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The similarity-attraction paradigm in persuasive technology: effects of system and user personality on evaluations and persuasiveness of an interactive system

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ABSTRACT

This paper presents a study that tests whether the similarity-attraction paradigm applies to persuasive technology. That is, the notion that similarity leads to more positive evaluations and persuasion of an interactive system was tested in an online study in which participants were provided with automated persuasive messages that had either a dominant or a submissive interaction style. The system with a dominant interaction style was expected to be more persuasive than the system with a submissive interaction style. Moreover, people with dominant personalities were expected to be persuaded more by a dominant system, while people with submissive personalities were expected to be persuaded more by a submissive one. Results showed that the dominant system was more persuasive than the submissive one, but also that the dominant system was perceived as less likeable than the submissive one. Expectations regarding the similarity-attraction paradigm were confirmed for people's evaluations of the system, but not for the system's persuasiveness. The current work could ultimately help creating technologies that adapt their persuasive messages to their users.

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Similarity-attraction paradigm; interpersonal dominance; system evaluations

1. Introduction

Many interactive technologies have persuasive elements in them. These elements are designed to change a person's attitudes, beliefs, or behaviour. When the goal of an interactive technology is to change a person's behaviour, an important distinction should be made between persuasion and manipulation. When the intended behaviour change is in the interest of the source, but not of the receiver, this is called manipulation. When the intended behaviour change is in the interests of both source and receiver, this is called persuasion (Harré 1985). Persuasion can thus be defined as an intent to change a person's attitudes, beliefs, or behaviour in ways consistent with that person's interests. When booking websites try to persuade their visitors to book a hotel room or a flight, they often apply the scarcity principle by showing messages like 'This is your last chance, there is only 1 room/seat left for this price.' This is persuasion rather than manipulation because we assume that the visitor of the website is searching for a cheap hotel room or flight ticket.

For some people this persuasive element may work better than for others. The reason for this is that the extent to which specific persuasive elements work could be largely determined by one's personality (Kaptein et al. 2009). It has been argued that the relation between type of advice you receive and your personality may have the potential to enhance the impact of persuasive technologies (Berkovsky, Freyne, and Oinas-Kukkonen 2012).

One of the most powerful principles of persuasion is similarity (Tajfel 1982; Wilson and Sherrell 1993). A reason for this is that similarity increases likeability, and a likeable source tends to be more persuasive than an unlikeable one (Chaiken 1980). A source can be likeable for a variety of reasons, and being similar to the receiver is one of those. For example, name similarity leads to an increased willingness to comply with a request for help (Gamer 2005). Even a mere perception of similarity leads to increased liking (Strauss, Barrick, and Connerley 2001). For this reason, similarity is argued to be an important determinant for persuasion (Fogg 2003), and it is regarded as one important design principle for persuasive technology (Oinas-Kukkonen and Harjumaa 2009). Would it be possible to apply this similarity principle to a persuasive message that matches its communication style to the personality of its user? In this paper, we present a study in which effects of system personality and user personality on evaluations and persuasiveness of an online interactive system are investigated.

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1.1. Personalized persuasion

Since the work by Kaptein et al. (2009), research in persuasive technology is shifting from group persuasion towards a more individualised approach. The main argument for this approach is that a strategy that influences the behaviour of one type of person may not have the same effect on another type of person. Indeed, several studies have since shown that persuasive strategies are more effective when they are designed for individuals as opposed to applying a one-size-fits-all design (Kaptein, Lacroix, and Saini 2010; Sakai et al. 2011; Hirsh, Kang, and Bodenhausen 2012; Orji, Vassileva, and Mandryk 2013, 2014; Orji, Mandryk, and Vassileva 2015). For example, people evaluate advertisements more positive evaluations when those advertisements are framed to fit their individual personality type (Hirsh, Kang, and Bodenhausen 2012).

Another approach is to repeatedly try to persuade people to change their behaviour by adapting a persuasive message to the probability of success based on earlier attempts (Sakai et al. 2011). This approach proved to be successful in a field trial in which people were motivated to respond to email reminders (Kaptein and Halteren 2013). This process of personalising persuasive messages from a system is called persuasive profiling (Kaptein et al. 2015). The design of a personalised persuasion system requires that individual users can be identified, different principles of social influence can be presented, personality traits of the users can be measured, and the persuasive message only represents a single principle of social influence (Kaptein et al. 2015).

When there is only a single interaction moment with a user, and the effectiveness of specific social influence techniques is unknown for this user, it is not possible to apply persuasive profiling. In this case, the persuasive strategy can only be adapted to the individual's personality. For this to be effective, knowledge about personality characteristics is still necessary, but that information is relatively easy to obtain by means of a short survey or other type of data collection. One personality characteristic that is relevant for persuasive technology is susceptibility to persuasion, or persuadability. Indeed, persuasive messages have a stronger effect on people high in persuadability than on those low in persuadability (Kaptein, Lacroix, and Saini 2010). This susceptibility to persuasion is shown to be related to various personality characteristics. For example, people who have feelings of personal inadequacy (Janis 1955) or are low in interpersonal confidence (Berkowitz and Lundy 1957) are more likely to be persuaded. On the other hand, people with a high need for cognition are more resistant to changing their newly formed beliefs (Haugtvedt and Petty 1992). These findings show that a number of personality characteristics could predict to what extent an individual is likely to be persuaded. A commonly used model of personality traits is the Five Factor Model of Personality (Digman 1990; Goldberg 1990, 1993).

1.2. Personality and interpersonal dominance

The Five Factor model allows individual personality traits to be identified and to subsequently be divided into five different dimensions. Based on these trait dimensions, persuasive technologies can be personalised to increase their effectiveness for individual users. The model consists of the following five personality traits: Openness to experience, Conscientiousness, Neuroticism, Agreeableness, and Extraversion (Digman 1990; Goldberg 1990). Each of these traits corresponds with specific preferences and behaviours.

People who are high in openness to experience tend to prefer doing new things rather than having routines. Conscientious people are known to be organised rather than spontaneous, and usually show self-discipline. Neuroticism is the tendency to be susceptible to stressful events, and to experience anxiety and depression rather easily. People who are high in agreeableness have a tendency to cooperate rather than compete, and usually have a trusting or even naive nature. Extraversion is also referred to as the power, status, or control factor, and it ranges from submissive to dominant (Friedman and Schustack 1999). People with dominant personalities are more likely to exert power over others, while people with submissive personalities tend to avoid such behaviour (Kiesler 1983).

Dominance is one of the key dimensions of interpersonal communication (Norton 1985). In fact, a relationship between two people can be defined according to the degree of dominance, submissiveness, or equality between the two (Burgoon and Hale 1984). When viewing dominance as an indicator of interpersonal relationships, it can help us understand the interaction dynamics between two people. Interpersonal dominance can thus be defined as an interaction state that reflects influence or control over another through communicative actions (Burgoon, Johnson, and Koch 1998).

A trait that is found to be correlated with a person's interpersonal dominance is masculinity (Wiggins and Broughton 1985). One would therefore expect that gender has an influence on a person's interpersonal dominance orientation. Indeed, analyses of conversations by males and females show that males control topics and interrupt more than females (Fishman 1978; West and Fenstermaker 1993). These effects could be related to

findings on gender differences in influenceability (Eagly 1978; Eagly and Carli 1981). More specifically, women are more persuadable than men in group pressure situations (Eagly and Carli 1981).

1.3. The similarity-attraction paradigm

Irrespective of a person's personality, they are more likely to be persuaded by a similar other than by a dissimilar other (Tajfel 1982; Wilson and Sherrell 1993). The common explanation for this is that people like others who are similar to them (Cialdini 1993). This phenomenon is known as the similarity-attraction paradigm, and can be described as the tendency of people to be attracted to others who are similar to themselves (Kelly 1955; Byrne 1969; Duck and Craig 1978).

The similarity-attraction paradigm has been empirically supported by a large number of studies. For example, perceived similarity is found to be the most significant factor in interpersonal attraction in college students (Newcomb 1956), and mutual friends among high school and college students tend to have similar personality profiles (Izard 1960). Moreover, among the countless studies on spousal relationships, similarity between personality types appears to be a key determinant in marital satisfaction (Murstein 1961; Blazer 1963). Finally, people are more sensitive to persuasion from similar others or members of their in-groups than from dissimilar others (Cialdini 1993; Cialdini and Trost 1998). These findings together show that when someone perceives another person as having a personality that is similar to theirs, they are more likely to be influenced in their attitudes and behaviour by that person.

The similarity-attraction paradigm does not only apply to human-human interactions, but also to interactions between humans and technologies, because those interactions are argued to be fundamentally social (Nass, Steuer, and Tauber 1994). In line with the Computers Are Social Actors (CASA) paradigm (Nass, Steuer, and Tauber 1994), social responses to computers are argued to occur without conscious attention (Nass and Moon 2000). In one particular study, people with dominant versus submissive personalities were randomly matched with a computer with either a dominant or a submissive personality, and results showed that people did not only evaluate the computer with a similar personality more positively, but they were also more satisfied with it (Nass et al. 1995). In other words, people have a stronger affiliation with a system that portrays a personality that is similar to theirs. The question remains whether the similarity-attraction paradigm also influences people's behaviour.

1.4. Research aims

In order to test whether the similarity-attraction paradigm can be applied to persuasive technology, a study was designed that investigates effects of system personality and user personality on evaluations and persuasiveness of an online interactive system. More specifically, we test whether a dominant versus submissive communication style influences people's perceptions and the persuasiveness of an online automated system.

Following earlier findings on masculinity and interpersonal dominance (Wiggins and Broughton 1985; Carli 2013), we expected that males would have more dominant personalities than females. Based on earlier work on the similarity-attraction paradigm (Nass et al. 1995), we hypothesised that people with dominant personalities would have more positive perceptions of the *dominant* system, whereas people with submissive personalities would have more positive perceptions of the *submissive* system.

Based on earlier work on gender differences in susceptibility to persuasion (Eagly and Carli 1981), we also expected females to be persuaded more than males, irrespective of the communication style. Moreover, a system with a dominant communication style was expected to be more persuasive than the same system with a submissive communication style. Finally, we expected the similarity-attraction paradigm to also have an influence on the persuasiveness of the system. More specifically, we expected dominant people to be persuaded more by the dominant system, and submissive people to be persuaded more by the submissive system.

These expectations were tested in an online study in which participants performed a so-called restaurant ranking task. This task was chosen because it enabled us to naturally provide an automated persuasive message with either a dominant or a submissive style. A simplified visualisation of the design of the study is shown in Figure 1, in which we classify both the person and the

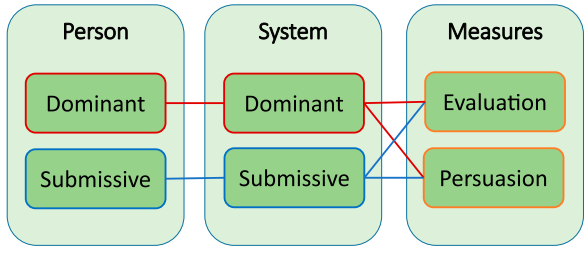

Figure 1. Visualization of the set-up of the study, with person and system dominance as predictors, and system evaluation and persuasiveness as dependent variables.

system to be either dominant or persuasive, and we measure people's evaluations and the persuasiveness of the system.

2. Methods

2.1. Participants and design

One hundred and thirty-one students (72 males and 59 females; age $M = 19.71$, $SD = 1.94$, Range = 17 to 27) sampled from a first year Bachelor course participated in an online experiment about interactions between people and technology. They were randomly assigned to one of two automated systems that varied in Communication Style, being either Dominant ($n = 64$) or Submissive ($n = 67$).

2.2. Materials

2.2.1. Restaurant ranking task

As part of the experiment, participants performed the restaurant ranking task adopted from Andrews and Manandhar (2009). This task was chosen for multiple reasons. First, it allows us to apply different communication styles in a controlled online environment. Second, it can be used as a measure for belief change in which a persuasive appeal is used to change existing preferences. In the task, participants were presented a scenario in which they were asked to imagine that they were going to have dinner with a friend, and that they wanted to pay at most €50 per person. After that, they would be shown five different restaurants with their attributes. These attributes included food quality, service quality, cost, décor, and whether it was their imaginary friend's favourite cuisine. After reading the information about each of the five restaurants (for an example, see Figure 2), participants were asked to rank their top three restaurants out of the list of five options, which would lead to their initial ranking.

On the next page, participants were shown an automated message that was designed to persuade them to flip the order of their top three restaurants. Half of the participants received this message with a dominant style, the other half received a submissive one. All participants were told that the message was coming from the chief editor from EatHelp, a fictional restaurant recommendation website. The messages were created based on earlier work on computer personalities (Nass et al. 1995). More specifically, participants in the Dominant condition encountered a chief editor named 'Max' who was displaying strong language expressed in the form of assertions and commands with a bold, sans-serif typeface. An example of such a message is shown below. The words between brackets varied based on the choices participants made and the characteristics of those choices.

> You have chosen [Del Posto] as your top preference. However, you will definitely ruin the dinner if you keep it as your best choice! Think about it: [this restaurant has the worst service quality]! It is absolutely unacceptable to make such a mistake!

Participants in the Submissive condition encountered a chief editor named 'Linus' who was displaying weaker language expressed in the form of questions and suggestions with an italicised, serif typeface. An example of such a message is shown below.

> You have chosen [Del Posto] as your top preference. However, would you please allow me to remind you that [the service quality in this restaurant is not good]? Perhaps you would like to reconsider your top preference?

This manipulation allowed us to have two different interaction styles that reflect system personality, one dominant and one submissive. At the same time, the message itself was the same in both conditions: participants were encouraged to flip the order of their initial preference. A such, the extent to which participants changed their preferences could be used as a measure of belief change, or persuasiveness.

After reading the persuasive message from the chief editor of EatHelp, participants were given the option to change their initial ranking of the restaurants. This option was given on the same page as the persuasive message to have that message visible the whole time. Participants had to re-enter their top three preferences, this

Figure 2. Description of one of the five options in the restaurant ranking task. Each of the options had different characteristics as indicated by the star ratings.

time choosing from the three restaurants they had picked in the previous step, leading to their final ranking.

2.2.2. Persuasiveness

In order to measure persuasiveness of the system, the difference between the initial and final rankings was calculated by counting how often two options should be switched between the initial and final rankings. When for example a participant's initial ranking was A, B, C, and the final ranking was B, A, C, persuasiveness would be 1, because there is one switch needed between A and B to derive the final ranking. If the initial ranking was A, B, C, and the final ranking was B, C, A, persuasiveness would be 2, because there are two switches needed, first between A and B, and then between A and C. The bigger the difference between initial and final rankings, the more a participant was convinced by the system to change their beliefs. Since there was a maximum of three switches possible, the variable Persuasiveness ranged from 0 to 3. An overview of the number of switches that is needed between every initial and final ranking is presented in Table 1.

2.2.3. Interpersonal dominance

A concept that is highly correlated with interpersonal dominance is masculinity (Wiggins and Broughton 1985). To measure masculinity, a list of 20 personality characteristics was adopted from Locke's(2000) BSRI masculinity scale. These characteristics measured the extent to which participants see themselves as dominant, having leadership abilities, and having a strong personality. All items are shown in Table 2. Participants were asked to what extent each of those characteristics fitted their personality on a 7-point scale, ranging from 1 'not at all' to 7 'completely' (Cronbach's $\alpha = .86$). Responses on the scale were averaged to form a score for Interpersonal Dominance.

2.2.4. System perception

Perceptions of the online system were measured with six 7-point scales adopted from earlier work on perceptions of computers (Nass et al. 1995). Four of the scales measured how participants perceived the system itself. Dominance measured the extent to which the system was perceived as assertive and forceful (9 items, Cronbach's $\alpha = .76$), Submissiveness measured the opposite: the extent to which the system was perceived as shy and timid (5 items, Cronbach's $\alpha = .76$). Affiliation focused on the system's likeability (4 items, Cronbach's $\alpha = .94$). Competence consisted of items such as intelligence and credibility (11 items, Cronbach's $\alpha = .93$). The complete list of items is shown in Table 2. A so-called Index of System Power Dynamic was created by calculating the difference between the Dominance and Submissiveness scores. Higher values on this index represent a more dominantly perceived system.

The other two scales measured how people perceived the interaction they had with the system. Satisfaction consisted of items such as enjoyable and satisfying (7 items, Cronbach's $\alpha = .91$), and Benefits contained items that indicated the extent to which the system was helpful, useful, and informative (3 items, Cronbach's $\alpha = .89$). Answers on all six scales were averaged to form separate scores of system perception.

Table 1. Persuasiveness as the difference between initial and final ranking.

Initial order	Final order	Persuasiveness
A,B,C	A,B,C	0
A,B,C	B,A,C	1
A,B,C	A,C,B	1
A,B,C	B,C,A	2
A,B,C	C,A,B	2
A,B,C	C,B,A	3

Note: The number represents the number of switches needed to transform the initial ranking into the final ranking.

Table 2. Overview of all the items on the scales used in the experiment.

Scale	Items
Masculinity	Self-reliant; Defend my own beliefs; Independent; Athletic; Assertive; Forceful; Strong personality; Analytical; Willing to take risks; Dominant; Self-sufficient; Aggressive; Make decisions easily; Have leadership abilities; Masculine; Ambitious; Willing to take a stand; Act as a leader; Individualistic; Competitive
Dominance	Aggressive; Assertive; Defends his beliefs; Dominant; Forceful; Independent; Makes decisions easily; Analytical; Competitive
Submissiveness	Submissive; Unaggressive; Yielding; Shy; Timid
Affiliation	Friendly; Likeable; Sympathetic; Warm
Competence	Intelligent; Knowledgeable; Rational; Insightful; Credible; Competent; Clever; Helpful; Efficient; Conscientious; Reliable
Satisfaction	Engaging; Enjoyable; Exciting; Fun; Interesting; Involving; Satisfying
Benefits	Helpful; Useful; Informative

2.3. Procedure

The experiment was performed online. On the first page, participants were informed about the goal of the experiment and they gave informed consent by clicking a 'Continue' button. After this, participants indicated their age and gender (which was used for counterbalancing the number of male and female participants in each condition).

Next, they arrived at the page with instructions about the scenario and the restaurant ranking task. After reading these instructions and all information about the five restaurants, participants made their initial ranking. They were then confronted with either the dominant or the

submissive persuasive message from the chief editor of EatHelp. After reading the persuasive message, participants indicated their final ranking and finished the task.

On the next page, participants completed the scales and were thanked for their contribution in the experiment. They were debriefed about the goal of the experiment and presented with the results in one of the next lectures in the course. Participants were not compensated financially for their participation.

2.4. Analyses

In order to test our hypotheses, we will follow the following statistical approach. We will first test whether our manipulation was successful by checking whether the dominant system was perceived as more dominant than the submissive system. Next, we test whether a difference exists in dominance between males and females. Both these expectations will be tested with an independent samples t-test.

Next, we will test whether the similarity-attraction paradigm works in terms of participants' perceptions of the system by submitting all evaluations (Affiliation with the system, Competence of the system, Satisfaction with the system, and Benefits of the system) to a Multivariate General Linear Model with Communication Style and Person Dominance as predictors.

In terms of persuasiveness of the system, we will test our hypothesis that the dominant system is more persuasive than the submissive one. A Chi-square test of independence will indicate whether participants are more likely to change their ranking in the dominant condition than in the submissive one. A Kendall rank correlation coefficient will indicate whether the *extent* to which participants change their ranking differs between the dominant and submissive systems. The same analysis will be used to test whether people with submissive personalities are persuaded more than people with dominant personalities, irrespective of the communication style of the system, and to test whether females are persuaded more than males.

Next, we will test whether the similarity-attraction paradigm works in terms of persuasiveness of the system with an ordinal regression (note that Persuasiveness is an ordinal variable with more than 2 levels). Finally, we perform exploratory analyses that may provide new insights into the relationship between person and system dominance.

3. Results

3.1. Manipulation check

To test whether the manipulation was successful and the dominant system was indeed perceived as more dominant than the submissive one, Index of System Power Dynamic was submitted to an independent samples t-test with the two communication styles of the system as groups. Results showed that the manipulation was successful: the dominant system ($M = 2.00$, $SD = 1.53$) was perceived as more dominant than the submissive one ($M = 1.46$, $SD = 1.60$), $t(129) = 1.94$, $p = .05$, Cohen's d=0.34, see Figure 3(a).

3.2. Interpersonal dominance and gender

To test the hypothesis that males would have more dominant personalities than females, Interpersonal Dominance scores were submitted to an independent samples t-test with males and females as groups. Results supported the hypothesis, showing that males ($M = 4.66$, $SD = 0.65$) had more dominant personalities than females ($M = 4.36$, $SD = 0.73$), $t(129) = 2.55$,$p = 0.01$, Cohen's $d = 0.45$, see Figure 3(b).

3.3. Perceptions of the system

To test the hypothesis that people with dominant personalities would have more positive perceptions of the dominant system, and that people with submissive personalities would have more positive perceptions of the submissive system, we analysed whether perceptions of the system differed between the two communication styles. A dummy variable called Person Dominance was created by splitting the sample in half based on Interpersonal Dominance scores. Participants with Interpersonal Dominance scores above the mean ($n = 62$) were classified as dominant, and those with scores below the mean ($n = 69$) were classified as submissive.

Next, scores on Affiliation, Competence, Satisfaction, and Benefits were submitted to a Multivariate General Linear Model with Communication Style and Person Dominance as predictors. No significant interaction effects were found on any of the measures. The pattern of responses was however in the expected direction for all indices, see Figure 4. As can be seen in this figure, dominant participants (blue bars) scored higher on all indices for the dominant system, while submissive participants (red bars) scored higher on all indices for the submissive system.

3.4. Persuasiveness of the system

To test the hypothesis that the dominant system would be more persuasive than the submissive one, we analysed whether participants in the Dominant condition were more likely to change their initial rankings than those in

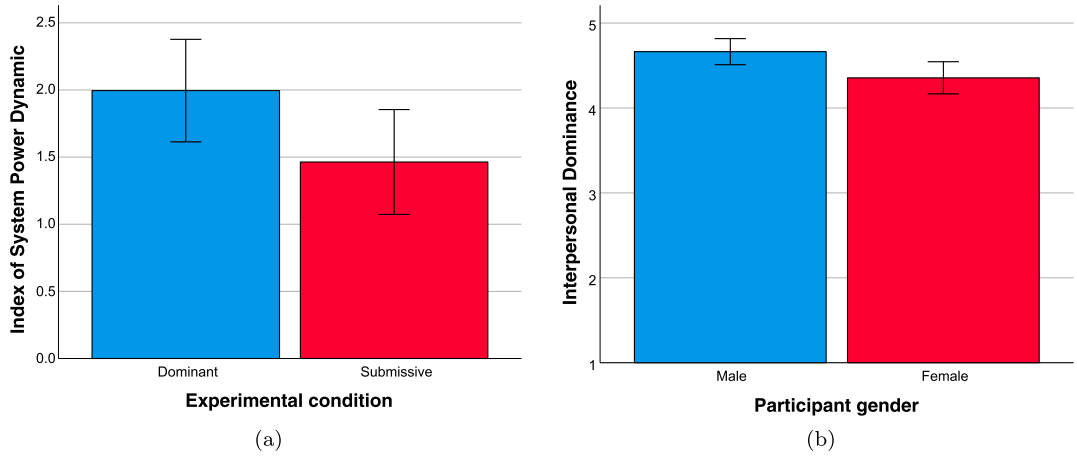

Figure 3. Visualization of (a) the Index of System Power Dynamic per Communication Style and (b) Interpersonal Dominance per Participant Gender. Whiskers represent 95% Confidence Intervals.

the Submissive condition. A Chi-square test of independence was calculated comparing the frequency of changing initial rankings per experimental condition. A significant interaction was found ($\chi^2(1) = 6.58, \ p = 0.01$). More specifically, in the Dominant condition, the number of participants who did not change their ranking (34) was about the same as the number of participants who did change it (30), whereas in the Submissive condition, the number of

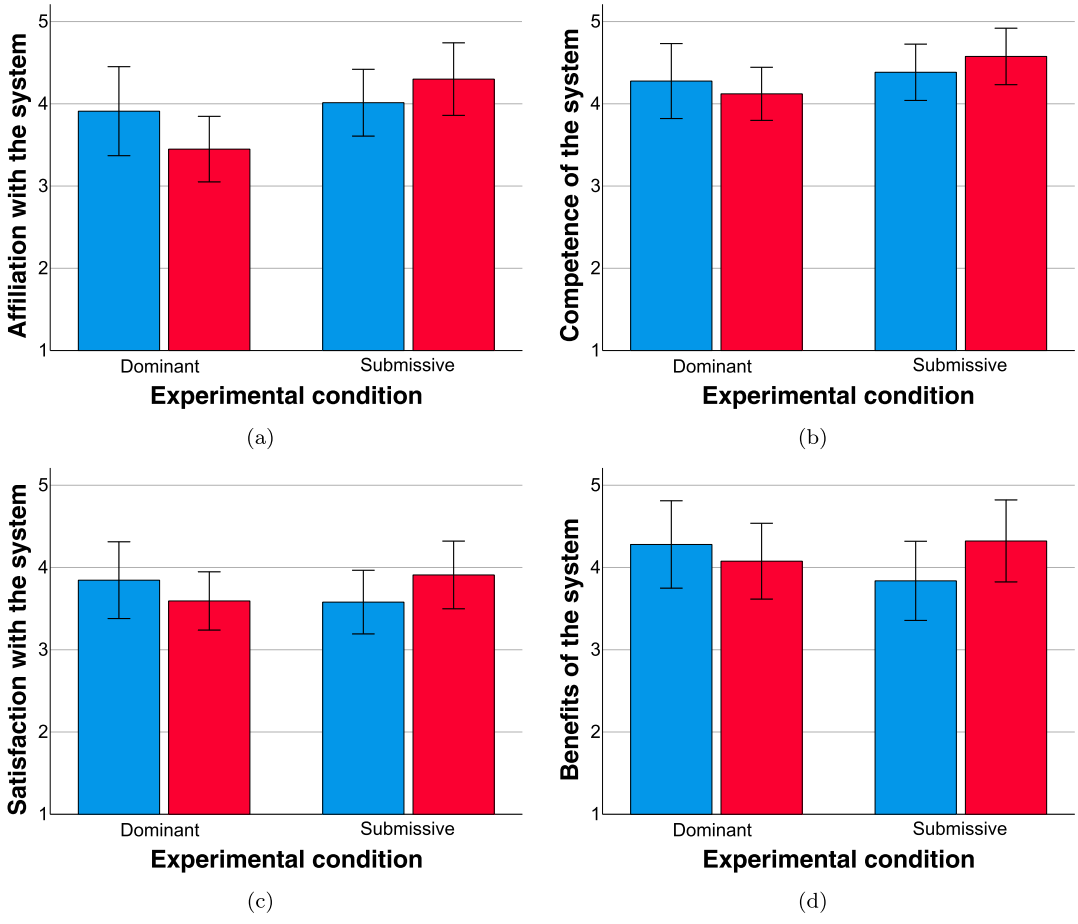

Figure 4. Visualization of the interaction between Communication Style and Person Dominance on (a) Affiliation with the system, (b) Competence of the system, (c) Satisfaction with the system, and (d) Benefits of the system. Blue bars represent participants with a dominant personality, and red bars indicate participants with a submissive personality. Whiskers represent 95% Confidence Intervals.

participants who did not change their ranking (50) was much higher than the number of participants who did change it (17).

Next, we tested whether the *extent* to which participants changed their ranking also differed between the two Communication Styles. This relationship was tested with Kendall's τ because Persuasiveness is an ordinal variable, making it unsuitable to perform a t-test or an ANOVA. Results showed that the relationship was significant, $r_\tau = .20$, $p = .02$. As can be seen in Figure 5 (a), the number of participants who did not make any change in their ranking is higher in the Submissive condition, while the number of participants making one or two changes after their initial ranking was higher in the Dominant condition. The number of participants who completely flipped their ranking was about the same in both conditions.

To test the hypothesis that people with more submissive personalities would be persuaded by the system more than those with dominant personalities, we analysed the relationship between Person Dominance and Persuasiveness. This relation was also tested with Kendall's τ. Results showed that this relationship was significant, $r_\tau = .17$, $p = .04$. As can be seen in Figure 5(b), participants with dominant personalities ($M = 0.47$, SD $= 0.92$) were persuaded less than those with submissive personalities ($M = 0.72$, SD $= 0.97$).

3.5. Persuasiveness and gender

To test the hypothesis that females would be persuaded more than males, we analysed the relationship between Persuasiveness and Gender. This relation was also tested with Kendall's τ. Results showed that there were no differences in Persuasiveness between the two genders, $r_\tau = .02$, *ns*, indicating that males ($M = 0.63$, SD $= 0.97$) and females ($M = 0.58$, SD $= 0.93$) were equally likely to be persuaded.

3.6. Persuasiveness and the similarity-attraction paradigm

To test the hypothesis that the similarity-attraction paradigm leads to changes in people's behaviour, Persuasiveness was submitted to an ordinal regression analysis. Note that Persuasiveness is an ordinal dependent variable with more than two levels (in our case 4 levels, ranging from 0 to 3). Therefore ordinal regression is the best analytic approach. The proportional odds model did not significantly support the expected relationship between the two predictors and Persuasiveness, $\beta = 0.48$, Wald statistic $= 0.17$, *ns*. This result indicates that there was no interaction between Communication Style and Person Dominance on Persuasiveness.

3.7. Exploratory analyses

Splitting the sample in half based on people's Interpersonal Dominance scores systematically reduces predictor variance. We therefore decided to also test the similarity-attraction paradigm with the continuous variable Interpersonal Dominance as predictor.

To test whether the similarity-attraction paradigm influenced participants' Affiliation with the system, a multiple linear regression analysis was performed with Communication Style and Interpersonal Dominance as predictors. Results showed that Communication Style and Interpersonal Dominance together explained a significant proportion of variance in Affiliation, $R^2 = .06$, $F(2, 128) = 3.79$, $p = .03$.

As can be seen from the regression lines in Figure 6, participants with low Interpersonal Dominance felt

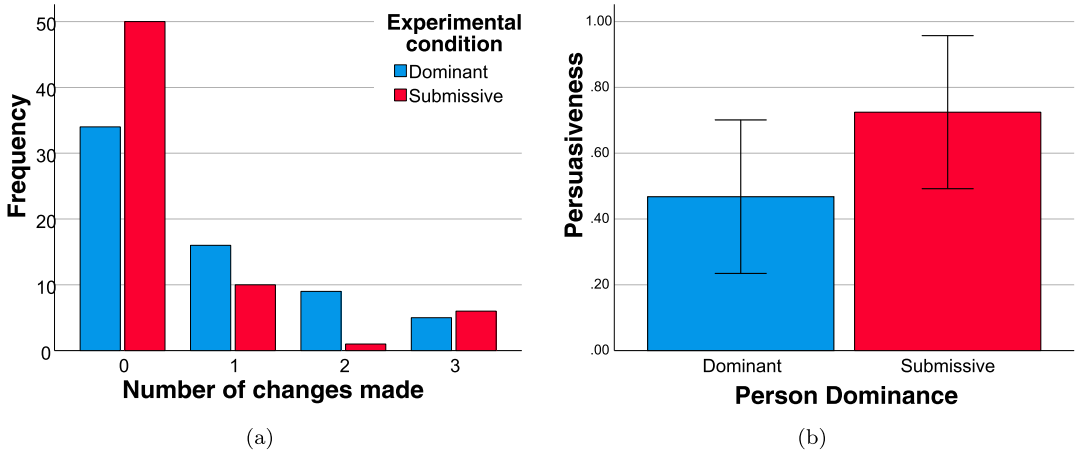

Figure 5. Visualization of (a) the number of changes made per experimental condition and (b) the Persuasiveness per Person Dominance. Whiskers represent 95% Confidence Intervals.

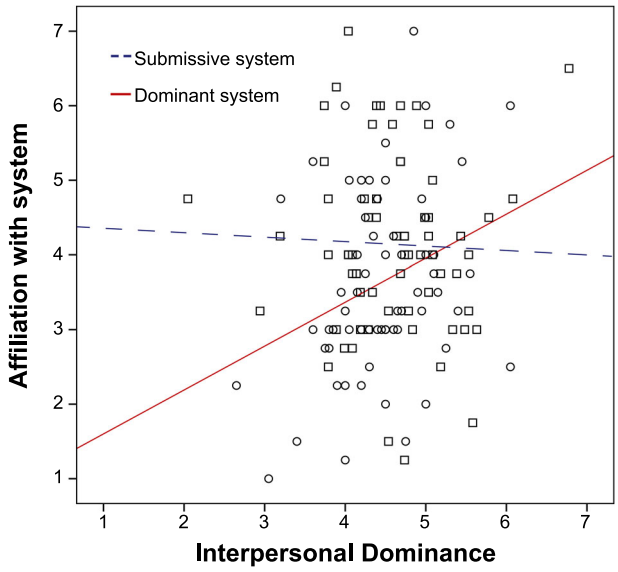

Figure 6. Visualization of two overlaying scatter plots of Interpersonal Dominance and Affiliation, one for each experimental condition. The circles and the red line represent data from participants who encountered the dominant system. The squares and the blue line represent data from participants who encountered the submissive system. The lines represent regression lines for the two experimental conditions.

more affiliation towards the submissive system, whereas participants with high Interpersonal Dominance felt more affiliation towards the dominant system.

To test whether the same effect occurred on Persuasiveness, we performed an ordinal regression analysis with Communication Style and Interpersonal Dominance as predictors. The proportional odds model did not significantly support the expected relationship between the two predictors and Persuasiveness, $\beta = 0.17$, Waldstatistic $= 0.20$, *ns*. This result indicates that there was no interaction between Communication Style and Interpersonal Dominance on Persuasiveness.

4. Discussion

The current study was designed to investigate whether the similarity-attraction paradigm can be applied to persuasive technology. To do so, we analysed effects of system communication style and user personality on evaluations and persuasiveness of an online interactive system. There were five hypotheses that can be split into three categories.

In terms of the personality of the participants, we expected that males would have more dominant personalities than females. In terms of the persuasiveness of the system, we expected females to be persuaded more than males, irrespective of the system's communication style. We also expected that the dominant system would be more persuasive than the submissive one. In terms of the similarity-attraction paradigm, we expected an interaction between the system's communication style and the person's personality. More specifically, we expected that people would have more positive evaluations of and be persuaded more by a system that matched their personality in terms of dominance. All expectations were tested in an online study in which participants performed a so-called restaurant ranking task. The next sections will discuss the findings per category of hypotheses.

4.1. Personality of the participants

Based on earlier work on masculinity and interpersonal dominance (Wiggins and Broughton 1985; Carli 2013), we expected that males would have more dominant personalities than females. This expectation was confirmed. It should not come as a surprise that men tend to have more dominant personalities than women, because dominance and power are rooted in our social systems. As Kaufman puts it, 'it [power] forms part of the core of religion, family, forms of play, and intellectual life' (Kaufman 1994, 59). As a consequence of this, men seem to display more power than women on masculine tasks as well as non-gender-linked tasks (Dovidio et al. 1988). The display of power is however not enough to exert influence over others, one also needs to possess task competence (Van Vugt 2006). However, merely behaving in ways to appear competent increases the influence people have on others, and it is individuals high in trait dominance who tend to behave in such ways (Anderson and Kilduff 2009).

4.2. Persuasiveness of the system

Following earlier work on gender differences in susceptibility to persuasion (Eagly and Carli 1981), we expected females to be persuaded more than males, irrespective of the system's communication style. Results did not support this expectation, showing no difference in the extent to which males and females were persuaded. One explanation for this could be that the persuasiveness of the system was rather low for both genders (just above 0.5 on a scale ranging from 0–3). However, differences in persuasiveness of the system were found between the two communication styles and between the two types of people based on interpersonal dominance. Another explanation for not finding the gender effect on persuasiveness is that there was no group pressure situation. Earlier research showed that women are more persuadable than men in group situations (Eagly and Carli 1981), but the interaction in our study was a one-on-one interaction.

Another explanation for the fact that we did not find a gender effect on persuasion could be that the interaction people had with the system was very short. The importance of understanding long-term effects of persuasive technology has been stressed before (IJsselsteijn et al. 2006; Reitberger et al. 2010), but they are still hardly investigated. Additionally, persuasion was measured with a single decision-making task, and not over a series of decisions made over time. While a single decision shows a direct persuasive effect, a longer series of decisions would be a more realistic representation of a persuasive system. In order to better understand the effectiveness of persuasive technology in the form of personalised persuasion, future studies should be designed to investigate these long-term effects.

We expected a dominant communication style to be more persuasive than a submissive one. This expectation was confirmed, indicating that a system that displayed strong language in the form of assertions was more likely to influence people's behaviour than a system that displayed weaker language in the form of questions and suggestions. This effect could be explained by people's tendency to obey orders from authority figures (Milgram 1963). Similar to some of the Milgram studies, the dominant system used phrases such as 'you will definitely ruin the dinner' or 'it is absolutely unacceptable to make such a mistake'. This type of language could have made participants more likely to obey and thus change the order of their preferred restaurants.

The rudeness of the messages could also explain why participants felt more affiliation towards the submissive system than towards the dominant one. This finding poses an interesting design challenge. Much work in the domain of persuasive technology is performed with the aim to develop and design systems that can influence a person's behaviour, while at the same time providing a pleasant interaction. Our findings show that the most persuasive system is also the least likeable one, which is of course an unwanted side-effect.

This lack of likeability for the dominant system could potentially even harm the persuasiveness of the system, since source likeability is shown to be a crucial determinant of persuasion (Roskos-Ewoldsen and Fazio 1992). Indeed, earlier research did show that computers that flatter their users are liked more than those that do not flatter (Fogg 1998), opening up the way towards effective persuasion. In contrast to this, the current study shows that the less likeable system was the more persuasive one. It should be noted however that the average values of affiliation scores were around the midpoint of the scale, indicating that the dislike experienced by people who encountered the dominant system was not that strong.

4.3. Similarity-attraction paradigm

Based on earlier work on the similarity-attraction paradigm (Nass et al. 1995), we expected an interaction between the system's communication style and the person's personality. More specifically, we expected that people with dominant personalities would have more positive perceptions of and be more persuaded by the *dominant* system, whereas people with submissive personalities would have more positive perceptions of and be more persuaded by the *submissive* system.

These expectations were partially confirmed. When splitting the sample in half based on people's interpersonal dominance, no significant interaction between communication style and person dominance was found on either people's evaluations of the system or the system's persuasiveness. When the sample was not split in half, however, such an interaction was found on people's affiliation with the system. The dominant system appeared to be more positively evaluated by people with more dominant personalities, whereas the submissive system appeared to me more positively evaluated by people with more submissive personalities. While this result is in line with earlier work on the similarity-attraction paradigm in the domain of human-computer interaction (Nass et al. 1995), they fail to show similar effects on people's actual behaviour. As stated before, the interaction people had with the system was also rather short, thereby reducing the possibility for the situation to become pressurised.

Another explanation for not finding effects of the similarity-attraction paradigm on people's behaviour could be the change in tone between the persuasive messages: whereas the submissive message was phrased as a kind reminder, the dominant one used much stronger (negative) language. The importance of tone and language of persuasive messages was already discussed by Fogg, who stated that language can serve multiple purposes, one of which is to elevate the mood of the user to make a request more fun and seem easy (Fogg 2003). This could also explain why people felt more affiliation towards the submissive system than towards the dominant one, while no differences between the two systems were found on any of the other indices of system perception.

4.4. Limitations and future work

This study was performed with a rather heterogeneous group of students, with 90% of them being 22 or younger, and all of them sampled from a single University course. This makes it hard to generalise our findings

to other target groups in specific e-coaching or health domains. An important next step is thus to extend our findings into different target groups and to include more personality traits in the system. For example, a study on the relation between a person's personality (measured on the Five Factor model of personality, see John, Donahue, and Kentle 1991) and their perceptions of persuasive technology showed a number of interesting correlations (Halko and Kientz 2010). It could thus be beneficial for a persuasive system to adapt its messages to match users' specific personality traits (Halko and Kientz 2010).

This adaptation was not possible because there was only one single interaction between the user and the system. It was therefore not possible to use multiple social influence techniques to find the most effective one, as was done in earlier work (Kaptein and Halteren 2013; Kaptein et al. 2015). This one-time interaction could also explain the low persuasiveness of the system on average (with all averaged scores below 1 on a scale from 1-3). Future work should be designed to include multiple interactions with a system, such that a higher persuasiveness can be achieved.

Another limitation is that the interaction with the system was a one-way interaction, in which the system provided a message, but the user was not able to respond or give reasons for not changing her mind. If a user is given the opportunity to respond or to explain their decisions, they may also be more likely to pay attention to the content of the persuasive message. This in turn would activate the central route of persuasion (Petty and Cacioppo 1986). When a person carefully reads the content of a persuasive message, they are more likely to be influenced through this central route (Oinas-Kukkonen and Harjumaa 2008). This could cause a negative message to backfire, but when a person relies on simple cues, they are more likely to be influenced though the peripheral route (Oinas-Kukkonen and Harjumaa 2008), making the content of the message less important. Since the content of the message is the only thing we can easily manipulate, a persuasive system may benefit from persuading its users through the central route of persuasion.

5. Conclusion

The current study was designed with the aim to extend earlier work on the similarity-attraction paradigm by including effects on persuasion. The paradigm appears to influence the effectiveness of persuasive technology, but only in terms of people's evaluations of the system. Nevertheless, a personalised persuasive interface that adapts its communication style to match the user's personality could be perceived more positively, and a system that is perceived more positively is more likely to be used and accepted by consumers of interactive technologies.

Our findings highlight the importance of similarity when it comes to the design of persuasive technologies. In a time where more data is gathered about the users of interactive technologies, it is not a big step to use these data for adapting those technologies to a specific user. Although it is hard to predict whether the effects found in the current study also work in real-world settings, we hope that the work in this paper can ultimately help creating technologies that successfully adapt their persuasive messages to their users.

Disclosure statement

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

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