INVESTIGATING INDIVIDUAL PREFERENCES AND BRAIN ACTIVITY IN A WINE TASTING EXPERIENCE: A NEUROMARKETING APPROACH

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ABSTRACT

The study examines physiological and neuronal processes of 26 inexpert wine drinkers in order to understand how consumers judge and choose wines during product experience. We analysed if an increase in the beta band activity can be related to reward process and individual preference for a wine. The results confirmed that 1) tasting different wines modulate individual preferences and beta band activity and 2) the higher preferences for a wine corresponded to a stronger decrease in beta band oscillations.

Keywords Neuromarketing; wine tasting; EEG; beta band; wine preferences

INTRODUCTION

Neuromarketing research examines physiological and neuronal processes in order to investigate how the product experience modulates individual preferences and consumer behavior (Alvino et al. (2018)). Several studies show that the frontal cortex (FC) is anatomically and functionally connected to structures that reward processes (Davidson & Irwin (1999)). Rewards can be defined as biological or cognitive stimuli that produce and reinforce approach behaviors (Naranjo et al. (2001)). The study of reward process in Neuromarketing research helps to link the sensory properties of reward to emotion (positive or negative) evoked by a product, as well as to determine how consumers behave during the exposition to positive (e.g., food or brand) or negative (e.g, high price) stimuli. Hence, investigating reward process can be used to determine consumers' preferences for a product and to predict consumers' buying behaviors. EEG activity in the beta band range (12-30 Hz), particularly in the frontal and central areas, is associated with reward process and pleasantness (Hajihosseini et al. (2012); Khushaba et al. (2013); Park et al. (2017); Vecchiato et al. (2013)). For instance, Lucchiari & Pravettoni (2012) found that increased beta activity is related to pleasure associated with a favorite brand. Similarly, Boksem & Smidts (2015) investigated if a rise in the beta

band activity would reflect individual preference for a movie trailer during the product experience. Authors found that high ranking of a particular movie was related to increase in the amplitude of beta band oscillation during the view of the movie trailer. Hence, the higher participants ranked a movie, the higher the amplitude of beta band oscillations.

The present experimental study used a Neuromarketing approach to analyze individual preferences and brain responses during the product experience. Particularly, the study is aimed at investigating whether beta band oscillation can be related to individual preference for a wine. We performed a conceptual replication of the Boksem & Smidts (2015) study in order to examine if an increase in beta band activity in the fronto-central cortex (reward process) can be associated to participants' high ranking of a wine. Hence, we aimed at investigating if beta band activity could add predictive power to self-reported preferences. The experiment was designed by recreating a real wine tasting experience. The participants' brain activity was recorded during wine tasting, using EEG and, individual preferences for wines were also measured based on self-reported preferences. A within-subjects design was employed and the experiment was divided in two sessions (52 tests in total). Overall, the present study tries to test if (H1) wines influence participants' preferences and brain activity (beta band); and if (H2) preference for a wine is related to an increase beta band activity.

METHODS

Participants

Twenty-six participants, all volunteers and inexpert or amateur wine drinkers, between 18 and 40 years of age (Female: Mage= 27.3; Male: Mage = 26.2) that participated in both sessions. They had no history of neurological illness or damage, were not using drugs or psychiatric medication, and had normal or corrected-to-normal vision and no color-blindness. The study was approved by the BMS Ethics Committee, which were all in line with the declaration of Helsinki.

Once participants arrived at the laboratory, they were asked to sign an Informed Consent form. Participants were invited to sit on a comfortable chair at a distance of approximately 100 (cm) at the eye level in front of a 24-inch LED computer screen in a sound attenuated and illuminated room. The EEG electrodes were applied and recorded continuously from 32 active Ag/AgCl electrode sites using an EasyCap-62 channel cap connected to an ActiChamp amplifier, with BrainVision Recorder software.

Task

Four different wines had to be judged. The wines were selected on the base of the same type of grape (Cabernet Sauvignon, 100 %). We selected two wines per country (Italy and Chile) from two different price ranges. Two wines, named *Chilean Expensive (CE)* and the *Italian Expensive (IE)* were high-priced wines (price category: 24-27 €), while the two other wines, named *Chilean Cheap (CC)* and the *Italian Cheap (IC)* were low-priced wines (price category: 3-5 €). The wine order was counterbalanced for all the participants. The order was changed according to the nationality (Italian, Chilean) and the price (Cheap, Expensive).

The wine tasting procedure consisted of four steps that were repeated for each wine.

1. Volunteers started with rinsing their mouth with water after which they had to wait for 10 seconds.
2. A glass containing red wine was presented in front of the participant for 20 seconds.
3. Volunteers had to smell the wine twice; once with a stationary glass and the second time after swirling the wine in the glass for three seconds.
4. Volunteers subsequently tasted the wine by taking a small sip, and swirling the wine in their mouth, to appreciate the full taste.

At the end of each wine tasting, the volunteers were asked to give an overall rating of the wine (*Wine preference*). The volunteers rated each wine, according to their preferences (6-points Likert scale, the greater the preference the higher the value).

EEG Analysis

The analysis was restricted to the six electrodes located over the frontal and central cortex (AFz, F1, F2, FCz, FC3, FC4). The electrodes were chosen on the basis of data analysis used in other studies (Boksem & Smidts (2015); Lucchiari & Pravettoni (2012)). A Fast Fourier Transformations analysis was performed on water and wine data. A log10 transformation was applied in order to normalize the EEG data. Next, the resulting spectral EEG data per each wine and water were averaged for all participants individually. Next, a subtraction was performed between wine and water log10 transformed data.

STATISTICAL ANALYSIS AND RESULTS

A repeated measured ANOVA was used to analyze changes in the beta bands for the different wines. For the behavioral data, the non-parametric Friedman test was used to analyze changes in

participants responses for wines rating (*Wine preferences*). For the ANOVA, associated *F-values*, *p-values*, *Means* and *Partial Eta Squared* were reported.

The results showed that there was a significant difference in the participants' beta band activity ($F(13.1)>2.9$ $p=0.049$, $\eta^2=0.1$) after tasting the four wines. Hence, the results confirmed that tasting different wines influenced participants' beta band activity. Next, a comparison between wines was performed in order to further explore the impact of each wine on beta bands activity. These results suggest that there was a strong decrease in the beta bands activity of the Chilean Expensive wine compared to the other wines (CE and IE ($F(58)>5.6$ $p=0.026$); CE and CC ($F(12.1)>5.6$ $p=0.026$); CE and IC ($F(37.4)>4.5$ $p=0.044$)). However, no significant difference was found between IE and CC ($F(17)>1.9$ $p=0.171$) or Altruris ($F(2.2)>0.3$ $p=0.592$), as well as between IE and IC ($F(6.9)>0.8$ $p=0.592$). A further analysis on the behavioral data, participants' judgment of wines (1 to 6), showed that there was a significant difference in the score that participants (*Wine preferences*) attributed to the four wines after the tasting ($\tilde{\chi}^2(7)=73.4$ $p<0.001$) in both the sessions. Participants strongly preferred the high-priced wines (1) Chilean Expensive, (2) Italian Expensive, instead the (3) Chilean Cheap and (4) Italian Cheap were less preferred. Next, the comparison between the behavioral and EEG data did not confirm the second hypothesis (H2). In fact, there was a decrease in the beta bands activity for the most preferred wines such as Chilean Expensive and the Italian Expensive, similarly for the Italian Cheap wine. Instead, for the less preferred wine Chilean Cheap there was an increase beta band activity.

DISCUSSION

The present study aimed at investigating the contribution of neural measures to the study of consumer's preference and behavior. Particularly, we attempted to demonstrate that changes in beta band activity could be related to individual preference for a wine during the the product experience (wine tasting). The results show that changes in participants' perception of the wine reflect changes in neural measures. Hence, tasting different wines might influence people's preferences and cognitive process as well as more internal processes such beta band oscillations. Unlike Boksem & Smidts study, participants' preferences for a wine were not connected to increased beta band activity. Instead, results show that there was an opposite trend, higher preferences for a wine corresponded to a stronger decrease in beta band oscillations. However, this might suggest that watching a movie might involve different cognitive and neuronal processes (e.g, visual attention) that are different from those that arouse from a wine tasting (e.g, processing of olfactory and gustatory signals). Results in

Boksem & Smidts study might be interpreted assuming that increased beta band oscillation reflect the consumer preferences for the movie on the base of an arousal of the visual system during increased visual attention. Instead, wine tasting do not imply visual attention process but processing of olfactory and gustatory signals that might have a different impact on beta bands oscillations. Hence, it is not possible to infer the findings of Boksem & Smidts for the wine product. Overall, these findings bring evidences that it is possible to link some properties of the collected EEG data (beta activity) during the product experiences (wine tasting) with the individual preferences. Thus, EEG data might be used to improve our knowledge of the neural and psychological mechanisms that underlying consumer's behavior during a product interaction experience. However, the present study also suggests that the study of consumer behavior during product experiences is still in the fledgling stage, and current investigations have been mostly targeted to basic research. For that reason, to date, the findings derived from the use of EEG tools in product evaluation must be carefully examined as well the use of EEG to predict consumer's preferences.

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