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Cognitive dissonance and social influence effects on preference judgments: An eye tracking based system for their automatic assessment ☆

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A R T I C L E I N F O

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A B S T R A C T

Researchers have investigated the social influence on the human decision making process. Social pressure and individual cognitive dynamics are complex variables in decision making that can give very useful insight in predicting human behavior. This is also useful in exploiting important factors that can be embedded in ICTs in order to equip them with human cognitive-inspired features. By tracking eye movements and measuring reaction times, we investigated the decision making process made when asked to rate two photos against each other. We manipulate the social information available to participants: no information (blind), information about responses of other participants (others), and information about responses of the community of friends of the participants. In particular the investigation of the social pressure effects (e.g., In–Out group bias and cognitive dissonance effects) on the human decision making represents an inspiring perspective of research for several domains. In this paper we demonstrate how this approach allows us to investigate both, the decision making process at individual level, and the role played by the social dimension. The possibility to create a formal model of these processes can give very useful clues and inputs to the ICT domain. On one hand, the computational modeling approach could allow us to predict the behavior of human people in order to optimize the interaction between users and ICTs. On the other hand, this new understanding can allow computer scientist equip technological systems with some interesting features that characterized the human cognitive system towards the Self-Awareness in autonomic centric systems.

1. Introduction

From the classical Sherif (1936) and Asch (1956) experiments on conformity, social influences on human decisions have been described by a broad literature (Cialdini and Trost, 1998). Empirical evidences support human conformity to group pressure, (i.e., people tend to do what others are doing). A variety of factors related to the pressure of others influence decisions: unanimous opinions, task difficulty or task importance (to name a few). These enhance the conformity effect whereas private responses (compared to public, face-to-face) are associated to less social influence (Cialdini and Trost, 1998). Moreover, the In group and the Out group dynamics are very relevant factors affecting social in conformity (Cialdini and Trost, 1998). People are more prone to be influenced in their decision by a group that an individual who belongs to group (the In group) compared to a group of people that an individual neither belongs nor he or she identifies with. In this manuscript, we investigate social influences in esthetic judgment manipulating the In group/Out group dynamics. Social pressure has been investigated in a variety of perceptual tasks (such as determining which line is longer) but few researches have been conducted on esthetic judgments. With expression esthetic judgments we intend a task requiring a subjective opinion about which object or element a person prefers on personal basis. Such a task is less affected to the conformity phenomenon compared to more physical and objective judgments (Cialdini and Trost, 1998). We employ this esthetic judgment task along with other factors that alter the social pressure effect. Measuring reaction times and ocular movements can help to investigate different processes behind a decision (Bednarik and Tukiainen, 2006; Hayes et al., 2011). In order to investigate how opinions are influenced by peers and community structure, we have developed a web application

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called PhotoRating. The PhotoRating application shows a series of photos by pairs and let the participants select their preferred one by sliding a cursor toward the chosen photo. Positioning the cursor at the extreme left means a strong reference for the left photo and vice versa. The average rating score from previous participants (or from friends of the current judge) was shown to the participants. Reaction times and ocular movements are recorded. Through this application it is possible to investigate both the influence of others choices on individual judgment and the cognitive processes that lead to that decision. We present an experiment about esthetic judgment employing this application. The main idea behind this experiment is to investigate through reaction times and ocular movements how social influence (i.e., In-group Out-group effect) conditions the esthetic decision. Moreover, this task can also give insight about what is going on in the individual cognitive system. In particular, we can suppose that an individual participant can experience a cognitive dissonance effect (Festinger, 1985). With this expression we are referring to a feeling of discomfort that rises in a person when he or she simultaneously holds two conflicting cognitions (Cooper, 2007). Regarding the PhotoRating task we suppose that when a participant has to make a decision (i.e., to decide what image he prefers), he is exposed to the social influence in different ways. Such an exposure can be represented as a factor affecting the cognitive process of the task, altering or even disruptively changing the process itself. The In–Out group bias effect and the cognitive dissonance represent fundamental factors that can help us to investigate not only social decision processes but also the individual organization of the human cognitive system. Understanding how these two levels (the individual and the social aspects) work (though the measure of reaction times and ocular movements) in a decision task can give new insights. The possibility to create a formal model of these processes can give very useful clues to ICTs (Cook and DasSmart, 2005). On one hand, the computational modeling approach could allow us to predict the behavior of human people in order to optimize the interaction between users and ICTs. On the other hand, these new insights can allow computer scientist in equipping technological systems with some interesting features that characterize the human cognitive system.

2. Experiment

We employ the PhotoRating task in order to investigate different cognitive processes behind an esthetic judgment influenced by different levels of conformity. The experiment provided three setups: blind, others and friend. In the Blind condition, no administered ratings were informed to the participant, i.e., the average rating score was not shown on the screen. Others condition showed the average position of the cursor of previous participants. Finally, the Friend condition provided individual friends rating. From the conformity effect perspective, we can expect that in the Friend condition participant will be influenced from the rating of their friends. Since in the others condition an individual observes the average rating of previous participants (unknown people), we can expect a lower influence of the conformity effect. The blind condition should represent a baseline in which the choice between the two photos is not influenced by social information. However, the PhotoRating task is characterized by some factors that weaken the conformity effect. So it could be that average rating of previous participants and rating of friends do not influence the decision of the observer. We think that although there are no differences in participants response, our methodology can shed light about how people evaluate social information.

2.1. Procedure

Eighty students of the University of Cambridge were recruited and have participated in the research. All were instructed at the beginning of the experiment in the same way about the usage of the devices (i.e., the laptop used to acquire the data, and the eye tracking system), and the dynamics of the experiment. The experiment consists of a set of 40 pairs of photos which are displayed one pair at a time. The participant is asked to indicate which of the two photos in each pair they prefer using a bar. Clicking far to the right on the bar indicates they greatly prefer the right hand picture, and slightly to the right indicates they slightly prefer the right picture. The position clicked on the bar is then transformed into an integer value ranging between 0 and 100, with 0 corresponding to greatly preferring the left hand picture and 100 corresponding to greatly preferring the right hand picture. Once the participant has rated all 40 pairs, the pairs are displayed in a different order, but now the average of all participants is calculated for each pair and displayed. The average that is calculated is derived from an average of all 3 phases of the experiment for all participants, i.e., so the average is actually changing in every experiment, nevertheless we got into account just the shift produced by the information delivered to the participants, instead of the absolute value of the rating. Noteworthy, the first participant was administered with a random generated information about the others ratings. Note this is not the average of just one of the phases, but an average of all the ratings made on this pair of photos. The participant is asked to rate all of the 40 pairs again with this extra information available. Finally, the 40 pairs are displayed again, but now the average of all 3 phases for the people in the participant's friend group is displayed. Again this average is calculated by taking all of the ratings made in each phase, but only for the people in the participants friends group.

The eye tracking data was been collected using a Tobii X20 Eye Tracker, with preliminary data analysis under- taken in Tobii Studio and further analysis performed in MATLAB (Bednarik and Tukiainen, 2006; Hayes et al., 2011). The eye tracker was placed so that the distance between the participant's eyes and the eye tracker was about 70 cm, and the maximum vertical angle that the screen made from the participants view was less than 35°. The eye tracker can only detect fixations made by the eye, and not the peripheral vision. To determine the point when a photo rating was made, the clicking made by the participant was tracked. A box was defined around the input bar that they used, and when they clicked inside of it this counted as moving on to the next photo, ending the current rating interval and beginning a new one. By defining time intervals like this, the eye tracking data can be split down so that there was eye tracking data for each pair of photos rated. For each interval there were two main paths of analysis that could be followed, one that focuses on the spatial distribution of the eye gaze and one that looks at the temporal information. The spatial information describes the amount of time that the participant looks at specific parts of the experiment, while the temporal information shows the flow from one point of interest to the next (Fig. 1).

2.2. Data analysis

In order to investigate the experimental hypotheses delineated in the introduction, the experimental log files have been exploited extracting (or mining) and defining 7 observables as order parameters (i.e., dependent variables). From the log file produced by the eye-tracking system (Fig. 2) we extracted 4 dimensions describing the gaze's dynamics characterizing the subjects' inspection of the picture during the rating. Such variables are the