Looking beyond traditional measures of advertising impact: Using neuroscientific methods to evaluate social marketing messages

ABSTRACT

Despite the growing popularity of neuroscientific methods to elicit more objective information compared to the traditional research methods, there is little research on the impact of social marketing and public service messages, using a combination of qualitative and neuroscience research methods. This paper compares the overall impact of an anti-binge-drinking campaign using focus group discussions and experimental Electroencephalography (EEG), a neuroscientific research tool. We find many similarities and differences in the results from these two methods. We also identify specific time and message points when attention and memorization processes occur, by combining two analytical tools for the EEG data - Global Field Power (GFP) and standardized Low Resolution Electromagnetic Tomography (sLORETA). These findings provides valuable insights into the impact of content, style and composition of public service and social marketing messages. We discuss the managerial implications of our findings for social marketers and public policy makers and future research directions.

Keywords: Advertising impact; Electroencephalogram; EEG; Focus group; Neuromarketing; Neuroscience

1. Introduction

Assessing the impact of advertising on consumers generally relies on the theoretical model called hierarchy of effects (HOE), which suggests that advertising influences opinions (cognitions) that affect attitudes (affect, feelings), which in turn impact behavioral intentions (Batra and Holbrook 1990). However, this linear unidirectional model is not always accurate because affective outcomes (e.g., feelings and emotions) involve independent brain processes and can precede cognitions and behavioral outcomes (Frijda, Manstead, and Bem 2000; Foo, Uy, and Baron 2009). Hence, advertising message processing is a complex phenomenon as it involves varying interactions between feelings and cognitions for different consumers.

Advertising impact is traditionally measured using a mixture of qualitative and quantitative research methods. Qualitative methods (e.g., focus groups, observations and in-depth interviews) are very useful to explore in-depth consumer views, attitudes and value judgements but they tend to be quite subjective because they rely on self-reports that may be biased and difficult to interpret objectively (Brigg 2006; Magid et al. 2016). Recent studies address these concerns by using neuroscience research methods that are considered relatively more objective in combination with the traditional behavioral research methods, to examine and evaluate the impact of advertising on consumers in advertising contexts such as social marketing and public service messages (Couwenberg et al. 2017).

In this context, Lieberman et al. (2011) test the effects of verbalizing and talking aloud (affect labelling) about the effects of negative emotional stimuli and they find that the verbal labelling of affect by participants has a dampening outcome on their emotional responses in general. Specifically, participants discuss their impressions of advertising messages during qualitative research, which requires appraisal, identification and labelling of their affective reactions. Cognitive labelling of affective advertisements triggers corresponding emotion

regulation processes, which reduce brain and somatic/physiological activation. When consumers cognitively label a negative emotional stimulus, the brain activations suggest cognitive reappraisals that are similar to distraction tactics to avoid negative affect thus achieving emotional regulation and less self-reported distress (Burklund et al. 2014).

Affect labelling triggers unconscious and implicit emotional regulation and hence traditional research methods cannot measure this implicit emotional regulation effect. However, by using neuroscientific tools such as Electroencephalogram (EEG), researchers may be able to monitor unconscious brain activation of emotional advertising messages, which reflect the attention, perception and memory of the consumers, and can be compared to affect-labelling responses gathered using qualitative research. In this paper, we extend this line of research by comparing the overall impact of a public service message (binge-drinking campaign) using focus group discussions and experimental Electroencephalography (EEG), a neuro-scientific tool (Lim 2018). We find many similarities and differences in the results from these two methods. By combining two analytical tools, Global Field Power (GFP) and standardized Low Resolution Electromagnetic Tomography (sLORETA) analysis for the EEG data, we identify specific time and message points when attention and memorization processes occur. These findings provides useful insights into the impact of content, style and composition of public services and social marketing messages.

We begin this paper by reviewing the various approaches used to evaluate the impact of public services and social marketing messages. We then describe our studies using focus group discussions and EEG methods, followed by a discussion of our findings and their implications for social marketers and public policy makers along. We also describe some useful future research directions in this topic of growing importance for marketing researchers, which reflects the broader social changes and challenges being experienced by consumers, marketers and public policy makers around the world.

2. Literature review and framework

2.1 Advertising messages and alcohol consumption

Social marketing studies tend to assume that unhealthy behaviors and habits can be changed by knowledge and positive emotional messages anticipating that target markets will change towards healthier behavioral choices (Wymer 2011). The development of effective social marketing communications campaigns is dependent on understanding the nature of the problem, its causes and solutions, much the same as in any commercial marketing endeavor. This includes a complete understanding of how emotions, can be paired with consequences and solutions to construct a memorable message for effecting behavioral change. For example, research suggests that guilt is best paired with a gain outcome to increase coping ability and self-efficacy for problem solving. Conversely, shame based messages may be more effective when combined with loss shame (Duhachek et al. 2012).

Past research suggests a positive relationship between marketing communications activities (e.g. advertising) and alcohol consumption (Scott et al. 2016; Jones and Magee 2011). Although each individual's susceptibility to advertising may be caused by a complex set of personal conditions, the pairing of alcohol with emotionally charged, culturally admired activities such as sporting events shown on TV can be a very powerful behavioral influence (O'Brien et al. 2015). Advertising is one tool used in social marketing that aims to change negative drinking attitudes and behaviors by advocating positive health promotion messages (Kubacki et al. 2015). Such messages usually involve emotional content with social interactions that are mostly processed automatically without much conscious and cognitive elaboration of advertising messages (Bargh et al. 2012; Ellenbogen, Carson, and Pishva 2010). Most of these messages also tend to be based on negative emotions and consequences such as guilt and shame (Duhachek, Agrawal, and Han 2012). However, it is not clear to what

extent these negative emotional advertising messages may reduce the propensity for binge-drinking and the harmful effects resulting from excessive drinking. Hence, there is a need to test these messages using a rigorous methodology in order to assess their effectiveness.

2.2 Neuroscience, EEG and social research

Neuromarketing combines the use of neuroscience and marketing techniques to explore a range of marketing questions and improves researchers' understanding of how consumers process emotional advertising messages, assess the degree of like or dislike evaluations (approach or avoidance reactions), and measure the consumer interest and attitudes towards behavioral changes (Bettiga, Lamberti, and Noci 2017, Lee, Broderick, and Chamberlain 2007; Lim 2018). Compared to traditional research methods, such as surveys and interviews that are likely to be relatively more subjective due to the respondents' reluctance to openly reveal their preferences and responses to stimuli, neuroscientific techniques are likely to help elicit relatively more objective information because these methods do not require an active or conscious response from the participants (Telpaz, Webb and Levy 2015).

Neuroscience offers the opportunity to fully explore decision making processes involving attention, attitudes, emotions and memory (Bettina et al. 2017; Plassman et al. 2012; Lim 2018). Hence, neuroscience may be particularly useful for exploring sensitive issues that are often the focus of social marketing or public service campaigns (Achrol and Kotler 2012), as indicated by the greater predictive power of neuroscience tests compared to more traditional methods applied to a variety of pro-social messages (Lee 2016). However, despite such growing evidence, the full potential of neuroscientific research methods in marketing research is not yet fully realized and more studies need to be conducted in this regard (Daugherty, Hoffman, and Kennedy 2016; Lee 2016; Lim 2018; Telpaz et al. 2015).

Neuroscience can be used to understand and address social marketing issues, such as binge-drinking. In naturalistic settings such as healthcare, the outcome of a problem is observed and then tests are conducted to discover and understand the root cause of the problem (Daugherty et. al. 2016). A similar approach can be adapted for social marketing problems such as binge-drinking, where the condition is well-documented but behavioral change is not easy to achieve. Social Neuromarketing attempts to tackle drinking problems through message evaluation by understanding how consumers' process complex affective and cognitive anti-drinking messages. Social Neuromarketing can identify the key message elements that activate the correct brain areas and help design more effective advertisements to achieve behavioral change, which is generally quite difficult to measure (Chikritzhs 2009).

Neuroscience may also offer a solution towards improving intervention strategies. For example, EEG tests can analyze second-by-second brain activation in response to message content that elicits positive activation (approach brain activation) and is worth retaining in the video. However, if message content elicits negative (avoidance brain activation) responses or inattention, these video segments can be changed or removed. Thus, EEG tests can help create more effective messages to activate long-term memory and initiate positive attitude formation (Gordon and Ciorciari 2017; Gordon, Ciorciari, and van Laer 2018; Harris, Ciorciari, and Gountas 2018a, b; T Vecchiato, Cherubino, Trettel, and Babiloni 2013).

The main aim of this paper is to find if qualitative research methods (e.g., focus groups) provide similar conclusions as a neuroscientific method (e.g., EEG), to evaluate young adults' reactions to ads against binge-drinking. We hypothesize that EEG will be able to identify the level of cognitive and affective engagement being evident in brain activation associated with cognitive processing of emotions, memory and avoidance or risk assessment. In contrast, focus groups are only likely to provide overall opinions on the consumers' likes or dislikes for the messages and not identify any cognitive processing activity. To summarize,

this study is a methodological test of the differences in the outcomes of focus groups and EEG methods, with the following specific research objectives:

- To investigate young adults' affective reactions to five advertising videos about the harmful effects of excessive drinking and suggested behavioral changes.

- Compare the overall message impact of the five advertising videos, as measured by the focus groups and EEG methods.

- To ascertain if the EEG can uncover implicit affect processing of advertisement messages that may not be possible using focus groups.

3. Research methodology

3.1 Sample and research design

We use a mixed methods approach with two studies, in which the participants watch and respond to five binge-drinking video advertisements. Study 1 uses qualitative research methods (stages 1 and 2), and Study 2 involves recording the EEG while viewing the videos (stage 3). Students at two Australian universities were invited via email to participate in a study of attitudes towards binge-drinking among young people. 40 students (aged 18-25 years, 20 males and 20 females) volunteered to participate in the study and they were randomly allocated to four groups with ten members each. Two trained facilitators began each focus group with a short discussion about perceived reasons for binge-drinking and attitudes towards binge-drinking following which the participants were shown five social marketing advertisements (short videos) aiming to discourage binge-drinking and anti-social behaviors. At the end of each focus group discussion, participants were asked to comment on the message content and impact of each video, to help explore their verbalized attitudes. Finally, individual EEG were recorded while each participant watched the advertisements in a randomized order, to help identify brain activation associated with the negative affective

content depicting shocking outcomes of anti-social behaviors. All EEG data were analyzed individually but only group averages are presented for statistical analysis.

3.2 Stimuli

Five video advertisements with alcohol reduction messages were used to elicit and measure participant's affective responses. These videos were selected after careful pre-tests of their messages to ensure that they indeed reflected accurately young adults' binge-drinking attitudes and violent behavioral outcomes found in 'dry' cultures (drinking without any food, e.g., in Australia). The choice of video stimuli containing strong affective messages was made because they elicit three emotional reactions according to Lang (1995); namely a) directionality (tendency toward approach or avoidance reactions), b) intensity (higher or lower activation or energy requirement), and c) control (continuation or interruption of the behavioral sequence). All these emotional outcomes or reactions as suggested by Lang (1995) are possible to evaluate through focus groups and EEG tests.

Video 1: Don't turn your night out into a nightmare, Know Your Limits - Binge-drinking Girl (http://www.youtube.com/watch?v=zkVqJTK0ioc). This video shows a young woman getting ready for a night out. As she dresses, she rips her clothes, pours red wine on herself and breaks the heel of a shoe. She goes to the bathroom, vomits and with her fingers she runs some vomit through her hair. She then leaves home to go out. The message is "You wouldn't start a night like this. So, why end it this way".

Video 2: Violent male (http://www.youtube.com/watch?v=kZFBjoTYD5E). A young man is talking to the camera about the ingredients of a 'good' night out: money, mobile phone, good clothes, mates, good venue, nice view (girls) and a few drinks. He then drinks a mix of beer with shots whilst saying "I'll have a few more". Another young man walks by and accidently spills a drink on the narrator who punches him in the face and knocks him to the

floor. He was thrown out of the bar, his friends stayed behind, so he decided to walk home in the road. He saw a car coming and assumed it could see him. Next, he turns his bloody, injured face to the camera and says "No", while his friends look distressed and frightened.

Video 3: Models on a runway (http://www.youtube.com/watch?v=nrDUiCrmp8I). Catwalk of a fashion show with young people as audience sitting on either side of the parade. A female model walks down the runway, squats, urinates, stands up and walks away. The audience response is shock and many gasp. Another female model walks down the runway, vomits on the floor and walks off. Again, the young audience gasp and look confused. Then, a male model walks out, turns around and bumps into another male model that is walking towards him. They push and shove each other, one of them falls on the floor and the other kicks him. The ad ends with "You wouldn't start a night like this. So, why end it this way".

Video 4 (description): Pregnant woman-Rethink Drink - Australian Anti-Drinking Advertisement (https://www.youtube.com/watch?v=FfY7L_QUk8o). A BBQ gathering in a garden, the scene is happy but there is one very drunk, unsteady male who spills his beer around him. The man hosting the BBQ indicates to the drunken man that his behavior is unacceptable and discourages more drinking. The party moves inside the house, the drunken man is jumping up and down, dancing, bumps into a pregnant woman and as she falls over, she knocks herself unconscious. The scene moves to a doctor examining the pregnant woman and conducting an ultrasound scan. The video finishes with the doctors sorrowful words "I'm very sorry…" The woman shouts NO!! Moreover, she cries uncontrollably.

Video 5 (description): After the Party Regret, Anti-Drinking TV ad - Don't turn you night out. (http://www.youtube.com/watch?v=baeJUpDbkFg). Young females arrive at a house party, dancing with bottles of alcohol at hand and pouring large drinks merrily. The scene moves to the next morning, a young male wakes up and see a girl sleeping next to him. He

starts remembering having sex with the girl during the night. He goes to the bathroom, starts vomiting and more memories come back of what happened. He remembers a girl vomiting in a bathtub full of water. He dresses quickly, goes downstairs, turns around and catches a glance of the girl he had sex with looking at him. He leaves the house, there is another girl, passed out, disheveled, lying in the garden. A sad song is heard saying, "don't cry my love…" The advert's final comment is "you wouldn't start a night like this. So, why end it this way".

4. Study 1 (Focus group discussion)

Study 1 consisted of two stages; i) focus group discussion, and ii) video viewing with follow up group evaluation of message impact. In stage one, the participants took part in a moderated focus group discussion in four groups of ten participants each. The aim was to gather information about young adults' views on alcohol consumption and the after-effects of excessive/binge-drinking on their social behavior. In stage two, all the participants viewed five binge-drinking videos sequentially, followed by a discussion to elicit their opinions and attitudes towards each video's impact.

4.1. Thematic analysis of focus groups responses

The facilitators began the focus groups by asking the participants to define binge-drinking and the reasons why people do it. The participants had varying opinions on what is binge-drinking but they all generally agreed that it involves drinking heavily for several nights of the week, drinking deliberately to get drunk, and drinking until one passes out. These views are in line with the tentative definitions and overall research findings on binge-drinking (e.g., Jones, Gordon, & Andrews 2016). Interestingly, none of the participants agreed with or accepted the veracity of the official health guidelines (two units per day) and found these to be too low. The following four key reasons for binge-drinking emerged from this discussion:

1. **Peer pressure:** young people seeking social acceptance; to fit in; to connect with others; to be 'cool'; to be sociable.

2. **Pleasure/fun-seeking:** to have a 'great' night out; "gives them a good story to impress friends the next day";

3. **Escape:** to escape from everyday life; relax, re-energize and unwind from stress; gain social confidence and feel able to socialize freely.

4. **Cultural norms:** it is normal to binge drink; because it is socially acceptable and is "engraved in our culture (Australian)"; violence is just one of these things, "it just happens" with drinking; males drink more, but females also binge drink as well. Parents may be good or bad influences on drinking habits.

4.2. Perceptions towards the video advertisements

Video 1: Don't turn your night out into a nightmare. Initially, this advertisement seemed to provoke some thinking about the somewhat disturbing situation, which used a "backwards" approach to tell a sad story. The participants were somewhat amused (insecure type of positive affect) rather than shocked and all participants agreed that the result, with girl in a mess after a drunken night out was very familiar but it was not surprising or shocking outcome. This type of situation is very familiar and seen frequently, but they do not see it as a terrible way to behave. The participants expressed their resigned acceptance of this kind of behaviors and were somewhat sympathetic to the character depicted. However, from their responses, it is hard to gauge the overall impact of the advertising message and to assess if it is a memorable enough to be highly likely to initiate behavioral change.

Video 2: Violent male. This was the only advertisement that left the participants sitting silently for a few seconds. After a momentary silence, the participants expressed agreement and acceptance of the ugly scenes of alcohol fueled violence, particularly amongst males, but

unfortunately, it is also seen amongst females as well. The notion of male aggression and violence due to drinking seems to be accepted as a cultural norm and some male participants admitted that they had been involved in fights either personally or intervening for a friend. The video had an emotional impact, maybe committed to memory and it may have altered some of the behavioral intentions for future situations. However, none of these impressions and their future influence is possible to measure accurately in a focus group setting.

Video 3: Models on a fashion runway or catwalk. The first responses were disgust and revulsion (avoidance/negative unpleasant affect), but quickly followed by acceptance (resigned acceptance) that such things happen very often. Although, the participants disliked the behaviors shown in the advertisement, they were neither shocked nor surprised. This video triggered a number of thoughts and feelings, but it is unlikely that the participants identify with the models walking on a catwalk embarrassing themselves in front of a crowd of people. Overall, the affective reaction was negative, tinged with emotions such as disgust and fear. The message is more likely to have an impact amongst the female participants rather than the males, but again it is hard to measure any of these affective responses and attitudinal changes using qualitative research methods such as focus groups.

Video 4: Pregnant Woman-Rethink Drink. The first emotional impressions of this advertisement were shock, horror and sadness. However, several male participants agreed that the pregnant woman should not have been at the party and therefore it was her fault for the terrible accident. They also blamed the husband for not taking better care of his pregnant wife as well as the host of the party for allowing the drunken man to continue drinking. Overall, the participants' attribution of responsibility for the accident shifted from the drunken male perpetrator to various other people, including the pregnant woman who did not do anything wrong. The overall expressed feelings were sadness, with some sympathy for the loss of the pregnant woman's child. However, they also felt negatively and disapproved of the

party host, the husband and pregnant woman for not doing the right things to protect themselves and others from the drunken man's actions. These findings suggest a shifting of the locus of control for the unfortunate outcome shown in this video.

Video 5: After the Party Regret. The story of the advertisement seemed most familiar to the participants. All young adults have seen similar situations at house parties where drunken people slept with strangers they could not remember the next day when they were sober. The affective reaction was a mild acceptance of the unwanted sexual events. They did not feel shocked or concerned but they expressed a detached amusement of a familiar situation reflecting "a normal part of their lives". The message is likely to be memorable, because it is familiar, and in some ways 'desirable' because getting drunk is one of the ways to be successful with sexual partners. However, it is not possible to ascertain the likely impact of this advertisement on the young consumers' future binge-drinking behaviors.

4.3. Discussion

Overall, the focus groups participants commented that little in the five videos shocked or concerned them because anti-drinking messages and anti-social behaviors are accepted as part of life. They suggested that there is a degree of desensitization to 'shocking' messages and therefore, such messages may not change their attitudes towards drinking. The key themes that emerged from the discussions include, shock at the (drunken) actors' behaviors, concern and acceptance of the anti-social and undesirable status quo behaviors, and lack of proper assessment of individual responsibility for their behaviors. Most of the participants became reflective of their own actions and somewhat disturbed by the familiarity of the scenes in all the videos. The participants also gave overall evaluations of the messages and their effectiveness in promoting anti-drinking behavioral changes. Table 1 shows a summary of the evaluative comments capturing the most common responses.

< Insert Table 1 about here >

5. Study 2 (Neuroscientific method - EEG)

EEG tests are able to predict individual preferences and choices in response to marketing stimuli (Telpaz et al. 2015) and verify participants' responses to media communications stimuli (Vecchiato, Astolfi et. al. 2011). This study combines two EEG techniques (Global Field Power EEG and sLORETA) to compare brain activity responses to the same videos shown to the same participants as in study one. Neuromarketing research shows a number of brain regions to be involved while watching advertisements (Cook et al. 2011); including *associative visual cortex (AVC)*, a region associated with emotional visual attentional processes; t*emporal-polar Area (TA)*, which supports visceral or negative emotional responses; *anterior frontal cortex (AFC)*, a strategic executive type of assessment processing and memory recall system; *temporal-parietal* cortex *(T/P)*, which is associated with language processing, *dorsolateral prefrontal cortex (DLPFC)*, a working memory system associated with planning and social cognition, and *orbitofrontal cortex (OFC)*, associated with avoidance and risk assessment (Mulert et al. 2004; Sonka and Fitzpatrick 2000).

An EEG source localization technique (sLORETA) was used to identify these areas or regions of interest (ROIs) (Pascual-Marqui, Michel, and Lehmann 1994; Pascual-Marqui 1999, 2002). Fluctuations associated with cognitive attention can also be measured using Global Field Power EEG (Vecchiato, Babiloni et. al. 2011; Klimesch 1999), which allows brain-related processes to be scrutinized and interpreted against validated neuropsychological findings. Combining these two techniques takes advantage of the temporal resolution and source localization, which are useful to deconstruct and construct more effective advertising and communication messages (Gordon et al 2018; Kong et al. 2013; Cook et al. 2011).

5.1. EEG recording and neuroimaging data analysis

EEG were recorded with participants seated comfortably in an electrically shielded room, seated at a set distance from the video screen, as in previous studies (Lawrence, Ciorciari, and Kyrios 2014). We used two EEG techniques - Global Field Power analysis (GFP), which has been used extensively to study advertising videos (e.g., Vecchiato et al. 2011; 2012; 2014) and sLORETA (Pascual-Marqui 1999) which can indicate brain regions or regions of interest (ROIs) which contribute to the decision making when attention or memorization was highest. To prepare the data for subsequent GFP and sLORETA analysis, a band-pass filter of 0.5-40Hz was applied to all EEG data. Once eye movement and blinks were removed from the EEG data, EEG power spectra epochs and time series were calculated for all bands for activation (video) and rest periods. These bands were theta (3.5-7.5Hz), alpha (8-12.5 Hz) and Beta (17.5-31 Hz). Theta and alpha were selected to quantify memory and attention (Klimesch 1999) while beta was selected based on its correlations with regional cerebral perfusion and ROI activation (Cook et al. 2011) in advertising studies (Mulert et al. 2004).

To gauge attentional processes or engagement across the whole viewing time of each video, the first 5 seconds, the middle 5 seconds and last 5 seconds of each video were selected for comparative purposes. If engagement was obvious (frontal brain activity) in all the three time-periods/epochs, ir would suggest that the video was effective in maintaining attention. To compare epochs from each video, sLORETA analysis for beta activity was used to identify ROIs during these periods to estimate engagement (Fuchs et al. 2002; Jurcak, Tsuzuki and Dan 2007; Pascual-Marqui 1999, 2002). Regions of activity or regions of interest (ROIs) were identified with dimensional coordinates (Talairach Coordinates - Brain Atlas technique). These ROI's identified as Brodmann areas are associated with a specific functional activity; such as executive cognitive decision making, sensory processing, memory or emotional processing (Garey, Von Bussmann, and Hirsch 2006; Sonka and Fitzpatrick 2000) based on prior Neuromarketing studies (Cook et al. 2011; Mulert et al. 2004). In

particular interest to this study are; the ROI for positive and negative emotional imagery (BA10, BA38), memory encoding (BA10), Information Processing (BA9, BA46), assessment of risk/ aversion (BA11), language processing (BA21, BA40) and visual association (BA19).

5.2. Statistical analysis techniques

For this study, beta activity between active viewing states and rest epochs were compared to determine levels of significance (Cook et al. 2011). Statistical analyses were performed using SPSS (SPSS Inc. Chicago), MATLAB (Mathworks 2016) and Brain Vision Analyzer 2 (Brain Products GmbH). Continuous EEG data (or time series) were analyzed to determine means and standard deviations and then compared with t-tests, and T-level threshold were computed, which correspond to a threshold of statistical significance ($p < .01$), a technique reported by Vecchiato et al. (2011).

To quantify the attentional and memory processes associated with specific events during each video, the EEG were analyzed using Global Field Power (GFP). This produces an EEG trace (time series) for each video, and analyzed to demonstrate statistically significant fluctuations of theta and alpha EEG. These data were then converted to z-scores to extract indexes of attention and memorization for the whole advertising video (Kong et al. 2013; Vecchiato, Astolfi et al. 2011; Vecchiato, Babiloni et al. 2011, Vecchiato, Kong et al. 2012). The process uses frontal electrodes to calculate the GFP. The z-scores greater than 2, are associated with a significant statistical threshold ($p < .01$) using Bonferroni correction (Zar 1984; Vecchiato, Babiloni et al. 2011). These are illustrated in Figure 5-9.

According to Vecchiato, Kong et al. (2012), if both theta and alpha z scores are higher for an event, then more emotional responses are elicited along with memorization, and therefore the event is evaluated as an overall impression index (Kong et al. 2013; Vecchiato, Toppi et al. 2011). All video events creating an impression (combining memorization and attention

scores) are indicated by white arrows on each of the GFP figures; Figures 5-9 (Kong et al. 2013; Vecchiato, Astolfi et al. 2011). However, one can have higher memorization scores with lower attention scores for an event, which may reflect some introspection process that is not necessarily going to lead to behavioral intentions (Vecchiato, Kong et al. 2012).

5.3. EEG results from sLORETA maps

The EEG neuroimaging study design identifies the participants' cognitive and emotional engagement during the viewing of the videos. Figures 1-3 illustrate attentional cognitive engagement during the viewing of each video segment, during the first 5, middle 5 and last 5 seconds of each video. Figure 4 illustrates the brain processing associated with the timing of each video's "message", including the necessary but less relevant aspects of reading and listening to the video messages. For all the figures (1-4), the top five images are superior views with left side being the frontal area and the right side of each image being the back or occipital side of brain. The bottom five images are side (or sagittal) views corresponding to top brain image respectively. Each panel in Figures 1-4 illustrates 2 orientations; superior (top) and sagittal (bottom) views of brain regions reporting significant activity ($p < .01$) of all highlighted regions of interest in red circles.

< Insert Figure 1 about here >

Figures 1 illustrates the first 5 seconds of EEG recordings (grand average of five seconds), while the participants' initially view all five videos. It is expected that at the start of each video brain activation occurs in the frontal areas showing engagement are also reading and listening to the video messages.

< Insert Figure 2 about here >

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Figure 2 illustrates the **middle 5 seconds** of EEG recordings (grand average of five seconds). Each panel illustrates 2 orientations; superior (top) and sagittal (bottom) views of brain regions with significant activity ($p < .01$) and all regions of interest are highlighted. The frontal brain areas are active indicating engagement with emotional processing. In addition, areas associated with word meaning (BA21) and language perceptions (BA40) are active suggesting a shift in attention towards listening to the videos more intently. The first video (Don't turn your night into a nightmare), and last video (After the party), demonstrate strong emotional processing activation (BA38), while the other videos (violent male; models on a runway and Rethink drink) demonstrate continued cognitive processing and attentional engagement (BA10), as shown in Figure 2.

< Insert Figure 3 about here >

Figure 3 illustrates the **last 5 seconds** of EEG recordings (grand average of five seconds). Each panel illustrates 2 orientations; superior (top) and sagittal (bottom) views of brain regions with significant activity ($p < .01$), highlighted. There is strong activation in the frontal areas (BA46 video 1 and 4), language association regions (BA40 videos 3 and 5) and auditory language processing (BA21 video 2 and 5) indicating attentional engagement and emotional semantic processing. However, by the end of viewing only video 1 demonstrates stronger overall emotional engagement, while the other four videos suggest that meaning of the messages is cognitively processed.

< Insert Figure 4 about here >

Figure 4 illustrates the **5 seconds** of EEG recordings (grand average) associated with all the messages' processing for each video. The sLORETA maps show more clearly in which brain regions is the "semantic message" for each of the five videos is processed. Each panel illustrates 2 orientations; superior (top) and sagittal (bottom) views of brain regions

highlighting the significant brain activation (p < .01). The analysis suggests that not all videos "grab" the attention and process the message equally well. Only videos 3, 4, 5 demonstrate more significantly language and visual association processing. The sLORETA images suggest that videos 4 and 5 produced stronger brain activation, which suggests cognitive and emotional processing by the participants.

5.4. Interpretation of EEG results from sLORETA maps

The EEG findings using sLORETA for each video are very useful because they pinpoint brain activity in brain regions, which are known to perform certain cognitive and affective functions. The sLORETA map analysis provide objective brain activations sources, but they cannot suggest clear interpretations because the semantic meaning of why and what exactly causes significant brain activation is not possible at this point in time.

Video 1: Don't turn your night into a nightmare. The participants are listening to the message but are not attending to the information or processing it meaningfully throughout the video. There is little cognitive impact because many regions are not significantly active. The EEG data suggests that while listening to the message, the participants were not emotionally moved but possibly accepted binge-drinking as a fact of life and have no concern for associated health problems (muted positive affect activation).

Video 2: Violent Male. The participants are listening to the message but are not actively attending or processing the information. There is little cognitive impact because most regions are not significantly activated. This is consistent with the qualitative data, which suggest that the participants were not moved "but accepted binge-drinking as a fact of life".

Video 3: "Models on a runway". The participants are engaged for most of this video while processing auditory and visual information, with a clear difference in the processing of

the auditory information associated with the video; listening carefully to soundtrack elicits the participants' attention, which "grabs" their attention. Overall, the video is effective but it is not possible to separate the effects of the music from the actual behavioral messages.

Video 4: "Rethink Drink". The participants are clearly processing both the visual and auditory information associated with this video and engaged for most of the video. It is clear from the EEG that this message was processed in terms of previous memories, and experiences and therefore the emotional engagement (affective approach) is likely to influence future behavioral choices.

Video 5: "After the Party". The participants are cognitively active processing the visual and auditory associations regarding the video messages. The EEG results indicate that the participants are processing the message and making a decision about the value of the message. Interestingly, there is no significant difference in the results between males and females responses to the videos messages.

< Insert Table 2 about here >

Table 2 summarizes the overall impact of each video and identifies the ROIs associated with each video over the whole of the viewing period and also indicates the regions of brain activation during the viewing of each video based on grand average sLORETA analysis. Brain regions activated are associated with processing positive and negative emotional imagery (AVC, TA), memory encoding (AFC), information processing (DLPFC), and assessment of risk (OFC) when it was generally active. Corresponding Brodmann areas (BA) are also listed in table 2. The statistical significance for all regional activity, T-level threshold were computed which correspond to a threshold of statistical significance ($p < .01$) for positive activation. The column labelled "overall judgement" (assessment) cross referenced with the horizontal row labelled "final message activation" indicate if the advertisement is

overall effective and if it is likely to have an attitudinal or behavioral impact. Table 2 reports the consistency of brain activation during the three analyzed epochs, 5 seconds during start, middle and end of each video message. Overall, the sLORETA analysis suggests that video 3 and 5 are the most effective because they maintained strong brain activation in the relevant regions to the end of the video processing.

5.5. EEG results from Global Field Power analysis

Figures 5-9 illustrate the specific responses of the z-score obtained by Global Field Power calculations of frontal electrodes in the theta (lower trace) and alpha (higher trace) normalized for the group average (*n=40*). The z-scores greater than 2 are associated with a statistically significant threshold of p < .01. GFP analysis produces specific results of attention and memorization brain activity for each video. Figure 5 shows the millisecond by millisecond changes in the alpha (attentional) and theta (memorization) activity, indicating significant changes in brain electrical activity for the first video "Why start a night like this?"

< Insert Figure 5 about here >

The peaks correspond to different events during the watching of the video "Why Start a Night like this?" Six events (higher spikes) have been identified where both theta (memorization) and alpha (attention) are high (high emotional or Impression index (white arrows) (an interpretation by Kong et al. (2013). Some peaks are high for attention but low for memory (black arrows). *The specific events (1-6) identified are, 1: Stockings rip, 2: Undressing-dressing up, 3: Vomit in hair, 4: Ripped Skirt, 5: Breaking shoe heal, and 6: Final Message.* Event 5 (breaking the shoe) demonstrates the largest Impression Index spike (both theta and alpha high). When we compare all GFP Figures, then attention and memorization levels, which vary over the course of the video, are not as high as the other

four videos. The lower attention and higher memorization indices indicate some introspective cognitive evaluation and that the events in the message are familiar, and unremarkable.

< Insert Figure 6 about here >

Figure 6 illustrates the normalized group average (n=40) responses of the z-score for the video entitled "Violent Male". Four events have been identified where both theta (memorization) and alpha (attention) are high (white arrows). Both measures of theta and Alpha are associated with emotional responses and produced high scores on the impression index. *The high impression indexed events (1-4) occurred during the scenes of, 1: I have Money; 2: Shocked Faces; 3: Bloody Face-nose; 4: Final Message.* Interestingly event 4 in the GFP (the final message) clearly demonstrates the largest Impression Index score (both theta and alpha high). We interpret the high attention and higher memorization indices that there is strong introspective cognitive evaluation, and overall, the content seems to have activated emotional engagement, associated with higher likelihood of behavioral change.

< Insert Figure 7 about here >

Figure 7 illustrates the overall responses for the video entitled "Runway". Five events have been identified where both theta (memorization) and alpha (attention) are high as they are associated with emotional engagement on the Impression index (white arrows). *The Events (1-6) highlighted are, 1: Model appears; 2: Skirt lifted-undress; 3: Vomit on floor; 4: First male model appearing; 5: Male models punching-kicking fighting.* Event 3 (female model vomiting) produces overall the largest Impression Index (both theta and alpha high). The lower memorization but higher attention shows that this video is more shocking initially but does not make a long-term impact on memory. Fighting seems to be normal (they have seen it before) and does not elicit a larger attention response. Overall, the video impact is low

and unremarkable apart from the shocking vomiting scene with the overall combined scores for emotional engagement and memorization.

< Insert Figure 8 about here >

Figure 8 illustrates the average responses of the z-score for the video entitled "Rethink Drink". Three events have been identified where both theta (memorization) and alpha (attention) are high and they are associated with emotional engagement on the Impression index (white arrows). *The high index events (1-3) are, 1: Mates having fun; 2: Drunken man dancing; 3: Pregnant woman sobbing.* Event 3 (pregnant woman sobbing) demonstrates the largest Impression Index (both theta and alpha high). The lower attention and higher memorization indices suggest that there is strong introspection or self-reflection implying that the viewed material is depicting unfamiliar event and it is more likely that the higher engagement index will influence future behavioral actions.

< Insert Figure 9 about here >

Figure 9 illustrates the average group responses of the z-score the different events during the video entitled "After the Party". Three events are selected with high theta (memorization) and alpha (attention) indicating a significant impression index or emotional engagement (white arrows). *The significant events (1-3) are, 1: appearance of the vodka bottle; 2: Couple in sexual activity; 3: viewing the final message.* Events 1 and 2 seem to make a higher impression (emotional response) but event 3 elicits more attention with lower memory encoding index score. The largest Impression Index (theta and alpha high measures) occur when the image of the alcohol bottle appears. The lower attention and higher memorization indices during the rest of the video suggest that participants may be going through cognitive self-reflection by recalling similar past events. Thus, participants are very attentive to the last part of the video but may not be very concerned as seen in the low memory index for event 3.

5.6. Discussion

The sLORETA analysis of the beta brain waves is a good indicator of neural activity during the pre-specified 5 second epochs (start, middle and end of each video). However, it is not equally capable as the GFP analysis to identify specific changes in attention and memorization which are combined to define the overall impression index, second by second throughout the video (Kong et al. 2013). If the z-score for alpha GFP and theta GFP are significantly high, it indicates high levels of attention and memory and therefore the overall impression index or emotional engagement is high too which indicates that a there is a higher likelihood of behavioral modification (Kong et al. 2013).

The Global Field Power findings indicate the specific points of the video that change attention, memorization and overall impression index. The sLORETA maps demonstrated regional brain activity associated during the 5 second epochs of time, but the GFP time series illustrates the attention and memory activity associated with each event during the length of the entire video. The GFP analysis produces more details about the dynamics of cognitive processes at more specific points in time. For example, if both alpha and theta are significantly high at the same time point, it indicates activation of higher attention, memory encoding and emotional engagement (comprising the overall impression index). However, if a specific video message event produces low memory index, but the attention is high then this indicates vigilant attention, which could be due to interesting or frightening novel stimuli. If, however, the attention index is low, but memory index is high for an event during the video, this indicates that memories are being processed. These memory processes may be associated with recognition of previous experiences or active processing of pertinent information for the future (Vecchiato et al. 2011, 2012, 2013; Kong et al. 2013). Out of all five advertising videos with the highest overall impression index (i.e., videos 2 and 4) are most likely to initiate attitudinal and therefore behavior changes in the future.

6. General discussion and implications

Different research tools produce different results because they are capable of analyzing different types of information. The focus groups produced interesting results regarding the video message appeal and impact. However, participants' forecast of their drinking choices in future is only a tentative expression of their intentions and it may not be a good predictor of their actual behavior, which could be influenced by many uncontrollable and unpredictable influences (e.g., past learning, role modelling, behavioral conditioning, socio-cultural trends and influences and biological changes). Qualitative research findings reflect affect labelling responses, which can reduce or dampen the overall emotional impact (Lieberman et al. 2007; Lieberman et al. 2011). In contrast, EEG brain scans should produce responses without the affect labelling dampening of the video messages, which suggests that the results between the focus groups and the EEG tests should be different from each other.

Interestingly, we find that both the research methods (focus groups and EEG) identify videos 4 and 5 to be most effective, albeit for different reasons. For example, the focus group participants' comments on videos 4 and 5 (Table 1) show these two videos as being most memorable and effective, possibly because the participants are able to express their reasons for the overall message benefits. Similarly, sLORETA images show that videos 4 and 5 produced stronger brain activation, which suggests more elaborate cognitive and emotional processing by the participants, and hence likely to be more effective than the other videos. Such information may be useful in designing future social marketing campaigns (Harris et al. 2017) by using shock (e.g., video 4) to improve memorability for the target audience and familiarity (e.g., video 5) to highlight relevance to the target audience's everyday lives.

Using the same video stimuli with different research methods (focus groups and two EEG analytical tools – GFA and sLORETA) allows a comparison of the strengths and weaknesses

of these methods in terms of their ability to assess the impact of different messages. The sLORETA analysis of 3 segments of 5 second epochs (start, middle and end of the stimulus) provides three detailed snapshots of brain activations, but it does not identify specific high activation scores for memorization or emotional activation and overall engagement or impression index, which the GFP does. Moreover, important brain activations may be missed if they occur in between the 5 second epoch's analysis, which is used in sLORETA analysis. Therefore, GFP analysis is probably the most useful tool to use because it analyses the overall video activation and indexes the highest activations along two useful measures, attention and memorization, which both constitute the overall impression index.

If the GFP analysis was followed by a qualitative research method (e.g., depth interviews and or focus groups) the interpretation of the high scores on the attention and memorization index would be very useful. EEG and other neuroscientific research tools are excellent in identifying brain location of neural activity but are not capable of explain why and what it means. The interpretation of brain activity is largely speculative depending on the type of experimental stimuli and design protocol. A combination of different research methods (e.g., qualitative, surveys, behavioral experiments and neuroscientific tools) is likely to provide a more comprehensive understanding of how consumers process advertising information and what are the prospects of future behavioral change. The ability to access a range of methods including neuroscience could help improve existing marketing models and develop new theory (Venkatraman et. al. 2015). Research methods that may explain greater variance in predicted behavioral changes in response to public service or social marketing messages may be invaluable for improving positive social outcomes.

Overall, the comparison between qualitative and EEG research methods presented in this paper provides useful information regarding the evaluation of advertising messages and their impact on the consumers' behavioral intentions. Advertising and marketing managers need to

understand the limitations and the advantages of different research methods and use them appropriately at different stages of the research process and for different research objectives. Advertising video messages are complex stimuli with multiple kinds of information (visual, kinesthetic, ideational and emotional), therefore isolating the most message impact becomes very difficult. Multiple testing with different experimental protocols and using multiple research tools can disentangle to complex communication puzzle.

Neuroscience tools produce reliable empirical information that is not accessible by any other traditional market research methods such as surveys, experiments and qualitative research. Advertising message construction can be improved enormously using neuroscientific tools and traditional research methods because irrelevant, boring and negative message segments can me identified and therefore replaced with more effective ones. Spinoza (2000) suggests that emotions stop being a passion as soon as humans develop a clear concept of how they feel about the issue causing the emotion. James (1890/1950) suggests that as soon as he expressed verbally an emotional state of anger, the very act of naming and expressing the emotion felt it changes momentarily the actual degree of feeling the angry emotion. Researchers need to be mindful of the cognitive changes of feeling experiences when verbalized in a focus group discussion and the inbuilt biased interpretation of the researcher analyzing qualitative research data. Neuroscientific tools can reduce some of these usually undetected research biases; hence, we need more research on neuroscientific research tools besides EEG, such as functional Magnetic Resonance Imaging or functional MRI (fMRI) and Magnetoencephalography (MEG), to better understand and interpret the association of brain activation with decision making and behavioral changes.

Cultural differences in social influences also play an important role in young adults' behavioral choice and these demand further systematic research in a more globalized and multicultural world. Although, culture as well as subculture may influence drinking behaviors

but legislation alone cannot achieve behavioral changes. Parental role modelling is often cited as a strong influence of drinking habits but difficult to measure reliably (Pettigrew et al. 2013). Early education and personal interventions may help change the attitudes and behaviors of young people (e.g., teenagers) before they become young adults. Building psychological resilience and resistance to peer pressure for some young teens is likely to reduce social insecurity and possible anxiety, which drives drinking behaviors.

Adaptation of advertising messages targeting more local level and subcultural groups of young people can be more appealing than mass advertising campaigns. Celebrity role model endorsements need to target younger groups (teens and younger children) highlighting the negative effects of alcohol. Concerted information campaigns focusing on reducing the social glamour that getting drunk is an achievement and that drunkenness is enjoyable. Involving young people at school in the development of advertisements alongside reduction of mass media positive coverage of drunkenness is likely to gradually change cultural attitudes and lifestyles towards more healthy consumption choices of alcohol. Cultural differences and religious values can influence differentially alcohol consumption because some cultures respond more or less favorable to regulation enforcement than others.

The last important domain is to identify biological markers, which predispose some individuals to consume more alcohol than others (differences in biological genotype characteristics). The use of fMRI could improve the understanding of which alcohol advertising messages activate pro-consumption brain regions. Designing a series of studies including actual behavioral experiments to test physiological, social and personality influences would be desirable to identify the various relationships of drinking behaviors. More studies on how certain 'behavioral choices become popular" amongst young people which continue later on to influence young adults would be very beneficial. If young people are more susceptible to new fashions for clothes, mobile phones, etc. then a similar process

may occur with the adoption of healthier drinking habits and behaviors like the wet cultures, in which people drink mainly alongside meals.

7. Limitations and future research

This study has a larger sample size compared to previous Neuromarketing studies (e.g., Vecchiato, Cherubino et al. 2013) and together with the focus groups' findings, the results help identify and understand which advertisement component(s) actually made the viewer think about the content, which in turn may lead to future behavioral intentions. Future studies could use other approaches such as field surveys to measure the actual behavioral changes after the viewing of these advertisements as part of a longitudinal study or lab experiments to identify the different conditions under which these effects may or may not take place. More studies with diverse demographic groups would also assist in developing more effective public service messages that address the needs of specific target groups. Finally, as highlighted by one of the anonymous reviewers, the participants in the focus groups may have been primed to pay attention to the ads; hence, future research may use more natural settings such as, videos or ads 'embedded' in a program to replicate these results.

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Table 1
Focus group findings (Study 1).

Advertisement	Avoidance/negative emotions (loss aversion)		Approach/ positive emotions of ugly and undesirable violent events happening			
	Shock	Concern	Acceptance	Reflection	Familiarity	Impact
Video #1: Don't turn your night out into a nightmare	No, but judged as "Gross" which could be interpreted as mild disgust.	No serious concern, but it was described "funny". This is a common nervous description used for a defensive answer.	"Does not bother me" "Lots of girls end up looking like that and often get worse".	"Girls put hours to look nice and getting ready to go out, but they look horrible when they return home"	"This is a familiar scene, you see this regularly at parties and especially in the city every night".	The ad is not memorable.
Video #2: Violent male	Participants were initially quiet and expressed that it felt "heavy but such things happen". The last scene with the man's bloody face shocked the participants.	Slight concern after the initial reaction. Participants were both uncomfortable with the scene but accepted the inevitability that such things happen.	"In our culture, guys like fighting when they are drunk". "Men are often aggressive when they drink". "Men are not responsible when drunk, this just happens"	"Driver's fault for hitting the drunk" "Friends should have stopped the drunk"	Violence is seen every weekend in many nightspots, it is a common outcome.	Mixed responses, some saying it was effective and others that it was too familiar. The story composition was boring,
Video #3: Models on a runway or catwalk	"Gross" "Weird" "Creepy" "The way it's shown is shocking"	No concern expressed.	"It's almost OK for guys to pee in the road but not for girls"	"Lose respect for people like that"	"We see things like this all the time, it is a common occurrence"	"More entertaining than educational" "The advertisement does not show the cause of the problems"
Video #4: Pregnant woman-Rethink Drink	Initial shock: "felt Sad, intense, and the ad plays on emotions" .	Very concerned: "Never want to be in that position, because you don't want to hurt a baby".	No acceptance and not quite believing of the situation depicted.	"The pregnant woman should have avoided the guy". "You assume she would be at home".	Not a familiar scene. "Who does stuff like that?" "Its pure accident that could happen to anyone".	Thought provoking but not immediately relevant to the younger audience.
Video #5: After the Party Regret	No surprise or shock at all, but, a bemused disinterest attitude.	No concern but possibly mixed feelings of guilt and secret pleasure.	"Girls are more likely to have regrets than guys." "It happens". "Very accurate scene about what happens in a house party".	"The advertisement does not make me think about changing my behavior" "If you want to know what you did last night, check Facebook".	"Very realistic". "We could all be in that situation".	"Show it in schools" (this ad would be effective).

Table 2
sLORETA analysis: Brain activation during the three epochs (first, middle and final five seconds) of each video.

Video Title Description	Emotional Arousal (positive) AVC (BA19)	Emotional Arousal (negative) TA (BA38)	Memory Encoding AFC (BA10)	Language Processing T/P (BA21, BA40)	Overall Judgement (Awards/Risk) DLPFC/OFC (BA46, BA11)
1. Why start your night like this					
Start	yes	no	yes	yes	yes
Middle	no	yes	yes	yes	yes
End	no	yes	yes	yes	yes
Final Message activation	*no*	*no*	*no*	*yes*	*no*
2. A good night out					
Start	no	no	yes	no	yes
Middle	no	yes	yes	no	yes
End	no	yes	yes	yes	yes
Final Message activation	*no*	*no*	*no*	*yes*	*no*
3. Models on a Runway	(BA19)	(BA38)	(BA10)	(BA21, BA40)	(BA46, BA11)
Start	no	no	no	no	yes
Middle	no	no	yes	no	no
End	no	yes	yes	yes	yes
Final Message activation	*no*	*no*	*yes*	*yes*	***yes***
4. Rethink Drink					
Start	no	no	yes	no	yes
Middle	no	no	yes	no	no
End	no	yes	yes	no	no
Final Message activation	*no*	*yes*	*no*	*yes*	*no*
5. After the Party					
Start	no	yes	no	yes	yes
Middle	no	yes	yes	yes	no
End	yes	no	no	yes	no
Final Message activation	*no*	*yes*	*no*	*yes*	*yes*

Fig. 1. First 5 seconds of EEG recording for the five videos.
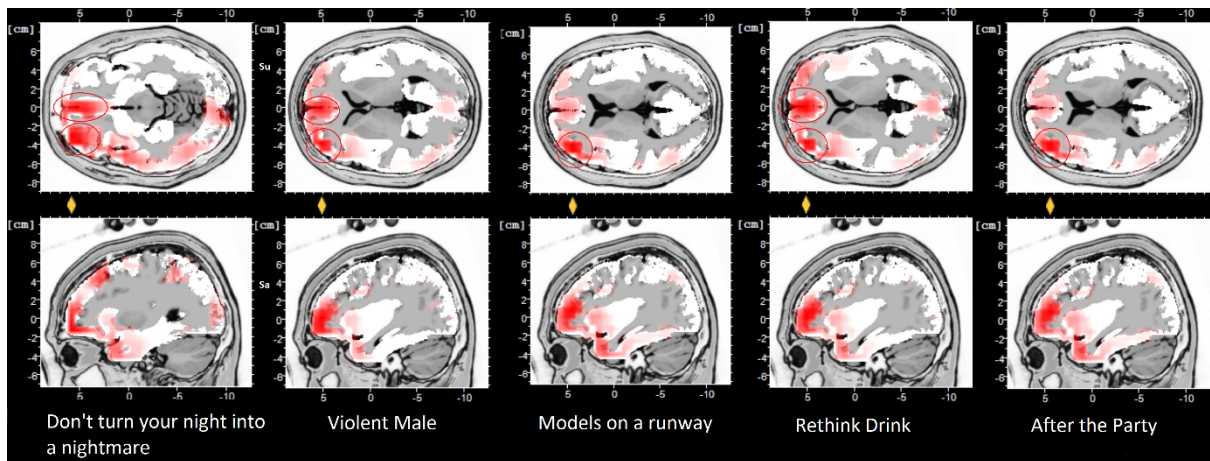

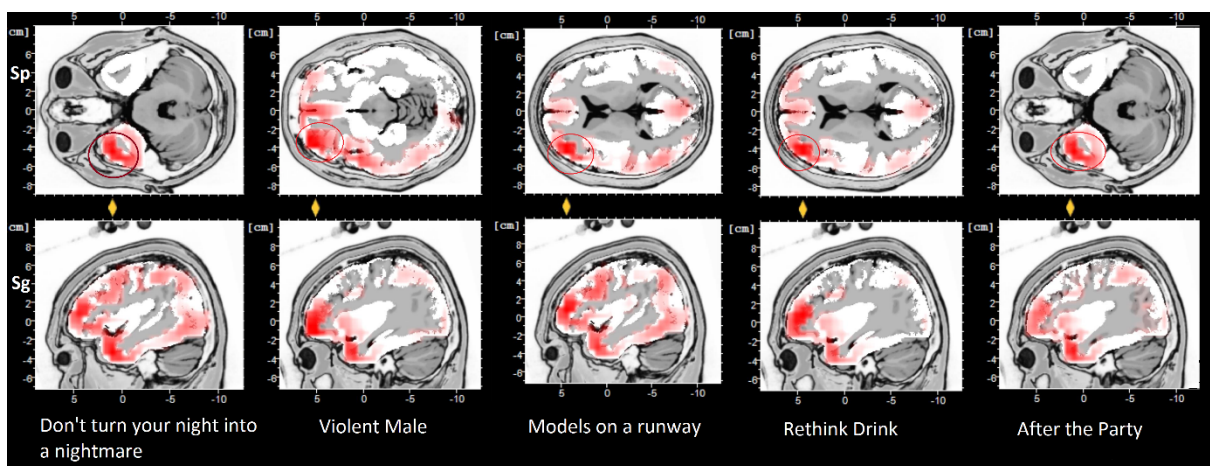**Fig. 2.** Middle 5 seconds of EEG recording of the five videos

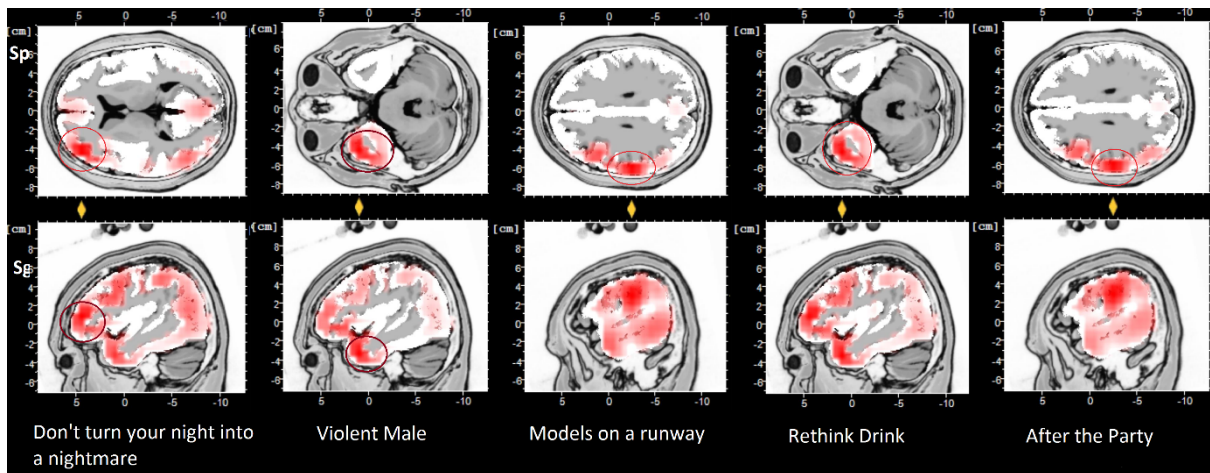**Fig. 3.** Last 5 seconds of EEG recording of the five videos

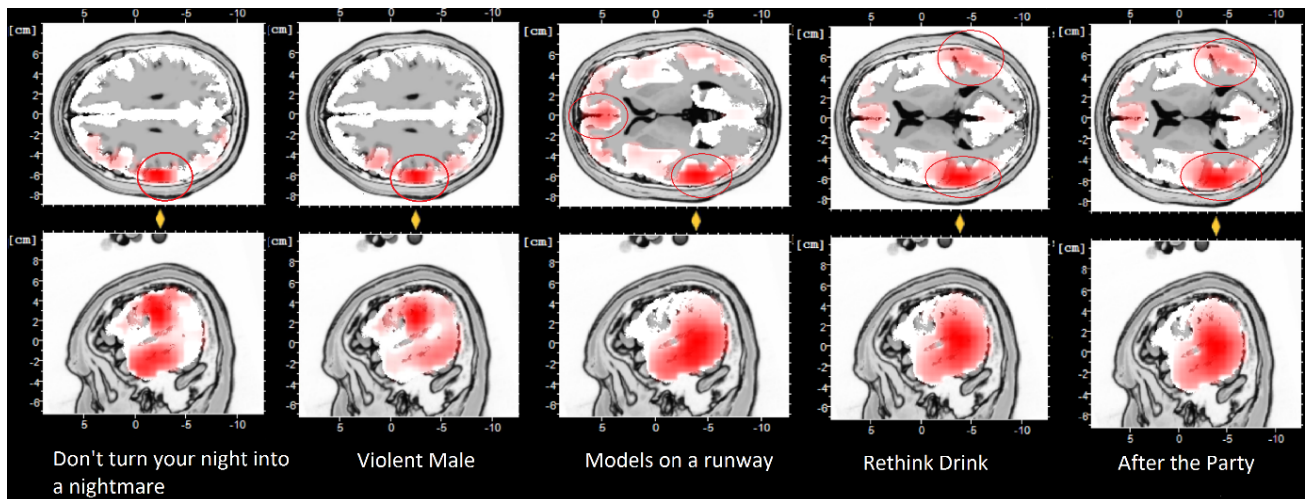**Fig. 4.** Listening to the "message" of drinking behavior
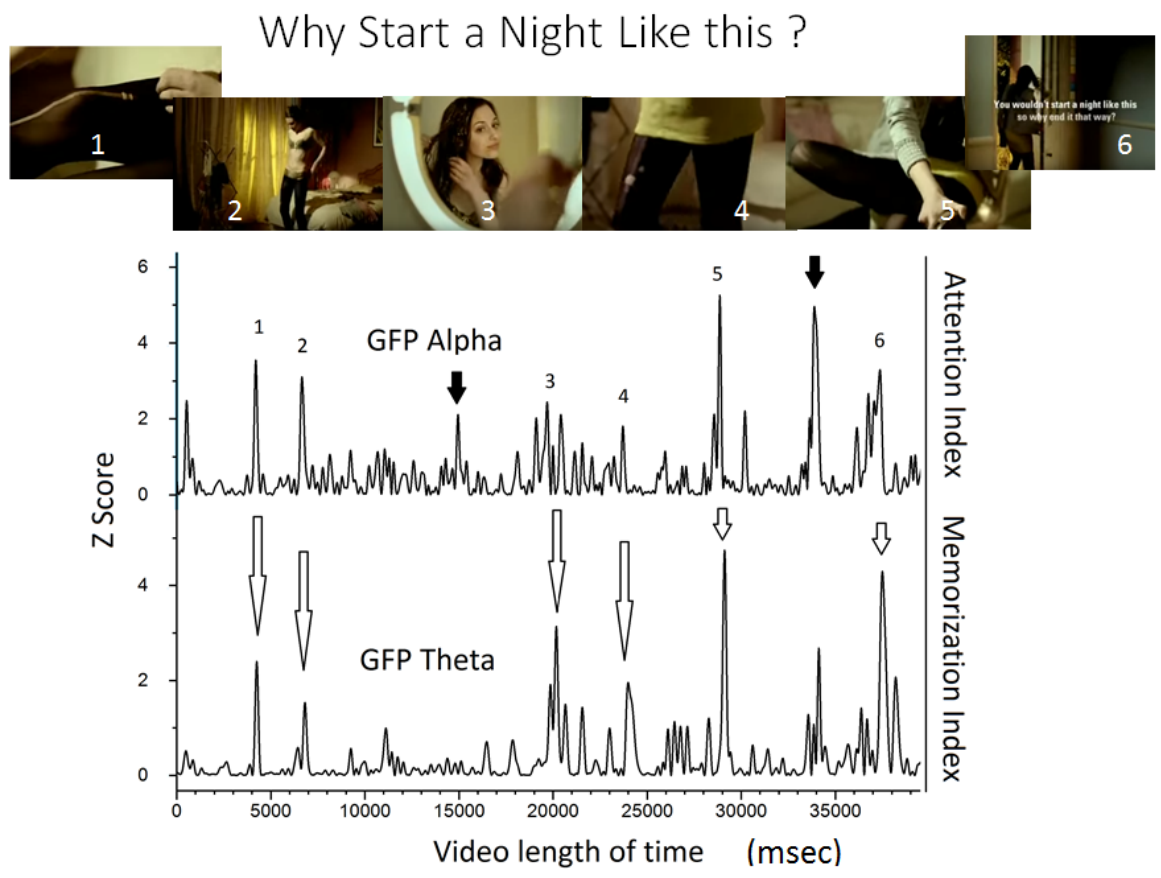
Fig. 5. Why start a night like this?
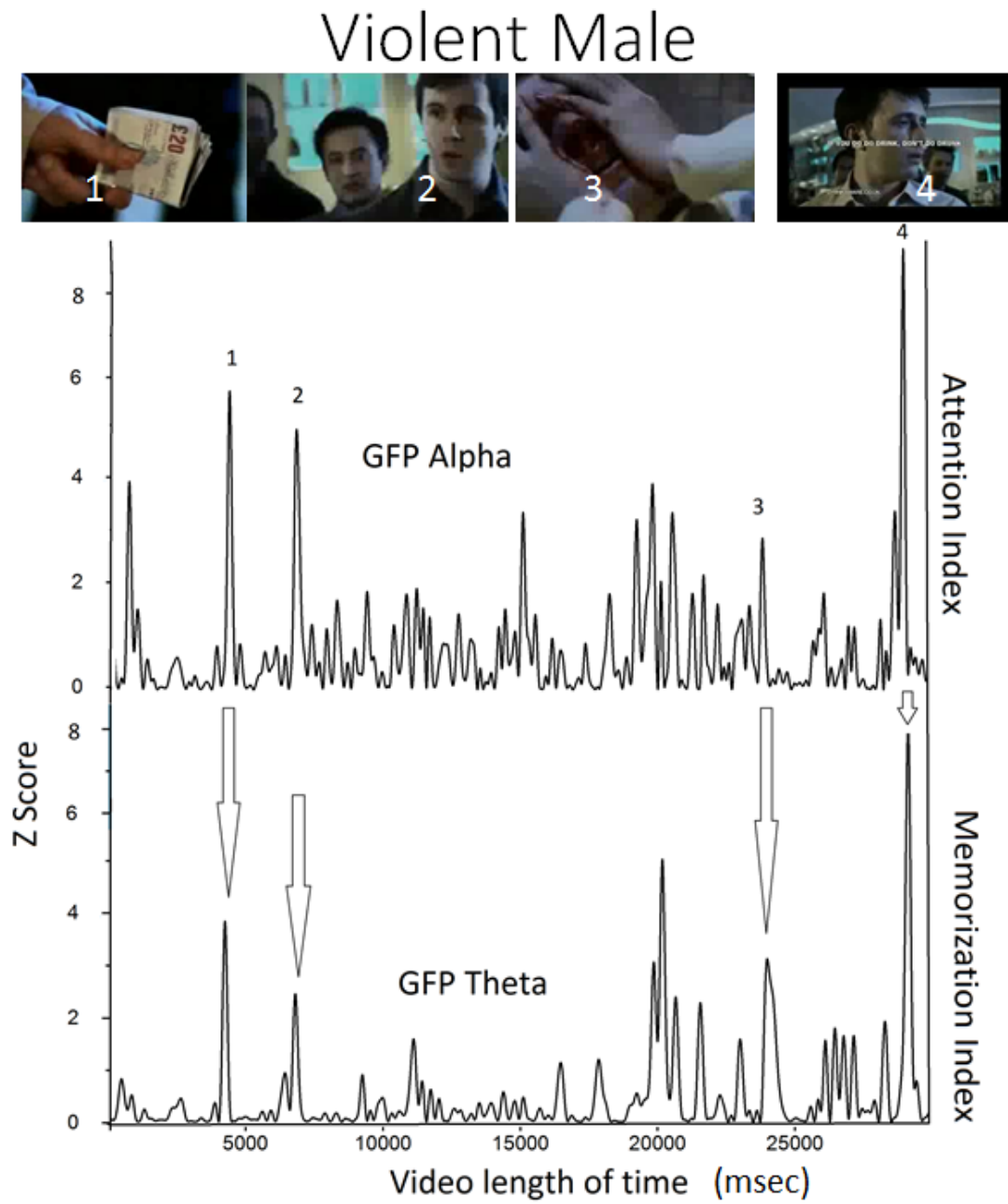
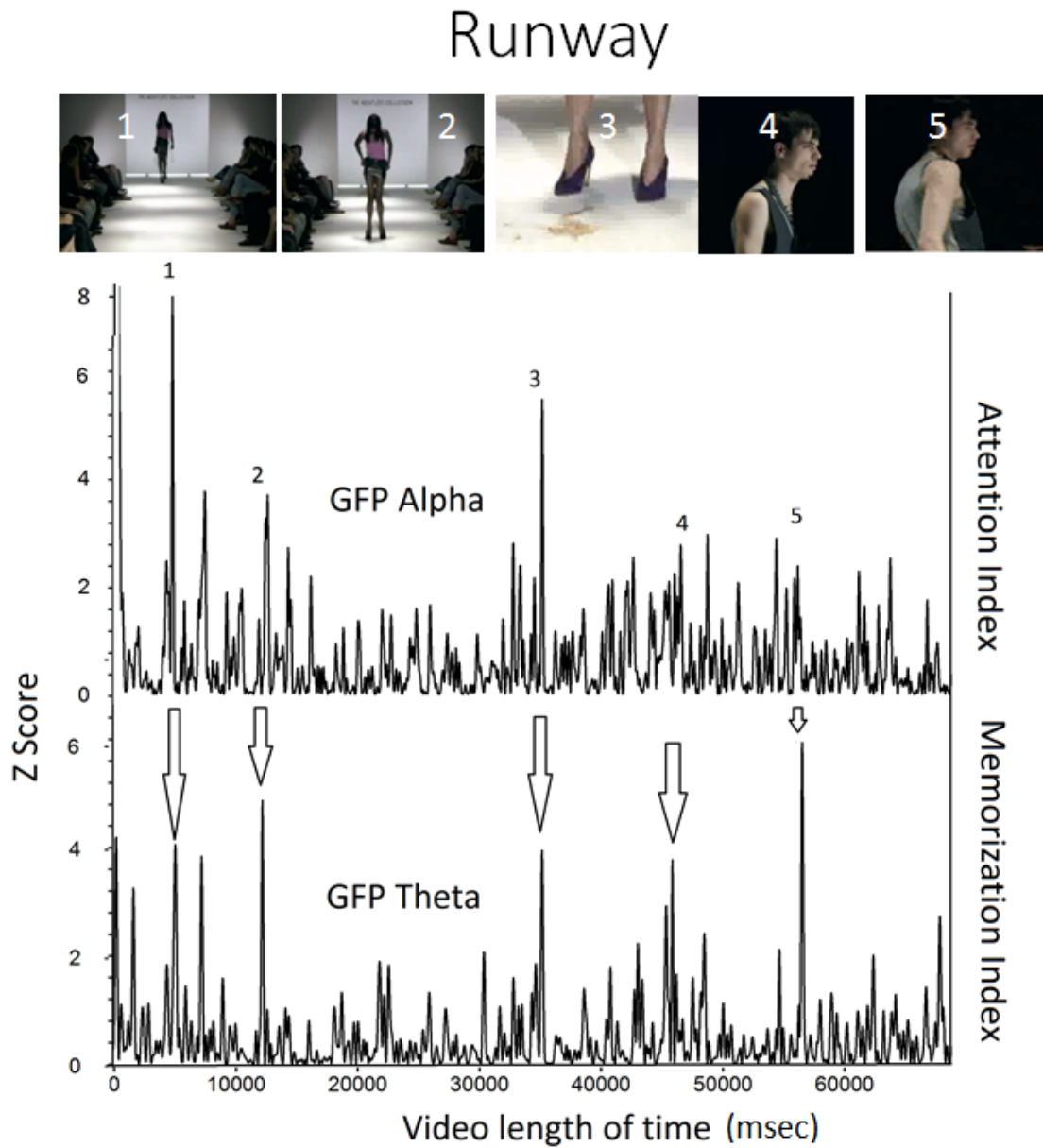**Fig. 6.** GFP analysis of "violent male" video

Fig. 7. GFP analysis of "runway" video

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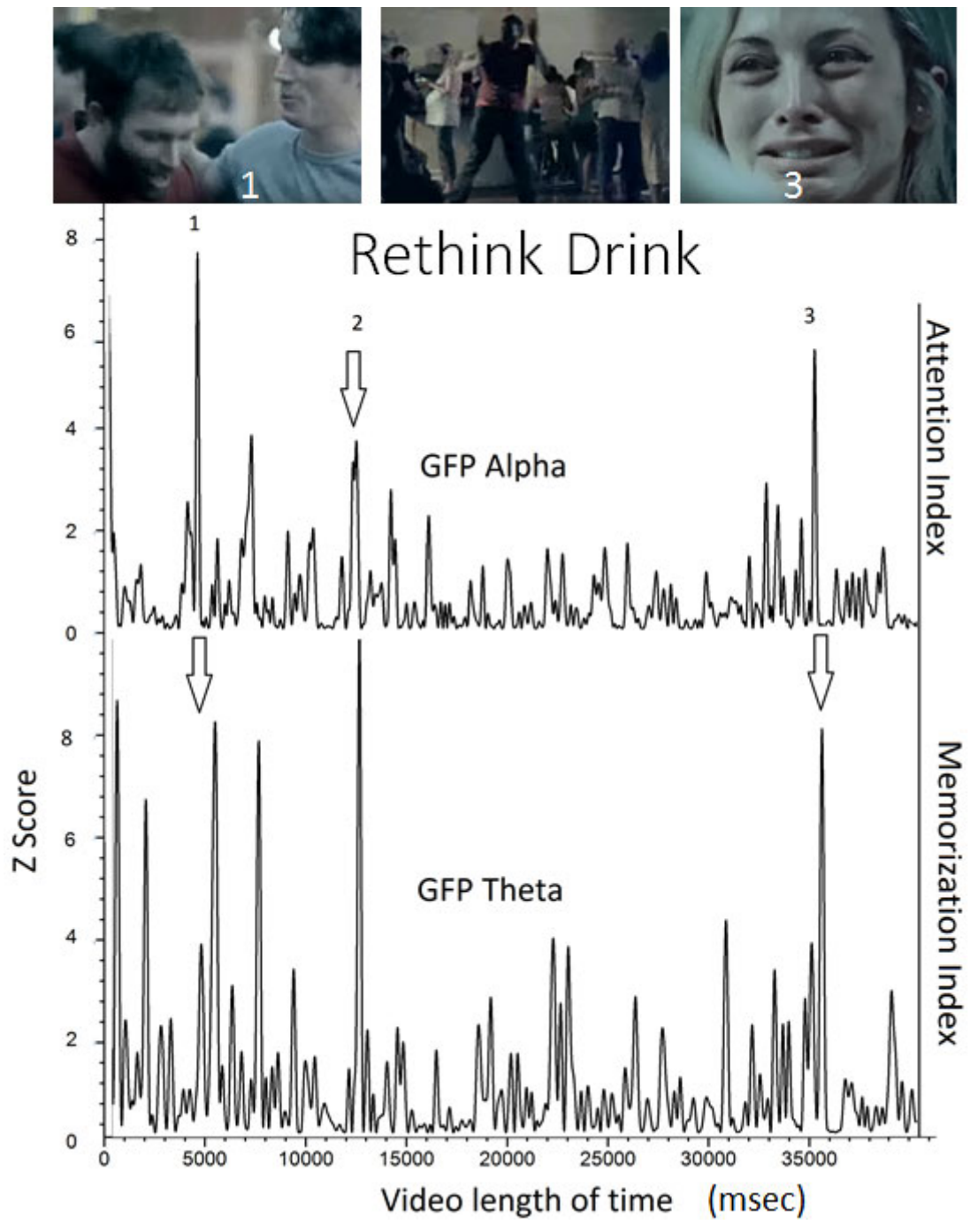**Fig. 8.** GFP analysis of "pregnant woman - rethink drink" video

Fig. 9. GFP analysis for "after the party" video