
Persuasive Technology

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Abstract

Since long, persuasion, or exerting influence, has been associated with certain professions such as sales people, therapists, coaches, and teachers. Recent technological developments create the possibility of using computers as persuasive instruments, as a means to elicit specific (desired) behavior, which paves the way for novel, intelligent systems that support the empowerment of seniors.

Behavior is explained as a combination of motivation, ability, and opportunity. A number of persuasive strategies can be applied to entice people to perform specific behavior, for instance commitment, social proof, and authority.

Smart homes are equipped with various kinds of sensors, actuators, and intelligent software, integrated in furniture, walls, and everyday objects. This enables people to be interconnected always and everywhere. Computers are able

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to recognize what people are doing, and in case the observed behavior deviates from the normal pattern, family members or an emergency service can automatically be warned. In this way, smart homes are excellent contexts for persuasive technology.

Energy saving and health are the two dominant application domains for persuasive systems in smart home environments. Current research and development projects are often in the experimental phase, implementing and evaluating only prototype systems. Extensive user studies providing a detailed account of the effect of an implemented persuasive system on people's behavior are therefore scarce. Challenges to be addressed in future research on persuasive technology in smart home contexts are related to the evaluation of the effectiveness of persuasive systems, the acceptance and adoption of these systems, and the ethical considerations.

Keywords

Persuasion • Motivation • Behavior change • Persuasive technology • Smart homes

Introduction

Since long, persuasion, or exerting influence, has been associated with certain professions such as sales people, therapists, coaches, and teachers. Recent technological developments create the possibility of using computers as persuasive instruments, as a means to elicit specific (desired) behavior. Smart homes are equipped with sensors that can record the behavior of people, with smart algorithms that can analyze and interpret sensor data, and with intelligent everyday objects that are wirelessly connected. These technical capabilities provide excellent opportunities to influence the behavior and attitude of people. In this way, technology can play an important part in encouraging healthy behavior (e.g., getting sufficient physical activity, taking medicine on time, training cognitive skills) or other desired behavior (social participation, energy saving). From a societal perspective, persuasive technology supports the empowerment of seniors, enabling them to live independently for as long as possible. From an economic perspective, persuasive technology holds the promise of reducing the costs of the healthcare system.

The Basics of Persuasion

Persuasion can be defined as an attempt to change attitudes or behaviors or both (without using coercion or deception) (Fogg 2002). Persuasion is different from conviction: where conviction relies on strategies rooted in logical proof and therefore appeals to people's reason and intelligence, persuasion relies primarily on strategies that trigger people's emotions (Oinas-Kukkonen and Harjumaa 2008).

In this chapter we focus on behavior change (i.e., changing how people act) rather than attitude change (i.e., changing the way people feel about something). Attitude may be really hard to change as it has to do with values and emotions. Moreover, attitudes do not always predict behavior. And, the other way around, behavior change does not always require an attitude change. Finally, it is easier to change attitude when the behavior change occurs first (Oinas-Kukkonen and Harjumaa 2009). In order to understand behavior change, we first need to understand behavior.

A Model of Behavior

Researchers in various disciplines (for instance from psychology, marketing, consumer behavior, information systems, etc.) have addressed the question which factors determine behavior. Most of the theories about behavior agree that whether or not certain behavior is performed is determined by three factors (see Fig. 1): motivation or intention, ability, and opportunity (Hughes 2007; Ölander and Thøgersen 1995; Fogg 2002; Deterding 2012). Ability and opportunity can be considered moderating factors on the connection between motivation and behavior: ability and opportunity influence how motivation leads to certain behavior.

Motivation (Does a person want to do it?) is a result of the fulfillment of various sorts of human needs: physiological needs (such as basic needs for food, water, and safety), social needs (such as power, belonging, and recognition), and psychological needs (such as needs for relatedness, autonomy, and competence (Ryan and Deci 2000)).

Fig. 1 Behavior is influenced by motivation, ability, and opportunity (From NBS.net)



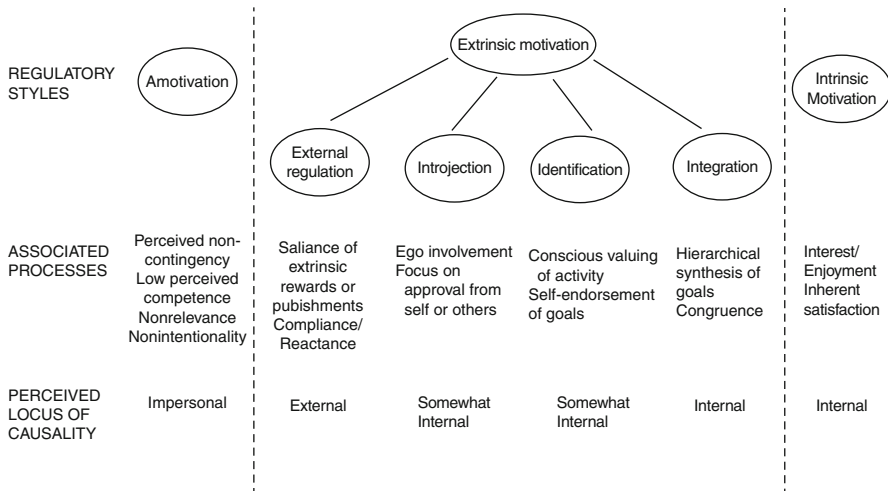


Fig. 2 A taxonomy of human motivation (From Ryan and Deci 2000)

Two types of motivation can be distinguished: intrinsic and extrinsic motivation; see Fig. 2 (Ryan and Deci 2000). Intrinsic motivation entails doing something because it is inherently enjoying or interesting. Intrinsic motivation is very closely related to the values that a person has and the things that he/she likes. Extrinsic motivation refers to doing something because it leads to a specific outcome; in other words, a person is doing something for its instrumental value. There are multiple levels of external motivation, differing in the extent to which a person has internalized the reasons for performing the behavior. External motivation ranges from unwillingness (low motivation) to active personal commitment (high motivation). Intrinsic motivation increases if internal human needs (for instance for autonomy or competence) are satisfied. External motivators, such as rewards or other less tangible things such as deadlines or fines, should be used carefully because they may undermine intrinsic motivation (Ryan and Deci 2000).

Ability (Is a person capable of doing it?). To be able to perform behavior, people need to know how to do it, they must have the right skills, and they have to believe that they are able to perform the behavior (self-efficacy, confidence). Also, they have to have willpower. They must be capable of taking the decision to perform the behavior. Habits and the presence of social support are important prerequisites for certain behavior to occur as well. And they have to get the right social support for doing so. Finally, they must be able to afford performing the behavior if costs are involved.

Opportunity (Does a person have the chance to do it?). People should have sufficient resources and relationships and the right environmental conditions to be able to perform the desired behavior. Moreover, opportune moments need to occur for the behavior to actually take place. If motivation is high and ability is provided for, creating an opportunity will make people really take the step to perform the behavior.

In sum, certain behavior occurs when people are motivated and able to perform the behavior and when they have the opportunity. If one of these conditions is lacking, the desired behavior may not occur. For instance, someone who wants to run every day, knows how to run, but doesn't have access to running shoes will find it hard to start running. Or someone who wants to reduce her energy consumption, has an intelligent thermostat, but doesn't know how to use it will have difficulty achieving his or her goals. Changing behavior thus entails increasing motivation, improving ability, and/or creating opportunities. Improving ability and creating opportunities are rather straightforward. Increasing motivation is much harder to accomplish. One way is to provide people with information to convince them of the necessity and benefits of the target behavior (or the negative effects in case of bad behavior need to be reduced). Another way is to make the behavior itself more fun, more interesting, or more challenging. This may be more effective, because it increases the intrinsic motivation of people to perform the behavior. Finally, motivation can be increased by using principles of persuasion that have long been used in many disciplines, such as marketing, therapy, education, etc.

Persuasive Strategies

Cialdini (2009) describes six persuasive principles that are commonly used (by for instance marketers, therapists, or teachers) to persuade people to start, increase, or decrease certain behavior.

Reciprocation: People are inclined (or even feel obliged) to repay, in kind, what a person has given them. If someone (or even a computer) does something for you, you feel obliged to repay. Reciprocity is a very powerful principle and one that is hard to resist.

Commitment and Consistency: Once we have taken a certain decision or standpoint, we will commit to this as much as possible, so as to maintain consistency. The commitment strategy is often applied in the form of goal setting. When people set their own goals, for instance in terms of the number of steps they aim to take every day, and personally write their goals down, they will most likely commit themselves to these goals and actually try to reach them. This effect is even larger if the goals are effortful and publicly visible.

Social Proof: What people determine to be correct behavior is dependent on what other people consider to be correct behavior. Even more powerful is the notion of similarity: people are inclined to follow the behavior of similar other people or people they like or admire. The principle of social proof can be observed in persuasive systems showing for instance who else is using the system and how they perform. The use of social proof as a persuasive technique has taken off since the rise of social media.

Liking: People are more inclined to follow the request of someone they know and like (on the basis of physical attractiveness, similarity, compliments, familiarity, cooperation). This principle can be observed in persuasive systems using a personalized avatar that shows resemblance to the person using the system.

Authority: People tend to follow a request if the request comes from authorities. This principle can be observed on many websites that have a quality label and in advertisements in which medical doctors or scientists recommend a particular health-related product.

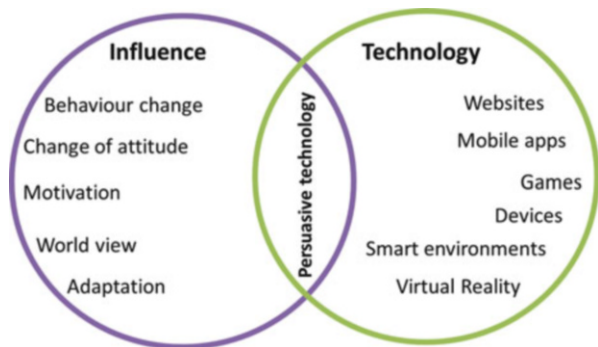
Scarcity: Opportunities seem more valuable to people when their availability is limited. The notion of competition is important in relation to scarcity: the feeling of being in competition for some scarce good has large motivating capabilities.

Persuasive Technology

Recent technological advancements, such as the miniaturization of computer chips and the widespread availability of wireless connectivity, ensure that smart technology is becoming increasingly integrated in people’s everyday life. Today a large proportion of the population (including elderly) uses a smartphone or tablet computer. In addition, many household appliances have become intelligent (for instance, the washing machine and the thermostat). Smart homes are equipped with all kinds of sensors, actuators, and intelligent software, integrated in furniture, walls, and everyday objects. Modern technology enables people to be interconnected always and everywhere. Computers are able to recognize what people are doing, and in case the observed behavior deviates from the normal pattern, family members or an emergency service can automatically be warned. In this way, computers have become excellent instruments for persuading people to perform specific behavior. Using computers to exert influence is called persuasive technology (see Fig. 3).

Using technology for persuasion has several advantages. In smart homes technology is omnipresent and can always be on, so that persuasive feedback can be provided at the most opportune moment (e.g., when people have been sitting in their chair for a couple of hours, but not when they have just received visitors). Moreover, the persuasive message can be given using the most appropriate modality (voice, sound, a movie, a simulation, etc.). Also, unlike humans, computers do not become frustrated or impatient when somebody needs to be reminded of the desired behavior several times a day. Finally, technology is anonymous, which makes it easier for people to ask for help and to try out new, unfamiliar behavior.

Fig. 3 Persuasive technology as a combination of influence strategies and technology (Adapted from Fogg 2002)



Roles

Persuasive technology can take on different roles. First of all, technology can be used as a persuasive *tool*, making certain behavior easier, more efficient, or more feasible to do. Examples of persuasive tools are a personal device that reminds people at the right moment to take their medication or a step counter that provides people with motivating measurements of their performance. Technology can also take on the role of persuasive *medium*, an instrument that provides a persuasive message in such a way that it motivates people: for instance, simulations and interactive experiences, which give people the opportunity to practice and to experience the effect of their behavior. Finally, technology can be used as a *social actor*, someone who gives compliments or motivational feedback, who provides reminders, who does suggestions, etc. In the role of a social actor, technology can have an animate appearance (e.g., an avatar), play an animated role (e.g., as a coach), or follow social rules such as politeness and turn-taking. In practice, persuasive systems will usually have more than one role (for instance a coaching system that provides insight into the user's performance, but also gives motivating feedback at opportune moments and connects the user with other users for social support).

Design Considerations

When designing persuasive systems the following issues need to be taken into consideration. Influence is not a single action, but an incremental process. Therefore, persuasive systems should support small, achievable, incremental steps, rather than trying to reach the target behavior in one giant leap. It is important that the ultimate goal should always remain clear to the user. Commitment is a very effective and powerful persuasive instrument, which should be designed for, for instance by making people set their goals and make them public. Persuasive systems should be as unobtrusive as possible and take action only at opportune moments. Finally, like interactive systems in general, persuasive systems should be useful and easy to use (e.g., error-free, providing adequate help, creating a nice user experience) (Oinas-Kukkonen and Harjumaa 2008; Fogg 2009a, b).

Persuasive Systems in Smart Homes

State of the Art

The advanced technology that is integrated in smart homes offers excellent opportunities for deploying persuasive systems. For instance, small, pervasive sensors, that are placed throughout the home, in walls, furniture, and daily objects, are able to monitor people throughout the day in an unobtrusive way. Intelligent algorithms are able to interpret the data coming from this sensor network in order to deduce a person's activities. By looking for patterns and recognizing deviations from these patterns, smart devices can adapt to the user's changing capabilities and changing

stages of behavior change. Context awareness and real-time information exchange enable delivery of the right persuasive message at the most opportune moment and in an appropriate form (Chatterjee and Price 2009).

Persuasive technology is a relatively new phenomenon, especially in the context of smart homes. As a consequence, research and development projects are often in the experimental phase, implementing and evaluating only prototype systems. Extensive user studies providing a detailed account of the effect of an implemented persuasive system on people's behavior are scarce. To date, energy saving and health are the two dominant application domains for persuasive systems in smart home environments. Most health-related projects are aimed at supporting people to live independently for as long as possible. Applications in this domain include systems for self-management of diseases, for instance dealing with diabetes (Chatterjee et al. 2012) and medication compliance (De Oliveira et al. 2010). In addition, quite a large number of applications focus on stimulating physical activity, for instance by means of accelerometers that are linked to an app or in the form of exercise games (Vankipuram et al. 2012; Albaina et al. 2009). Finally, social interaction and the prevention of isolation and loneliness are frequently addressed (Romero et al. 2010; Vargheese et al. 2013).

In general, existing projects often use relatively simple technology, such as mobile phones, accelerometers, single sensors, etc. Few projects make use of complex sensor networks in combination with intelligent data processing algorithms. Overall, the technological capabilities that the smart home context offers are not yet fully exploited. In some projects existing hardware is used (for instance, a tablet computer or television set), whereas in other projects dedicated hardware is developed that fits more easily into people's daily life, without becoming obtrusive. In current systems persuasive technology takes on different roles, both as a social actor (for instance virtual coaches or socially assistive robots) and as a tool (for instance a reminder of medication). Persuasive principles that are commonly observed in current persuasive systems for smart homes are principles of social proof, commitment (personal goal setting), and liking.

Research Challenges

There are a number of challenges that have not received sufficient attention in current projects on persuasive systems in smart homes, although they are vital for the successful deployment of these systems. As mentioned before, most projects about persuasive technology in smart homes are in the experimental phase; the system itself is often not more than a prototype. In order to assess whether a persuasive system has the desired effect (i.e., whether the behavior of the user actually changes as a result of using the system), large-scale, long-term user evaluations with working systems are required. Central questions in such evaluations should be: what is the attitude of people toward the system? How persuasive is the system considered to be? What is the effectiveness of the system? Does it really change users' behavior, also on the long term? An important challenge in this respect

is to determine which outcome measures can be used to quantify how persuadable and effective a system is.

One of the key factors determining the effectiveness of a persuasive system is the acceptance or adoption of the system by its users. Whether or not people intend to use the technology depends on a variety of factors, including to what extent the system meets the needs and demands of the users. Involving end users in the design process ensures that the product solves an actual and relevant problem and that the product reaches its target group. Paradoxically, people who are most easy to reach and most eager to adopt a system usually are the people who least need such a system. For instance, applications showing performance data about physical activity usually appeal to people who like to be active anyway, whereas the people who need this type of application the most, the inactive people, are usually the least interested. Other important factors for the adoption of persuasive systems are to avoid patronizing and stigmatization, to make interaction fun and challenging (thus appealing to people's intrinsic motivation), and to support autonomy. More research is needed to understand how these rather abstract notions can be translated into practical guidelines for the design of persuasive systems.

Finally in the design and implementation of persuasive systems, ethical aspects should be carefully considered. Important issues to consider are related to control, trust, privacy, and transparency. Especially when sensors are used to collect information, it is important that the user is aware of what information is collected and what it is used for. Also, persuasive systems should always be transparent about their persuasive intent. Now that smart home systems are increasingly able to act autonomously and adapt on the basis of knowledge about the user and the use context, it is important that the user always remains in control. Influence should be done openly, and no coercion should take place. To date, ethical issues like these have largely remained unaddressed in research related to persuasive technology (Oinas-Kukkonen and Harjumaa 2009).

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