Multichannel Neuroscience and the Roles of EEG, Heart Rate, and Galvanic Skin Response in Measuring Emotions, Memory and Ad Effectiveness

The past decade has seen a tremendous increase in the use of various neurophysiological measurements in the market research industry to assess consumers' emotional and cognitive responses for predicting, among others, the effectiveness of marketing materials. These include electroencephalography (EEG), galvanic skin response (GSR), heart rate (HR), facial expressions, and functional magnetic resonance imaging (fMRI). Yet the validity and effectiveness of these different measurements, either alone or in combination with each other, remain unclear and further validations are required to fully understand the potential of the different methods and their best applications. Moreover, the Ipsos framework on how people make decision shows how using a multi-methodological approach, able to capture different inputs of the decision-making system, can help obtain a more complete understanding of human behavior and decision-making .

Ipsos's Global Science Organization, in partnership with the Center for Applied Research in Decision Making (CARD) at Temple University, conducted a multi-channel research project. Here, we leveraged different neuroscience and physiological measurements commonly used in marketing research (EEG, GSR, HR) in parallel, along with self-reports, to gain a better understanding of the reliability and effectiveness of these measures, their limitations, and their complementarity.

Approach

A total of 93 respondents participated in a laboratory study (NYC, 2019). We recorded EEG, GSR, and HR data in addition to self-report measures. Respondents were exposed to an in-house ground-truth emotional dataset consisting of 49 images, 16 emotionally intense videos, and 20 TV advertisements in separate blocks. These stimuli were previously validated to span a broad range of emotional valence (positive vs. negative emotion) and arousal (calm vs. intense) ratings. Respondents rated each stimulus on valence and arousal. We also obtained an independent creative effectiveness index for evaluating the TV ads.

This ad effectiveness measure is an Ipsos proprietary composite score that incorporates both purchase intent and brand recognition components and has been independently validated to reflect in-market performance for hundreds of ads.

Participants also completed a gambling task where they could win or lose from $1 to $3 during each trial. This task was aimed at inducing different levels of valence (win, lose) and arousal ($1 vs. $3). At the end of the experimental session, participants completed a surprise recognition task where they were presented with 40 ad frames (two from each TV ad) along with frames of ads not presented during the test and asked if they remembered seeing each during the session or not. This was aimed at creating a recognition score for each ad.

We then processed the data recorded during the session. From the heart rate data, we measured the inter-beat-interval (IBI), the time occurring between two consecutive heart beats, which has been linked by previous research to emotional, attentional, and memory responses. For GSR, we measured the skin conductance response (SCR) and the skin conductance

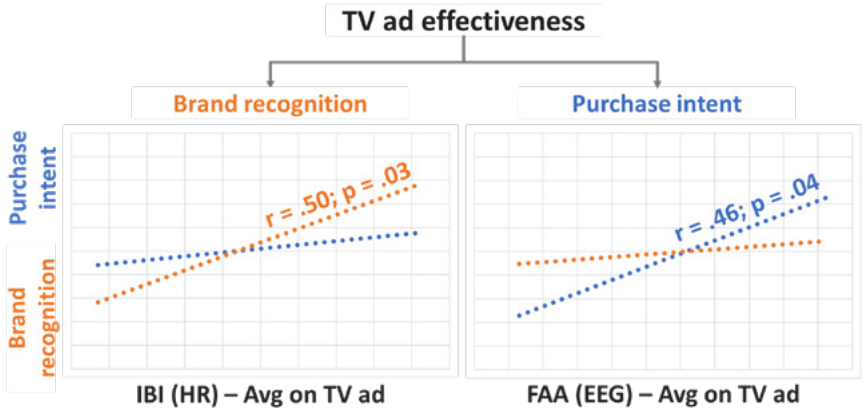

Figure 1: (left) The IBI, averaged on the TV ad, was significantly correlated with brand recognition but not with the purchase intent component of the effectiveness score. (right) On the contrary, the average FAA during a TV ad was significantly correlated with purchase intent but not with brand recognition highlighting the complementary value of these two measures.

level (SCL) and for EEG we determined the frontal alpha asymmetry (FAA), a widely known EEG-derived measure which has been associated with the approach versus avoidance motivation.

Results

We first focused on measuring emotional responses, valence and arousal. Across all experimental blocks, the inter-beat-interval (IBI) derived from the heart rate consistently predicted stimulus valence: we found that the IBI was larger (slower heartbeat) for negative than positive images, negative than positive videos as well as losses (negative valence) than gains in the gambling task. The EEG measure (FAA) showed some inconsistency, being a predictor of valence in the gambling task but not for the image nor the video stimuli. Skin conductance amplitude (GSR) was a significant predictor of arousal across images and videos.

Then, we tested the ability of the different neuro and physiological measurements to predict recognition of TV ads. While EEG and GSR could not predict recognition, IBI during encoding of a TV ad predicted recognition accuracy at both ad and frame level. In other words, by measuring the IBI during viewing of a TV ad we could predict to what extent that ad was encoded in memory and subsequentially recalled during the surprise recognition task conducted at the end of the experiment.

Finally, we focused on predicting the in-market effectiveness of the TV ads. Critically, while self-reported valence and arousal did not predict effectiveness, both EEG (FAA) and HR (IBI) were significant predictors of ad effectiveness. Moreover, FAA and IBI jointly led to a better prediction of effectiveness than each measure independently, indicating their complementary value in bringing information regarding the ability of an ad to drive sales and brand recognition. Specifically, we found that while FAA was linked to the ability of an ad to drive purchase intent for the advertised product, IBI reflected the ad's ability to generate new memories linked with the advertised brand.

Conclusions

The aim of this study was to investigate the ability of different neurophysiological methods commonly used in marketing (EEG, GSR, HR) to reliably measure emotional response, memory encoding and predicting ad effectiveness. Our findings, in addition to validating the well-established role of GSR in measuring emotional arousal, show that heart rate (IBI) can be a reliable indicator of emotional valence and memory encoding of videos and images. On the other hand, EEG (FAA), a commonly used method to measure emotional responses, only predicted valence for the gambling task. This research also highlighted the complementary role of IBI and FAA in measuring ad effectiveness by tapping into brand recognition and purchase intent respectively. The complementary nature of these measures provides valuable insights into the dynamics of adaptive decision-making across domains.

REFERENCE

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