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Emotion and advertising effectiveness: A novel facial expression analysis approach

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ABSTRACT

Neuroscience has revealed the importance of emotion in the human cognitive process. For the first time, a GfK-EMO Scan, a facial expression recognition software developed by the Fraunhofer Institute for Integrated Circuits IIs, is used to investigate the long-term effect of advertising on individual attitudes toward driving. The effects of high emotional and low emotional advertising were measured using the GfK-EMO software on 60 participants with a 50/50 male to female ratio. Each participant was subjected to either a high emotional or low emotional safe driving video advertisement. While watching the advertisement, the GfK-EMO facial recognition software recorded the unconscious emotions of participants who were also requested to fill a modified version of the National Survey of Speeding Attitudes and Behavior. A driving attitude score was then computed using this survey directly after the participant had viewed the advertisement and again two weeks later. Noticeable differences in the attitude score were recorded between participants having watched the high emotional advertisement against participants having watched the low emotional advertisement. The high emotional advertisement generated a higher and more durable safe driving attitude score in comparison to the low emotional advertisement.

1. Introduction

Total advertising spending in the US is on an ever-increasing curve. In 2014, American businesses spent over B$180.12 (Emarketer, 2015). Globally, in 2015, over B$540 billion was spent on advertising, a 4.6% increase over 2014 (Adage, 2015) with the general public being exposed to an increasing number of advertisements. In 1985, the average urban American would see around 2000 advertisements per day. By 2016, this number is estimated to shoot up to 5000 advertisements per day (NY Times, 2015). Yet out of a sample of 350 advertisements watched per day, only 153 advertisements receive attention for more than a few seconds (SJ Insights, 2014). Measuring advertising effectiveness has always been the greatest challenge of marketing and advertising professionals. There are two main methods for measuring advertising effectiveness (Lehmann and Reibstein, 2006): One focuses on measuring indicative marketing metrics (such as awareness, preference, customer satisfaction, and loyalty); while the other focuses on measurement of tangible marketing metrics (such as sales, market share, profits, return on investment, cash flow, and firm value) (McAlister et al., 2016). For most businesses, monitoring the effectiveness of their advertising campaign remain a challenge (McCarthy and McDaniel, 2000).

An effective advertisement influences consumer attitudinal and behavioral responses (Meyers-Levy and Malaviya, 1999; Lee et al., 2015). Advertising effectiveness can be assessed along five independent dimensions: the first dimension evaluates the target audience attitude toward the advertisement itself; the second sizes the audience's attitude toward the brand (Lewinski et al., 2014; Mitchell and Olson, 1981); a

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third and fourth measure the audience purchasing intention and actual purchase (Lewinski et al., 2014); and finally a fifth estimates recall for the brand and product being advertised (Turley and Shannon, 2000). Attitude toward the advertisement describes the likings, enjoyment, and valence of feelings of individuals toward the advertisement while attitude toward the brand measures the likings, enjoyment, and valence of feelings toward the brand in the advertisement (Chattopadhyay and Basu, 1990; Phillips, 2000). In terms of the audience purchasing intention, behavior intention has been defined as the subjective probability dimension of an individual that connects him or her to a particular behavior (Fishbein and Ajzen, 1975). A behavioral intention, therefore, refers to a person's subjective probability that he will perform a given behavior (Lewinski et al., 2014). Recall is recognized as a fundamental dimension of advertising effectiveness since it will impact the buying decision (Turley and Shannon, 2000).

The complexity of measuring advertising effectiveness increases if the variable “emotion” is introduced (Corvi and Bonera, 2010). Emotion has been found to considerably impact the response an individual will have toward a message (Lewinski et al., 2014; Mai and Schoeller, 2009). An emotional message in advertisements increases the audience attention toward the advertisement and product, boosts product attractiveness, and generates a higher level of brand recall. For example, Page et al. (1990) found that emotional advertisements are more likely to be remembered than informative commercials. Poels and Dewitte (2006) posited that emotion is a predictor of advertising effectiveness. Measuring consumer emotional response provides a robust appraisal of the advertisement impact on consumer attitude, behavior, and recall.

Wiles and Cornwell (1990) provided a comprehensive review of the various methods employed to evaluate emotion in advertising research. The emotional response can either be measured using self-report or autonomic measure. The visual self-report requires the respondent to choose a cartoon character matching his or her emotional state, while in verbal self-report respondents answer an open-ended question or rate their emotional state on a Likert-type scale (Lewinski et al., 2014). Self-reports usually capture the conscious state of the individual while the autonomic capture the body's reactions. Body reactions (such as heart rate fluctuation or variation in skin acidity) are, most of the time, beyond the conscious control of the individual (Lewinski et al., 2014). Self-reports and surveys suffer from heavy bias; for example, the Theory of Social Desirability posits that interviewees will tend to avoid socially unacceptable responses or will tend to provide answers which the interviewer perceives to match the value system of the interviewer (Benstead, 2013). Autonomic measures directly assess the respondent's unconscious appraisal of an issue and as such appear to overcome the limitations of self-report questionnaires (Lewinski et al., 2014; Poels and Dewitte, 2006). Tools such as facial readers or facial recognition software have been popular amongst researchers (Lewinski et al., 2014). Accordingly, this research uses facial recognition software to investigate the potential link between emotion and public service advertising effectiveness.

2. Literature review

Corvi and Bonera (2010) posit that measuring advertising effectiveness is problematic since an individual response to an advertisement is not only impacted by the advertisement itself but also by a broad range of economics, cultural, socio-demographics and psychosocial stimuli. Another challenge is that advertising outcomes vary and cannot always be translated into strictly quantitative terms, such as sales results. Lastly, the advertising impact does not immediately ensure the campaign launch with results differing in time (Corvi and Bonera, 2010).

2.1. Core elements of advertising effectiveness

The core elements of advertising effectiveness are the attitude toward the advertisement, the attitude toward the brand, the intention, and ultimately the actual behavior (Lewinski et al., 2014) and memory recall (Turley and Shannon, 2000).

Recent research has posited that attitudes toward advertising is significantly related to advertising effectiveness since attitude is a driver for behavior (Linget al., 2010; Mehta, 2000; Ting and de Run, 2015). Fishbein and Ajzen (1975) define an individual's attitude toward an object as both a cognitive and affective evaluation of this object and a predicator for behavioral intention. In turn, behavioral intention is a predicator of the strength of the individual's willingness to perform a given behavior (Ajzen, 1988). Yet for Tan and Chia (2007) belief is the central dimension to attitude toward advertising (Tan and Chia, 2007) since a change in beliefs about advertising leads to a change in attitude toward the advertisement and consequently influences the purchase intention (Ting and de Run, 2015; Wang, Sun, Lei and Toncar, 2009). In other words, the intention to perform a behavior becomes more probable once a positive belief about the outcome is formed (Shook and Bratianu, 2010).

Advertising recall research has long been a research interest. Before neuroscience research, Bozinoff and Dacin (1985) proved that particular advertisements could be recalled after more than 11 years. Creativity has been pointed as an important component of advertising recall with highly creative advertisements being easier to recall than control advertisements (Lehnert et al., 2013). McDuff et al. (2015) studied 12,000 facial responses from 1223 persons who were exposed to 170 advertisements and found that advertisements with higher emotion were more likely to be remembered than advertisements with less intense emotion (McDuff et al., 2015). Using fMRi imaging Bakalash and Riemer (2013) found that emotional advertisements elicited stronger amygdala stimulation and consequently were also the most memorable advertisements.

2.2. Emotions and advertising effectiveness

2.2.1. The role of emotions in the cognitive process

In humans, emotions are a reaction to stimuli that impact one's immediate sensory environment (Kiehl et al., 2001; Petrides, 2007; Ramsøy et al., 2012). LeBlanc et al. (2014) not only show that emotions are necessary to human function but also that emotion are strongly correlated to attention, decision making and memory. Researchers such as Öhman and Mineka (2001); Algom et al. (2004), and Estes and Verges (2008) have shown that emotion impacts the allocation of resources to the visual system. The emotional object, especially negative stimuli, will be allocated more attentional resources than neutral stimuli. In their research based on computational neuroscience, Milosavljevic and Cerf (2008) showed that attention is a corner stone to intention and decision making. Earlier Loewenstein (1996) emphasizes that primitive emotions, such as hunger or sexual arousal, can largely affect the decision-making process. Additionally, emotions influence both individual's attitudes and judgments, which in turn influence the decisions being made (Gutnik et al., 2006). Besides, Lerner et al. (2015) note that emotions constitute potent, pervasive, predictable, sometimes harmful and sometimes beneficial drivers of decision making. Across different domains, important regularities appear in the mechanisms through which emotions influence judgments and choices (Lerner et al., 2015).

2.3. Measuring emotions in advertising

Poels and Dewitte (2006) distinguished between two types of measures of emotions in advertising which are: self-reports and autonomic. Self-report is indeed the simplest way to measure emotion (Lewinski et al., 2014). However, this forces the individual into a

conscious, self-awareness process (Pryor et al., 1977). Conscious answers can be manipulated or a socially awkward emotion can be hidden (Lewinski et al., 2014). Poels and Dewitte (2006) suggest that self-report increases the probability of "cognitive bias" incidences. For instance, respondents tend to answer what the interviewee senses to be in line with the value system of the interviewer (Benstead, 2013). On the other hand, autonomic measures are outside of the respondent's conscious appraisal and hence are a more accurate assessment of the respondent's emotional reactions (Poels and Dewitte, 2006). The autonomic measure can assess respondent brain activity (EEG or fMRI), heart rate fluctuation, skin conductance variation, eye movement or facial expressions (Langleben et al., 2009; Cook et al., 2011; Lewinski et al., 2014). The majority of these measurement tool tend to be invasive, except for facial recognition software. For example, EEG required numerous electrodes to be positioned on a participant's scalp and the interpretation of EEG data remains complex. On the other hand, automatic facial recognition does not involve wiring the respondent and provides a good assessment of the respondent's emotional state; the results are also rather intuitive and their analysis more accessible (Dieckmann and Unfried, 2014). Jack et al. (2012) found that human faces could express over 20 different emotions. Facial muscles involved are linked to the cerebral cortex through the corticobulbar track (Martinez and Du, 2012). More specifically Whalen et al. (2013), in analyzing recent research, showed that the amygdala, generally considered a key player in emotion, social behavior, and emotion inhibition and regulation (Phelps and LeDoux, 2005), was responsible for all potential value of all facial expression (Whalen, 2013).

Based on the foregoing discussion, the following null hypothesis has been proposed:

H1. Response to emotional stimuli is not stereotypical, i.e. reaction to an emotional stimulus varies from respondent to respondent.

H2. Highly emotional advertisements, as oppose to low emotional advertisements, do not impact attitude variation over time.

3. Research methodology

This research uses GfK-EMO Scan, a facial recognition software developed by the Munich-based Fraunhofer Institute for Integrated Circuits IIs. GfK-EMO Scans use webcam technology to provide a non-invasive, automatic, real-time emotional reaction to marketing stimuli (Garbas et al., 2013). GfK-EMO Scans can record over 20 frames per second, enabling an accurate measure of real-time emotional responses (Garbas et al., 2013). Two safe driving advertisements from the UK were shown to a group of 60 students and their emotional reactions were recorded. Both public service advertisements convey the same message about the danger of speed and road safety. While one advertisement used a highly affective message strategy, the other advertisement relies mostly on rational/cognitive strategy. The high emotional video presents a dramatic car accident with casualties, and conveys a high level of negative emotions, including grief, fear and shock. The low emotional advertisement delivers scientific facts and the law of physics to demonstrate how a biker could have avoided a deadly accident by driving under 68 km/h.

3.1. Pilot study

To test the emotional valence of each advertisement, a pilot study was conducted. Both advertisements were showed to a random sample of ten university graduate and undergraduate students, five males and five females. They were asked to rate their emotional experience. Eight participants out of ten described the car accident video as being highly emotional, while nine participants out of ten described the motorcycle video as low emotional. (Fig. 1).

60 volunteer students, 30 males, and 30 females, were recruited. A group of 30 students, of which there were 15 males and 15 females, watched the high emotion advertisements, while the other group of 30 students (also 15 males and 15 females) volunteered to watch the low emotion advertisement. Directly after watching the advertisements, and again two weeks later, the students were requested to answer a survey adapted from the National Survey of Speeding Attitudes and Behavior (NSSAB). The survey was first conducted in 2011 to measure individual driving attitudes (Schroeder, Kostyniuk and Mack, 2013). Results of the study, which were published by the US Department of Transportation, National Highway Traffic Safety Administration (NHTSA), show that drivers could be segmented into three distinct groups, of which 30% were speeders, 40% were sometime speeders, and the remaining 30% were nonspeeders. Demographically speaking, it was found that speeders were more likely to be higher income young males in comparison to sometime-speeders and non-speeders. The results of the survey also tested phone usage (texting and calling) while driving. Alarmingly, the survey showed that speeders also tended to use their phones more often while driving than sometime-speeders and non-speeders.

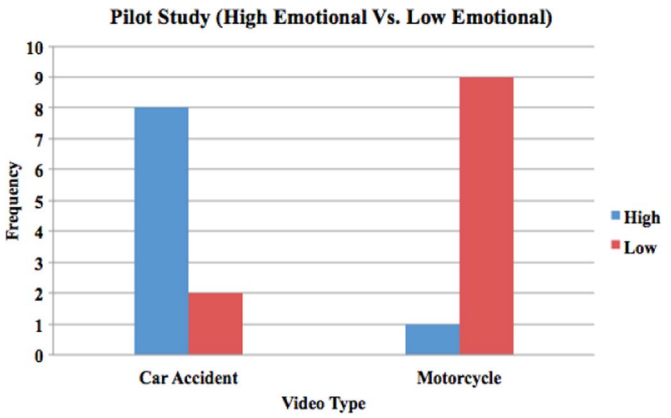

Fig. 1. Pilot Study to Categorize Videos.

The second survey that took place two weeks after the initial exposure to the advertisement was aimed at measuring the impact of emotions on recall and attitude change. The two-week time frame was chosen after a study by Di Vesta and Smith (1979) who showed that after being exposed to fairly meaningful materials, people tend to forget around 48% of this material after a two week period.

4. Experiment results and findings

After conducting the experiment, all of the recorded videos of the 60 respondents were sent to the GfK laboratory in Germany for analysis. The analysis provided both mean and median emotional response. The median results were found to be more accurate as they offset the outliers from the mean values.

4.1. Experiment results

4.1.1. High emotional video, all-participants

Fig. 2 shows the median values of the group who was shown the high emotional video (HEV). The first seconds of the advertisement show a young couple kissing and, not surprisingly, a positive emotion is recorded. But immediately after this scene, a car hits the teens and the emotional valence turns negative and remains negative until the end of the advertisement. The highest emotional negative instant experienced by all participants was captured at 50.5″ with a relative value of −18.62. Although the scene in Fig. 2 marked at 50.5 s does not display any strong emotional cues, the intense negative emotion recorded is conceivably due to "accumulated" emotions by the respondents. Other scenes where respondents experienced highly negative emotion were recorded when the girl hit by the car is on the operating table, the

Fig. 2. HEV All-Participants Emotional Valence Peak Value.

Fig. 3. HEV High Emotional Scene (a).

Fig. 5. HEV High Emotional Scene (c).

Fig. 4. HEV High Emotional Scene (b).

Fig. 6. HEV High Emotional Scene (d).

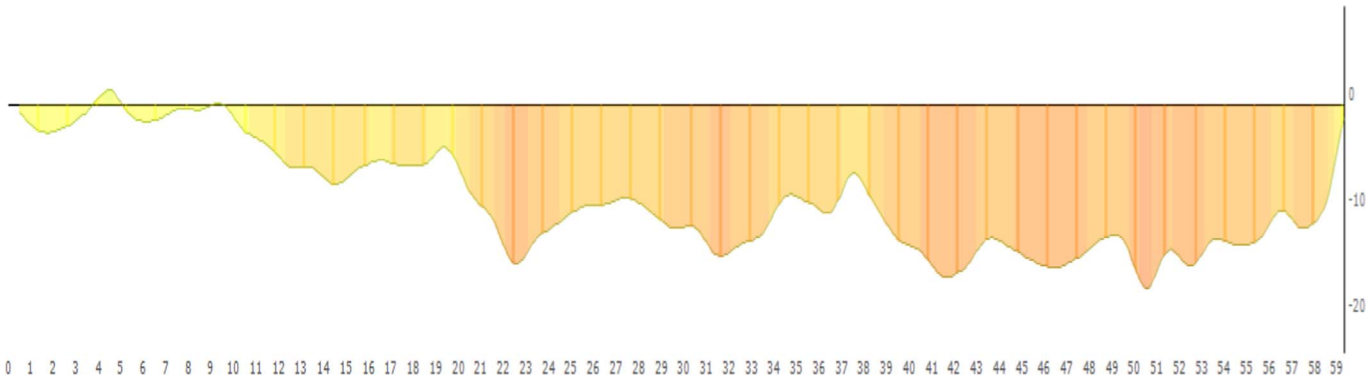

Fig. 7. HEV All-Respondents Emotional Valence Graph.

parents crying next to the body of their dead son at the morgue, the scene showing the car overturning after colliding with the fence, and the driver's expression while he loses control of his car (Figs. 3–6).

4.1.2. Low emotional video: all-participants

Emotional valence recorded for all participants who watched the low emotional video (LEV) was notably less than the recorded values for the participants who watched the high emotional advertisement (Figs. 7 and 8). Fig. 9 shows the highest emotional instant is captured at 41.6 s with a relative value of −17.07. The scene does not contain any emotional cues; instead, it shows a quick variation of the speedometer which forced the respondents to lower their gaze and eyebrows and was subsequently interpreted as a shock or negative emotion by the system.

5. Survey findings

All of the 60 participants filled in the survey. The survey asked the participants if they drove a car and if so which type of vehicle they drive most often. The majority (93.33%) stated that they most often drove a sedan-type car while 6.67% of the sample logged an SUV-type as the vehicle they drove most often. Participants were also asked to indicate their driving frequency. 38.33% of the sample drove every day or almost every day. 33.33% drove only certain times a year. 18.33% of the sample drove several days a week, while 10% drove once a week or less. The age categories of the sample are divided as follows: 68.33% of the sample is between 21 and 23 years old. 21.67% of the participants are aged between 24 and 26 years old. Respondents between 18 and 20 years old represent 3.333% of the sample, while 6.67% of the sample is above 26 years old and none were below 18 years old.

5.1. Rational driving score over time

Participants were asked to provide answers to 21 items using a 5-point Likert scale (Strongly Agree to Strongly Disagree). The sum of the 21 items per participant helped assign a rational driving score (Maurer and Pierce, 1998). The calculated score is compared to the ideal score of 105 (calculated as the sum of best answers for all the 21 items). For the 30 HEV participants, scores of very little variation were recorded between the first survey (Survey 1) and the second identical survey (Survey 2) which was administered two weeks later. On the contrary, for the 30 LEV participants, a notable decrease in the safe driving score was recorded after two weeks (Fig. 10 and Fig. 11).

5.1.1. Checking assumptions

A paired *t*-test was conducted to compare RDS for HEV participants of “Survey 1” and “Survey 2”. Randomness, independence and normality were tested and validated before running the paired *t*-test. Randomness and independence assumptions were validated with the sample choice while a “Shapiro-Wilk W” test, along with a normality plot, validated the normality requirement.

A paired *t*-test resulted in a p-value equal to 0.15457 showing that there was no significant difference between the RDS of “Survey 1” and “Survey 2” for the high emotional video. However, the paired *t*-test for the low emotional video returned a p-value of 4.1287E-7, proving that a significant difference in RDS with a 99% certainty. A paired *t*-test resulting in a p-value of.

2.0643E-7 showed that the safe driving score recorded by the second survey is significantly lower than the safe driving score recorded by the first survey administered right after the respondents were shown the videos. The safe driving score was shown to have significantly decreased by 6 points.

Similarly, the difference in RDS variation over time between HEV and LEV advertisements were tested. A paired *t*-test found a p-value of 0.00003, confirming that the mean difference in the RDS over time for HEV is statistically significantly lower than the mean difference in the RDS for LEV over the same two-week period. Hence H1 is rejected and we can conclude that the response to the advertisements is stereotypical; in other words, respondents react identically to a given stimulus.

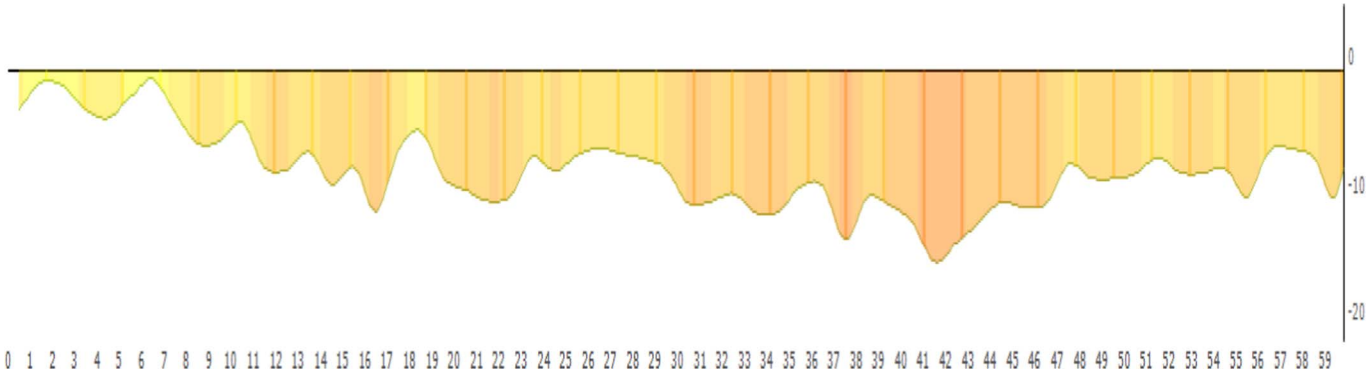

Fig. 8. LEV All-Respondents Emotional Valence Graph.

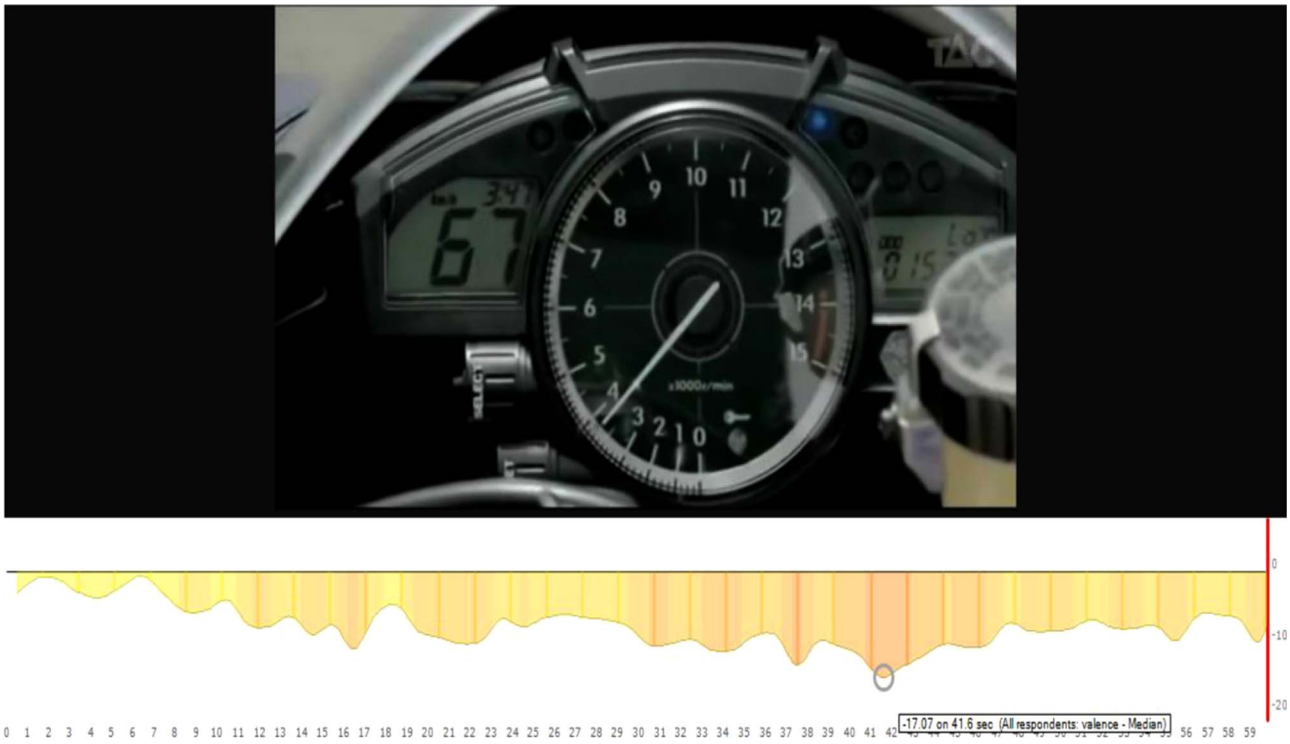

Fig. 9. LEV All-Participants Emotional Valence Peak Value.

Finally, potential correlation between RDS over time and video type were tested using linear regression. Video type was set as a dummy variable with '0' assigned to LEV and '1' assigned to HEV. Prior to running the regression, both normality and linearity assumptions were verified. A significant linear relationship between the video type and the difference in the RDS was found. The high emotional advertisement led to a smaller decrease in RDS over time compared to the low emotional advertisement. The variation in the video type explains 24.51% of the variation in the RDS over time; meaning there are other factors that would need to be taken into consideration.

In conclusion, the highly emotional advertisement led to a persistence in the safe driving attitude score while low emotional advertisement led to a 6 point decrease in the safe driving attitude score. This confirms that emotions impact attitude modification over time. The higher the emotions, the lower the decrease in the safe driving attitude score over time. This supports H2.

5.2. Speed limit reinforcement over time

In addition to the rational driving score, participants were asked to determine the frequency by which police should reinforce the speed limit. The calculated score is termed Speed Limit Reinforcement, or SLR. While comparing the frequencies in "Survey 1" and "Survey 2", it was detected that the 30 HEV participants responded with approximately the same frequencies in both stages, while the 30 LEV participants responded with lower frequencies in the second stage compared to the first stage of the survey (Figs. 12 and 13).

5.2.1. HEV vs LE speed reinforcement over time

A paired *t*-test at 0.05 significance level returned a p-value of 0.83149, confirming that there was no significant difference between the SLR values of the first survey and the second survey which took place two weeks after. However, a paired *t*-test for the LEV advertisements returned a p-value equal to 1.20921E-7, indicating a significant decrease in the SLR score within the two-week period. This supports H1. A paired *t*-test also concluded to a significant difference between the variation in speed limit reinforcement over time between the high emotional advertisement and low emotional advertisement. Finally, a linear regression analysis showed a significant linear relationship between the video type and the difference in the speed limit reinforcement score. With the high emotional advertisement leading to a lower decrease in the SLR score compared to the low emotional advertise-

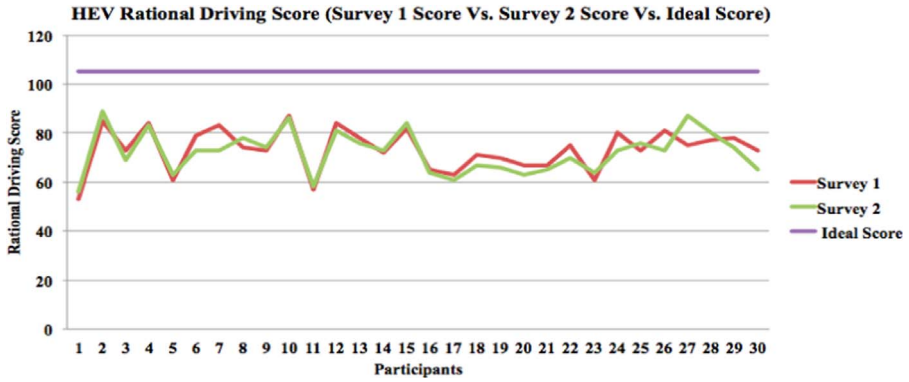

Fig. 10. HEV Rational Driving Score over Time.

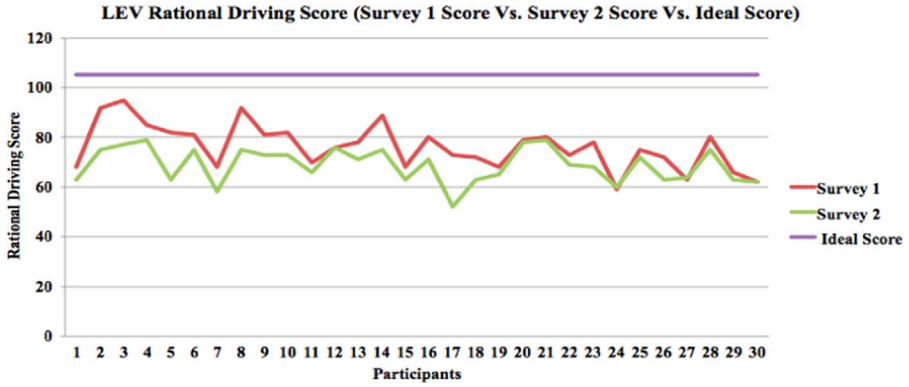

Fig. 11. LEV Rational Driving Score over Time.

ment. Therefore, H2 is supported. In addition, the variation in the video type explains 30.89% of the variation in the SRFs over time, meaning there are other factors that should be taken into consideration.

5.3. Frequency of texting while driving over time

The survey also measures attitudes toward texting and speaking on the phone while driving. A paired *t*-test found that neither the high emotional video nor the low emotional video had any impact on the change in attitude over the two-week period. This is certainly due to the advertisement contents, whose safe driving message was about speed and did not address the issue of phone usage.

6. Results analysis

A first result from this study suggests that response to an advertisement is constant across a given population. Although a noticeable variation was noted between genders, both male and female had an identical emotional reaction to a given stimulus. This was also reported by Hasson et al. (2004) who demonstrated using fMRI that much of the cortical response was stereotypical. Another key finding of this study pertains to the impact of high emotional vs low emotional advertisements on attitude and attitude change over time. Respondents subjected to highly emotional stimuli while watching the high emotional advertisement reported a better safe driving attitude score than a respondent who had watched the more rational, less emotional advertisement. Regarding memory effect, this study also showed that high emotional advertisements lead to a more stable attitude change than low emotional advertisements. The safe driving attitude score of respondents who had watched the low emotional advertisement dropped significantly after two weeks while respondents who had watched the highly emotional advertisement maintained the same high score after two weeks. Hence, the message conveyed within an emotional strategy appears to benefit from better storage and retrieval than the same message transferred through a low emotion strategy. This study also demonstrates that emotions tend have an impact on respondent cognizance specifically centered on the message relating to the advertisement. Although both advertisements concerned safe driving, the advertisements conveyed a specific message about the danger of speed, thus both advertisements managed to significantly influence respondent attitude towards speed but had no effect on other hazardous driving attitudes, such as texting and phoning while driving. Finally, this study substantiates the effectiveness of Franhofer Institute's GfK-EMO facial analysis webcam technology as a non-invasive, efficient and accurate real-time tool to measure emotional reaction to marketing stimuli.

7. Conclusion and implications

This study supports previous findings regarding the prevailing role of emotion in the human cognitive process. LeDoux (2007) has showed that there is a high density of upward communicative pathways going from amygdala to the cortex, but no downward connection from the cortex to the amygdala. The amygdala is involved in the perception and conversion of stimuli related to present or habitual emotional goals and is biased toward focusing on hostile cues (Neta and Whalen, 2011; Ochsner et al., 2012). The cortex or cerebrum is associated with higher brain functions, such as thought and action. In other words, emotions can control thoughts and action whereas the reverse is not true (LeDoux, 2007). Yet researchers have proposed that emotion could be rationally controlled, stating that regions of the cortex (such as the dorsolateral, the posterior prefrontal cortex, anterior cingulate cortex and the ventrolateral prefrontal cortex) could potentially take a role is the cognitive control of emotion (Ochsner et al., 2012) yet Raio et al. (2013) showed that cognitive emotion regulation often fails in everyday life situations.

Implications are far reaching, both in term of advertising effectiveness and ethical issues. Firstly, emotional advertising is clearly able to foster a relatively strong and enduring attitude and behavioral change

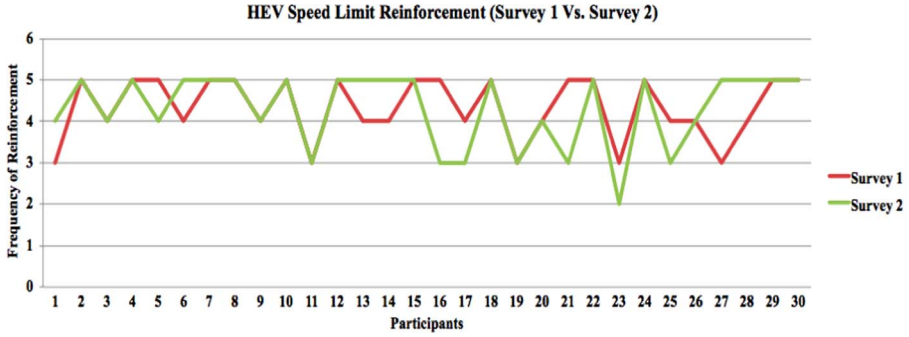

Fig. 12. HEV Speed Limit Reinforcement over Time.

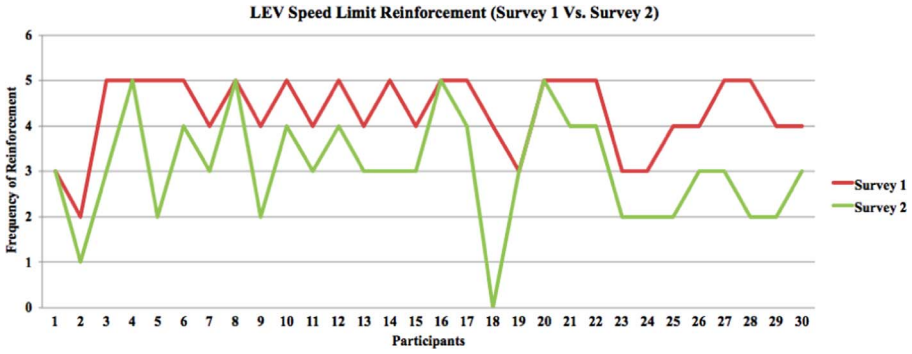

Fig. 13. LEV Speed Reinforcement over Time.

in an unprepared audience. A second implication pertains to the measurement of the effectiveness of an advertisement. The traditional methods of measuring whether or not an advertisement is effective is a costly exercise that is generally done post-campaign and relies on gathering data from many respondents. Marketers can use facial detection on a much lower number of subject to obtain information that would otherwise not be obtainable through traditional marketing research techniques to predict the efficiency of a campaign before it is launched. Last but not least, there is indeed an obvious moral issue behind "finding the 'buy button in the brain' and … creating advertising campaigns that we will be unable to resist." (Nature Neuroscience, 2004, p. 683).

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