Influencing the Others' Minds: An Experimental Evaluation of the Use and Efficacy of Fallacious-Reducible Arguments in Web and Mobile Technologies

Antonio Lieto[*1] and Fabiana Vernero[*2]

[1]Università degli Studi di Torino
ICAR – CNR, Palermo (Italy)

[2] Università degli Studi di Torino
(Italy)

ABSTRACT

The research in Human Computer Interaction (HCI) has nowadays extended its attention to the study of persuasive technologies. Following this line of research, in this paper we focus on websites and mobile applications in the e-commerce domain. In particular, we take them as an evident example of persuasive technologies. Starting from the hypothesis that there is a strong connection between logical fallacies, i.e., forms of reasoning which are logically invalid but psychologically persuasive, and some common persuasion strategies adopted within these technological artifacts, we carried out a survey on a sample of 175 websites and 101 mobile applications. This survey was aimed at empirically evaluating the significance of this connection by detecting the use of persuasion techniques, based on logical fallacies, in existing websites and mobile apps. In addition, with the goal of assessing the effectiveness of different fallacy-based persuasion techniques, we performed an empirical evaluation where participants interacted with a persuasive (fallacy-based) and with a non-persuasive version of an e-commerce website. Our results show that fallacy-based persuasion strategies are extensively used in existing digital artifacts, and that they are actually effective in influencing users' behavior, with strategies based on visual salience manipulation (*accent* fallacy) being both the most popular and the most effective ones.

Keywords: *Mobile persuasion, web persuasion, logical fallacies, captology, e-commerce.*

1. Introduction

In the last decade several studies in the field of Human-Computer Interaction (HCI) have started to focus attention on forms of persuasive interaction where the goal of one of the two agents involved in the process, namely, the technological artifact, is that of "orienting" the attitudes and/or behaviors of the other agent (the user) according to a

---

[*]Corresponding Author:
Antonio Lieto
Università degli Studi di Torino, c.so Svizzera 185, 10149, Torino
E-mail: alieto@acm.org

predefined direction. It has long been pointed out that digital artifacts which are perceived as *social actors*, i.e., which elicit social responses and emotional involvement on the part of their users, can apply similar persuasion strategies to those used in human-human interaction (Fogg, 2003). Similarities in the arguments used by persuasive technologies and human persuaders, however, are not limited to the cases where computers are perceived as almost-living entities. In this paper, we start from the hypothesis, first formulated in our previous work (Lieto and Vernero, 2013), that there is a strong connection between *logical fallacies* (forms of reasoning which are logically invalid but cognitively effective, studied since the antiquity in the fields of logics and rethorics) and some of the most common persuasion strategies adopted within digital technologies. We present the results of two studies: a survey carried out in the e-commerce domain, aimed at ascertaining the use of persuasion techniques based on logical fallacies in existing websites and mobile apps, and an empirical evaluation where we compare user choices in a persuasive (fallacy-based) and in a non-persuasive website, with the goal of assessing the effectiveness of different fallacy-based persuasion techniques. The rest of the paper is organized as follows: Section 1 introduces the theme of fallacies; Section 2 presents a short introduction to captology and to the description of the connections we identified between fallacious arguments and some of the techniques used in persuasive technologies; Sections 3 and 4 present, respectively, our survey and our empirical evaluation, and discuss the results we obtained. Finally, our conclusions and a discussion of future work are presented in Section 5.

2. Arguments in Logics

Logic[1] is "the discipline studying the theory of valid inferences[2]. An inference is composed by a set of initial propositions (premises) from which other propositions (conclusions) are derived. All the valid rules of classical logic are based on deductive inferential schemes where the conclusion C is a logical consequence of the set of premises ‹P1, Pn›. An example of deductive inference is the following:

P1: *All the men are mortal*

---

[1] Here with this term we refer to the classical formal logic.
[2] For the sake of simplicity, we will consider here the term "inference" as a synonym of the term "argument" (Nolt et al., 1998).

P2: *Socrates is a man*

C: *Socrates is mortal*

However, not all the inferences are deductive and, therefore, logically valid (Cohen, Cohen and Nagel, 1993). There are, in fact, several types of inductive[3] inferences where the conclusion does not logically follow from the premises. An example of inductive inference is shown below:

P: *All the Mexicans that I know love Voltaire's books*

C: *Mexicans love Voltaire's books*

Within the class of inductive inferences, logical fallacies enjoy a special status. In fact, they are inferences that, "even if invalid from a formal point of view, appear as plausible and therefore are psychologically persuasive" (Cohen et al., 1993; Hamblin, 1970). According to this definition, then, not all inductive inferences can be considered as fallacious. An important aspect to point out regards the connection between inferential validity and rationality: a fallacious argument, in fact, is not necessarily "irrational". Indeed, since the psychological/cognitive aspect plays a crucial role in the dynamics of persuasion, a fallacious argument is usually an invalid argument endowed with psychological plausibility and a proper heuristic value.

From an historical perspective, the study and classification of logical fallacies goes back to the Philosopher in the *De Sophistichis Elenchis* (Aristotle, 1995). During the centuries different research areas such as logic, rhetoric and argumentation theory dealt with the problem of fallacies, pointing out that fallacious arguments are suitable to be used as techniques for achieving persuasive goals (Perelman, Olbrechts-Tyteca and Meyer, 1958). In addition, it is worth mentioning the attempts that, during the centuries, different scholars have pursued in order to design "persuasive machineries" or mechanisms able to influence the human audiences through the presentation of particular combinations of logical and paralogical arguments. Examples of this case are the *Ars Magna* of Ramon Llull (Bonner, 1985), that later widely influenced also the works of Giordano Bruno and Gottfried Leibniz.

In the last 30 years, in the field of argumentation theory, a number of criticisms have been raised about the use of classical logic as an instrument for the analysis of

---

[3] For the sake of simplicity, here we will refer to all the inferences that are not deductive with the term "inductive inference". Therefore even the abduction, in this case, can be ascribed to the category of "inductive   inferences".

fallacious arguments, and some alternative solutions have been proposed in order to justify the use of such arguments in certain contexts (e.g. in the case of the "New Dialectic" approach proposed by Douglas Walton (Walton, 1995). However such criticisms have, in our opinion, some limits. More specifically: i) they do not allow to characterize the difference between fallacies, errors, and weak arguments, and (ii) the risk of "relativism" seems to be around the corner since these approaches hypothesize contexts where the traditional fallacies are no more considered "fallacious". For these reasons, in the following, we present the link individuated between fallacious arguments and persuasive technologies.

3. Fallacies and Persuasive Technologies

In the Nineteen Nineties, B.J. Fogg (Fogg, 2003) coined the term "captology" as an acronym for the expression "Computers As Persuasive Technologies", to describe a research area which regards computer technologies as potential persuaders and focuses on both their analysis and their design. According to Fogg, persuasion can be defined as an attempt "to change attitudes or behaviors or both (without using coercion or deception)" (Fogg, 2003). Following on from this definition, all computer technologies which are purposely designed with the aim of changing their users' attitudes or behaviors can be considered as persuasive (Fogg, 2003).

In the field of captology, the above mentioned connection between fallacies and technology-based persuasion has been firstly pointed out in our previous work (Lieto and Vernero, 2013), where we carried out a preliminary investigation, aimed at recording the use of different fallacy-based persuasion strategies in existing e-commerce websites. However, to the best of our knowledge, there is still lack of wider empirical studies, performed on different technological environments, aimed to confirm (or disconfirm) such an hypothesis.

The analysis on mobile apps and websites presented in this paper can be seen, then, as an effort to provide a wider empirical framework to the assumptions that were proposed in (Lieto and Vernero, 2013).

In the rest of this section we will present the connections that we identified between some well-known logical fallacies and some of the techniques used in the field of persuasive   technologies.

The logical fallacy known as *argumentum ad populum*, or "appeal to the majority", consists in accepting a certain thesis based on the mere fact that most people accept it. A typical example of such a fallacy is: "Most people like a certain book, then that book is worth-reading".

This fallacy can be compared to those strategies, commonly used in the realm of persuasive technologies, which owe their persuasive potential to the exploitation of social dynamics. For example, technologies which grant access to social networks can leverage influence dynamics among peers to stimulate their users to attain certain goals. More specifically, Fogg refers to well-known social psychology theories, such as social comparison and conformity (Turner, 1991), which can be applied to computer technologies. According to social comparison theory, for example, people who are uncertain about the way they should behave in a situation actively seek information about others and use such information to form their own attitudes and behaviors. Conformity theory, on the contrary, focuses on normative influence, claiming that people who are part of a group usually experience a pressure to conform to the expectations of the other members of their group.

A further commonality with fallacies can be found focusing on the discussion about credibility that characterizes the area of persuasive technologies (Fogg, 2001). The perceived credibility (and, therefore, persuasiveness) of both people and computers is known to be affected by the so-called *halo effect* (Dion, Berscheid and Walster, 1972), according to which a positive evaluation with respect to a certain feature (e.g., physical attractiveness) produces a "halo" which causes an extension of such an evaluation to other, unrelated, features (e.g., expertise).

Similarly, the fallacy of *argumentum ad verecundiam* (also "appeal to authority") refers to cases where some theses are assumed to hold based on the fact that the person asserting them is wrongly assumed to be an authority about the topic of the discourse because of his/her achievements in other, unrelated, fields. An example of such a fallacious argument is the following: "the economist X claims that vegan diet is dangerous for our health. Therefore: it is wrong to follow vegan diets".

Technologies which implement *tailoring* techniques are persuasive because they provide each individual with the information they are likely to find the most interesting, based on their personal preferences, goals and experience. Obtaining personalized information does not only save users the effort to examine an overwhelming amount of content, but it is also more likely to draw their attention and, in case the so-obtained information is accepted, it can determine deeper and longer-lasting changes. Various

personalization techniques are commonly adopted in adaptive systems and in recommender systems, such as collaborative and content-based filtering (Adomavicius and Tuzhilin, 2005). Personalization techniques can be considered fallacious because they are based on the assumption that (i) people will maintain their past preferences in the future (content-based filtering) or that (ii) people who have proved to have similar preferences in the past will maintain this similarity also in the future (collaborative filtering), which, although being probable, cannot be taken for granted.

Tailoring can be compared to the so-called *audience agreement* technique, which is well known in rhetoric and theory of argumentation (Perelman et al., 1958). According to this technique, persuaders should only use arguments which have already been accepted by their audience in order to be effective.

Differently, according to the *argumentum ad consequentiam*, a proposition is accepted based on the desirability or undesirability of its consequences (a positive example of this fallacy is: "If there is an afterlife, then we will meet our loved ones again. Therefore: there must be an afterlife").

In the field of persuasive technologies, allowing users to explore cause-and-effect relationships is a well-known technique, which exploits the possibility to offer computer simulations where users can manipulate certain inputs (e.g., their daily food intake) and observe their consequences (e.g., changes in their weight) (Fogg, 2003). Prominent examples which show how cause-and-effect simulations can be used with persuasive effects can be found in environmentalist websites which allow users to calculate their ecological footprint (i.e., the number of planets which would be needed if everyone lived like them) based on their lifestyle and consumption habits. Similarly, in some online shops, users might be able to virtually try on a piece of clothing in order to anticipate how they would look like if they bought it and wore it.

Finally, the *accent* fallacy, which occurs when emphasis is used to manipulate the actual meaning of a proposition, is commonly adopted with a persuasive intent in computer technologies, especially in its visual variant where certain elements are made more visually prominent in order to emphasize them. A common example of the (visual) *accent* fallacy occurs when special offers (e.g., discounts) are highlighted with big fonts and bright colors, while the possibly restrictive conditions to enjoy them are made scarcely visible. In Human-Computer Interaction, the *accent* fallacy can be compared to misplaced salience, which is known as one of the "demons" hindering situation awareness (Endsley, Bolt and Jones, 2003). While appropriate salience can help to identify the most important information in a certain context, misplaced salience

emphasizes irrelevant cues, confusing users and leading them to inappropriate behaviors.

In our previous work (Lieto and Vernero, 2013), we had also pointed out some similarity between *surveillance* technique and the *argumentum ad baculum* fallacy. Surveillance is based on the idea that people tend to change the way they behave when they are aware that they are being observed, especially if the observer has the power to punish or reward them (in this case, they will tend to match the observer's expectations) (Turner, 1991). The covert menace which underlies surveillance technique is not too dissimilar to the *argumentum ad baculum*, where the persuader resorts to threats of force in order to make his/her thesis be accepted. An example of this fallacy, inspired to Pascal's Gamble (Pascal, 1864), is: "If you don't believe that God exists, when you die you will be judged and sent to Hell, so it is safer to believe in God". It is important to notice, however, that the use of some form of coercion is borderline with respect to Fogg's definition of persuasion (Fogg, 2003). Moreover, in (Lieto and Vernero, 2013) we had observed that only a very small percentage of the websites we had examined made use of persuasion strategies which could be mapped to the *argumentum ad baculum* (e.g., making the actions performed on the website totally "transparent", so that users might be induced to buy products or services which are consistent with the self-image they want to show to others). For these reasons, we will not consider this fallacy in our current work.

Fallacy	Websites and App features
Arg. ad populum	Best seller products, ratings
Arg. ad verecundiam	Improper testimonials
Audience agreement	Personalization
Arg. ad baculum	Public visibility of purchased/browsed items or wish lists
Arg. ad consequentiam	Cause-effect simulations
Accent	Emphasis/hiding of information

Table 1. Correspondence matrix between fallacious arguments and websites/mobile-apps displayed features.

4. Survey on Persuasion Techniques in e-Commerce Apps and Websites

In order to investigate whether, among the techniques used in persuasive technologies, there actually are some which are reducible to arguments based on logical fallacies, as hypothesized in (Lieto and Vernero, 2013), we carried out a survey

on 101 mobile apps and 175 websites in the e-commerce domain[4]. In fact, we surmised that technologies with a clear persuasive goal (i.e., selling goods) should make an extensive use of persuasive techniques.

Figure 1. An example of the arg. ad populum fallacy in Comtech.de (a) and Edeka 24 (b).

Our set of websites, which extends the one examined in our previous work (Lieto and Vernero, 2013), was collected by searching for "online shopping" on Google and selecting all pertinent results. As far as apps are concerned, we first searched for apps directly related to the e-commerce websites on the Apple App Store, and found 71 of such apps. The remaining 30 apps were identified by querying the App Store for "online shopping", similarly to what we did for websites[5].

In order to run the evaluation we created a correspondence table (see Table 1) where the presence of fallacious arguments is connected to the use of some specific features in the examined apps and websites.

As shown in Table 1, the *argumentum ad populum* has been associated to the case in which either "best seller" products (see Figure 1) or user ratings are displayed (in this case the persuasion strategy is based on the following argument: "Most people buy/like X, then it is positive to buy X"). The *argumentum ad verecundiam* has been associated to the presence, in one or more parts of the websites and apps, of improper testimonials for certain products, and the *audience agreement* has been associated to

---

[4] The complete list of websites and apps analyzed is available at: https://sites.google.com/site/techsuasion/.
[5] Some preliminary results regarding our analysis of mobile apps were presented in (Lieto and Vernero, 2014).

the use of recommendation techniques (see Figure 2). Finally, the *argumentum ad consequentiam* has been associated to the presence of software environments which are able to simulate the consequences of certain user choices, and the *accent* fallacy to the case when part of the purchasing-related information is emphasized and part is hidden (e.g. when shipping or tax costs are presented only at the end of the purchasing process, or when certain products are given more visual prominence than others).

Figure 2. An example of the audience agreement fallacy in AllSaints, (a, content-based suggestion) and Edeka 24 (b, collaborative-filtering-based suggestions).

4.1 Results

Table 2 shows the obtained results. We have recorded no use of fallacious-reducible arguments only on the 16% of mobile apps and on the 13,1% of websites in our set. The most recorded fallacies result to be the *accent* (apps: 57%; websites: 54,3%), the *argumentum ad populum* (apps: 37%; websites: 49,7%) and the *audience agreement* (apps: 21%; websites: 36%). Notice, however, that the percentages of adoption of the *argumentum ad populum* and the *audience agreement* fallacies drop significantly in the case of mobile apps. Concerning the least observed fallacies, the *argumentum ad verecundiam* appears more often in websites than in apps (where it obtains the lowest count), and the same happens for the *argumentum ad consequentiam*. It should be observed that, while the use of the other fallacies does not seem to be related to the type of items sold by a certain website or application, the *argumentum ad*

consequentiam is used almost only by shops selling clothing, shoes and make-up products, i.e., items for which consequences are relatively easy to anticipate and simulate.

In order to better understand whether the differences we observed between websites and apps should be ascribed to device-dependent peculiarities on the use of fallacious-reducible techniques or to some bias due to more general differences between the two sets, we focused on the 71 websites and on the 71 apps which are directly related to each other (i.e., they were designed to promote the same company/brand). Results for this second analysis, which are quite close, in general, to those we obtained for the whole dataset, are presented in Table 3. *Accent* maintains its primacy as the most popular fallacy among both websites and apps, while persuasion strategies based on the *argumentum ad populum* and the *audience agreement* fallacies still appear to be adopted less often in mobile apps than in the corresponding e-commerce websites, thus confirming and actually expanding the adoption gap we could observe in our whole dataset. This difference is especially clear for the *argumentum ad populum*, which could be observed only in 28,2% of the apps, while it was much more popular among websites (50,7%). On the contrary, the adoption gap between apps and websites is slightly smaller in the reduced than in the whole dataset if we consider persuasion strategies based on the *argumentum ad consequentiam*. Functionality and features which implement this fallacy are probably considered distinctive for a certain company/brand, so that, when adopted, they are applied cross-platform.

Our data also suggest that apps are usually endowed with less fallacious and persuasive features than websites, an insight which could be explained by the fact that mobile applications are a more recent, not yet fully mature, technological environment.

Fallacy	% - apps	% - websites
Arg. ad populum	37%	49,7%
Arg. ad verecundiam	3%	13,1%
Audience agreement	21%	36%
Arg. ad consequentiam	4%	8,6%
Accent	57%	54,3%
None of the above	16%	13,1%

Table 2. Percentages of e-commerce apps and websites using fallacious-reducible persuasive mechanisms.

Fallacy	% - apps	% - websites
Arg. ad populum	28,2%	50,7%
Arg. ad verecundiam	2,8%	15,5%
Audience agreement	25,4%	42,3%
Arg. ad consequentiam	5,6%	8,5%
Accent	56,3%	59,2%
None of the above	21,1%	7%

Table 3. Cross-platform comparison of 71 directly-related apps and websites.

5. Experimental Evaluation

Having observed that most of the examined e-commerce apps and websites make use of at least one persuasion strategy based on fallacious arguments, we carried out an experimental evaluation aimed at empirically assessing the relative effectiveness of fallacy-based strategies in a controlled environment.

As a use case, we chose a fictional online bookshop. We concentrated on a website (rather than a mobile app) for various reasons: on the one hand, websites require no installation on the part of users and provide a familiar, uniform interaction modality across different software/hardware platforms; on the other hand, people are still more likely to do their shopping using a website than a smartphone app[6]. For simplicity of implementation, and because they can be adopted independently of the kind of goods that are sold, we chose to focus on four fallacies out of the five we examined in our survey: *accent*, *argumentum ad populum*, *argumentum ad verecundiam* and *audience agreement*.

Our evaluation was divided in two phases: first, we carried out a pilot study where participants interacted with a simple website where no persuasion strategies were adopted. This study was meant to highlight how users choose books to buy in a non-persuasive context and served as a control condition. Then, we conducted a larger study with a "persuasive" version of the same website implementing design elements directly related to fallacious arguments as showed in the correspondence matrix presented in Table 1.

---

[6] According to the 2013 "Local Media Tracking Study" conducted by marketing research company Burke (http://www.burke.com/) in the U.S.A., consumers increasingly turn to mobile devices for their online shopping. However, about seven consumers out of ten prefer using mobile websites than apps.

5.1 Participants

Seven people participated in our pilot study and 19 in the larger one. All of them were selected from the same population, i.e., students and colleagues at the Department of Computer Science, University of Turin, using an availability sampling strategy. They are 42% female and 58% male, aged 22-45. They read 8,5 books per year on average and most of them (77%) have bought books online at least once. Their preferences about literary genres are quite variegated, with 35% of the participants being passionate about adventure fiction, 19% not loving it, but being keen on some adventure-related genres (e.g., fantasy or science-fiction) and the remaining 46% having different tastes (e.g., essays).

5.2 Material

Having decided to carry out our experiment in the context of an online bookshop, we prepared some basic information to present ten imaginary books belonging to the same genre, seafaring adventures: the title, the name of the author and a short description. All information was made up and we paid attention that it followed a similar format for all the books, in order to limit the number of factors which might influence participants' choices. For example, we had a book entitled "Docking at Sibyl Island (Attracco all'Isola della Sibilla)", written by the imaginary author "S. Sand", with the following short description: "This book deals with a seafaring adventure on Sibyl Island". Moreover, all books had the same price (10.50 €).

Figure 3. A screenshot of the non-persuasive version of the online bookshop website.

In the non-persuasive version of our online bookshop, organized according to a one-column layout, books were simply listed in alphabetical order, depending on their title (see Figure 3). Each book was accompanied by a "Buy" button, pressing which participants landed to a confirmation page that recapped the details of their (simulated) purchase.

In the persuasive version of our online bookshop, which had a similar look and feel to the non-persuasive one, the main page presenting all available books was preceded by an intro page where we explained that the bookshop offered personalized recommendations and asked participants to choose their favorite book between two classics, "The Pirates of Malaysia" by Emilio Salgari and "Moby Dick" by Herman Melville, in order to provide the website with some information about their preferences (both books were accompanied by a short summary of their plot, drawn from the Internet). In the bookshop main page, which was organized according to a two-column layout, four books were presented in a peculiar way, following the four fallacious persuasion strategies we experimented with (see Figure 4):

- *Accent fallacy:* a book was presented on top of the page, in a box named "Our highlight for this month" and extending across the two columns. It was given visual prominence through the use of a larger font size and an accompanying badge with the text "book of the month".
- *Argumentum ad populum fallacy*: a book was presented in a box named "Our best seller", in the right-side column. It was accompanied by a sentence explaining that it was the best-selling book among the customers of the bookshop.
- *Audience agreement fallacy*: a book was presented in a box named "Chosen for you", in the right-side column. A short sentence explained that it had been selected according to the participant's preferences.
- *Argumentum ad verecundiam fallacy*: a book appearing in the alphabetically-ordered list in the left-side column was accompanied by the photo of a celebrity and a comment of theirs, stating that it was "the best adventure book ever". We used a photo of Mario Draghi (an economist and the current President of the European Central Bank) in half the cases and of Fernando Alonso (a Spanish Formula One racing driver, racing for Scuderia Ferrari at the time of our experiment) in the other half.

Figure 4. A screenshot of the persuasive version of the online bookshop website (fallacious persuasion strategies are highlighted).

The book to present as a personalized suggestion (*audience agreement)* was selected according to the similarity of its title to that of the classic chosen by a certain participant in the intro page, while the books connected to the other three fallacies were chosen at random for each participant. The remaining six books were simply presented in alphabetical order, in the left-side column.

5.3 Procedure

The study took place in a room at the University of Turin, one participant at a time. Instructions were provided in written form, according to the following script: "Our Bookshop is specialised in adventure novels. Imagine you have decided to buy yourself a book of this genre for Christmas. Which one would you choose? Feel free to think aloud while you are exploring the bookshop website. Mind: you can choose a single book. Once you have made your choice, please select "buy" to conclude the experiment. Don't worry: this is just a simulation and you will not be charged any amount."

The experimenters silently observed participants' interaction with the website, intervening only in case they were posed some explicit question. Moreover, they noted

down all the comments participants expressed during the evaluation. After participants had chosen a book to buy, one of the experimenters carried out a short interview aimed at collecting information about their demographics and reading-related habits.

5.4 Results

In the pilot study, the seven participants chose five different books, namely, they made quite heterogeneous choices, as it can be expected when there are no other factors than personal preferences which can exert their influence. Gini Heterogeneity Index, a measure of dispersion for categorical variables which ranges from a minimum of 0 to a maximum of 1, equals 0,86, a value indicating high dishomogeneity in participants' behavior. Moreover, in their thinking aloud, all participants actually explained their choices based on the appeal of the title.

In the second study, involving the interaction with the persuasive (fallacy-based) version of the website, a record of participants' choices was collected. The results of this analysis are presented in Figure 5: 47% of the participants chose a book presented according to one of the four persuasion strategies, and motivated their choice accordingly in their thinking aloud. Participants who chose the "book of the month" (*accent fallacy*, 26%) explained either that it was the first one they had noticed, or that, dealing all the books with similar topics, they trusted what seemed to be a recommendation on the part of the bookshop owners. Participants who chose a book which was recommended to them based on their previously-expressed preferences (*audience agreement fallacy*, 16%) motivated their choice with the very fact that they were confident to like such a personalized suggestion. Finally, the only participant who chose a book promoted by a celebrity (in her case, Mario Draghi) was actually impressed by his endorsement. The remaining participants, who chose books not presented through any persuasion strategy (53%), motivated their choice with arguments referring to the appeal of the title, as it happened in the pilot study.

Our results suggest that persuasion strategies based on logical fallacies actually have an effect on people's behavior, at least in the context of an e-commerce website. As we have observed before, in fact, people only took into account intrinsic item properties (in our case, the book title) in a situation where no persuasion strategies were used, while they were guided by fallacious heuristics (i.e., they used different criteria to evaluate the available options) in almost half of the cases in a persuasive environment.
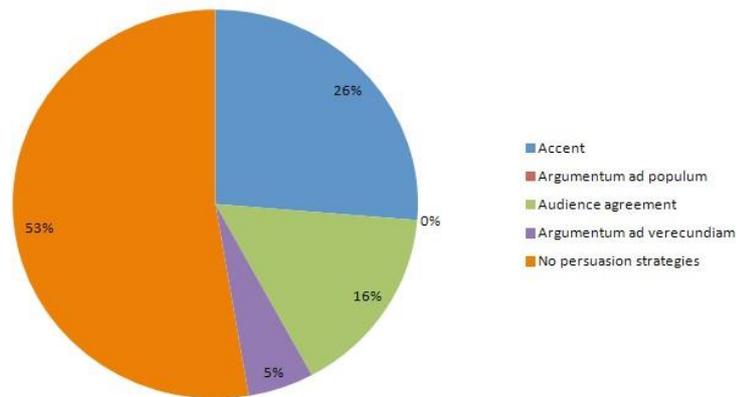
Figure 5. Distribution of user choices with respect to the persuasion strategy used for book presentation.

Comparing these results with those of our survey (see Section 4), we noticed that the effectiveness of persuasion strategies, according to our empirical evaluation, seems to be proportional to their popularity in existing e-commerce websites and apps, with *accent* being the top strategy in both cases, followed by the *audience agreement* and *argumentum ad verecundiam* fallacies. Interestingly, however, we also noticed a big exception: the *argumentum ad populum* fallacy, used by almost 50% websites and about 37% apps, was totally ineffective in our evaluation. Not only books presented as the "best sellers" were not chosen by any participant, but a couple of them also stated that knowing what other people had bought was useless to them, and that suggestions based on the preferences of other people were far less relevant than personalized ones. This somehow unexpected fact might be explained considering that all our participants belong to an academic environment and are probably more critical towards "blockbuster" books than the average person. In addition, we surmise that, in some cases, participants might have provided socially desirable answers, avoiding to choose best seller books to maintain their self-image of smart, critical and independent thinkers.

6. Conclusion and Future Work

In this paper we have presented the results of a double empirical analysis aimed at investigating both the actual use of fallacious-reducible arguments in persuasive

technologies (such as e-commerce websites and mobile applications) and their efficacy in influencing human decision making when implemented, with an explicit persuasive goal, in an e-commerce website.

Our results show that fallacy-based persuasion strategies are extensively used in existing digital artifacts, with some subtle differences between websites and mobile apps, and that – at least for the case of e-commerce websites - they are actually effective in influencing users' behavior, offering shortcut heuristic criteria to ease their decision-making. In particular, the strategy based on salience manipulation (*accent* fallacy) resulted to be both the most popular and the most effective one.

As a short-term future goal, we are planning to carry out an empirical evaluation (by following the same *rationale* used for the evaluation of the influence of fallacy-based strategies in the e-commerce websites) based on the observation of the behavior of users browsing a persuasive and a non-persuasive version of the same mobile app.

Similarly, we are considering to re-run our evaluation with a less homogeneous set of participants in terms of their educational background: this would allow us to determine whether the unexpected ineffectiveness of the persuasion strategy based on the *argumentum ad populum*, which we observed in our present study, should be ascribed to the peculiar features of our participants or to a more general trend.

In addition, we plan to extend our analysis by increasing the number of both the examined logical fallacies (and the correspondence matrix between fallacies and persuasion techniques we individuated), as well as the technological environments where they have been (or can be) used. In particular: the social networking environments and the systems based on avatar technologies adopting forms of linguistic interaction seem to be ideal candidates for investigating the feasibility of our approach in other technological scenarios.

From a more general perspective, the research carried out and resulting from this work can be productive in at least two orthogonal lines of investigation. On the one hand, in fact, it can be useful for the implementation of algorithms that - starting from the individuated correspondence matrix between fallacies and displayed technological features – can be used for the automatic or semi-automatic detection and classification of fallacious-reducible strategies adopted on a large volume of websites, mobile applications and other technologies. Such detection could be useful for individuating cases of unethical use of fallacy-based strategies w.r.t. the end-users.

On the other hand, the results obtained with the evaluation of the efficacy of fallacy-based persuasion mechanisms in different technological contexts could be useful in

order to individuate standard "persuasions patterns", and the most efficacious combinations of them, that can be directly used as a basis for the design of novel persuasive technologies. Since the application of such patterns should be, as mentioned, delegated only to ethically acceptable uses of persuasive technologies, the two lines of research individuated above, despite different, will require a continuous interaction.

Finally, in case we identify logical fallacies not yet finding a correspondence with existing persuasion strategies used in the field of captology, these could serve as a basis for the design of new persuasive features and patterns.

7. References

Adomavicius, G., & Tuzhilin, A. (2005). Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions. *IEEE Transactions on Knowledge and Data Engineering*, *17*(6), 734-749.

Aristotle, J.B. (1995). *Complete Works of Aristotle*. Princeton: J. Barnes.

Bonner, A. (Ed.) (1985). *Selected Works of Ramon Llull (1232-1316)*. Princeton: Princeton University Press.

Cohen, M.R., Cohen, M.R., & Nagel, E. (1993). *An Introduction to Logic*. Cambridge, MA: Hackett Publishing.

Dion, K., Berscheid, E., & Walster, E. (1972). *What is Beautiful is Good. Journal of Personality and Social Psychology*, *24*(3), 285-290.

Endsley, M.R., Bolt, B., & Jones, D.G. (2003). *Designing for Situation Awareness: An Approach to User-Centered Design*. London and New York: Taylor & Francis.

Fogg, B.J. (2003). *Persuasive Technology: Using Computers to Change what we Think and Do*. Amsterdam: Morgan Kaufmann.

Fogg, B.J., Marshall, J., Laraki, O., Osipovich, A., Varma, C., Fang, N., Paul, J., Rangnekar, A., Shon, J., Swani, P., & Treinen, M. (2001). What Makes Web Sites Credible? A Report on a Large Quantitative Study. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 61-68). New York: ACM.

Hamblin, C.L. (1970). *Fallacies*. London: Methuen.

Lieto, A., & Vernero, F. (2013). Unveiling the Link between Logical Fallacies and Web Persuasion. In *Proceedings of the 5th Annual ACM Web Science Conference, WebSci '13* (pp. 473-478). New York: ACM.

Lieto, A., & Vernero, F. (2014). Persuasion in Mobile Apps and Logical Fallacies: A Preliminary Study. In *Adjunct Proceedings of the 9th International Conference on Persuasive Technology* (pp. 40-42). Padova, Italy: CLEUP.

Nolt, J., Rohatyn, J., & Varzi, A. (1998). *Introduction to Logic*. New York: McGraw Hill.

Pascal, B. (1864). *Oeuvres Complètes de Blaise Pascal*. New York: Hachette.

Perelman, C., Olbrechts-Tyteca, L., & Meyer, M. (1958). *Traité de l'Argumentation: La Nouvelle Rhétorique*, vol. 1. Paris: Presses universitaires de France.

Turner, J.C. (1991). *Social Influence*. Milton Keynes, UK: Open University Press,.

Walton, D.N. (1995). *A Pragmatic Theory of Fallacy*. Tuscaloosa: University of Alabama Press.