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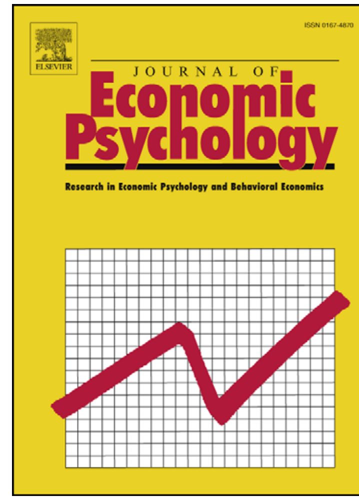


# Using the P3a to Gauge Automatic Attention to Interactive Television Advertising

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**Title:** Using the P3a to Gauge Automatic Attention to Interactive Television Advertising.

**Abstract:** This paper is the first step to an understanding of how engagement with interactive television advertisements may increase the relevancy of a brand and therefore facilitate the automatic processing of the brand's logo (measured via the P3a) after viewing the advertisement, compared to non-interactive television ads. Event-related potentials (ERPs) and attitudes were measured in response to advertisement specific brands. ERP latencies and self-report measures were analysed with mixed design analysis of variance. P3a latency decreased for the brands associated with the longer interactive ads, but remained stable for the brands associated with the normal ads and increased for the control brands. This indicates that automatic attention was greater for those brands during the brand stimuli which were associated with the Dedicated Advertiser Location (DAL) ads in the ad reel. The findings of this analysis suggest that brands associated with interactive ads do have more attention automatically allocated to them.

**Keywords:** Interactive television, P3a, Event-Related Potential, Neuromarketing

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# Using the P3a to Gauge Automatic Attention to Interactive Television Advertising

A key feature of the changing television landscape is the fragmentation of audiences across a growing number of broadcast networks and media platforms, increasing the need for advertising that relies on viewer engagement rather than TV exposure alone. The conversion from analog to digital television provides an opportunity for new ad formats, including interactive TV ads, which allows viewers to increase their engagement with advertised brands. This paper is the first step to an understanding of how engagement with interactive television advertisements may increase the relevancy of a brand and therefore facilitate the automatic processing of the brand's logo (measured via the P3a), compared to non-interactive television ads.

### Interactive Television

The digitization of television has introduced new capabilities to the television viewing experience, including new interactive formats for advertising (Cauberghe & De Pelsmacker, 2006). In the United States, Canoe Ventures, a joint initiative by the six largest cable companies, including Cablevision Systems, Comcast and Time Warner Cable, promises to roll out interactive television (iTV) ads in the fourth quarter of 2009 to over 38 million homes, which already have two-way-communication digital cable boxes installed (Spangler, 2009). Viewers watching these ads will be able to press their remote controls to make a "request for information" (RFI) about a product, or even buy the product (Arango 2008; Petrecca 2008). Interactive TV advertising services are also likely to be featured on emerging platforms such as IPTV (Schechner and Kumar 2009) and mobile phones (Nasco and Bruner 2007), and are already present with some video-on-demand (VOD) and digital video recorder (DVR) services (Manly 2006). This study investigates a key question for broadcasters and marketers: how effective are these new iTV ads?

We also compared the effectiveness of two iTV ad formats currently in use around the world: (1) *Impulse response* ads do not take viewers away from the TV content, which plays out under interactive banners (or "snipes"). The interactive content is limited by the size of these banners, however, usually to the process of completing the transaction (which generally requires a second, confirming, button press). This format is used widely in the UK and in the US on the OpenTV platform. (2) *Dedicated Advertiser Location (DAL)* ads take viewers away from their program to a series of sub-channels, which look like a PowerPoint presentation or small website ("microsite"). The potential for interactivity is very high with this format, as viewers can navigate (change channel) across many pages of content by pressing the colored buttons on the remote control. Again, this format is used widely in the UK.

Interactivity has been associated with greater satisfaction, self-efficacy, and memory (Rafaeli, 1988), more comprehension (Lustria, 2007), a higher sense of involvement and belonging (Rafaeli & Sudweeks, 1997), the generation of more thoughts, especially positive thoughts (Sicilia, Ruiz, & Munuera, 2005), as well as having a positive effect on attitude toward the site (Johnson, Bruner, Kumar, 2006). We expect to see a similar positive benefit of interactivity in facilitating memory for the advertised brand, which should in turn increase the chances of the brand being purchased (e.g., Alba & Hutchinson, 1987).

Additionally, we expected to see differences in performance between the two interactive TV (iTV) ad formats. DAL iTV ads provide a longer viewing experience than Impulse ads, and longer form ads are usually more effective because: (1) longer ads are more likely to be attended to, at more points in time (Rossiter & Percy, 1997); (2) they provide space to make more arguments, and to more completely substantiate arguments; (3) they provide space for the inclusion of a product category message, useful when the target audience is unfamiliar with the category; and (4) they provide execution and response options not available in shorter advertising formats (Agee & Martin, 2001; Chapman & Beltramini, 2000; Singh, Balasubramanian, & Chakraborty, 2000; Singh & Cole, 1993). The additional duration of interactive engagement with the brand provided by the DAL format should further increase the benefits of interactivity, compared to the simple impulse response format.

**The Use of Neuroscience in Media and Marketing**

Even though the use of neuroscience in the marketing research area is controversial, especially within the neuroscience community (see Lee, Broderick, Chamberlain, 2007), studies have highlighted the decision making neural processes and systems associated with advertising material. The most spectacular forms of this research have used brain scanning techniques such as fMRI. For example, Schaefer and Rotte (2007b) found that the area of the brain associated with self-relevant processing, the medial prefrontal cortex, demonstrated in increase in activity only when participants saw logos for prestigious and familiar cars, which presumably were more desirable for them than less familiar and pragmatic cars (see also Schaefer, Berens, Heinze, & Rotte, 2006). Schaefer and Rotte (2007a) use the somatic marker hypothesis (Damasio, Everitt & Bishop, 1996; Bechara & Damasio, 2005) to infer their findings on favourite brands and neuroanatomical reward circuits. They suggest that meaningful brands could act as external stimuli which could then generate somatic markers and influence a person's economic behaviour by automatically and unconsciously biasing their selections.

Although contemporary research in the area uses various functional imaging techniques (Kenning & Plassman, 2005), the cost of these scanning methods can be an inhibiting factor. In contrast, electroencephalogram (EEG) measurement is very cost efficient and has excellent temporal resolution (timing) compared to fMRI (Plassman, Ambler, Braeutigam, Kenning, 2007). The recording of an EEG is a continuous measurement and quantification requires the analysis of various frequency bands (Stern, Ray & Quigley, 2001). An event-related potential (ERP) is a voltage fluctuation within an EEG recording that is time sequenced to a specific event. The components of the ERP can be measured by peak latency (measured in milliseconds) or by peak amplitude (measured by microvolts). The ERP is elicited by each trial or event but needs to be repeated and group averaged to improve the signal to noise ratio. Each ERP is therefore a statistical mean. While the temporal resolution of the ERP is accurate enough to measure processing activities occurring within the brain, the spatial resolution of this technique is only adequate enough for us to estimate the locations of these processes (Picton et al, 2000).

One of the most commonly researched components from the ERP is the P300. The P300 is so called because it is a positive peak occurring at about 300 milliseconds after the presentation of a stimulus. The P300 can be elicited by a target stimulus in an odd-ball paradigm when participants are required to respond to the target. This component is not generated by the standard stimulus (Polich, 2003). Polich (2007) suggests that the P300 latency is correlated with cognitive performance, in that shorter latencies are related to superior cognitive performance. The P300 is thought to reflect cognitive processing and in particular has been used to indicate working memory processes (Donchin et al, 1986, as cited in Polich, 2003) and its peak latency correlates with stimulus evaluation time (Polich, 1986; Polich 1987). Andreassi (2007) suggests the role of the P300 as an endogenous component (a component affected by internal events) related to the meaning of the stimuli to an individual. P300 is a measure of cognitive activity, and shorter onset latency indicates a faster speed of information processing.

This study measured the P3a, which is a particular form of the P300. The definition of the P3a is not uniform across various researchers. Some researchers interchange "novelty P300" with P3a (Daffner et al, 2003), whereas others define it, as we do, as the P300 that occurs maximally in the frontal area (such as Polich, 2007) because the P3a is known to have a more anterior (frontal) distribution and is mainly localised in the fronto-central region (Fjell & Walhovd, 2003). For example, in research using a three-stimulus paradigm (stimulus, target, plus nontarget distractor), the novel distractor stimulus produces a large P300 component, with a shorter latency, in the frontal areas of the scalp (the novelty P300: Polich, 2003). However, a shorter latency has also been shown to be elicited by a typical (not novel) stimulus (Comerchero & Polich, 1998), and target stimuli in general (Dien, Spencer & Donchin, 2004; Simons, Graham, Miles & Chen, 2001).

The P3a is the early attention process in the P300 that is generated by a frontal working memory representational change (Polich, 2007). The P3a has a latency of about 240 milliseconds and is generated in the frontal lobe, whereas the P3b has a longer latency and is generated in the temporal/parietal lobe and is the results of memory updating operations (Polich, 2007). P3b is only relevant (or evoked) when a task is required based on the stimulus. Tachibana, Toda and Sugita (1992) suggest that the P3a reflects automatic processing. It has been suggested that the P3a indicates involuntary attention allocation (Kaipio et al, 1999) with Polich (2007) postulating that the P3a may be related to attention based on the findings that neuro-electric signals of these components originate in the alpha and theta bands of the EEG. In response to auditory (Muller-Grass, Macdonald, Schroger, Sculthorpe & Campbell, 2007) and visual stimuli (Verbaten, Huyben & Kemner, 1997) the P3a was an automatic process and was not dependent upon available central capacity. Even though many studies use an auditory stimulus, Jeon and Polich (2001) found that a P3a-like potential can be elicited with a visual stimulus in a passive viewing environment without the stimulus being novel. Naatanen's model of the P3a posits that a relevant but not attended stimulus can evoke the P3a by interrupting the executive function controlling cognitive activities (Näätänen 1988) and potentially guiding awareness to the stimulus input (Macdonald, Jamshidi & Campbell, 2007). In this study, we have defined the P3a as the peak occurring within the shorter time window and in the frontal region.

This study aims to triangulate the ERP data with other measures (such as self-report; behavioral measures and cognitive measures) to provide further understanding of the cognitive processes involved in brand processing after exposure to an interactive television ad.

To ascertain exactly how interactive television advertising would impact upon a viewer's attention and subsequent attitude toward the product or brand, this paper used the P3a as a measure of automatic attention. The literature suggests that the P3a may reflect involuntary attention allocation to salient stimuli changes (and perhaps direct more attention to stimuli that means more to the participant).

Additionally, interactive advertisements allow the viewer to engage with the content through attending to and cognitively processing the interactive content of the ad, which is usually brand or product specific. This greater engagement with the advertisement and this high level of information processing should increase the relevancy of the brand for the interactor. As the P3a is a measure of attention and is reciprocally related; a decrease in latency is associated with an increase in attention, it was hypothesised that when brands associated with interactive ads were presented to a viewer, a greater decrease in P3a latency was expected because more attention would be automatically allocated to stimuli that meant more to the participant, and furthermore that this decrease would be greater for brands associated with DAL advertisements (because they offered a longer interactive experience). Additionally, the interactive advertisements would be rated more favorably compared to normal advertisements.

## Method

### Participants

A total of 28 adults (15 males and 13 females) with a mean age of 25.29 years (SD = 3.91) participated in the research and were recruited via word of mouth. All research was approved by the University Human Research Ethics committee.

### Recording Conditions

Participants wore a 32 channel EEG cap (Quickcap) with electrode placement using the International 10/20 system during their session to record and then estimate the ERP. The electrodes were referenced to the mastoid bones and scalp ground (via the electrocap). Electrode impedances were kept below 5kΩ. Vertical eye movements were monitored with electrodes placed directly below the left eye and horizontal eye movements were monitored with electrodes placed at the outer canthi of the right eye. Electrode recordings were collected by Nuamps amplifiers (Neuroscan) with a band-pass of .01-100Hz with a sample rate of 256 Hz. Participants were offered a rest break half way through stimulus presentation.

ERP raw traces were epoched into 1000 millisecond windows and then baseline corrected. Trials with excessive eye movement and muscle artifact were removed from the average. A band-pass filter of 0-30 Hz was applied and a smoothing function of seven points and 7 sweeps was implemented as the final average. The P3a peak was defined as the largest positive peak between 180 and 300 msec at the Fz electrode. The ERP is averaged to improve the signal to noise and therefore allow the estimation of the latency of each P3a. Four averages were used in the analysis – one average for each type of ad (DAL, impulse response, normal, and control [not seen during the session]). Novel brands were not used in the analysis.

**Stimuli and Procedure**

The ERP was measured using a passive odd-ball paradigm where the participant didn't have to respond in any way to the target stimulus; just observe. The target stimuli were the brands (brand logos) associated with advertisements and the standard stimulus was a fixation cross (presented a random number of times prior to the brand presentation). Two brands associated with DAL ads, two brands associated with impulse response advertisements, four brands associated with filler normal ads, and two control brands (i.e., brands for ads recalled from memory) were used as target slides (total of 10). Each slide was randomly presented 22 times with a total target slide presentation of 220. The standard and target stimuli were presented for one second with one second intervals. The stimulus was presented on a computer screen situated approximately 100 cm from the participant's eyes. The stimuli were presented on an iMAC computer screen with dimensions 37cm by 23 cm.

Prior to the initial stimulus presentation but after preparation, the participants were shown a training DVD on how to use the interactive media. After the initial stimulus presentation, participants watched and interacted with (forced interaction) a group of television advertisements.

Three versions of the content with different sequences of the advertisements were presented. The media content included four interactive ads (2 high involvement products [1 DAL, 1 impulse response]; 2 low involvement products [again, 1 DAL, 1 impulse response]) and 8 normal filler ads. Note that each ad format was associated with at least two brands, to control for the confounding of brand and ad type. These ads were arranged in one of three random orders to avoid primacy-recency effects and competitive interference.

After the viewing of the advertisements, participants were again exposed to the same stimuli presentation before completing a survey including attitude scales. Attitude toward the ad was measured using three 7-point semantic differential scales previously used to measure attitude to websites (good/bad; pleasant/unpleasant; favourable/unfavourable) (Sicilia, Ruiz & Munuera, 2005). Attitude toward the brand was assessed using another three 7-point semantic differential scales (attractive/unattractive; I like it/I do not like it; it is good/it is bad) (Sicilia et al, 2005).

**Data Analysis**

When a stimulus is only passively viewed, smaller amplitudes are produced (Polich, 2007), therefore amplitudes were not analyzed in this study. Instead, the occurence of the P3a peak, defined as the largest positive peak between 180 and 300 msec, and its latency will be used for further analysis.

ERP latencies and attitude scales were analysed with SPSS (Version 15, SPSS Inc, 2006) repeated measures analysis of variance (ANOVA) with missing values of ERP latencies replaced with the participant mean value, as recommended for psychophysiological research (Blumenthal et al. 2005). A Huyn-Feldt epsilon was applied when the assumption of sphericity was violated in the univariate approach. An alpha level of .05 was the criterion used to test for significance.

**Results**

A 2 (time - pre vs. post) x 4 (brand type – DAL ad, impulse response ad, normal ad, control ) repeated measures ANOVA was used to investigate the ERP latencies. A significant interaction ($F(2.49, 67.33) = 3.16$, $p < .05$) was further investigated with *t*-tests. As shown in Table 1, P3a latency decreased for the brands associated with the DAL ads ($t(27) = 1.98$, $p = .058$), but remained stable for the brands associated with the normal ads ($t(27) = 1.11$, *ns*) and impulse response ads ($t(27) = .36$, *ns*), but also increased for the control brands ($t(27) = 1.99$, $p = .057$). This indicates that automatic attention was faster for those brands that were associated with the DAL ads in the ad reel. The findings of this analysis suggest that brands associated with at least one interactive ad format can have attention automatically allocated to them faster. There was no main effect of time or ad type (both $F < 1$) for P3a latencies indicating that overall latencies (the average of pre- and post-latencies) didn't differ across the brands associated with different ads. As a demonstration of these latency differences, Figure 1 and 2 illustrate the ERP associated with before and after conditions for a DAL advertisement related brand test.

A one way repeated measure ANOVA (ad – DAL, impulse response, normal) was used to investigate attitude toward the advertisement. As shown in Table 2, attitudes toward the impulse response and normal advertisements were significantly more positive than the attitude to the DAL advertisements ($F(2,42) = 3.95$, $p < .05$).

A second one way repeated measure ANOVA (ad – DAL, impulse response, normal) was used to investigate attitude toward the brand. As shown in Table 2, the average attitude toward the brand for brands seen in impulse response interactive advertisements and normal advertisements were rated significantly more positive than the brands seen in the DAL advertisements ($F(1.68, 40.24) = 6.19$, $p < .05$).

**Discussion**

The findings of this study suggest that brands associated with longer interactive advertisements (DAL advertisements) do have attention automatically and therefore more rapidly allocated to them because P3a latency was shorter in response to the brands associated with that particular ad model. However, while these brands were processed faster, they were not perceived more positively. In fact, there was evidence that the longer-duration interactive experience actually reduced the favorability of attitudes toward the ad and the brand.

The lack of support for our expectation that longer-duration interactive advertisements would be rated more favorably compared to shorter-duration interactive ads and normal ads was surprising but not unexplained. Whilst Sicilia et al (2005) found a positive evaluation of both product and website during interactivity in their study investigating interactivity on the Web, their interactivity was restricted to low and medium levels of control over the information flow. Ariely (2000) found detrimental effects on the ability to utilize information presented in a high information control scenario, as the cognitive load exceeded capacity. Perhaps this finding is related to our unexpected result – the cognitive effort required to interact with the DAL ads was too much and therefore negatively impacted on attitudes toward the brands and advertisements. However, in our study, interactivity was forced, so the effects of increased control on capacity could only have been imagined. Another possibility is that the long duration of the forced interactivity negatively impacted on participant attitudes towards both the advertisement and the brand, while at the same time providing plenty of opportunities for rehearsal of brand information, which would have facilitated the processing of brand information. Future studies should use a 'free will interactivity' paradigm to disentangle and further clarify these effects. Interactive television advertisements have been found to increase purchase intention in a naturalistic lab setting (Reading, Bellman, Varan, & Winzar, 2006) when the interactivity was voluntary.

This finding though does add an interesting feature to the ERP data. It suggests that the decreased latency of the P3a was not positively related to valence, as the ads with the shortest P3a latencies (the longer DAL iTV ads) were rated less positively than the other ad types on evaluation scales.

Polich (2007) infers that the P3a is the result of focal attention to the stimulus for evaluation. In a consistent paradigm for ERPs, a standard stimulus, a target (which you need to respond to) and a distractor will be randomly presented. In our paradigm, perhaps our targets could be viewed as distractors because they didn't need a response. If this is the case, the P3a in our study could be derived from stimulus-driven attributes. Polich (2007) suggests that distractor component variations occur because of variation in the top-down monitoring of the frontal attention mechanisms that are involved in stimulus evaluations. Our results could be attributed to this change, in that the extended exposure to the brand during the DAL interactive experience could facilitate a more rapid allocation of attention to the brand when viewed later as a stimulus.

There is some discussion about the P3a being a response exclusive to novel stimuli but Comerchero and Polich (1999) found that an infrequently occurring nontarget (but typical in structure) visual stimulus can elicit focal attention similar to a novel stimulus. When the target/standard discrimination is easy, as it was in our study (because it was easy to distinguish the target [brand] from the standard [fixation cross]), an intense attentional focus isn't required and therefore automatic processing is facilitated (Katayama & Polich, 1998; Verbaten et al, 1997). While the other brands also elicited the P3a because they initiated frontal processing, the brands associated with the DAL interactive ads elicited a faster P3a. Faster redirection of attention to the distractor (iTV ad brands) would occur because of the faster frontal lobe activation that underlies the generation of the P3a (Jeon & Polich, 2001).

Translating these results to the marketing and advertising industry suggests that the extra engagement of interactive television ad models such as the DAL, does increase the likelihood of viewers and in turn consumers automatically attending faster to the advertised brand away from the primary advertisement. According to Alba and Hutchinson (1987) brand detection processes that are automatic inhibit the detection of other brands. In a complex stimulus environment (such as buying non-prescription medication in a supermarket) or a time-pressured environment, brand logos that are automatically processed faster will be noticed faster and probably chosen over other alternatives (Alba & Hutchinson, 1987). However, we note that our results suggest that while brands seen in DALs may be processed faster, if the valence associated with the brand is also retrieved during the decision process (as opposed to a positive judgment of brand familiarity), then because the DAL brands were evaluated more negatively than other brands, they might be less likely to be bought than brands seen in other types of ads, including impulse response interactive TV ads.

Because our target stimuli were more complex than the usual stimuli used in traditional ERP paradigms (which use shapes or letters) it is unclear exactly what characteristic of the brand logo (brand name, logo color, shape or design, font) elicited the P3a for all our brands. However, because we used a repeated measures (pre-post) design, regardless of the characteristic responsible for the change in latency of the P3a, it only occurred *after* viewing the television advertisements (even for the control brands, which were familiar brands).

The use of event related potentials can aid the understanding consumer decision making processes because they measure unconscious cognitive processes that cannot be affected by the biases that can distort self-reports. Future research could replicate this study using a counter-balanced approach for brand and ad type and perhaps also add some type of stimulus related task. Future researchers might also consider the use of multi-level models to handle missing data rather than the more conservative approach we used: replacement by the participant's mean. Although more refining of this paradigm is required, it is a small forward step to taking basic neuroscience research methods and applying it to real world practice. This study is also interesting in that the ERP was measured after the viewing of the commercial and therefore measuring post-viewing effects of the interactive advertisement. Plassman et al.'s (2007) question about whether duration of advertising exposure can affect brand memories is not directly answered by this study, but we do know that length of exposure to brand related material (via a DAL) can impact on automatic attention allocation to the brand and this faster automatic attention allocation is not valence related.

In conclusion, translating the effect of a shorter latency of the P3a in response to brands associated with DAL advertisements to the marketing and advertising industry suggests that the extra engagement of interactive television ad models, such as the DAL, does increase the likelihood of viewers and in turn consumers automatically attending faster to the advertised brand away from the primary advertisement. While this one measure is not enough to build a campaign upon, it is the first neuroscience measure that has been used to investigate and illustrate the benefits of the new interactive television ad formats made possible by the switch to digital television.

## Tables

Table 1: Mean (and standard deviation) P3a latency values (in milliseconds) in response to four different brand types.

| Brand Type | P3a Latency before advertisement exposure | P3a Latency after advertisement exposure |
|---|---|---|
| **DAL advertisement brands** | 242.98 (24.45) | 237.46 (25.85) |
| **Impulse advertisement brands** | 238.14 (24.49) | 236.4 (27.57) |
| **Normal advertisement brands** | 238.44 (25.47) | 240.91 (30.23) |
| **Control brands** | 230.80 (29.18) | 240.37 (32.23) |
| **N** | 28 | 28 |

Table 2: Mean (and standard deviation) attitudes toward the advertisement and the brand across the three different advertisement types.

| Ad Type | Advertisement Attitude | Brand Attitude |
|---|---|---|
| **DAL ad** | 7.54 (3.25) | 8.88 (3.26) |
| **Impulse ad** | 9.93 (5.06) | 10.88 (3.52) |
| **Normal ad** | 9.92 (3.64) | 10.9 (3.49) |
| **N** | 22 * | 25 |

*N differed because of missing values.

**Figures**

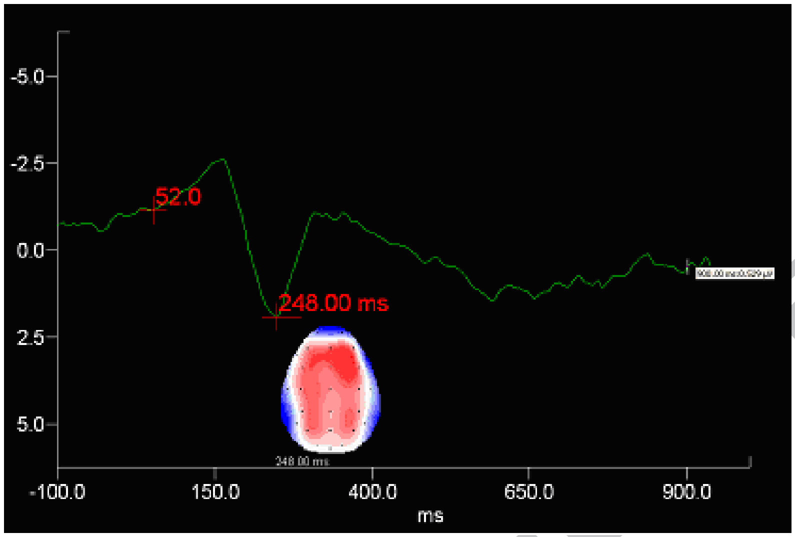


Figure 1: Individual ERP illustrating the topography and latency of the P3a before DAL advertisement exposure

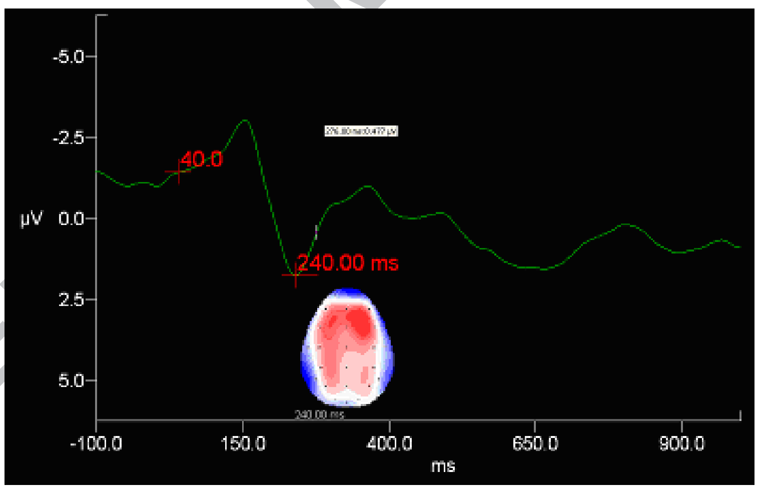


Figure 2: Individual ERP illustrating the topography and latency of the P3a after DAL advertisement exposure.

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