The effects of social communication: a research study on neuroscientific techniques application

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Introduction

The effectiveness of social advertising is still an open issue in the scientific community. On one side the evaluation of advertising efficacy is still a big challenge to accomplish in terms of scientific measures. On the other side, the social advertising is often based on emotional appeals, in order to capture and affect audience attention, and the attempt to measure emotional reactions in a scientific way is still debated by scientists as well. Nowadays the evaluation of advertising is laying on traditional techniques, the so called "explicit self-report measures", based on direct questions to subjects exposed to advertisement. The limit of these traditional techniques is the potential overlap (and confusion) of what is felt by subjects by means of their rational appraisal with what is really perceived by them from an emotional standpoint [1,2].

Today the technological improvements and neuroscientific findings provide an important knowledge that might contribute to develop new kind of measures based on neuro and psycho-physiological activity correlating with affective reactions during the advertising exposure. In comparison to "direct self-report measures", these techniques are based on *indirect* measures ABLE to provide more complete information about subjects reactions and reduce the potential contributes from affective bias.

Purpose and methodology

The present work presents the results from a scientific study about a social spot (lasting 50 seconds) aimed to sensitize public opinion about discrimination made by men against women.
The goal of the research was to evaluate the different effects played by the spot on male subjects in comparison to female ones. Previous research already showed important differences between males and females regarding social communication, in particular about the level of engagement [3] and the cortical activation measured by electroencephalography [4,5].
Aside traditional methods based on self questionnaires, some neuroscientific techniques were also applied, as eye-tracking recordings with a RED 250 system from SMI [6] synchronized with electroencephalography (EEG) monitoring from Emotive Epoc headset [7,8] while watching the spot. In addition to these techniques has been used the automatic quantitative analyses of Emotional facial expressions computed by FaceReader 5, a software from Noldus [9,10].
60 subjects, 30 males and 30 females, have been enrolled in the study, they were all students from IULM University. After filling up consent forms about the research purposes and ethical issues, they have been asked to

sit down in front of the computer in order to watch the spot while all their eye-gaze, facial expressions and EEG brain waves were monitored.

Results

All subjects have filled up a self-report questionnaire after watching the spot . According to results, the females judged the spot better, with an average of 4,84 over a Likert scale [11] ranging from "1 = I did not like the spot at all" to "7 = I liked the spot very much" in comparison to males (with the average of 5,56). However, the difference has been not statistically significant (t-test: $p \geq 0{,}05$). Moreover, the results show a qualitative difference enabling to understand that females liked the spot more than males, but without any additional information about the affective and cognitive processes that leaded to this preference. For this reason, the qualitative result has been integrated with further information from neuroscientific tecniques application.
The results from the automatic quantitative analyses of facial emotional expressions of all subjects while watching the spot show that on average the whole sample reacted with a neutral face (dominating on all other facial emotional expressions – fear, anger, sadness, happyness, surprise and disgust) for the 63% of the whole exposure, on a range between 0 and 100%. The second predominant facial reaction has been "Sad" for the 21 % on average of the whole esposure of all subjects. We can conclude that the main facial emotional reaction of all subjects (aside "neutral" condition) has been "sad" on average. (See the box plot graph showed in Figure 1).

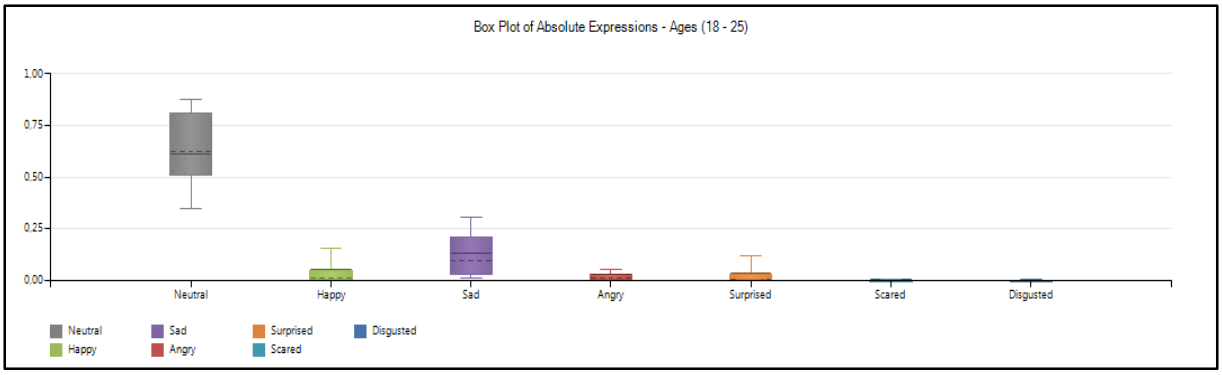

Figure 1. Face Reader outputs for the **whole sample** of 60 subjects. On the "x" axe, from left to right, emotional conditions automatically computed by the software: Neutral, Happy, Sad, Angry, Surprised, Scared and Disgusted. On the "y" axe, the values are expressed between "0" and "1" (0= probability that the face is showing one of the 7 conditions is equal to 0%; while 1= probability that the facial expression is showing one of the 7 conditions is equal to 100%).

If the results are analyzed according to male and females subgroups, it is possible to observe that results are not the same. Females felt emotions of "happiness" (0.05=5%) and "surprise" (0.04=4%) (even if in small percentage, the difference with males is significant, t-test: $p \leq 0.05$) (see the graphs in Figure 2; in purple the happiness, in orange the surprise).
Instead, in the subgroup of male subjects, it is possible to see that they reacted, aside "neutral" and "sad", with some facial expressions detected as "angry" (0.03 = 3%), significantly different from females (who reacted with an "angry" face with 0.01=1% - t-test: $p \leq 0.05$), as shown in the graph below (see the graph in Figure 2; neutral in grey, angry in red).

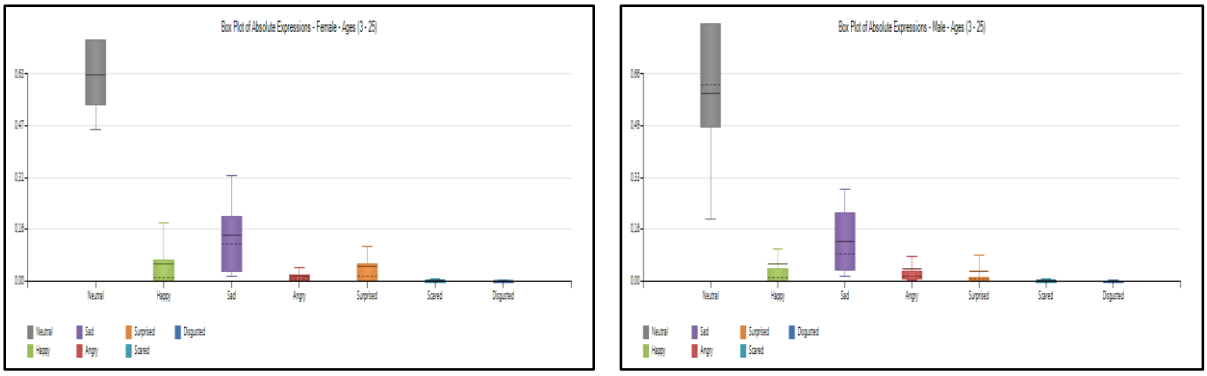

Figure 2. On the left, Face Reader outputs for the **female sample** of 30 subjects. On the right the output for the **male sample**.

Considering the automatic analyses from the Face Reader software about the level of valence (the probability, btween "+1.00" – "positive" 100% and "–1.00" – "negative" 100 % - whereas "0.00" is equal to "neutral" condition) of the face patterns there are significant differences (t- test: $p \leq 0.05$) between males and females: males showed on average a **negative valence** of the face that is almost the double (-0.18) in comparison to famels (-0.10).

Aside the data concerning the facial expression analyses, the data from electroencephalography (EEG) were also monitored while the 60 subjects watched the spot. Data were computed by the Affective Suite software from Emotiv that automatically processes all the data, that is providing 3 indicators: a) "engagement", the general cortical activation elicited by a stimulus or a situation; in a very broad way, this pattern of cortical activation is characterized by a predominance of beta waves activity, more associated with increased cognitive and/or affective mental states [12,13] with a decreased activity of Alpha waves, more active in relaxation situations [14,15]; b) "Excitement short term", the cortical activation elicited in a time window of few seconds after a stimulus, characterized by the predominant activity of sympatetic branch of the autonomous noervous system in comparison to the parasympathetic activity branch), c) "frustration", the cortical activity associated with cognitive and affective process while trying to cope with a situation characterized by negative emotional states. Further analyses about classic bandwiths (as Alpha waves, Beta waves, etc.) will be computed and analysed in future paper works. Data were then cleaned from motion artifacts and outliers, and averaged across all male and female subjects, along the whole exposition to the spot.

Examining the results about "Engagement", it is possible to see (Figure 3) how the females subjects (in pink) are almost always showing higher values in comparison to male ones (in blue). Females, on average, showed an engagement value higher (0,65=65%) in comparison to males (0.62=62%); however, this can be considered such a trend only, as difference were not significant (t-test: $p \geq 0.05$).

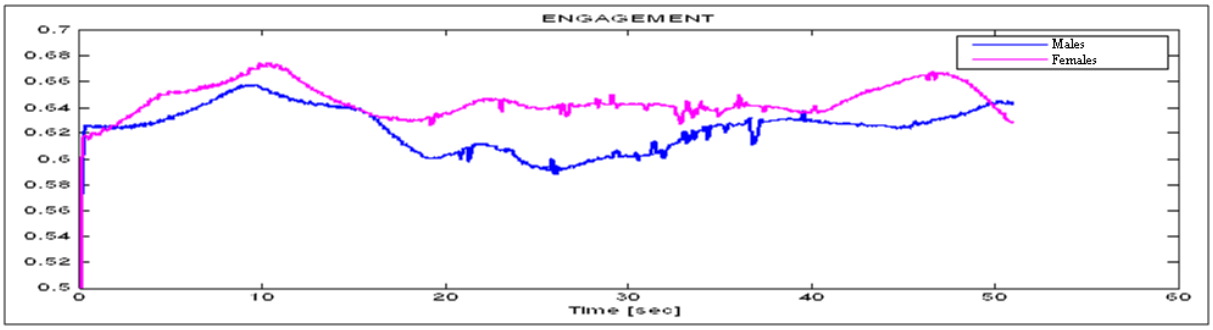

Figure 3. "Engagement" index for males and females while watching the social spot; on "x" axe time is expressed in seconds, while on the "y" axe the level is expressed in percentage (from 0.00=0% to 1.00=100% of the level of "engagement").

Considering the "frustration" index, males showed (Figure 4) an higher "frustration" index (0.48=48%) in comparison to females (0.44=44%). However also this result has to be taken into account as a trend, since there are not significant differences (t-student test: $p \geq 0.05$)

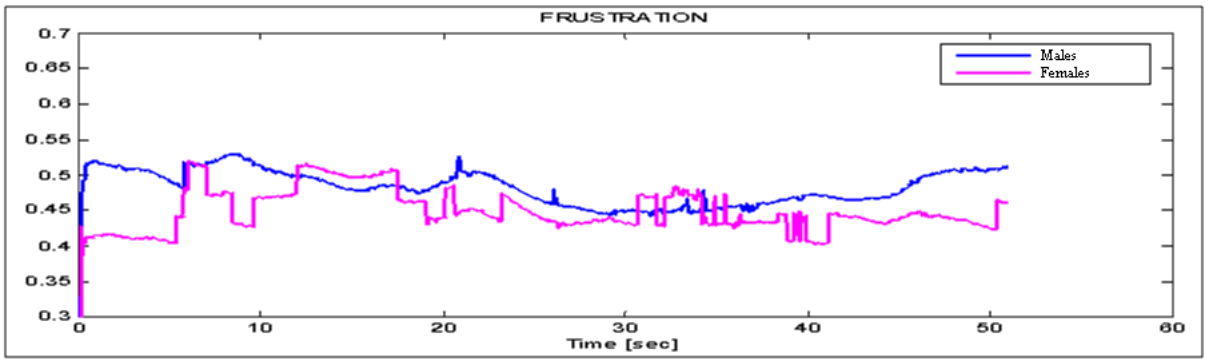

Figure 4. "Frustration" index level for males and females while watching the social spot; on "x" axe time is expressed in seconds, while the "y" axe the level is expressed in percentage (from 0.00=0% to 1.00=100% of the level of "frustration").

Last, looking at the index "Excitement short term" has been considered and analyzed it is possible to notice that males are always showing higher values in comparison to females ones (Figure 5). The difference is significant (t-test: $p \leq 0.05$).

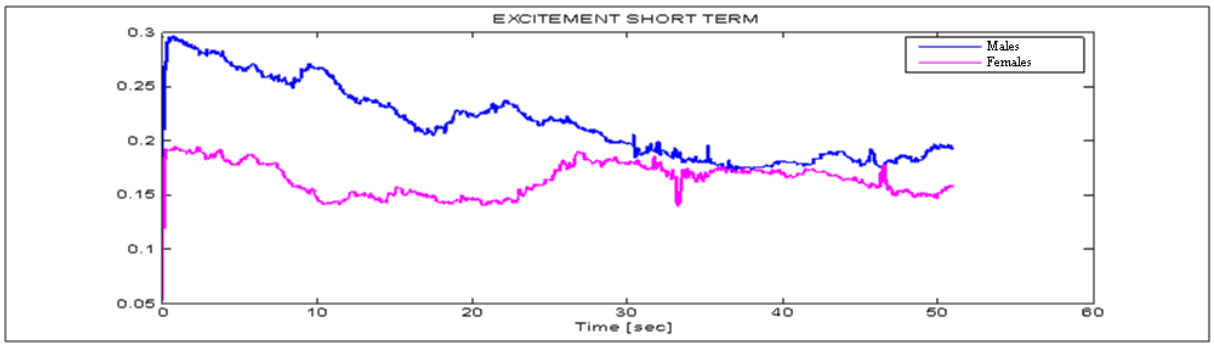

Figura 5. "Excitement short term" index from EEG data for males and females while watching the social spot; on "x" axe time is expressed in seconds, while the "y" axe the level is expressed in percentage (from 0.00=0% to 1.00=100% of the level of "Excitement short term").

Considering now the data from the Eye-tacking system, the synchronization between the EEG indicators and the pointing of the gaze is showed by Figure 6. In the upper part of Figure 6 some frames from the spot are showed, with correspondant values from EEG Affective Suite indicators from EEG (in the lower part of the figure). The peaks of red line (corresponding to the average index of "engagement" across all 60 subjects) are linked with scene from the spot where male charachters are showing negative social behaviors (such as writing on the white space of the advertising bills of the social campain in favour of wemen) against women. Moreover, the eye-fixations analyses showed different visual behavior between males and females. On one side, males looked on average more at male characters faces (in the social spot considered, the only male characters enrolled were showing a stereotyped social behavior against women) in comparison to female participants. Males, over 50 seconds of the whole spot exposition, spent on average almost 5 seconds (4916 milliseconds) in looking at male characters faces (appearing for a total of 7 seconds over the 50 seconds), while females spent on average almost 4 seconds (4025 milliseconds in total). The difference between males and females gaze behavior is significant (t- test: $p \leq 0.05$). On the other side, female subjects looked on average more at female charachter faces (28 seconds in total) in comparison to male participants (26 seconds in total), however the difference is not significant (t- test: $p \geq 0.05$)

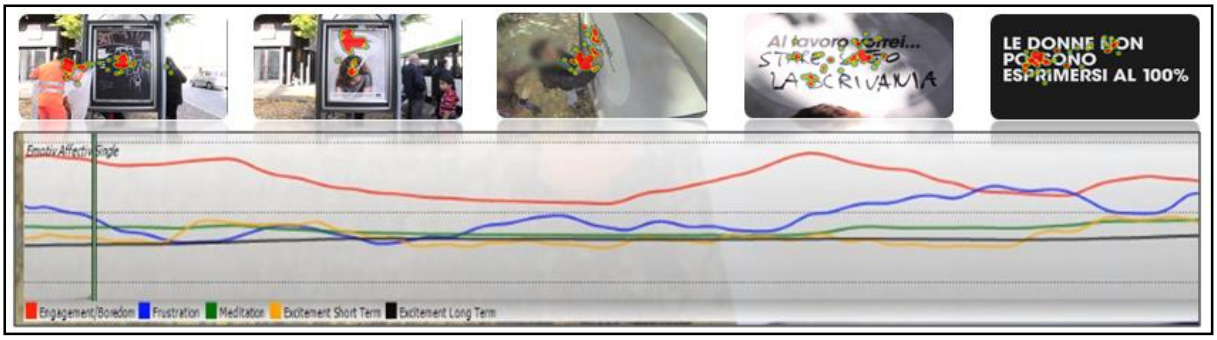

Figure 6. In the lower side of the picture, EEG indicators are showed: red line is "Engagement" trend, blue line is "Frustration" index, while "Excitement shor term" is the yellow line. In upper part of the figure, the correspondant frames of the spots.

Conclusions

In conclusion, according to self-report results, it is possible to claim that female subjects liked the social spot more than male ones. Self-reports represent one of the traditional ways to evaluate the effectiveness of communication in consumer psychology. However, the application of some neuroscientific techniques allows to go beyond the traditional methods in order to understand in a more complete way the consumer reactions. For instance, from facial expression analyses, it is possible to claim that females showed less negative emotions in comparison to males, who watched more the male characters enrolled in the spot (see the data from the eye-tracking) who were doing bad social actions against women. Combining results from facial expression and from eye-tracking, it is possible to claim that male participants identified themselves more with males characters who were showing negative social behaviors against women. This is the reason why they reported more negative emotional expressions by means of their face. In addition, also the EEG results showed a stronger activation about "frustration" and "excitement short term", supporting the claim that male subjects reacted with a stronger negative emotional reaction in comparison to female subjects, who were possibly feeling better, thus showing less negative emotional reactions as they were watching a social communication rejecting stereotyped negative social behavior against women usually made by men as depicted by the spot.
Aside the significant results that allows to understand why females appreciated the spot better in comparison to males, the aim of this work is to show also how the integration of traditional and innovative techniques from neuroscience can provide a wider range of information enabling a wider understanding of subjects' evaluation processes, as the empirical analyses of quantitative data showed in the results section of this research work. Even if the positive results must to be taken into account with caution, due to the pioneering application of neuroscientific procedures to the field of communication, implications, limits and advantages are discussed from a methodological point of view for further future research questions.

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