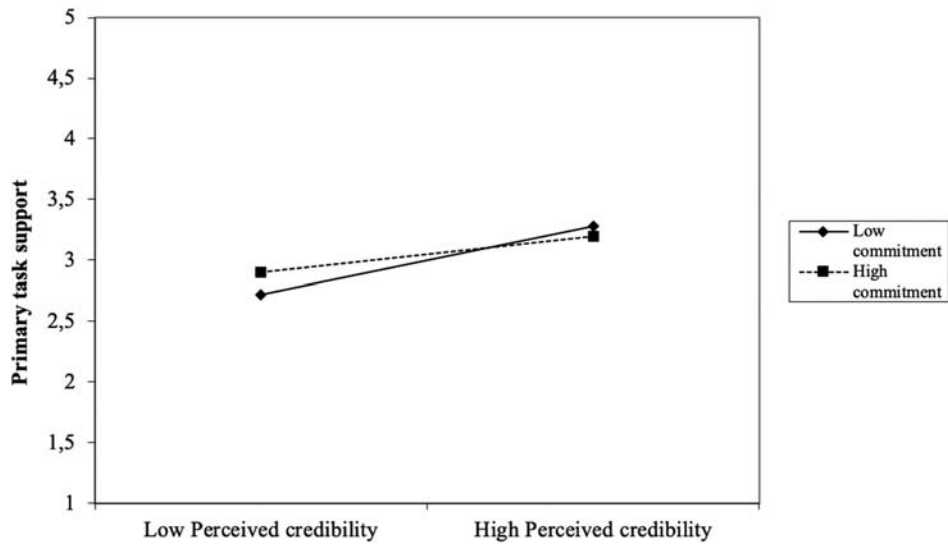
Design aesthetics effect to Dialogue support moderated by consensus strategy.



Design aesthetics effect to Perceived credibility moderated by authority strategy.



Perceived credibility's effect Primary task support moderated by scarcity strategy.



Perceived credibility's effect Primary task support moderated by commitment strategy.