# Advancing Typology of Computer-Supported Influence: Moderation Effects in Socially Influencing Systems

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**Abstract.** Persuasive technologies are commonly engineered to change behavior and attitudes of users through persuasion and social influence without using coercion and deception. While earlier research has been extensively focused on exploring the concept of persuasion, the present theory-refining study aims to explain the role of social influence and its distinctive characteristics in the field of persuasive technology. Based on a list of notable differences, this study outlines how both persuasion and social influence can be best supported through computing systems and introduces a notion of computer-moderated influence, thus extending the influence typology. The novel type of influence tends to be more salient for socially influencing systems, which informs designers to be mindful when engineering such technologies. The study provides sharper conceptual representation of key terms in persuasive engineering, drafts a structured approach for better understanding of the influence typology, and presents how computers can be moderators of social influence.

**Keywords:** influence typology, computer-moderated, persuasive technology, computer-mediated, computer-human, socially influencing systems

## 1    Introduction

Persuasive technologies are commonly engineered to change behavior and attitudes of users through persuasion and social influence without using coercion and deception [9]. Both persuasion [22] and social influence [11] have been studied as concepts in behavioral, cognitive, and social psychology for long time. Evidently, they both exert capacity to alter human attitude and behavior, but each of them employs specific attributes to achieve that through face-to-face communication and presence in the physical world [3], [21].

While computers are becoming ubiquitous as tools, media, and social actors, it is necessary to clarify how the concepts of persuasion and social influence can be engineered in computing systems [9], [29]. More importantly, before designing such persuasive systems, scholars and practitioners should be aware of how each concept can be operationalized and what consequences each design component can bear [28].

According to Fogg [9], people can respond socially to computer products, which opens the door for social influence aspects [29] to exert their powers of motivating

and persuading users. Thus, computers can be perceived as social entities or actors that influence people on their own [28]. This happens when people make inferences about social presence [26] in persuasive technology through social cues, such as physical (face, eyes, body, movement), psychological (personality, similarity, feelings), language (spoken language, praise, language recognition), social dynamics (dialogues, reciprocity), and social roles (authority, doctor, teacher). Although it broadens understanding of computers as social actors, such discussion is focused on perceiving computers as individual entities with human-like characteristics rather than means for computer-supported influence that originates from other users [29].

To address this gap, the present research aims at clarifying the role of social influence [17], [25], [27], [33] and its distinctive qualities in the field of persuasive technology (Section 2). Based on these differences, this paper outlines how the concepts of persuasion and social influence can be best supported through computing systems (Section 3). Further, the notion of interpersonal computer-moderated influence is introduced, its place among other relevant types of persuasion is defined, and its specific role in the realm of persuasive technology is explained (Section 4). Lastly, the paper discusses implications of this research for scholars and designers of socially influencing systems (Section 5), and provides final conclusions (Section 6).

## 2 Socio-Psychological Foundation

Concepts of persuasion and social influence are often used interchangeably when describing a phenomenon of behavioral or attitudinal change that is caused by other people. Although persuasion and social influence can achieve the same goal of shaping human attitude and behavior, research in social psychology (Table 1) demonstrates that both concepts have notable differences in character and encompass distinct properties [14], [16].

According to Wood [31], *persuasion* typically includes detailed argumentation that is presented to people in a context with only minimal social interaction (e.g. one-to-one or one-to-many verbal persuasion), whereas *social influence* is usually enabled and facilitated by more complex social settings (e.g. many-to-one or many-to-many social contexts). O'Keefe [21] has argued that persuasion mainly relies on and is built upon reasoning and argument to shift attitudes and behavior of individuals towards a desired agenda, but social influence is commonly driven by the behavior and actions of surrounding people.

An additional perspective by Cialdini [3] has proposed that persuasion works by appealing to a set of deeply rooted human drives and needs, such as liking, reciprocity, consistency, authority, and scarcity. At the same time, humans look for social proof as a source of influence, and rely on the people around them for cues on how to think, feel, and act. In earlier work, Cialdini together with Goldstein [4] also claimed that social influence is a psychological phenomenon that often occurs in direct response to overt social forces. Finally, in recent collaborative work with Guadagno and Ewell [11], Cialdini specified that social influence refers to the changing of attitudes, beliefs, or behavior of an individual because of real or imagined external pressure.

**Table 1.** Persuasion and social influence in social psychology literature

| Reference | Persuasion | Social Influence |
| --- | --- | --- |
| Cialdini [3] | Works by appealing to a set of deeply rooted human drives and needs, such as liking, reciprocity, consistency, authority, and scarcity. | Humans look for social proof, therefor rely on the people around them for cues on how to think, feel, and act. |
| Guadagno et al. [11] | | Refers to the changing of attitudes, beliefs, or behavior of an individual because of real or imagined external pressure. |
| O'Keefe [21] | Mainly relies on and is built upon reasoning and argument to shift attitudes and behavior of individuals towards a desired agenda. | Commonly driven by the behavior and actions of surrounding people. |
| Petty and Cacioppo [22] | Two basic routes to persuasion. One is based on the thoughtful consideration of arguments central to the issue, whereas the other is based on peripheral cues. | |
| Rashotte [23] | Focuses merely on written or spoken messages sent from source to recipient. | Defined as change in thoughts, feelings, attitudes, or behavior of an individual that results from interaction with another individual or a group. |
| Wood [31] | Typically includes detailed argumentation that is presented to people in a context with only minimal social interaction. | Usually enabled and facilitated by complex social settings. |

Petty and Cacioppo [22] have argued that there are two basic routes to persuasion. One route is based on the thoughtful consideration of arguments central to the issue, whereas the other is based on peripheral cues in the persuasion situation. Rashotte [23] has defined social influence as change in thoughts, feelings, attitudes, or behavior of an individual that results from interaction with another individual or a group.

## 2.1 Persuasion

Persuasion is broadly defined as the action of causing someone to do something through reasoning or argument [21-22]. According to Rashotte [23], current research on persuasion focuses merely on written or spoken messages sent from source to recipient. This research is based on the assumption that people process messages carefully whenever they have motivation and ability to do so. Modern persuasion research is mainly dominated by studies employing either the elaboration likelihood model (ELM) [22] or heuristic-systemic models (HSM) [8].

## 2.2 Social Influence

Social influence is broadly defined as the capacity to have an effect on the behavior of someone in a social context. In general, social influence is naturally and instantly present in most social contexts of everyday life. According to earlier research [27], the study of social influence is central to social psychology and essential to understand group dynamics and intergroup relations. Historically, the research on social influence covers a broad range of topics, from persuasion and attitude change [31], to compliance and conformity [4], to collective action and social change [18]. Social influence is the process by which people really change their behavior depending on interaction with others who are perceived to be similar, desirable, or expert [23].

## 2.3 Understanding Distinctive Characteristics

Earlier discussion on persuasion and social influence creates an understanding that both paradigms are present in settings with two or more people that lead to behavioral or attitudinal changes in one or many of them. However, it is also important to clarify the distinctive characteristics of the two paradigms so that researchers and designers would be able to implement them in a proper way and study their effects on human behavior in a rigorous manner. Social psychology research on persuasion and social influence (Table 1) suggest numerous aspects that differentiate the two, therefore further discussion focuses only on the four main distinctive characteristics that are categorized in Table 2, i.e. the *origin*, the *driver*, the *impact*, and the *direction*.

**Table 2.** Distinctive characteristics of persuasion and social influence

|  | Persuasion | Social Influence |
| --- | --- | --- |
| **Origin** | Intention or agenda | Presence of other people |
| **Driver** | Reasoning or argument | Behavior of surrounding people |
| **Impact** | Controlled and guided | Unpredictable and ambient |
| **Direction** | Push | Pull |

**Origin.** Persuasion generally originates either from an *intention* to change an attitude and behavior of an individual or from a broader agenda of shaping what crowds of people think and do. In contrast, social influence effects occur and persist in the *presence* of other people around an individual.

**Driver**. According to earlier definitions [21], persuasion mainly relies on and is built upon *reasoning* and argument to shift attitudes and behavior of individuals towards a desired agenda, whereas social influence is commonly driven by the behavior and *actions* of surrounding people.

**Impact.** For persuasion to exert a desired impact on an individual through consistent reasoning and argumentation, it has to be performed in a *controlled* and guided manner. But, social influence primarily depends on the presence of other people and their behavior in a given social environment, therefore making its impact *unpredictable* and reliant on a particular context.

**Direction.** Prior research demonstrates that persuasion by definition operates as *push* mechanism that communicates an intended agenda with supportive arguments through guided approach, i.e. a persuader intentionally attempts to shapes the behavior and attitudes of receivers. Whereas in case of social influence, an individual is rather *picking* up an influence from a particular social context, i.e. individuals acquire sense of influence from surrounding people and their behavior.

## 3 Influence Typology

Computer-supported influence holds considerable promise as a topic of research [10]. Prior research in the realm of persuasive technology [9] has distinguished three relevant types of persuasion [13], i.e. interpersonal persuasion, computer-mediated persuasion, and human-computer persuasion. To advance this research area, the aforementioned types have been adjusted and are further discussed as: interpersonal *face-to-face (FTF)* influence, interpersonal *computer-mediated (CME)* influence, and *computer-human (CHU)* influence, respectively.

Based on the distinctive characteristics of persuasion and social influence (Table 2) and the ways in which both can be supported through computing systems, this paper outlines the existence of another type, namely interpersonal *computer-moderated (CMO)* influence, and explains its place and role within the realm of computer-supported influence (Fig. 1). More elaborate comparison of the four types of influence is provided in Table 3.



**Fig. 1.** Influence typology
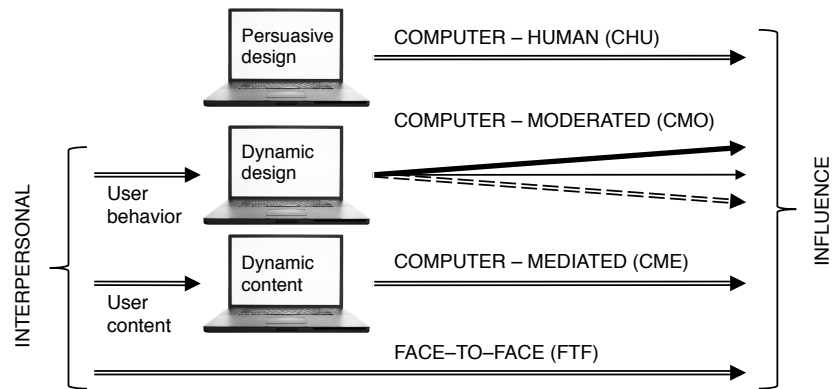
### 3.1 Interpersonal Face-to-Face (FTF) Influence

According to Wilson [30], interpersonal influence can take place during an interaction of two or more people, involving verbal and non-verbal forms of behavior, personal feedback, and coherence of behavior. Further, this type of influence is termed as face-to-face (FTF) [20] to distinguish it from computer-supported influence (Fig. 1).

## 3.2 Interpersonal Computer-Mediated (CME) Influence

Interpersonal influence can also take place through various computing technologies, such as emails, mobile messaging, video chats, etc. In this case, the chosen technology serves as a mediator of interpersonal influence without any additional agenda to affect its users. Therefore, this type of influence is termed as interpersonal computer-mediated (CME) influence (Fig. 1) [11-12] and it can be well operationalized through fixed content (FC) and dynamic content (DC) components that are further explained in Section 4.1 and presented in Table 4.

Prior research also exposes that scholars have been active in studying interpersonal CME persuasion [15], [24], and its comparison to interpersonal FTF persuasion for many years. For example, Di Blasio and Milani [7] found that computer-mediated discussion could possibly activate the central route of persuasion [22] more easily than face-to-face interaction. This knowledge can be instrumental to explore more granular differences between the two types of influence.

**Table 3.** Comparing the four types of influence

| | Interpersonal | | | |
| | Face-to-face (FTF) | Computer-mediated (CME) | Computer-moderated (CMO) | Computer-human (CHU) |
| --- | --- | --- | --- | --- |
| **Origin** | Human | User | User behavior | Designer |
| **Description** | People can influence each other in the physical world. | Users can influence each other through computers. | Computers can amplify, decrease, or reverse influence based on the presence (or absence) of other users and their behavior. | Computers can influence users when designed to do so. |

## 3.3 Computer-Human (CHU) Influence

Computer-human (CHU) influence is very different from both types of interpersonal influence previously discussed, i.e. FTF and CME, because it is based on the notion that computers can be designed to perform the role of social actors [9], and thus they can have capacity to influence users independently of interpersonal relationships with other users (Fig. 1). For this reason, the CHU influence can be better operationalized through the fixed design (FD) component, which is described in Section 4.1 and presented in Table 4.

Earlier research provides different collections of techniques and principles that can be useful for designing and evaluating persuasive technologies. For instance, the behavior change technique taxonomy contains 93 hierarchically clustered techniques to build an international consensus for the reporting of behavior change interventions [19]. According to Fogg [9], there are various theory-driven persuasive principles that can be incorporated into the design of computers to improve their persuasiveness. Many principles and techniques by definition and design can support the CHU influence, but not all of them. Those principles that are primarily dependent on behavior of

other users rather fall under the interpersonal computer-moderated (CMO) influence, as discussed further in the next section.

### 3.4 Interpersonal Computer-Moderated (CMO) Influence

Interpersonal computer-moderated (CMO) influence is distinct from all other types of influence described above with its unique characteristic of being able to amplify, decrease, or reverse the persuasion effect through computing technology depending on the presence (or absence) of other users and their behavior.

Interpersonal CMO and CME influences differ, because the latter serves as a mediator without affecting interpersonal influence, while the effects of the former can fluctuate depending on the actual behavior of other concurrent users. In other words, the role of a computer in the interpersonal CME influence is mainly to mediate interpersonal persuasion, whereas in case of the interpersonal CMO influence, the role of a computer is to facilitate the effects of social influence though the dynamic design (DD) component, further described in Section 4.1 and exhibited in Table 4.

As it can be observed from Fig. 1, interpersonal CMO influence also substantially differs from CHU influence, because the latter is not supposed to receive any input from other users, thus the CHU influence is solely based on the intentions that its designers have preset in the interfaces of the computing technology (the FD component). Another way to better understand the nature of the interpersonal CMO influence and how it differs from the interpersonal CME influence is to think about the common attributes of moderation and mediation in social psychological research [2].

## 4 Computer-Supported Influence

Computing technologies increasingly penetrate various aspects of everyday life. This advancement continuously expands ways of how people can be reached, thus experience persuasion or social influence through human-computer interaction [10] and computer-mediated communication [10].

According to Wilson [30], communication via computer is intrinsically less suitable for persuading as compared to face-to-face interaction, because of deficiencies to transmit non-verbal cues and limited number of utilizable strategies. At the same time, computers can be designed to play the role of a social actor [9], which means that they are capable not only to mediate persuasive communication but also support persuasion and social influence through intentionally designed computer software and interfaces [13].

### 4.1 Components

Before designing persuasive technologies [9] and socially influencing systems [29], it is very important to understand the main components of how computers can support influence (Table 4). The two main components of computing systems, which are directly exposed to users through interfaces, are *content* (e.g., texts, photos, sounds,

videos) and *design* (e.g., layout, navigation, colors, features). Both components can be operationalized either as *fixed* or *dynamic*.

**Table 4.** Components of computer-supported influence

|  | Content | Design |
|---|---|---|
| **Fixed** | (FC) | (FD) |
|  | Preset by developers and owners | Preset by designers |
|  | Supports CHU influence | Supports CHU influence |
| **Dynamic** | (DC) | (DD) |
|  | Generated by users | Evolving through user behavior |
|  | Supports interpersonal CME influence | Supports interpersonal CMO influence |

Historically, computer systems were often built with fixed design that was preset by designers and fixed content that was predefined by system developers and owners. With the overall technological advancement, computer systems are becoming more social and dynamic by both allowing users to contribute own content and displaying their interactions with the systems.

Through clearer understanding of the four components, the designers of computer systems become better equipped with ways of how both persuasion and social influence can be operationalized more effectively.

Based on the distinctive characteristics of persuasion and social influence (Table 1), the likelihood of support for both concepts was assessed and reported for each component in Table 4. That is, if an intention is to persuade users through computing systems, then the *fixed content (FC)*, *fixed designed (FD)*, and *dynamic content (DC)* components are suitable in achieving that. However, if an aim is to leverage social influence through socially influencing systems [29], then the DC and *dynamic design (DD)* components can yield favorable results.

In this[?] case, if a system is implemented with fixed design and fixed content so that users can see only outcomes of their own actions, then the chances for social influence to play a role in the given context are very limited. Of course, the fixed components can contain preset messages conveying social influence aspects, e.g. social normative statements [5], but their effects can decline over time, as they do not change. Nevertheless, dynamic content and dynamic design expand user interaction and enable them to see what others are doing. In that way, both dynamic components open up multiple ways for social influence to occur and affect users.

## 4.2 Operationalization

The concepts of computer-supported influence can be operationalized in many ways depending on a given context and intended behavior change. To give an example, imagine a situation where a person is concerned about his health conditions and has decided to exercise more by jogging each morning. As part of this plan, the person installs a mobile application intentionally designed to help achieve the target behavior change. First, the mobile app enables a jogger to check weather conditions, and sec-

ondly, enables users to see how many others are jogging at that moment (Fig. 2). The counter of joggers is an operationalization of the DD (dynamic design) component from Table 4, as it purely depends on the behavior of other users.



**Fig. 2.** Example of an interpersonal computer-moderated influence: on the left, nice weather in Stanford and 374 are jogging; in the middle, bad weather in Eindhoven and only twelve are jogging; on the right, cold and windy weather in Chicago and no one is jogging outside

If the weather conditions are great in Stanford and the counter shows that 374 people are currently jogging outside (Fig. 2, left), then the user would experience increased motivation to go out and exercise together with others. Instead, the heavy rain and the comparative low number of joggers on the streets and in the parks of Eindhoven (Fig. 2, middle) would most likely to decrease the motivation of a user to step outside. Now, imagine a situation when there is one extremely cold and windy morning in Chicago (Fig. 2, right). The alarm clock rings, the user opens the application and notices the bad weather conditions, which naturally affects the motivation for jogging that morning. Now what? The user looks at the number of others jogging at that exact moment. Quite simply, a zero joggers in the picture would discourage the individual from jogging that morning, a small number would make the user hesitant, but a large number of other joggers would still give an extra boost to the motivation.

This example demonstrates how the behavior of other users can increase, decrease, or reverse the persuasive effect of a mobile application that is complemented with the design principle of social facilitation [32], which represents social influence. In a similar manner, it can be easily illustrated how other social influence design principles would end up having the same pattern. The competition principle [6] that is implemented as a top, for example, would amplify its persuasive potential only as long as an individual has competitive position among other users. Whenever the individual falls behind the competition, this principle naturally loses its capacity to influence.

# 5    Discussion

This theory-refining research highlights the importance and necessity to continue studying various facets of persuasion and social influence in the realm of persuasive technology. The substance of this paper demonstrates that both concepts maintain distinctive qualities, and therefore their nature has to be better understood before making an attempt to design and implement them in computing technologies.

The contribution of this paper is fourfold. First, the paper provides a comparison of persuasion and social influence that clarifies the nature of both concepts in a structured manner. Second, the paper outlines four components of how computers can support persuasion [21-22] and social influence [11], [23]. Third, the influence typology is presented and, forth, extended with an introduction of interpersonal computer-moderated (CMO) influence.

Overall, the outcome of this research effort demonstrates that there are various ways that persuasion and social influence can be facilitated through computing technologies, but a positive effect is not always guaranteed. In the case of the interpersonal CMO influence, intended effects can be amplified, decreased, or reversed depending on the presence (or absence) of other users and their behavior.

## 5.1    Implications for Designers

The designers of persuasive technologies should be very careful when designing interpersonal computer-moderated (CMO) influence, which is mainly about implementing aspects of social influence. In order to avoid possibly negative effects of the interpersonal CMO influence, the designers of persuasive technologies can and oftentimes should incorporate specific rules and triggers to control for the likelihood of unwanted effects occurring. If such control mechanisms were in place, another kind of an implementation could be deployed as long as necessary. For example, when the number of joggers on the streets of Chicago (Fig. 2) drops below twenty, instead of reporting a low number, the mobile app can show an average number of joggers at that time of day which is aggregated over the last month or over ten other days with similar weather conditions.

## 5.2    Future Research

This research provides additional evidence that the theoretical work on persuasive technologies and socially influencing systems has potential for further research initiatives. In the next steps, each aspect of social influence has to be further studied separately and rigorously in line with related theories from social psychology. Then these aspects need to be designed, implemented, and tested to assess thresholds of when interpersonal computer-moderated (CMO) influence begins to shift its effect from amplifying to decreasing and from decreasing to reversing. Conducting such studies is highly important, as they would contribute to more detailed understanding of how and when socially influencing systems [29] are gaining, losing, or reversing their capacity to affect user involvement, participation, and engagement [28].

# 6 Conclusions

The present study explained the role of social influence and its distinctive characteristics in the field of persuasive technology. Based on the unique differences between persuasion and social influence, this paper described ways of how both concepts can be best supported through computing systems.

The study introduced the notion of interpersonal computer-moderated (CMO) influence and defined its place within the influence typology. Compared to the other types, the CMO influence firmly relies on four distinguishing characteristics of social influence, namely origin, driver, impact, and direction. By definition, the CMO influence can amplify, decrease, or reverse an intended effect on users, therefore designers of socially influencing systems [28] should be mindful when engineering them.

To summarize, this research outlined a sharper conceptual representation of the key terms in persuasive engineering, drafted a structured approach for better understanding of the influence typology, and presented how computers can be moderators of social influence. Consequently, future research attempts can be directed towards formalizing and operationalizing the influence typology, and advancing the methodology for socially influencing systems [29].

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