



A user-adaptive persuasive system based on ‘a-rational’ theory[☆]



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ABSTRACT

Persuasion is a form of social influence and is a ubiquitous part of contemporary life. Even if sometimes it is marked as negative, there is a growing interest from the research community in designing and developing intelligent systems that use persuasive technologies for promoting behavior change in several domains. In this paper we present a computational model of persuasion, which combines the emotional and rational modes. In the proposed approach we simulate the process used by human to persuade someone to perform a given action by combining rational strategies with emotional ones and to adapt them to some user's characteristics. In particular, the system reasons on the strength of alternative (rational and emotional) strategies of persuasion in order to select the most appropriate one. The persuasion model has been used to produce personalized persuasion dialogs in the well-being and healthy eating domains by reasoning on the user's personality traits and living habits.

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1. Introduction

Computing systems of many types, Web sites, mobile applications and smart objects are becoming increasingly focused on motivating and influencing the users in changing wrong behaviors. Several coaching systems have been developed that use persuasion and motivational strategies in various application domains such as e-learning, fitness and healthy living, therapy adherence (Bevacqua et al., 2007; Bickmore, 2003; de Rosi et al., 2006; Klein et al., 2013; Lehto, 2013).

Recently massive attention has been placed on the well-being domain, in particular concerning the combination of physical activity and nutrition. However, many of the existing systems focus on aspects aiming at motivating the user while they are following the plan for enacting the behavior changing process (Michie et al., 2011). But, in our opinion, behavior change requires first of all adopting the intention of changing lifestyle by bridging the intention–behavior gap in the user behavior. Therefore, coaching or behavior change support systems should, first of all, persuade the user to change.

Persuasion is a form of social influence and is a ubiquitous part of contemporary life. Even if sometimes the very idea of persuasion is marked as negative, a relatively new trend in the research community shows a growing interest into intelligent information technologies, and for better or for worse, persuasive technologies are already part of the everyday technological landscape (Fogg, 2002).

Coming from persuasion and technology, persuasive technologies are not exempt from ethical issues: they should be employed to change peo-

ple's attitudes or behavior without coercion or deception, acting therefore upon users' beliefs always in an atmosphere of free choice, where they are autonomous and able to change their mind. Moreover, influencing is not a direct and rough suggestion, but is supported by a careful selection of the target's beliefs, values or attitudes and of the methods to activate or strengthen them. Persuasive communications matched with the Receiver's motivations will more likely succeed than those engaging not so salient desires. Knowledge of what the Receiver wants (preferences, goals, beliefs and significant values) is therefore essential in selecting the aspects on which to focus the persuasion process, that is, the outcomes the suggested behavior would enable.

Therefore, to simulate the persuasion process the intelligent interfaces should have the ‘social intelligence’ that enables them to observe the Receiver, so as to reason on both the strength of alternative (rational and emotional) strategies in order to select the most appropriate one, and the responses to the Receiver's reactions. Indeed, emotions play an important role into the persuasion process: it is widely acknowledged that persuasion appeals to informative as well as emotional components. The new trend of research concerns the study of emotional model that may strengthen the persuasion power. Emotional persuasion is often considered as synonymous of irrational persuasion, while it is not necessarily an irrational attempt to influence the mental state of the receiver, because, again, the persuader performs a process of rational reasoning and planning (Miceli et al., 2006).

Researchers in natural argumentation and persuasion typically distinguish between cognitive modes of persuasion and emotional ones (Petty et al., 1986; Chaiken et al., 1989). Conversely, according to

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a-rational Theory of persuasion (Miceli et al., 2006), this work is an attempt to build a computational model in which rational and emotional modes of persuasion may be integrated to produce effective strategies in different contexts. It is worth specifying that, while it is generally considered the role of the emotions expressed by the Receiver and the Persuader in the persuasion process (for example, emotional communication style or emotional facial expression), or the social relations between the two participants in the persuasion process, the model proposed considers emotions as an integrated part of the persuasion process: it considers emotions as characterizing a mode of persuasion and takes into account the influence of emotional aspects aroused by the Persuader on the Receiver's mental state, that is, the role of emotional strategies in influencing the attitude of the Receiver. Although there is no doubt about the importance of technological aspects related to persuasion (Fogg, 2002), the present work is centered on theories and models to be used beyond technology in order to implement a reasoning capability on the context and the user in order to adapt the persuasion strategy. It presents an extension of (Mazzotta et al., 2007a) where the principles behind a user-adapted persuasion system called PORTIA were presented. PORTIA, by reasoning on the user's personality traits and living habits, generates user-tailored persuasion messages in the well-being and healthy eating domains. In this paper we will present in details how persuasive messages are generated in natural language from the monological and dialogical viewpoint.

After presenting an overview of the related work, Section 3 explains briefly how PORTIA has been designed. In particular, in Sections 4 and 5 we discuss how the parameters of the model have been set in order to improve the effectiveness of a strategy and how the knowledge in the model is then used for the argumentation phase (Section 6). Section 7 addresses the problem of natural generation of messages from the monological and dialogical viewpoint; Section 8 presents two significant examples of PORTIA at work; finally, in the last section conclusions and future work directions are provided.

2. Background and motivations

Persuasion is a form of social influence, that is, the broad process in which the behavior of one person alters the thoughts or actions of another. Social influence involves the production of any kind of change of others' beliefs, goals, or behavior, and includes a much broader class of phenomena than mere persuasion. It is a topic addressed by many disciplines and approaches such as marketing and advertising, law, linguistics and rhetoric, social psychology and communication studies, politics, public relations, human-computer interaction, and persuasive technologies. While social influence can occur when receivers act on cues or messages that were not necessarily intended for their consumption, persuasion occurs within a context of intentional messages that are initiated by a communicator in hope of influencing that recipient (Perloff, 2007). Therefore, persuasion involves the persuader's awareness that she is trying to influence someone else. It also requires that the person being persuaded makes a decision to change her mind about something. Consequently, persuasion is a strong example of social influence without coercion, nor manipulation: coercion implies force; manipulation implies deception; persuasion implies a voluntary change without deceptive stratagems.

Among the various definitions of persuasion proposed during the years, the one used in this work comes mainly from Miceli et al. (2006) general definition of intentional attempt to induce an intention through communication, and in a non-coercive way.

As far as methods to represent the persuasive information, O'Keefe (2002) suggests defining persuasion as "human communication designed to influence others by modifying their beliefs, values or attitudes". By influencing others, one may intend to attempt modifying either their beliefs or their intentions, and may name 'argumentation' and 'persuasion' the respective communication processes: That is, argumentation means to induce a belief, persuasion means to induce an intention to

do something. In particular, inducing the intention to do something requires acting on the Receiver's beliefs (Castelfranchi, 1996), therefore argumentation is used in persuasion. In both cases, influencing is not a direct and rough suggestion, but is supported by a careful selection of the target beliefs, values or attitudes and of the methods to activate or strengthen them. Factors related to the Receiver, the context in which the persuasion occurs and the sources of provided information are considered to be of primary importance for the success of a persuasion attempt (O'Keefe, 2002). According to Fogg (2002), computer tools may increase the persuasion power by providing tailored information or by leading people through a selected process.

Persuasion is often confused with argumentation. Although in both cases the goal of the communication process is to convince somebody, argumentation means inducing to believe while persuasion inducing to do. In the former case, the communicator's goal is to influence an addressee's beliefs, while in the latter the goal is to influence the addressee's intention to perform some action. However, inducing someone to do requires changing his beliefs (Castelfranchi, 1996), and so, there is overlapping between the two communication processes: argumentation is a resource of persuasion.

A persistent theme in persuasion scholarship -from Plato to the present era- is ethics. Some people believe that attempting to change another person's attitudes or behaviors is always unethical, or at least questionable. Other people view persuasion as fundamentally good. The rub is that persuasive communication can be used with great effectiveness by both moral and immoral persuaders. Persuasion can be used for good or bad purposes, with ethical and unethical intentions (McCroskey, 1997). Therefore, persuasive communications must be judged by the consequences of the act, the intentions of the persuader, the morality of the message, and the context in which persuasion occurs.

Emotions play an important role in persuasion: it is widely acknowledged that persuasion appeals to the rational as well as emotional components of the human mind. It is generally assumed that emotions are a biological device aimed at monitoring the state of reaching or threatening of our most important goals (Carbonell, 1980; Oatley et al., 1987). Within the various fields of psychological research, two schools of thought appear to dominate the debate regarding the nature of emotions (Restifcar et al., 1999). The first one assumes that there are several basic defined emotions, while more complex emotions can be defined as a function of them, often classified as primary and secondary emotions. For example, Plutchik (1908) proposed a system of emotion classification containing eight fundamental emotions; Ekman (1999) proposed a system consisting of six fundamental, or basic, emotions; Lazarus describes nine negative (Anger, Anxiety, Guilt, Shame, Sadness, Envy, Jealousy, Disgust) and six positive (Joy, Pride, Love, Relief, Hope, Compassion) emotions, with their appraisal patterns (Lazarus, 1991). An alternative view considers emotions as a continuous function of one or more dimensions (for example, the circumplex model of emotion classifies them in terms of relative values on the dimensions of arousal and valence (Russell, 1980)).

According to the evolutionary theories, emotions were inherited during evolution and are automatically triggered with no cognitive intervention (for example, Ekman, 1999). On the contrary, cognitive theories of emotions assume that cognition is essential in the triggering of emotion (for example, Ortony et al., 1988)).

Miceli et al. (2011) define persuasion as "the intention of a Persuader (P) to modify, through communication, an addressee, the Receiver (R), beliefs or their strength, as a means for P's superordinate goal to have R freely generate, activate or increase the strength of a certain goal and, as a consequence, to produce an intention instrumental to it, and possibly to have P pursue this intention; but the minimal condition is that R has that intention." In other words, persuasion can be defined as one's intention to modify another's beliefs through communication, and possibly to cause one to modify their behaviors in pursuit of this goal. This can be done by appealing to the rational as well as to the emotional component. In fact, persuasion is aimed at modifying attitudes, which are complex

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