

A Systematic Framework for Designing and Evaluating Persuasive Systems

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Abstract. A growing number of information technology systems and services are being developed to change users' attitudes or behavior or both. Despite the fact that attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behavior, these theories have basically provided checklists or rules of thumb rather than systematic design methods or methodologies to develop software solutions. This article is conceptual-theoretical by its nature. It discusses the process of designing and evaluating persuasive systems and describes what kind of content and software functionality may be found at the final product. Seven underlying postulates behind persuasive systems, ways to analyze the user and the use context, and persuasive design strategies and guidelines are highlighted. Based on the works of Fogg, the article also lists techniques for persuasive system content and functionality, describing example software requirements and implementations. Some new techniques are suggested. Moreover, a new categorization of these techniques is proposed, composing of the primary task, dialogue, system credibility, and social support categories.

Keywords: Design, functionality and techniques, models and frameworks, strategies, theories.

1 Introduction

Interactive information technology designed for changing users' attitudes or behavior is known as persuasive technology [4]. Traditionally persuasion has meant "human communication designed to influence the autonomous judgments and actions of others" [20]. The Web, Internet, mobile and other ambient technologies create opportunities for persuasive interaction, because users can be reached easily. In addition, the Web and other Internet-based systems are optimal for persuasive communication, because they are able to combine the positive attributes of interpersonal and mass communication [1]. There are certain areas where persuasive technology could be especially useful. For example, health care software applications may be developed to motivate people towards healthy behavior, and thereby possibly delay or even prevent medical problems as well as ease the economic situation in public health care [9].

Persuasive systems may be defined as "computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without

using coercion or deception” [16]. In this definition, three potential, successful outcomes for a persuasive system are reinforcement, change or the shaping of attitudes and/or behaviors. A reinforcing outcome means the reinforcement of current attitudes, making them more resistant to change. A changing outcome means changes in a person’s response to an issue, e.g. to social questions. A shaping outcome means the formulation of a pattern for a situation when such one does not exist on beforehand. In many cases a shaping outcome may have a higher likelihood of success than communication that aims at behavior change [11]. Different goals may imply the use of differing persuasion strategies and techniques.

Persuasive systems may utilize either computer-human persuasion or computer-mediated persuasion.¹ Admittedly, the concept of a persuader is relatively complex. As computers do not have intentions of their own, those who create, distribute, or adopt the technology are the ones who have the intention to affect someone’s attitudes or behavior [4], [5]. Although computers can not communicate in the same way as humans, recent studies suggest that some patterns of interaction similar to social communication may be utilized in human-computer interaction [15], [6]. Computer-mediated persuasion means that people are persuading others through computers, e.g. discussion forums, e-mail, instant messages, blogs, or social network systems.

Despite the fact that attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behavior, these theories have basically provided checklists or rules of thumb rather than systematic design methods or methodologies to develop software solutions. Fogg’s framework and principles provide useful means for understanding persuasive technology, but specifically for designing and evaluating persuasive systems they seem to be at a too general level [8]. This article, in spite of being conceptual-theoretical by its nature, aims at discussing the process of designing and evaluating persuasive systems as well as describing what kind of content and software functionality may be found at the final product. It is based upon our empirical work and conceptual analysis as well as related research. Since many of the presented techniques are based upon the framework of Fogg, the major differences to it will be highlighted.

Section 2 will define the underlying assumptions behind persuasive systems. Section 3 will discuss how different use and user contexts may be analyzed. Section 4 will define and describe various techniques for the content and functionality of a persuasive system. Section 5 will provide the conclusions of the article.

2 Fundamental Issues Behind Persuasive Systems

Based upon our empirical work and conceptual analysis as well as related research we define seven postulates² that need to be addressed when designing or evaluating persuasive systems. Two of these postulates relate how we see the users in general, two of the postulates relate to persuasion strategies, and three of the postulates address actual system features.

¹ The definition here differs from the definition by Fogg [4] who defines that persuasive technology is computer-human persuasion only.

² One might also call these as underlying assumptions or our biases.

Our first postulate is that *information technology is never neutral*. Rather it always influences people's attitudes and behavior in one way or another. Moreover, people are constantly being persuaded in a similar manner to how teachers persuade students in schools, and there is nothing bad in it in itself. This also means that persuasion may be considered as a process rather than as a single act. Persuading a user is a multi-phased and complex task, and different factors, such as the user's goal, may change during the process. For instance, in the beginning of using a pedometer a user might be simply interested in the number of steps but after using the device for a while (s)he may get more interested in burning calories. Persuasive systems should be able to adapt for this kind of changes.

The second postulate is that *people like their views about the world to be organized and consistent*. This is based on the idea of commitment and cognitive consistency [2]. If systems support the making of commitments, users will more likely be persuaded. For example, a user may express greater confidence in his or her decision to exercise regularly after one has bought a gym membership card. The idea of commitment also implies that persuasive systems could provide a means to make private or public commitments for performing the target behavior. This can be implemented, for example, by offering an easy way to send a text message or email for one's relatives, friends, or colleagues.

Cognitive consistency becomes important, because inconsistency may motivate for attitude change [20]. Psychological inconsistency disturbs people and they easily want to, perhaps even feel obliged to reorganize their thinking and restore consistency.³ Inconsistency may exist between attitudes and behavior, attitudes towards other people, attitudes towards objects and other people's attitudes towards the same objects [20]. The inconsistency must be represented and brought to the attention of the receiver. If a person finds the inconsistency unpleasant, (s)he will accept personal responsibility for it, and then cognitive dissonance will occur. The dissonance has to be powerful enough, however, to motivate the person to engage in an attitude or behavior change in order to restore cognitive consistency [7]. The idea of cognitive consistency may be subject to criticism. Philosophically, people are not fully consistent in their actions but have to deal with minor inconsistencies every day. People also have to feel commitment before inconsistency creates dissonance. For example, if one feels that (s)he could reverse a decision at any time, (s)he is unlikely to experience dissonance. Also, if one believes that (s)he had no other choice but to behave inconsistently, (s)he may live with it. The idea of cognitive consistency can be used in persuasive designs in many ways, for example by offering information to a user that is inconsistent with his or her thinking. For instance, an application for encouraging to safe driving could ask users why they are speeding, if they are well aware of the fact that speeding is one of the main reasons for serious traffic accidents. Inconsistencies may also encourage a user to reflect the arguments presented, and shape his or her attitudes based on this.

The third postulate states that *direct and indirect routes are key persuasion strategies* [16]. An individual who carefully evaluates the content of the persuasive message may be approached by the direct route, whereas an individual who is less

³ It should be noted that also correctness "drives" people [17]. People evaluate correctness by comparing their opinions to the opinions of others, for instance.

thoughtful and uses simple cues or stereotypes for evaluating the information may be persuaded through the indirect route. Direct and indirect processes may act simultaneously⁴, and both strategies may be supported through numerous software system features. Direct persuasion has turned out to be the more enduring of the two [17, 13]. However, in the era of information overflow people are often forced to use indirect cues more often than before, because of the abundance of information to be handled. When an individual sees relevant cues, heuristics are triggered. These may also be called cognitive shorthands, shortcuts, or rules of thumb. Heuristics are normally derived from experience and may have some empirical validity. Heuristics are often socially shared, but in practice a heuristic is available only if there is a stored heuristic representation in one's memory [23]. This postulate implies that a user's personal background and the use situation have an influence on his or her information processing. When the user has a high motivation and a high ability, (s)he is more likely interested about the content of the persuasive message than when (s)he has a low motivation and a low ability. In challenging situations such as when being in a hurry, it is highly likely that one will use heuristics for processing the information.

The fourth postulate states that *persuasion is often incremental*. This suggests that it would be easier to initiate people into doing a series of actions through incremental suggestions rather than a onetime consolidated suggestion [12]. This implies that a persuasive system should enable the making of incremental steps towards target behavior. For example, an application for healthier eating habits could first encourage users to eat at least some vegetables at their meals whereas the system could later suggest filling half of the plate with vegetables. Oftentimes, a system should also encourage users to make an immediate decision rather than postponing it for a later occasion. For example, Web sites for preventing alcohol abuse could provide stories from people who have received bad consequences, such as memory problems or brain damages, because of alcohol abuse. From the ethical point of view, it is necessary that the overall goal is made clear at all steps of incremental persuasion.⁵

The fifth postulate is that *persuasion through persuasive systems should always be open*. Content that is based on untruthful or false information does not fit with the overall goal of user's voluntary attitude change. It is also very important to reveal the designer bias in behind of the persuasive system. For instance, simulations may bear great persuasive power but if the designer bias remains unclear for the users they may either lose some of their persuasiveness or they may end-up misleading their users.

The sixth postulate states that *persuasive systems should aim at unobtrusiveness*, i.e. they should avoid disturbing users while they are performing their primary tasks with the aid of the system. The principle of unobtrusiveness also means that the opportune moment for a given situation should be carefully considered. The use of persuasive features at improper moments, e.g. a heart rate monitor suggesting one to

⁴ Our approach differs from the Elaboration Likelihood Model (ELM) [17] in the simultaneity of the direct and indirect processes, whereas it follows the Heuristic-Semantic Model (HSM) [23] in this matter. The ELM calls the direct and indirect routes as central and peripheral processes, whereas the HSM calls these as systematic and heuristic routes.

⁵ The so called "foot-in-the-door techniques" [2], or at least how they are used in everyday practice, may not be considered as part of incremental persuasion due to the fact that the overall goal often is not revealed for the persuadee.

exercise when being sick or getting a reminder to do one's daily sit-ups when giving a presentation at a meeting, may result in undesirable outcomes.

According to the seventh postulate, *persuasive systems should aim at being both useful and easy to use*, i.e. to really serve the needs of the user. This includes a multitude of aspects, such as convenience, ease of access, error-freeness, high information quality, as well as positive user experience, attractiveness, and user loyalty. Quite understandably, if a system is useless or difficult to use, it is unlikely that it could be very persuasive. It should be noted, however, that the abovementioned aspects are general software qualities rather than specific for persuasive systems.

3 Analysis of Use and User Contexts

The process of persuasion has to be carefully analyzed both in given situations as well as in a larger context. We refer to these as use and user contexts.

Analyzing *the use context* requires a thorough understanding of what happens in the information processing event, namely understanding the roles of persuader, persuadee, message, channel, and context [16]. Persuasive communication produces a complicated psychological event in person's mind. Basically, a persuadee is a human information processor [13]. This information processing view emphasizes the role of attention and comprehension in the persuasion process.⁶ In order for a person to be persuaded information must be presented, and the persuadee must pay attention to the argument(s) presented and comprehend it. After this the persuadee often yields to the position presented and retains (at least for some time), but in a successful persuasion the persuadee takes action to comply with the new position [13]. Persuasion-in-full occurs only when attitude change takes place. Changing a previous attitude is harder than originating or activating an attitude or the reinforcement of an attitude. Also if user's existing attitudes are based on one's personal experience (sometimes learned through a long socialization process), they are harder to change. In proportion, if user's existing attitudes are recently learned from other people, they are easier to change [11].

According to McGuire, in a persuasion situation the persuadee is ideally supposed to make optimal compromises among conflicting forces [13]. This principle has been criticized by Cialdini et al. [2], because it emphasizes the rational processing of arguments. Nevertheless, this is a relatively large part of the whole picture. Since persuasion is defined as changing the attitudes and/or behavior of others, the persuader is often trying to convince the persuadee of something. Drawing the line between convincing and persuasion is difficult. Persuasion relies primarily on symbolic strategies that trigger the emotions, whereas conviction relies on strategies rooted in logical proof and appeals to persuadees' reason and intelligence [14].

In addition to relatively straightforward information processing situations, such as learning, users may also be approached through larger contexts in their lives, such as

⁶ The information processing approach and cognitive consistency approach differ from each other in that the cognitive consistency approach emphasizes that if people first change their behavior, e.g. through legal constraints, their attitudes will change later, whereas the information processing approach states that people first change their attitudes in order to produce a change in behavior [13].

a middle-age crisis or a loss of a loved one. Whereas use analysis basically only focuses on the question what information is relevant for a user in a given situation, the user may and should be approached also in a more holistic manner. This may be referred to as *the user context*. This context analysis in-the-large means analyzing user's needs, interests, motivations, abilities, pre-existing attitudes, persistence of change, cultural factors, deep-seated attitudes, social anchors and perhaps even the whole personality.

In sum, both the use and user contexts have to be analyzed. Otherwise it will be harder or even impossible to recognize inconsistencies in user's thinking, figure out opportune moments for delivering messages, and effectively use persuasion techniques. In addition to analyzing the use and user contexts, also analyzing the message and the persuader is needed. The complexity and potentially controversial nature of the message and the earlier (use) history of the persuasive system needs to be carefully understood.

4 Design of System Features

Fogg's functional triad and its design principles [4] provide the first and most utilized conceptualization of persuasive technology. A weakness of this model is that it does not explain how the suggested design principles can and should be transformed into software requirements and further implemented as actual system features. Yet, to be able to design and evaluate the persuasiveness of a software system, it becomes essential to understand both the information content and the software functionalities.

Requirements specification is one of the most central phases in software development. It covers the activities involved in discovering, documenting, and maintaining a set of requirements for the computer-based information system to be designed and developed [22]. Requirements are descriptions of how the system should behave (functional requirements), qualities it must have (non-functional requirements), and constraints on the design and development processes [22], [18]. A system's persuasiveness is mostly about system qualities.

System features may be categorized as providing primary task, dialogue, system credibility, or social support.

4.1 Primary Task Support

The design principles in this category support the carrying out of the user's primary task. The design principles in this category are reduction, tunneling, tailoring, personalization, self-monitoring, simulation, and rehearsal. See Table 1.

Even if the design principles in this category are based on the works of Fogg [4], there are also many differences to them. The key benefit of suggestion is meaningful content for the user rather than providing support for carrying out a process or making a task simpler to do. For this reason, it is tackled in another category. In our view, surveillance and conditioning are not acceptable means for persuasive systems. Oftentimes people can not choose whether they may be observed or not which easily leads to covert approaches. In a similar manner, operant conditioning oftentimes is not open. Moreover, we also tend to think that users act more or less rationally in the way how they form and modify attitudes on the basis of beliefs and values rather than performing behavior as a result of conditioning.

Table 1. Primary task support

Principle	Example requirement	Example implementation
<p>1. Reduction A system that reduces complex behavior into simple tasks helps users perform the target behavior and it may increase the benefit/cost ratio of a behavior.</p>	System should reduce effort that users have in regard to performing their target behavior.	Mobile application for healthier eating habits lists proper food choices at fast food restaurants [24]. Smoking cessation web site provides an interactive test which measures how much money a user will save with quitting.
<p>2. Tunneling Using the system to guide users through a process or experience provides opportunities to persuade along the way.</p>	System should guide users in the attitude change process by providing means for action that brings closer to the target behavior.	Smoking cessation web site offers information about treatment opportunities after a user has answered an interactive test about how addicted (s)he is on tobacco.
<p>3. Tailoring Information provided by the system will be more persuasive if it is tailored to the potential needs, interests, personality, usage context, or other factors relevant to a user group.</p>	System should provide tailored information for its user groups.	Personal trainer Web site provides different information content for different user groups, e.g. beginners and professionals. Web site for recovering alcoholics presents a user such stories which are close to one's own story.
<p>4. Personalization A system that offers personalized content or services has a greater capability for persuasion.</p>	System should offer personalized content and services for its users.	Users are able to change the graphical layout of an application or the order of information items at a professional Web site.
<p>5. Self-monitoring A system that helps track one's own performance or status supports in achieving goals.</p>	System should provide means for users to track their performance or status.	Heart rate monitor presents a user's heart rate and the duration of the exercise. Mobile phone application presents daily step count [3].
<p>6. Simulation Systems that provide simulations can persuade by enabling them to observe immediately the link between the cause and its effect.</p>	System should provide means for observing the link between the cause and effect in regard to their behavior.	Before and after pictures of people who have lost weight are presented on a Web site.
<p>7. Rehearsal A system providing means with which to rehearse a behavior can enable people to change their attitudes or behavior in the real world.</p>	System should provide means for rehearsing a target behavior.	A flying simulator.

4.2 Dialogue Support

The design principles related for implementing computer-human dialogue support in such a manner that helps users keep moving towards their goal or target behavior include praise, rewards, reminders, suggestion, similarity, liking, and social role. See Table 2.

Table 2. Dialogue support

Principle	Example requirement	Example implementation
8. Praise By offering praise a system can make users more open to persuasion.	System should use praise via words, images, symbols, or sounds as a way to give positive feedback for a user.	Mobile application which aims at motivating teenagers to exercise praises user by sending automated text-messages for reaching individual goals. [24]
9. Rewards Systems that reward target may have great persuasive powers.	System should provide virtual rewards for users in order to give credit for performing the target behavior.	Heart rate monitor gives a user a virtual trophy if they follow their fitness program. Game rewards users by altering media items, such as sounds, background skin, or a user's avatar according to user's performance. [21]
10. Reminders If a system reminds users of their target behavior, the users will more likely achieve their goals.	System should remind users of their target behavior during the use of the system.	Caloric balance monitoring application sends text-messages for their users as daily reminders. [10]
11. Suggestion Systems offering suggestions at opportune moments will have greater persuasive powers.	System should suggest users certain behaviors during the system use process.	Application for healthier eating habits suggests children to eat fruits instead of candy at a snack time.
12. Similarity People are more readily persuaded through systems that remind themselves in some meaningful way.	System should imitate its users in some specific way.	Slang names are used in an application which aims at motivating teenagers to exercise. [24]
13. Liking A system that is visually attractive for its users is likely to be more persuasive.	System should have a look and feel that appeals to its users.	Web site which aims at encouraging children to take care of their pets properly has pictures of cute animals.
14. Social role If a system adopts a social role, users will more likely use it for persuasive purposes.	System should adopt a social role.	E-health application has a virtual specialist to support communication between users and health specialists. [19]

The dialogue support related design principles are partly adopted from Fogg's ideas on social actors (attractiveness, similarity, and praise) and media (virtual rewards). Reminders and social role suggest new design principles, whereas the idea of reciprocity was excluded from this framework because it is rather a characteristic of a user than a system feature.

Table 3. System credibility support

Principle	Example requirement	Example implementation
15. Trustworthiness A system that is viewed as trustworthy (truthful, fair, and unbiased) will have increased powers of persuasion.	System should provide information that is truthful, fair and unbiased.	Company Web site provides information related to its products rather than simply providing advertising or marketing information.
16. Expertise A system that is viewed as incorporating expertise (knowledge, experience, and competence) will have increased powers of persuasion.	System should provide information showing expertise.	Company Web site provides information about their core know-how. Company Web site is updated regularly and there are no dangling links or out-of-date information.
17. Surface credibility People make initial assessments of the system credibility based on a firsthand inspection.	System should have competent look and feel.	There are only a limited number of and a logical reason for ads on a company Web site.
18. Real-world feel A system that highlights people or organization behind its content or services will have more credibility.	System should provide information of the organization and/or actual people behind its content and services.	Company Web site provides possibilities to contact specific people through sending feedback or asking questions.
19. Authority A system that leverages roles of authority will have enhanced powers of persuasion.	System should refer to people in the role of authority.	Web site quotes an authority, such as a statement by government health office.
20. Third-party endorsements Third-party endorsements, especially from well-known and respected sources, boost perceptions on system credibility.	System should provide endorsements from respected sources.	E-shop shows a logo of a certificate which assures that they use secure connections. Web site refers to its reward for high usability.
21. Verifiability Credibility perceptions will be enhanced if a system makes it easy to verify the accuracy of site content via outside sources.	System should provide means to verify the accuracy of site content via outside sources.	Claims on a Web site are supported by offering links to other web sites.

Table 4. Social support

Principle	Example requirement	Example implementation
<p>22. Social learning A person will be more motivated to perform a target behavior if he or she can use a system to observe others performing the behavior.</p>	System should provide means to observe other users who are performing their target behaviors and to see the outcomes of their behavior.	A shared fitness journal in a mobile application for encouraging physical activity. [3]
<p>23. Social comparison System users will have a greater motivation to perform the target behavior if they can compare their performance with the performance of others.</p>	System should provide means for comparing performance with the performance of other users.	Users can share and compare information related to their physical health and smoking behavior via instant messaging application. [21]
<p>24. Normative influence A system can leverage normative influence or peer pressure to increase the likelihood that a person will adopt a target behavior.</p>	System should provide means for gathering together people who have the same goal and get them to feel norms.	Possibility to challenge relatives or friends to quit smoking from a web site via email or text message.
<p>25. Social facilitation System users are more likely to perform target behavior if they discern via the system that others are performing the behavior along with them.</p>	System should provide means for discerning other users who are performing the behavior.	A shared fitness journal in a mobile application for encouraging physical activity. [3]
<p>26. Cooperation A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to co-operate.</p>	System should provide means for co-operation.	The behavioral patterns of overweight patients are studied through a mobile application, which collects data and sends it to a central server where it can be analyzed in detail. [10]
<p>27. Competition A system can motivate users to adopt a target attitude or behavior by leveraging human beings' natural drive to compete.</p>	System should provide means for competing with other users.	Online competition, such as Quit and Win (stop smoking for a month and win a prize).
<p>28. Recognition By offering public recognition (for an individual or a group), a system can increase the likelihood that a person or group will adopt a target attitude or behavior.</p>	System should provide public recognition for users who perform their target behavior.	Personal stories of the people who have succeeded in their goal behavior are published on a Web site. Names of awarded people, such as "quitter of a month", are published on a Web site.

4.3 System Credibility

The design principles in the system credibility category describe how to design a system so that it is more credible and thus more persuasive. The category of system credibility composes of trustworthiness, expertise, surface credibility, real-world feel, authority, third-party endorsements, and verifiability. See Table 3. The design principles in this category have been adopted and modified from Fogg [4].

The differences to the functional triad are that the ideas of fulfillment, ease-of-use, responsiveness and near perfection have been excluded from this category, because they belong to the postulates. Since personalization is very closely related to tailoring it can be found from another category. On the other hand, the key benefit of referring to an authority is to increase system credibility in a similar manner to other principles in this category. Undoubtedly presumed credibility, reputed credibility, and earned credibility influence users, oftentimes even more than the abovementioned principles, but since these can not really be represented as system features, they are excluded from here.

4.4 Social Support

The design principles in the social support category describe how to design the system so that it motivates users by leveraging social influence. The design principles that belong into this category, are social facilitation, social comparison, normative influence, social learning, cooperation, competition, and recognition. See Table 4. These principles have been adopted from Fogg's principles on mobility and connectivity. Kairos factors and the ideas in behind of convenience, mobile simplicity, mobile loyalty, mobile marriage, and information quality have been covered in the postulates.

5 Conclusion

This paper has presented a new framework for designing and evaluating persuasive systems. The underlying postulates behind persuasive systems were defined and the importance for a thorough analysis of the use and user contexts was brought into attention.

Although this paper is conceptual-theoretical by its nature, it has practical implications. It was proposed that persuasion principles should be considered mainly as requirements for software qualities, relating either to content or to functionality. Twenty-eight design guidelines, mostly based on Fogg's functional triad, were defined with software requirement and implementation examples. A new categorization of the principles was based on their key benefits, which makes them more practical for actual systems development. The suggested postulates, means for analyzing the use and user contexts, new categorization, and design principles may become especially useful in motivating and persuading users to reach their personal goals.

In the future, experimental work will be needed to demonstrate the framework's applicability in real-life design and usage situations. We invite other researchers to use the framework and its principles and help us further develop the framework.

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