



**Evaluating cognitive processing and preferences through
brain responses towards Country of Origin for Wines: The
Role of Gender and Involvement**

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Evaluating **cognitive processing** and preferences through brain responses towards Country of Origin for Wines: The Role of Gender and Involvement

Abstract

Purpose: To analyse the impact of the country of origin of wines on **cognitive processing** and preferences through brain responses for consumers from the perspective of gender and the level of involvement.

Design/Methodology/Approach: A wine tasting experiment was performed using electroencephalography. The sample consisted of 40 students from an important Brazilian university. In the first group, the participants tasted two glasses of wine with Brazilian then French origins. In the second group, the participants only tasted one glass of wine, without the origin information. The wine was the same in both groups and from Brazilian origin. Throughout the tasting process, participants had their brain responses recorded via the EEG.

Findings: The main findings suggest that the country of origin did not have a significant influence on **cognitive processing** or preferences for consumers in general, neither for women nor consumers of high involvement. For men, there was greater **cognitive processing** for Brazilian Wines. However, there was no preference for men among the origins of wines. For consumers with low involvement, there was a difference in cognitive processing, presenting a greater value for Brazil and without origin information. Also, for low-involvement consumers, a greater preference for wine from France was seen.

Originality: This study presents a new contribution to the literature by analysing the **cognitive processing** and preferences through brain responses for consumers from the perspective of gender and the level of involvement.

Keywords: Country of origin effect. Wines. EEG. Experiment. Genders. Consumer involvement.

1 Introduction

The origin of wines is very important for consumers to a greater extent; studies have shown that origin has a powerful effect on the way consumers evaluate products (Dobrucali, 2019; Wijaya, 2020) and has strongly influenced consumer attitudes and buyer behavior towards products (Wijaya, 2020). Besides, several researchers have found that many consumers

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3 use information about the origin of wines (country of origin) as a synthesis of information
4 regarding price, value, performance, and product quality (Papadopoulos and Heslop, 2014; Rini
5 and Sembiring, 2019). Wine is understood to be a somewhat more complex product, in variety
6 and number of attributes, than other products in the food store. Research has shown that there
7 are strong associations between the decision to buy wine and the country of origin such as in
8 the study carried out by (Milovan-Ciuta, *et al.*, 2019) which found that the country of origin
9 was an important variable in the choice of wine. In contrary to this, the taste was seen as a true
10 perception of consumer intent, since it can be modified by affective, cognitive processes and
11 also by expectations (Palotas, Soos and Zsofi, 2019). Moreover, this study also pointed out that
12 even though the molecular composition determines the taste, there are several other factors such
13 as the external characteristics that influence the pleasure of the drink. The country of origin is
14 one of those external characteristics influencing the consumer's choice.

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24 Researchers have found that the products' origin influences the cognitive and normative
25 affectional aspects for consumers in the process of product evaluation, a phenomenon known
26 as the country-of-origin (COO) effect (Verlegh and Steenkamp, 1999). Several studies point
27 out the current relevance of the country of origin effect associated with a range of products
28 (Papadopoulos and Heslop, 2014; Alshibly, Alghizzawi and Zaabi, 2019; Dobrucali, 2019;
29 Rini and Sembiring, 2019; Septianto, Chiew and Thai, 2020; Wijaya, 2020). According to
30 Balestrini and Gamble (2006) and Veselá and Zich (2015), stereotyping caused by the country
31 of origin is very common in the wine industry and the origin is seen as an important standard
32 of assessment. However, the country of origin effect in the wine selection may have different
33 levels of intensity depending on the consumer's gender (Bruwer and Buller, 2012; Concha
34 Velásquez *et al.*, 2018; Ferreira *et al.*, 2019) and level of involvement (Verlegh, Steenkamp and
35 Meulenberg, 2005; Bruwer and Buller, 2012; Concha Velásquez *et al.*, 2018).

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45 In context to this, Forbes, Cohen, and Dean (2008) found that although the relative
46 importance of product class knowledge for wines, affecting consumer behavior, is significantly
47 documented an understanding of the subject and objective knowledge based on gender is yet to
48 be fully captured. Their study found gender associated with the knowledge of wines, but it was
49 objective knowledge of wines that had significant relationships with gender. It inclines to
50 participants' understanding through consumption and involvement in buying decision making
51 for wines along with respective gender.

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60 Furthermore, Septianto, Chiew, and Thai (2020) pointed to past research that suggested
emotions based on origin could influence consumer assessments of products. However, it is still
unclear when and how country-based emotions can influence decision making. In this context,

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3 this study aimed to evaluate the brain responses to the country-of-origin effect of wines by
4 considering the comparisons of gender and their respective involvement level. That is, more
5 specifically, we sought to analyse, through the EEG, the **cognitive processing** and the preference
6 of the origin information of wines for consumers in general, and for different groups of gender
7 and involvement. Analysis using Electroencephalography (EEG) for the country of origin effect
8 makes it possible to gain a better understanding of marketing efforts, as it examines, in
9 particular, the influences of consumer behavior. As part of this study, with the use of these
10 methods proposed by neuroscience techniques, things that are difficult to identify can be made
11 visual, such as emotions (Yağci *et al.*, 2018) as captured through EEG. Kolev (2019) highlights
12 that the interest in the use of EEG consists of the high temporal resolution it has. Furthermore,
13 the neural measures are likely to produce more concrete and impartial predictors, free from the
14 limitations of traditional measurements (Hakim and Levy, 2019).

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24 There have been no similar studies found across some of the key international academic
25 databases (Science Direct, Scopus, Web of Science, Inderscience, Springer, Sage, and Emerald)
26 that assesses consumers' brain responses to gender and the level of consumer involvement
27 through the **cognitive processing** and the preference of the origin information of wines for
28 consumers in general, and associated with the gender and the level of involvement. Thus, this
29 paper makes a key theoretical and methodological contribution to the developing pool of
30 knowledge. Most research present in the literature of country origin effect using brain analysis
31 were studies that analysed the combined effect of price and country of origin (Alvino *et al.*,
32 2019) and music and country of origin (Hsu and Chen, 2019). No studies were found that
33 analysed the country-of-origin effect, in terms of brain emotional responses to gender and
34 involvement, particularly, in terms of **cognitive processing** and preferences.

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The use of the EEG neuromarketing tool allows obtaining deeper and more accurate
information than traditional marketing methods, this making it possible to know which
emotions are triggered by certain stimuli (Horska *et al.*, 2016, Hafez, 2020). Yağci *et al.* (2018)
highlight that neuromarketing will make it possible to gain a better understanding of marketing
efforts, as it examines, in particular, the causes of consumer behavior. In the context of the wine
industry, this research deepens the understanding of cognitive processing, since the participants'
delta and beta brain responses are measured and analysed, indicating the emotions and the
cognitive processing related to wine preference. This knowledge may help the wine industry by
providing information about cognitive processing (via the delta wave) and preferences (via the
beta wave). Thus, this study intends to fill the key gap and further contribute to the emerging

international literature in the area by attempting to better understand the influence of country of origin for wines on consumers' emotional brain responses by employing EEG analysis.

2 Literature Review

2.1 Country of origin effect for wines

A study by Silva et al., (2015) about the country-of-origin effect in the wine sector, identified that consumers aspiration to the perceived quality, purchase intent, and the willingness to pay the superior price for the wine differentiates drastically, with the availability of country of origin information – in this case, it was Chilean and Chinese wines. Veale and Quester (2008) also, earlier, established that the price and country of origin effect proved to be more relevant to the perception of wine quality than its actual taste. Most recently, Milovan-Ciuta et al., (2019) found that consumers used the country of origin as an affirmation to reduce the perceived risk of buying and to assess the social acceptability of the products purchased. Wang and McCluskey (2010) saw that when the country of origin information was mentioned, Chinese consumers in Beijing and Shanghai would be more willing to pay more for France's "Old World" wines than for "New World" wines. In addition to these researchers who analysed the country-of-origin effect for wines, many others like, Schooler (1965), Elliot, Papadopoulos, and Kim (2011), Papadopoulos and Heslop (2014), Foroudi *et al.*, (2019), and Yang and Yun (2020) verified the influence of the country-of-origin effect for the most diverse products through their respective studies.

A contradictory result, in which the country of origin effect did not prove to be significant, was seen by Balestrini and Gamble (2006) that found there was no significant difference in the importance of the country of origin apart from the fact when there were any special occasions included and tied with products, in which there could be a chance of judgment in some cases. Other researchers such as Usunier (2011), Samiee (2011), and Ensor (2013) also found that the country-of-origin effect may not be significant in some product considerations. However, these authors did not evaluate brain responses regarding the country of origin effect. In addition to studies in the traditional way, the country of origin effect was also verified through EEG in our research.

Alvino *et al.*, (2019) who analysed the country of origin and price effect in cheap Chilean, cheap Italian, expensive Chilean, and expensive Italian combinations, saw that differences in participants' preferences for wine could be related to changes in brain responses. The authors then realised that the wines of greater preference caused a more marked decrease

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3 in the beta wave. It was also found by the authors a decrease in the beta wave for the most
4 preferred wine (most expensive Chilean) and a greater oscillation for the least preferred wines
5 (expensive Italian, cheap Chilean, expensive Italian). Moreover, the study by Hsu and Chen
6 (2019) explored the effect of different musical styles on the preference of wine tasting through
7 EEG. It was established by the authors that the musical stimuli caused different brain wave
8 activities. The authors found, through correlation analysis, a negative correlation between the
9 activities of the alpha, beta, and gamma waves of musical stimuli with the activity of the alpha
10 wave. A negative correlation between the alpha wave activity of musical stimuli and the beta
11 activity of the second round of tasting was also seen, with the other associations being
12 significant and positive.
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21 Caratu et al., (2018) conducted a pilot study to investigate whether the sense of smell
22 represents a statistically significant variable in the wine tasting experience. The experience
23 provided the tasting of two types of Italian wines, the process also being divided into two
24 phases: smell and tasting. Through the frontal asymmetry analysis of the alpha wave of the right
25 (Fp2, AF4) and left (Fp1 and AF3) electrodes and through statistical analysis, the authors saw
26 a statistically significant increase in the wine's smell phase compared to the phases of the wine
27 tasting with and without olfactory component. Concerning this, one of the most well-known
28 studies that have spurred much other marketing and neuroscience research was the Coca-Cola
29 and Pepsi experiment carried out by McClure *et al.*, (2004), using the fMRI, wherein the
30 participants' brain responses were recorded while they tasted Coca-Cola and Pepsi drinks in a
31 blind test. Before the brands were disclosed, the participants showed an equivalent preference
32 between the two drinks, but after the brand was informed, 75% of them showed preference
33 towards Coca-Cola.
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43 As for coffee, Yucel et al., (2015) saw that the participants who drank coffee they liked
44 the most, were more relaxed, and felt stressed when they drank coffee they did not like. Hayashi
45 et al., (2020), in turn, investigated the signs (EEG and ECG) under the stimulation of basic
46 flavors: sweetness, salty, sour, bitter, and salty taste (umami), taking into account the individual
47 preference in the evaluation. The biological signals were used by the authors to classify the
48 emotion and compare it with subjective evaluation. The results of the experiment proved that
49 human emotion is affected by taste stimuli. Thus, it was assumed that the knowledge and
50 information about the country-of-origin influence consumers' brain responses, leading to the
51 following research hypothesis:
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3 **Hypothesis 1:** The wine's country of origin leads to greater **cognitive processing** in
4 consumers in general.

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6 **Hypothesis 2:** The wine's information of origin leads to more stress for the less
7 preferred wine origin for consumers in general.
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10 **2.2 Country of origin effect for wines for genders**

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13 Many studies suggest that gender is the first vector for segmenting the wine market
14 (Atkin, Nowak, and Rosanna, 2007; Bruwer and Li, 2007; Ferreira *et al.*, 2019). The literature
15 shows a difference in the way men and women evaluate products. Rappaport *et al.*, (1993) found
16 that men and women differ in the attributes of health, pleasure, and convenience in the
17 consumption of drinks and food. A survey conducted at the North American Science Museum
18 with 400 individuals showed that women are more super-tasters than men (Nuessle *et al.*, 2014;
19 Spence, 2019). Atkin *et al.*, (2007) verified how men and women differ. It was seen that women
20 were better able to seek information and preferred to buy from national, international wineries,
21 or supermarkets. Men, on the other hand, have a greater tendency to read books on wine, to
22 seek information outside the point of sale, and have a greater preference for small wineries.
23 Atkin, Nowak, and Garcia (2007), in their other study, found that wine labels, awards, and
24 medals were more important for women than for men. And also, women showed a stronger
25 preference for South American wines than men. But both rated US wines above international
26 wines.
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30 The economic and neuropsychological literature indicates differences when comparing
31 the responses of the genders (Lucchiari and Pavettoni, 2012), given that the stimuli may impact
32 the brain activity differently and, consequently, the cognitive and emotional responses. Gender
33 differences are a vital characteristic of customer behavior studies and must not be neglected
34 when behavior is studied (Lucchiari and Pavettoni, 2012). A systematic review of the literature
35 on neuroimaging studies made by Chao *et al.*, (2017) about functional magnetic resonance
36 imaging (fMRI) and positron emission tomography (PET) revealed that there is a difference in
37 neural correlations for men and women for stimulating food. It was identified that women
38 responded better to visual images of food and exhibited greater neural activation than men in
39 the frontal, striated, fusiform, and limbic gyrus.
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43 Another study by Cornier *et al.*, (2010) sought to examine the differences between men
44 and women regarding neural and behavioral responses to food. Through the fMRI, the authors
45 found that women had greater activation of the lateral and dorsolateral prefrontal cortex
46 (DLPFC) and parietal cortex than men. According to the authors, this may suggest that greater
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pre-frontal neuronal responses lead to increased cognitive processing related to executive function. Based on this, given the tasting of the origins of the 'Brazilian', 'French' and 'No information' wines, it is expected that women present greater cognitive processing than men. Therefore, research hypothesis 3 was formulated:

Hypothesis 3: The wine's country of origin leads to greater cognitive processing in women than in men.

Moreover, Ferreira et al., (2019) found that the region of origin and the experience of prior knowledge was the reason why men choose wine. Women are more confident in their previous experience and the wine brand. Besides, men associate wine with sensory and youthful pleasure, while women associate it with the context of consumption. In the context of the country-of-origin effect, some researchers found that men gave more importance to the region of origin of the wine than women did (Gelinard, 2008; Lockshin and Hall, 2003), while others found that women gave more importance to the region of origin than men (McCutcheon, Bruwer and Li, 2009; Josiassem, Assaf and Karpen, 2011, Concha Velásquez *et al.*, 2018). Bruwer and Buller (2012) found that women had more tendency to influence decision-making for purchasing wine and that they were responsible for driving the growth of sales for "New World" wines. As more researchers found a greater influence on the country-of-origin effect in women than in men, the hypothesis of this element was built based on a greater influence on women.

As documented within the literature around the country-of-origin effect for wines, studies for genres and EEG were not found. Alvino et al., (2019) realised that the wines of greater preference caused a more marked decrease in the beta wave. As for coffee, Yucel et al., (2015) saw that the participants who drank coffee felt stress when they drank coffee they did not like (characteristic of the beta wave). Based on this, and research that found that women gave more importance to the region of origin than men (McCutcheon, Bruwer and Li, 2009; Josiassem, Assaf and Karpen, 2011; Concha Velásquez *et al.*, 2018) the following hypothesis was formulated:

Hypothesis 4: The wine's information of origin leads to more stress for the less preferred wine origin for women than for men.

2.3 Country of origin effect for wines for consumer involvement

Besides gender, the country-of-origin information may influence consumers differently, depending on whether their involvement with the product is low or high. The literature points out that involvement is an important variable in the segmentation of consumers (Lesschaeve and Bruwer, 2010) and that the classification between high and low involvement is widely accepted (Barber *et al.*, 2007). According to Bruwer and Buller (2013), the wine category contains all the attributes of the source of involvement suggested by Laurent and Kapferer (1985). Barber *et al.*, (2007) in their study of involvement and purchase of wine found that consumers with high and low involvement react differently concerning the country of origin, grape variety, price, design, quality, and consumption situation. In addition to this researcher, the literature points out that there is a difference between the perceptions of consumers of high and low involvement.

Low-involvement consumers are considered more loyal to a small number of brands and occasionally drink wine (Lockshin and Spawton, 2001; Lockshin, Quester and Spawton 2001). Barber *et al.*, (2007) point out that low-involvement consumers rarely read specialized magazines, do not consider wine as their lifestyle, and take longer at retail. Highly involved consumers regularly drink wine and are unlikely to be more loyal to the brand and consider wine as part of their lifestyle (Lockshin and Spawton 2001; Locksin, Quester and Spawton, 2001). Barber *et al.*, (2007) highlight that highly involved consumers seek information and use it in the wine purchase decision process. Because they have a high interest in wine, highly involved consumers have greater knowledge about wine and use more complex information clues showing greater spending and buying behavior (Barber *et al.*, 2007). Consumers seek to maximize expected satisfaction through the choice process (Laurent and Kapferer, 1985). As **cognitive processing** is associated with responses of mental processes, such as thinking, solving a problem, classifying, planning, creating, and reasoning (Flavell, 2019), it is noted that consumers with high involvement seek information and use it in the wine purchase decision process (Barber *et al.*, 2007) and seek to maximize the expected satisfaction (Laurent and Kapferer, 1985) the fifth research hypothesis was formulated:

Hypothesis 5: The wine's country of origin leads to greater **cognitive processing** for high involvement consumers than for low involvement ones.

The literature also points out that wine consumers, whether they are of high or low involvement, use the country of origin as a way to attribute the quality to the wine, without the

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3 need for these consumers to have visited that country (McCutcheon, Bruwer and Li, 2009).
4 Lockshin et al., (2006) found that consumers with high involvement buy less wine from regions
5 about which they have little knowledge, compared to consumers with low involvement. Santos
6 et al., (2008) ended up verifying that highly involved consumers give more importance to the
7 brand, the country of origin, and the information on the label. A similar result was found by
8 Hollebeek et al., (2007) who saw that consumers with high involvement were more influenced
9 by their country of origin than consumers with low involvement. Likewise, Concha Velásquez
10 et al., (2018) saw that consumers with a high involvement are influenced by the country of
11 origin to determine the quality of the wine. Verlegh, Steenkamp , and Meulenberg (2005)
12 highlights that state that the country of origin has a more significant impact on the evaluation
13 of the product when consumers have low involvement with it. Bruwer and Buller (2012), who
14 concluded that high-involvement consumers showed a strong preference for wines produced in
15 the "Old World", especially those from France and Italy than low-involvement consumers did.

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17 These authors did not assess brain responses for the level of involvement. Thus, it is
18 expected that the information from the country-of-origin influences consumers' emotional brain
19 responses. On the other hand, with regards to the evaluation of wines for consumers with a high
20 and low level of involvement through the EEG, no studies have been found that have made this
21 analysis. What was found was a study by Mauri et al., (2016) who analysed the reactions of
22 expert and non-expert consumers on wine consumption. The EEG data showed that non-
23 specialist consumers feel stressed about evaluating wine compared to experts. Alvino et al.,
24 (2019) realised that the wines of greater preference caused a more marked decrease in the beta
25 wave. As for coffee, Yucel et al., (2015) saw that the participants who drank coffee felt stress
26 when they drank coffee they did not like (characteristic of the beta wave). As a result, the
27 following and final hypothesis 6 for this study were formulated:

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46 **Hypothesis 6:** The wine's information of origin leads to more stress for the less preferred wine
47 origin for high-involvement consumers than for low-involvement ones.

48 49 50 **3 Methodology**

51 52 53 **3.1 Participants**

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55 The sample was constituted, following convenience selection criteria, made up of 40
56 undergraduate and graduate students (20 men and 20 women, mean age 21.8) of a public higher
57 education institution in the state of São Paulo, Brazil. These students were at least 18 years old,
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3 healthy, right-handed, and did not have any brain illnesses nor a history of alcohol abuse
4 (Vecchiato *et al.*, 2011). The sample size of EEG studies is relatively smaller when compared
5 to quantitative studies due to the time spent and great effort to treat and analyse the brain waves.
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7 In their studies with EEG, Dimpfel (2015) and Morillo *et al.*, (2016) used 10 interviewees.
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9 Vecchiato *et al.*, (2011), in their two research studies, used 11 participants in one experiment
10 and 15 participants in another. In this context, a sample of 40 subjects was established to be an
11 adequate sample size when compared to some of the other similar research studies using the
12 EEG.
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20 **3.2 Experimental design and task description**

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22 The stimulus manipulation process occurred upon making the wine glasses available for
23 the study subjects, providing different information regarding the country of origin of the product
24 for the participants (such as Brazil, France, and no information). In the first group, each
25 participant would taste two glasses of wine, each having a different description of the wine
26 origin: one with the information of the wine being from Brazil, and the other one from France.
27 The order of presentation was randomised for each participant to avoid order bias. For the
28 second group, we did not provide any information regarding the origin of the wine. It is
29 important to emphasize that the same wine was used in both glasses and it was of Brazilian
30 origin. Hence, only the information about the wine's country of origin was manipulated.
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33 The order of presentation of the country of origin information was alternated, with half
34 of the participants receiving the first order ('Brazil then France'), and the other half, the second-
35 order ('France then Brazil'). Since two stimuli were attributed to the same individual, this design
36 is characterized as intra-subjects. To the second group, no information was given on the country
37 of origin where the wine was produced and the wine was tasted only once. The participants
38 signed a detailed and well-informed consent form, indicating agreement for participation in the
39 study. Following this, a clinical tracking to verify if the participants had brain illnesses and
40 histories of alcohol abuse was conducted (Vecchiato *et al.*, 2011).
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43 The EEG Emotiv Epoc equipment was prepared before being placed on the participant's
44 head. Each electrode was moistened with a saline solution that facilitates the capture of brain
45 responses. After preparation, the equipment was placed on the participant's head. With the
46 equipment in place, each participant was provided a glass of water and a piece of bread to clear
47 the palate. For the experimental group, we offered the first glass of wine. The duration of the
48 brain wave recording was 20 seconds, following Cochin *et al.*, (2009). Then, the participant
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3 was offered water and a piece of bread to clean the palate again, followed by the second glass
4 of wine. The duration of brainwave recording was also 20 seconds, per Cochin et al., (2009).
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6 For the second group, each participant was also provided water and a piece of bread to clear the
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8 palate, followed by a single glass of wine. The duration of the recording was also 20 seconds.
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10 Each glass had 20 ml of wine according to Bazoche, Combis, and Giraud-Heraud (2013).
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14 **3.3 Data collection instruments**

15 **3.3.1 EEG**

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20 Electroencephalography (EEG) is a mapping tool that allows locating the electrical
21 activity of the brain (cortical regions). Through electrodes that are placed on the scalp, it is
22 possible to capture the electrical signals emitted by the brain (Jabbarli and Jafarova, 2019). The
23 electrodes are positioned in four brain regions: Parietal, responsible for perceptions such as
24 palate, heat, pain, sensitivity, and spatial localization (Lundy-Ekman, 2011). Frontal,
25 responsible for the capacity to respond to stimuli, the establishment, and change of strategies,
26 organization, social and motor behaviors, memory, and the emotional behavior of individuals
27 (Costa, 2004; Lundy-Ekman, 2011); Temporal, responsible for the processing of auditory
28 information (Lundy-Ekman, 2011) and Occipital, responsible for the processing of visual
29 stimuli (Lundy-Ekman, 2011). This tool works with five brainwaves, each having a frequency
30 range. Such five waves are known as alpha, beta, theta, gamma, and delta (Aldayel, Ykhlef, and
31 Al-Nafjan, 2020; Kucewicz *et al.*, 2017).
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41 The alpha wave is seen in the frequency range of 8 to 13 Hz (Aldayel, Ykhlef, and Al-
42 Nafjan, 2020). This wave is seen in states of relaxation, where the stress is controlled,
43 weakening emotional and cognitive blockages (Aldayel, Ykhlef, and Al-Nafjan, 2020; Bercea,
44 2012). The beta wave is seen in the frequency range of 13 to 25 Hz (Porjesz *et al.*, 2002). The
45 characteristics of this wave are alert states, tension, vigil, intense activation of the central
46 nervous system (Aldayel, Ykhlef, and Al-Nafjan, 2020; Bercea, 2012). The theta wave is seen
47 in the frequency range of 4 to 8 Hz (Aldayel and Ykhlef and Al-Nafjan, 2020). This wave is
48 seen in states of sleepiness and calm (Aldayel, Ykhlef, and Al-Nafjan, 2020; Bercea, 2012).
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55 The delta wave is seen in the frequency range of 1 to 4 Hz (Aldayel, Ykhlef, and Al-
56 Nafjan, 2020). The characteristics of this wave are Problem-solving ability also known as
57 cognitive processing, during sleep, in deep anesthesia, attention support for internal processing
58 on a perceived perceptual alternative (Aldayel, Ykhlef, and Al-Nafjan, 2020; Gruzelier *et al.*,
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2014, Bercea, 2012). The gamma wave is seen in the frequency range Low gamma of 30 to 60 Hz; High gamma of 60 to 100 Hz (Kucewicz *et al.*, 2017). The characteristics of this wave are Facial recognition, memory (Aldayel, Ykhlef, and Al-Nafjan, 2020; Anaki, Zion-Golumbic, and Bentin, 2016).

The instrument used for collecting data on the brain responses was the EEG equipment by Emotiv Epoc. This equipment presents two reference channels, one for localization, and 14 channels (AF3, AF4, F3, F4, F7, F8, FC5, FC6, P7, P8, T7, T8, O1, O2) that are located according to the international system of 10-20 electrodes (Emotiv Epoc, 2020). The sampling rate is at a 128-Hz frequency. The bandwidth of the amplifier is between 0.2 and 43 Hz, with digital filters between 50 and 60 Hz. The resolution is of 16 bits (14 effective bits) and one LSB equal to 0.51 μV . The dynamic interval is 8400 $\mu\text{V}(\text{pp})$ (Emotiv Epoc, 2020). The impedance rate was kept at 10 k Ω , following Cochin *et al.* (1999).

3.3.1.2 Choice of channels and waves

Choice of channels: frontal lobe channels were selected (AF3, AF4, F3, F4) because they are responsible for emotion (Davidson, 1992) and the influence of taste (Brown, Randolph, and Burkhalter, 2015). As this study is based on wine tasting and emotion (stress) and cognitive processing, the choice of these channels was determined as adequate in the context of the research. In addition to being responsible for the emotion that is characteristic of these four channels (AF3, AF4, F3, F4), they also have some specific characteristics. Channel AF4 is associated with judgment/restrictions, channel AF3 with attention and filter input, and channel F3 and F4 for commitment, motivation, and emotional expression (Shaari *et al.*, 2019, Aldayel, Ykhlef and Alnafjan, 2020).

Choice of waves: to meet the objectives of this paper, the delta and beta wave was selected. **Delta wave:** The country of origin can be considered as an influence that it exercises on the affective, normative, and cognitive aspects of consumers (Verlegh, 1999). Because of the characteristic related to the attention support for internal processing associated to a perceived perceptual alternative (Gruzelier *et al.*, 2014; Harmony *et al.*, 1996) and of problem-solving ability to delta wave is also known as “cognitive processing” (Feinberg *et al.*, 1990). And an important factor to be considered for endorsement or effect of the country of origin is cognitive processing. Furthermore, as delta wave is also associated with internal processing related to a perceived perceptual alternative, and consumers must value an alternative from the country of origin: 'Brazil and France', 'France and without origin information' and 'Brazil and

without origin information', the escort of this wave shows to be adequate in the context of the investigation. **Beta wave:** The choice of this wave was based on the studies of the country of origin and the brand to serve half the responses to the brain. Alvino et al., (2019) found that the wines of greater preference caused a more marked decrease in the beta wave. As for coffee, Yucel et al., (2015) saw that the participants who drank coffee felt stress when they drank coffee they did not like (stress is a beta wave characteristic). The beta wave is observed when the individual is in a state of alertness, tension/stress, wakefulness, intense activation of the central nervous system and is inhibited by mental effort and attention (Bazane, 2012; Bazanova and Vernon, 2014). Besides, Lucchiari and Pravettoni (2012) identified that the beta-medium range was higher for women when the brand was well known and preferred. Thus, the escort of this wave shows to be adequate in the context of the investigation.

3.3.1.3 Data processing EEG

1) Noise removal: for the removal of noise, the MATLAB R2015a EEGLAB package software was used. The sampling rate of 128 Hz was fixed and a low-pass bandwidth of 2 Hz and a high-pass of 45 Hz were performed, a procedure followed by Cohen (2014). Then the independent component analysis (ICA) was performed. The algorithm used to run this technique was the runica algorithm, one of the most used in the literature. ICA is much used to remove artifacts associated with eye blinking, hair oiliness, eye movements, and other noises (Vecchiato *et al.*, 2011). After performing the ICA, the components and data baseline were removed, in that order. In sequence, the automatic removal of channels was made (for channels that did not capture the data well), and finally the continuous rejection that excludes parts of frequencies that are not directly linked to stimuli and that are caused by external variations.

2) Conversion of the data in spectral bands: the spectral power analysis was performed. The spectral analysis allows us to observe the amount of power (microvolts) that exists within a specific wave range (Kim *et al.*, 2018). It allows an analysis of the dynamic topology of positrons, which allows describing the kinetic behavior (Cunningham *et al.*, 1998). The waves were fixed at the following frequencies: alpha 8-13 Hz, beta 13-22 Hz, delta 1-4 Hz, theta 4-8 Hz (Aldayel, Ykhlef, and Al-Nafjan, 2020). To perform the spectral analysis, Fast Fourier Transform (FFT) was used, which is widely used in signal processing such as EEG (Yang *et al.*, 2017).

3.3.2 Measure of involvement

To analyse the role of involvement in the country of origin effect, we applied a structured questionnaire after experimenting, which was an adaptation of the one developed by Laurent and Kapfered (1985). We selected four of such dimensions (Interest, Importance of Risk, Symbol, and Pleasure) and a 7-point adapted Likert scale was used. To classify the respondents as having high or low involvement, the answers were standardized for all these four questions for all of the 40 interviewees. The consumers with values below 0 were classified as of low involvement, while those with values equal to or over 0 were classified as having high involvement. There were 10 consumers with low and 10 consumers with high involvement in the experimental group. In the control group, the sample had 14 low involvement consumers and 6 high involvement consumers.

4 Statistics

We performed a normality test to verify if the data presented a normal distribution. As it was not the case, we performed the non-parametric Mann-Whitney test to verify if there were brainwave differences among the different groups, making statistical comparisons of each hypothesis (for each channel) in this study with the STATA software. The level of significance used was 5%.

5 Results

The analysis was performed in the frontal channels (AF3, AF4, F3, F4) of beta and delta waves. First, the statistics of consumers, in general, were carried out (without being divided into gender and involvement). The level of significance used was 5%. There was no statistical significance when comparing the emotional brain responses of 'Brazilian', 'French' and 'Without information' wine alleged origin in any of the beta and delta and any of the AF3, AF4, F3, F4 channels (all p-value > 0.05).

Regarding genders, for men, there were statistical differences in the emotional brain responses in the AF3 channel in the delta wave of Brazilian (SPD = -39.65) and French (SPD = -43.82) wine (p-value = 0.029). Table 1 shows the statistic found, that is, the spectral power (SPD) of the wine with the information Brazil, the spectral power (SPD) of the wine with the

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3 information of being from France, the p-value of the statistical test, the value the Mann-Whitney
4 U test and the Z value.
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8 **INSERT HERE:** Table 1 - Emotional brain responses for men of Brazilian and French
9 origins – delta wave
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13 Note that the only difference for the delta wave was found in the AF3 channel. In the
14 other channels, all p-values were greater than 0.05. For men, no statistically significant
15 differences were found in the comparison “Brazil and without information” and “France and
16 without information”, in the beta wave in the analysed channels (AF3, F3, F4, AF4). (All p-
17 values > 0.05). For women, there was no statistically significant difference in the comparison
18 "Brazil origin and no information", "France origin and no information" and "Brazil and France"
19 neither in the beta wave and neither in the wave delta in the analysed channels (AF3, F3, F4,
20 AF4) (all p-value > 0.05).
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27 Regarding the level of involvement, the internal validity test (Cronbach alpha) of the
28 used questionnaire was first checked. The Cronbach alpha value obtained was 0.769, which is
29 considered good. About brain waves for the high-involvement consumers, there were no
30 statistically significant differences in the comparison "Brazil and France", "France and without
31 information" and "Brazil and without information" neither in the beta wave neither in the delta
32 wave in the analysed channels (AF3, F3, F4, AF4) (all p-values > 0.05). As for the low
33 involvement consumers, there were significant statistical differences in the emotional brain
34 responses on the channel AF3 for Brazilian (SPD = -40.75) and French (SPD = -43.55). Also,
35 there were significant statistical differences in the emotional brain responses F3 channel for
36 Brazilian (SPD = -39.92) and French (SPD = -43.23). Table 2 shows this difference.
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46 **INSERT HERE:** Table 2 - Emotional brain responses for low involvement consumers
47 of Brazilian and French origins – delta wave
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51 Also, for low-involvement consumers, there were significant statistical differences in
52 the emotional brain responses channel AF3 in the delta wave for France (SPD = -43.55) and
53 without information (SPD = -38.90). There were significant statistical differences in the
54 emotional brain responses channel F3 in delta wave for France (SPD = -43.23) and without
55 information (SPD = -38.73) and also in channel F4 in delta wave for France (SPD = -39.63)
56 and without information (SPD = -33.47). Table 3 shows the statistics found.
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5 **INSERT HERE:** Table 3 - Emotional brain responses for low involvement consumers
6 of Without information and French origins – delta wave
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10 Also, for low-involvement consumers, a significant statistical difference was found in
11 the beta wave for France (SPD = -66.39) and without information (SPD = -60.98) in channels
12 AF3. There were significant statistical differences in the emotional brain responses channel F3
13 in delta wave for France (SPD = -64.67) and without information (SPD = -61.87) and also in
14 channel F4 in delta wave for France (SPD = -63.00) and without information (SPD = -58.89).
15 Table 4 shows the statistics found
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22 **INSERT HERE:** Table 4 - Emotional brain responses for low involvement consumers
23 of Without information and French origins – beta wave
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28 **6 Discussion**

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31 We found that for consumers in general (without being divided into gender and
32 involvement), there were no changes in consumers' brain responses on delta and beta waves on
33 channels AF3, AF4, F3, and F4. Moreover, the delta wave is associated with the attention
34 support for internal processing related to a perceived perceptual alternative (Gruzelier *et al.*,
35 2014; Harmony *et al.*, 1996) and problem-solving ability also known as “cognitive processing”
36 (Feinberg *et al.*, 1990). **Cognitive processing** is associated with the ability to plan, reason,
37 create, etc. (Flavell, 2019). This means that the origin of the wines (France, Brazil, and without
38 information) was not sufficient for consumers in general to realise their perceptual and
39 evaluative ability. This means that the information from the country of origin is not significantly
40 important to the extent that consumers have assessed the origins of the wine. Thus, hypothesis
41 1 could not be confirmed.
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50 It was also seen that there were no statistically significant differences in the beta wave.
51 As noted in the literature review, the beta wave is observed when the individual is in a state of
52 alertness, tension, wakefulness, intense activation of the central nervous system, and is inhibited
53 by mental effort and attention (Bazane, 2012; Bazanova and Vernon, 2014). This was marked
54 by Yucel *et al.*, (2015) in their study where the participants who drank coffee felt stress when
55 they drank coffee they did not like (stress is a beta wave characteristic. Alvino *et al.*, (2019)
56 realised that the wines of greater preference caused a more marked decrease in the beta This
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3 means that consumers, in general, did not show any preference (in terms of liking) for the
4 origins of Brazil, France and without origin information, that is, the origin of the wines proved
5 to be of little relevance to consumers in general. Thus, hypothesis 2 could not be confirmed.
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8 This result found in our study has not been established yet in the existing literature, in
9 terms of emotional brain responses to the country of origin and wines effect. That is, in terms
10 of **cognitive processing** and the assessment of preference (liking) for wine. But the literature
11 reported studies that analysed the combined effect of price and country of origin (Alvino *et al.*,
12 2019) and music and country of origin (Hsu and Chen, 2019), through brain analysis, showing
13 no change in emotional brain activities when the origin was mentioned. In addition to these
14 results, the literature shows, other than through brain analysis, that there is no clear result
15 regarding the country-of-origin effect. For some researchers this effect is relevant (Schooler,
16 1965; Papadopoulos and Heslop, 2014; Foroudi *et al.*, 2019; Yang and Yun, 2020), for others
17 not (Usunier, 2011; Samiee, 2011; Ensor, 2013).
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20 The lack of changes in the emotional waves regarding the wine origin in this study may
21 indicate that the intrinsic attributes could cause a greater impact than the extrinsic ones (such
22 as the country of origin). This study did not find an impact of the information on the origin of
23 wines within consumers' emotional brain responses. Therefore, establishing the verification of
24 gender and involvement is important in this case, as explained below:
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27 With the differences between the genders, it was seen that the origin of the wines did
28 not prove to be significant in the delta wave for women. This means that women did not have
29 significant **cognitive processing** concerning information on the origin of wines. It implies that
30 the origin of the wines (France, Brazil, and without information) was not sufficient for women
31 to realise their perceptual and evaluative ability. This means that the information from the
32 country of origin is not significantly important to the point that women have assessed the origins
33 of the wine. For men, the country of origin of the wines influenced the emotional brain activity
34 in the delta wave in the AF3 channel (see table 1) suggesting that the origin of the wines (France,
35 Brazil, and without information) was sufficient for men to realise their perceptual and
36 evaluative ability. Thus, it can be inferred that the Brazilian origin brought higher **cognitive**
37 **processing** and motivation than that of the French origin in men
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53 According to the literature, Chao *et al.*, (2017) identified that women responded better
54 to visual images of food and exhibited greater neural activation than men in the frontal, striated,
55 fusiform, and limbic gyrus. Cornier *et al.*, (2010) found that women had greater activation of
56 the lateral and dorsolateral prefrontal cortex (DLPFC) and parietal cortex than men. According
57 to the authors, this may suggest that greater pre-frontal neuronal responses lead to increased
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3 **cognitive processing** related to executive function. Atkin et al., (2007) established that women
4 were better able to seek information. All of the characteristics of these three studies refer to
5 cognitive processing. However, the first two studies were done for food, and women were
6 expected to have superior cognitive processing. Also, it was observed that men showed
7 **cognitive processing** regarding the origin of the wines.
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12 Therefore, the third hypothesis of the research cannot be confirmed. This result validates
13 the economic and neuropsychological literature which states that men and women react
14 differently to certain stimuli (Lucchiari and Pavettoni, 2012). It is worth mentioning that no
15 studies have been found that have analysed the cognitive effect, through the brain responses of
16 EEG for men and women to the effect country of origin of wines. In terms of emotional brain
17 responses for men and women, what was found in the literature was a study on the impact of
18 brand attachment in which it was verified that the beta-medium range was higher for women
19 when the brand was well known and preferred (Lucchiari and Pravettoni, 2012).
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23 Regarding the preference of the origin of wines between men and women (hypothesis
24 4), it was seen that there were no statistically significant differences in the beta wave neither
25 for men nor for women in the analysed channels (AF3, F3, F4, AF4). As already mentioned,
26 Yucel et al., (2015) found that the participants who drank coffee felt stress when they drank
27 coffee they did not like (stress is a beta wave characteristic. Alvino et al., (2019) realised that
28 the wines of greater preference caused a more marked decrease in the beta. This means that
29 since there have been no significant statistical changes in the beta wave, neither men nor women
30 have shown that they like one source more than the other.
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34 These results go against the research by Gelinard (2008) and Lockshin and Hall (2003)
35 who found that men gave more importance to the region of origin of the wine than women and
36 also goes against the findings of the studies conducted by McCutcheon, Bruwer, and Li (2009),
37 Josiassem, Assaf and Karpen (2011), Concha Velásquez et al., (2018) and Ferreira et al., (2019)
38 who found that women gave more importance to the region of origin than men. One of the
39 reasons for not having differences between men and women in terms of the origin of wines can
40 be given because for young people cons Brazilian humidors, the intrinsic attributes of wine
41 have greater relevance than the extrinsic attributes. Therefore, hypothesis 4 cannot be
42 confirmed.
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46 In relation to the consumers of high and low involvement, we found that for consumers
47 of high involvement the information from the country of origin did not exert influence in terms
48 of the delta wave. This means that the origin of the wines (France, Brazil, and without
49 information) was not sufficient for highly involved consumers to realise their perceptual and
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3 evaluative ability. For consumers with low involvement, there were differences in **cognitive**
4 **processing** when comparing the origins of the wine “Brazil and France” in channels AF3 and
5 F3 (see table 2) and “France and without information” in channels AF3, F3, and F4 (see table
6 3). The **cognitive processing** was greater for Brazilian wine in the “Brazil and France”
7 comparison and the **cognitive processing** was greater for wine without origin information in the
8 “France and without information” comparison. In fact, in the literature on the country-of-origin
9 effect, the level of involvement has not yet been analysed using EEG or brain responses.
10 Nonetheless, the literature indicates that the higher the consumer's involvement with the
11 product, the more likely they are to use the country of origin information to evaluate the product
12 (D'Astous and Ahmed, 1999). Moreover, the wine origin influenced high-involvement
13 consumers (Bruwer, and Buller, 2012), and that consumers with high involvement in the
14 purchase of wine are mainly influenced by the country of origin to determine the quality of the
15 wine and invest in the product, regardless of the brand (Concha Velásquez *et al.*, 2018). In terms
16 of the evaluation of wines for consumers with a high and low level of involvement through the
17 EEG, virtually no studies have been found that have made this analysis. There is the work of
18 Mauri *et al.*, (2016), who analysed the reactions of expert and non-expert consumers on wine
19 consumption. The EEG data showed that non-specialist consumers feel stressed about
20 evaluating wine compared to experts.
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34 In this study's results, the high-involvement consumers showed to be indifferent to the
35 wine origins in terms of cognitive processing. This may have occurred because high-
36 involvement consumers did not consider the wine origin variable relevant to judge its quality,
37 paying attention to other variables intrinsic to the product. Besides, such consumers may not
38 have noticed differences between the wines since it was the same wine after all and, thus, they
39 were not influenced by the origin variable.
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44 Despite the literature reporting that highly involved consumers seek more information
45 about wine, greater knowledge about wine and use more complex information clues showing
46 greater spending and buying behavior, maximize the expected satisfaction through the choice
47 process (Quester and Spawton, 2001; Barber *et al.*, 2007; Laurent and Kapferer, 1985) only
48 with the information spoken audibly during the wine tasting process did not make these types
49 of consumers assess the origin of the wines. However, it caused low-involvement consumers to
50 assess the origin information. Therefore, hypothesis 5 cannot be confirmed.
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56 Finally, there were no statistically significant differences in the beta wave for consumers
57 with high involvement in channels AF3, F3, F4, and AF4 (see table 4). However, significant
58 statistical differences were found for consumers with low involvement in the beta wave in the
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3 comparison “France and without information” in channels AF3, F3, and F4. It was seen that
4 consumers showed greater stress for wine without information of origin than for French wine.
5 (See table 4). Yucel et al., (2015) saw that the participants who drank coffee felt stress when
6 they drank coffee they did not like (stress is a beta wave characteristic. Alvino et al., (2019)
7 realised that the wines of greater preference caused a more marked decrease in the beta. As
8 there was greater stress for wine without information, this implies that low-involvement
9 consumers showed to like French wine more. High-involvement consumers did not show a
10 preference (in terms of liking more) over the origin of wines.

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12 The result found goes against the research by Santos et al., (2008) whose study verified
13 that highly involved consumers give more importance to the brand, the country of origin, and
14 the information on the label. It also goes against the research by Hollebeek et al., (2007) who
15 found that consumers with high involvement were more influenced by their country of origin
16 than consumers with low involvement. Likewise, it contradicts the research of Concha
17 Velásquez et al., (2018) that found consumers with a high involvement are influenced by the
18 country of origin to determine the quality of the wine. Furthermore, it also goes against the
19 result of Bruwer and Buller (2012), who concluded that high-involvement consumers showed
20 a strong preference for wines produced in the "Old World", especially those from France and
21 Italy than low-involvement consumers did. Therefore, hypothesis 6 cannot be confirmed.
22 Again, it is worth mentioning that this result has not yet been found in the literature for
23 consumers with high and low involvement in terms of the beta brain wave.

39 7 Conclusions and Implications

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42 This article aimed to evaluate the brain responses for the country-of-origin effect of
43 wines considering the roles of gender and involvement level. In particular, we sought to analyse,
44 through the EEG, the **cognitive processing** and the preference of the origin information of wines
45 for consumers in general, and also for groups of gender and level of involvement. It was seen
46 that for consumers in general (without being segmented by gender and level of involvement)
47 there were no statistically significant differences in **cognitive processing** regarding the origins
48 of Brazil, France, and without information. No significant changes in the delta wave were
49 found. It was also seen, for consumers in general, that there is no statistically significant
50 difference in preferences between the origins of Brazil, France, and without information. No
51 significant changes in the beta wave were found.

Concerning men and women from a gender perspective, it was noted that for women there is no significant statistical difference neither in **cognitive processing** nor in the preferences of the origins of the wines in Brazil, France and without information (there were no statistical differences in the delta and beta wave in the analysed channels). For men, there were statistically significant differences in cognitive processing, in which **cognitive processing** was shown to be greater for the wine of Brazilian origin. However, in men, there was no statistical difference in preference for the origins of the wines (beta wave was not significant in the analysed channels).

For high and low involvement consumers, it was found that for high involvement ones there were no statistically significant differences in **cognitive processing** or preferences between origins in Brazil, France and without information in the analysed channels. For consumers with low involvement, there was a statistically significant difference in cognitive processing, showing greater **cognitive processing** for the wine of Brazilian origin and without information. Also, for low-involvement consumers, there was a greater preference for wine with information from France than for wine without information of origin.

Although the hypotheses have not been confirmed, the results found to present an impactful contribution to the body of literature. The study shows that the country-of-origin effect on gender and involvement may be very specific, both on consumer types and methodological settings. It reinforces that studying the country of origin effect is dealing with many specific situations, and the effect may be greater or less depending on the type of product analysed.

This result has important implications for both the literature and the wine producers and companies. For the literature, it shows a result not yet found in terms of the use of EEG to verify the **cognitive processing** and preferences about the influence of the origin of wines for the gender and level of consumer involvement. Thus, the findings add to the literature by obtaining a deeper knowledge and understanding of **cognitive processing** and preferences towards the influence of the country-of-origin effect of gender and level of involvement. These results help advance research and can assist future studies in this context.

In practical terms, it helps wineries to better understand the role of gender and level of involvement in wine evaluation. In the context of the wine industry, this research provides a deeper understanding of cognitive processing, since the participants' delta and beta brain responses are measured and analysed, indicating the emotions related to wine preference. This knowledge may help the wine industry by providing information about cognitive processing (via the delta wave) and preferences (via the beta wave). The results obtained through the EEG

benefits the wine industries by confirming that the wine origin should be used in the communications strategies (advertising, publicity, personal and virtual word of mouth marketing, and advertisements). As seen, although the wine used in this research was the same for all groups, we have seen changes in the cognitive processing for men and consumers with low involvement, as well as there were differences in preferences for consumers with low involvement. This shows that informing the origin of the wine can be beneficial for certain types of consumers (in this case, those with low involvement).

Furthremore, the results of this research can be applied in advertisements and other forms of communication, highlighting the origin of wine and the benefits of consuming wine from a specific country. It will be helpful to inform and guide consumers about the importance of knowing the origin of wines. The research findings also help to segment marketing actions for consumers who showed a greater preference for wines from a specific country and to create wine advertisements aimed at the male audience highlighting the origin of the wines. Since men showed greater cognitive processing for the wine of Brazilian origin, but this cognitive processing did not imply that they liked wine more, knowing this helps marketing managers to better shape their communication and promotional activities to better highlight the importance of knowing the information about the country of origin of the wine. Likewise, marketing managers could establish enhanced communication strategies for the female audience emphasising the importance of the information from the country of origin.

Finally, for low-involvement consumers, it was seen that the information from the country of origin influences cognitive processing and preference for wine. Knowing this, marketing managers could design advertising campaigns and further targeted communication plans (such as fairs, exhibitions, advertisements, campaigns, and point-of-sale availability, among others) for consumers to highlight the source information of wine. For highly involved consumers, marketing managers could create education strategies regarding the information from the country of origin, tracing a communication more appropriate to this segment.

8 Limitations and Further research

In terms of limitations, the convenience sampling compromising of the student population poses limited capture of other consumers' profiles potentially. Also, convenience sampling may not imply generalization to the entire population. Another limitation may be related to the sample size, which was 40 in this research, although it is adequate for studies using EEG. One last limitation can be found in the equipment of the EEG Emotiv Eporc. This

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3 equipment only measures the electrical activities on the surface of the brain. For deeper
4 analysis, it is necessary to use another neuroscience tool.

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7 Future studies could use other brain tools, such as fMRI, or biological ones such as
8 galvanic skin response, eye-tracking and facial coding, or even both, reconciling brain and
9 biological tools, to deepen the investigation of wine preferences. Future studies could use other
10 wine products, such as sparkling, white, and rosé wines, among others, to verify whether the
11 perceived effects remain. Variables other than gender and level of involvement, such as price,
12 brand, and age could be investigated. Besides, other studies could be carried out using wines
13 from different origins and different types of grapes. Finally, in terms of the analysis of the data
14 obtained by the EEG, future studies could perform the analysis using other methods, such as
15 ERPs and frontal asymmetry.
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23 24 **References**

25
26 Alvino, L., van der Lubbe, R., Joosten, R. A., & Constantinides, E. (2019). Which wine do you
27 prefer? An analysis of consumer behaviour and brain activity during a wine tasting
28 experience. *Asia Pacific Journal of Marketing and Logistics*.

29
30
31
32 Alshibly, Motteh S., Alghizzawi, Mahmoud and Al Zaabi, Adil Darwish (2019). "The Effect
33 of Country of Origin on Consumers' Perceptions of Hospitality Products". *International
34 Journal of Information Technology and Language Studies*, Vol. 3, No. 2, pp.41-53.

35
36
37
38 Anaki, D., Zion-Golumbic, E and Bentin, S (2007). "Electrophysiological neural mechanisms
39 for detection, configural analysis and recognition of faces". *Neuroimage*, Vol. 37 No 4,
40 pp.1407-1416.
41
42
43

44
45
46
47
48
49
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51
52
53
54
55
56
57
58
59
60
Atkin, T., Nowak, L. and Rosanna, G. (2007), "Women wine consumers: information search
and retailing implications", *International Journal of Wine Business Research*, Vol. 19 No. 4,
pp. 327-339.

Atkin, T., Nowak, L., and Garcia, R. (2007). Women wine consumers: information search and
retailing implications. *International Journal of Wine Business Research*

Balestrini, Pierre and Gamble, Paul. (2006). "Country-of-origin effects on Chinese wine
consumers". *British Food Journal*, Vol.5, No.108, pp.396-412.

- 1
2
3 Barber, N., Ismail, J., and Dodd, T. (2007). Purchase attributes of wine consumers with low
4 involvement. *Journal of Food Products Marketing*, 14(1), 69-86
5
6
7 Bazanova, O. M. and Vernon, D. (2014). "Interpreting EEG alpha activity". *Neuroscience &*
8 *Biobehavioral Reviews*, Vol. 44, pp. 94-110.
9
10
11
12 Bazoche, Pascale., Combris, Pierre., Giraud-Héraud, Eric. and Traversac, J. B. (2013).
13 "Willingness to pay for appellation of origin: results of an experiment with pinot noir wines in
14 France and Germany". *Wine Economics*, pp. 129-145.
15
16
17
18 Bercea, Monica Diana. (2012). "Anatomy of methodologies for measuring consumer behavior
19 in neuromarketing research". *Proceedings of the LCBR European Marketing Conference*, pp.
20 1-14.
21
22
23
24 Bruwer, Johan and Buller, Courtney (2012). "Country-of-origin (COO) brand preferences and
25 associated knowledge levels of Japanese wine consumers". *Journal of Product & Brand*
26 *Management*, Vol.21 No.5, pp.307-316.
27
28
29
30 Bruwer, J., and Li, E. (2007). Wine-related lifestyle (WRL) market segmentation:
31 demographic and behavioural factors. *Journal of Wine Research*, Vol. 18, No1, 19-34.
32
33
34
35 Caratù, M., Cherubino, P., & Mattiacci, A. (2018, September). Application of neuro-marketing
36 techniques to the wine tasting experience. In *Proceedings of the 11th Annual Conference of the*
37 *EuroMed Academy of Business*
38
39
40
41 Chao, A. M., Loughead, J., Bakizada, Z. M., Hopkins, C. M., Geliebter, A., Gur, R. C., and
42 Wadden, T. A. (2017). Sex/gender differences in neural correlates of food stimuli: a
43 systematic review of functional neuroimaging studies. *Obesity Reviews*, 18(6), 687-699
44
45
46
47 Cochin, Stéphanie, Barthelemy, Catherine, Roux, Sylvie and Martineau, Joelle (1999).
48 "Observation and execution of movement: similarities demonstrated by quantified
49 electroencephalography". *European Journal of Neuroscience*, Vol.11 No 5, pp.1839-1842.
50
51
52
53 Cohen, Mike X. (2014). "Analyzing neural time series data: theory and practice". MIT press.
54
55
56
57 Concha Velásquez, J. R., Rocío Mora, A., Velásquez, J. J., & Reyes, H. (2018). Efecto país de
58 origen en las preferencias de los consumidores de vino en nuevos mercados. *Pensamiento &*
59 *Gestión*, (44), 216-242.
60

1
2
3 Costa, Danielle I., Azambuja, Luciana S., Portuguez, Mirna W. and Costa, Jaderson C. (2004).
4 “Avaliação neuropsicológica da criança”. *Jornal de Pediatria*, Vol. 80 No 2, pp.111-116.
5

6
7 Cornier, M. A., Salzberg, A. K., Endly, D. C., Bessesen, D. H., & Tregellas, J. R. (2010).
8 Sex-based differences in the behavioral and neuronal responses to food. *Physiology &*
9 *behavior*, 99(4), 538-543.
10
11

12
13 D’Astous, Alain and Ahmed, Sadrudin A. (1999). “The importance of country images in the
14 formation of consumer product perceptions”. *International Marketing Review*, Vol.16 No 2,
15 pp.108-126.
16
17

18
19 Dimpfel, W., & Morys, A. (2014). Quantitative objective assessment of websites by
20 neurocode-tracking in combination with eye-tracking. *Journal of Behavioral and Brain*
21 *Science*, 2014.
22
23

24
25 Dobrucali, Birce. “Country-of-origin effects on industrial purchase decision making: a
26 systematic review of research”. *Journal of Business & Industrial Marketing*, 2019.
27
28

29
30 Elliot, Statia, Papadopoulos, Nicolas and Kim, Samuel Seongseop (2011). “An integrative
31 model of place image: Exploring relationships between destination, product, and country
32 images”. *Journal of Travel Research*, Vol.50 No 5, pp.520-534.
33
34

35
36 Emotiv Epoc. *Manual*. 2020.
37

38
39 Ensor, John (2013). “Runway logic:" Y" Generation Y prefer fashion brand over country-of-
40 origin”. *Transnational Marketing Journal*, Vol.1 No.1, pp 22-40.
41
42

43
44 Feinberg, I., Thode Jr, H. C., Chugani, H. T. and March, J. D. (1990). “Gamma distribution
45 model describes maturational curves for delta wave amplitude, cortical metabolic rate and
46 synaptic density”. *Journal of theoretical biology*, Vol.142 No.2, pp.149-161.
47
48

49
50 Ferreira, Carla, Lourenço-Gomes, Lina, Pinto, Lígia M. Costa., Silva, Ana Patrícia,”Is there a
51 gender effect on wine choice in Portugal?–A qualitative approach”. *International Journal of*
52 *Wine Business Research*, 2019.
53
54

55
56 Flavell, J. H. (2019). *El desarrollo cognitivo* (Vol. 87). Antonio Machado Libros
57
58
59
60

1
2
3 Forbes, S. L., Cohen, D. A., & Dean, D. L. (2008). An assessment of wine knowledge amongst
4 global consumers.

5
6
7 Garneau, N. L., Nuessle, T. M., Sloan, M. M., Santorico, S. A., Coughlin, B. C., & Hayes, J.
8 E. (2014). Crowdsourcing taste research: genetic and phenotypic predictors of bitter taste
9 perception as a model. *Frontiers in integrative neuroscience*, Vol. 8, No.33.

10
11 Gelinard, E. (2008). A matter of taste. *Sydney Morning Herald*, Vol.11, No.8.

12
13
14 Gruzelier, John H., Foks, M., Steffert, T., Chen, M. L. and Ros, T. (2014). “Beneficial outcome
15 from EEG-neurofeedback on creative music performance, attention and well-being in school
16 children”. *Biological psychology*, Vol. 95, 86-95.

17
18
19 Hakim, Adam and Levy, Dino J. (2019). “A gateway to consumers' minds: Achievements,
20 caveats, and prospects of electroencephalography-based prediction in neuromarketing”. *Wiley*
21 *Interdisciplinary Reviews: Cognitive Science*, Vol. 10, No. 2, pp.1-21.

22
23
24
25
26
27
28 Harmony Thalía, Fernández Thalía, Silva Juan, Bernal Jorge, Díaz-Comas Lourdes, Reyes, A.,
29 ... and Rodríguez, Miguel (1996). “EEG delta activity: an indicator of attention to internal
30 processing during performance of mental tasks”. *International journal of psychophysiology*,
31 Vol.24 No 1-2, pp. 161-171.

32
33
34
35
36 Hollebeek, L. D., Jaeger, S. R., Brodie, R. J., and Balemi, A. (2007). The influence of
37 involvement on purchase intention for new world wine. *Food Quality and Preference*, Vol.18,
38 No.8, 1033-1049.

39
40
41 Hsu, L., & Chen, Y. J. (2019). Music and wine tasting: an experimental neuromarketing
42 study. *British Food Journal*.

43
44
45
46 Jabbarli, Urfan and Jafarova, Saadat. (2019). “Neurophysiological and behavioral responses
47 and their roles in neuromarketing”.

48
49
50
51 Josiassem, Alexander, Assaf, A. George and Karpen, Ingo O. (2011). “Consumer ethnocentrism
52 and willingness to buy”. *International Marketing Review*.

53
54
55
56
57
58
59
60
60 Khushaba, R. N., Wise, C., Kodagoda, S., Louviere, J., Kahn, B. E., & Townsend, C. (2013).
Consumer neuroscience: Assessing the brain response to marketing stimuli using

1
2
3 electroencephalogram (EEG) and eye tracking. *Expert Systems with Applications*, 40(9),
4 3803-3812.

5
6
7 Knyazev, Gennady G. (2012). "EEG delta oscillations as a correlate of basic homeostatic and
8 motivational processes". *Neuroscience & Biobehavioral Reviews*, Vol. 36 No 1, 677-695.

9
10
11 Kolev, D. (2019). NEUROMARKETING AND APPLICATION OF swLORETA qEEG
12 DURING DECISION MAKING PROCESS. *International Journal on Information*
13 *Technologies & Security*, 11(1).

14
15
16 Kucewicz, Michal T., Berry, Brent M., Kremen, Vaclav, Brinkmann, Brinkmann H., Sperling,
17 Michael R., Jobst, Barbara C., ... and Das, S. Richard (2017). "Dissecting gamma frequency
18 activity during human memory processing". *Brain*, Vol 140 No 5, pp.1337-1350.

19
20
21 Laurent, Gilles and Kapferer, Jean-Noel (1985). "Measuring consumer involvement profiles".
22 *Journal of marketing research*, Vol. 22 No1, pp. 41-53.

23
24
25 Lesschaeve, I., & Bruwer, J. (2010). The importance of consumer involvement and
26 implications for new product development. In *Consumer-driven innovation in food and*
27 *personal care products* (pp. 386-423). Woodhead Publishing.

28
29
30 Lockshin, L., and Hall, J. (2003). *Consumer purchasing behaviour for wine: what we know*
31 *and where we are going* (Doctoral dissertation, University of South Australia, Wine
32 Marketing Research Group).

33
34
35 Lockshin, L., and Spawton, T. (2001). Using involvement and brand equity to develop a wine
36 tourism strategy. *International Journal of Wine Marketing*.

37
38
39 Lockshin, L., Jarvis, W., d'Hauteville, F., and Perrouy, J. P. (2006). Using simulations from
40 discrete choice experiments to measure consumer sensitivity to brand, region, price, and
41 awards in wine choice. *Food quality and preference*, Vol.17, No.(3-4), pp166-178.

42
43
44 Lockshin, L., Quester, P., and Spawton, T. (2001). Segmentation by involvement or
45 nationality for global retailing: A cross-national comparative study of wine shopping
46 behaviours. *Journal of Wine Research*, Vol.12, No.3, pp. 223-236

47
48
49 Lucchiari, Claudio and Pravettoni, Gabriella (2012). "The effect of brand on EEG modulation".
50 *Swiss Journal of Psychology*.

- 1
2
3 Lundy-Ekman, Laurie (2011). "Neurociência fundamentos para reabilitação". *Elsevier Brasil*.
- 4
5
6 Mauri, M., Petruzzellis, L., Pezzi, A., Chiappa, M., Ciceri, A., & Russo, V. Sense Effects about
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
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40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
- McClure, S. M., Li, J., Tomlin, D., Cypert, K. S., Montague, L. M., & Montague, P. R. (2004). Neural correlates of behavioral preference for culturally familiar drinks. *Neuron*, 44(2), 379-387.
- McCutcheon, E., Bruwer, J., and Li, E. (2009). Region of origin and its importance among choice factors in the wine-buying decision making of consumers. *International Journal of Wine Business Research*.
- Milovan-Ciuta, Anca Maria et al. (2019.) The country of origin influence on the decision to buy wine. A research framework proposal. *Ecoforum Journal*, Vol. 8, No. 1.
- Morillo, L. M. S., Alvarez-Garcia, J. A., Gonzalez-Abril, L., & Ramírez, J. A. O. (2016). Discrete classification technique applied to TV advertisements liking recognition system based on low-cost EEG headsets. *Biomedical engineering online*, 15(1), 75.
- Palotas, A., Soos, G., Zsofi, Z. (2019). Cognitive disposition to wine consumption: how the brain is wired to select the perfect bottle with a novel musical twist. *Frontiers in Neuroscience*, 13, 1157.
- Papadopoulos, Nicolas and Heslop, Louise A. (2014). "Product-country images: Impact and
- Rappoport, L., Peters, G. R., Downey, R., McCann, T., & Huff-Corzine, L. (1993). Gender and age differences in food cognition. *Appetite*, Vol.20, No.1, pp. 33-52
- Rini, Endang Sulistya and Sembiring, Beby Karina Fawzee (2019). "The Effect of Country of Origin, Price and Quality Perception on Customer Satisfaction and Loyalty at Della Collection Store Medan". *International Journal of Research and Review*, Vol. 6, No. 11, pp. 79-85.
- Samiee, Saeed (2011). "Resolving the impasse regarding research on the origins of products and brands". *International Marketing Review*, Vol. 28 No 5, pp.473-485.
- Schooler, Robert D. "Product bias in the Central American common market"(1965). *Journal of marketing research*, Vol. 2, No. 4, pp. 394-397.

1
2
3 Septianto, Felix, Chiew, Tung Moi and Thai, Nguyen T.(2020). “The congruence effect
4 between product emotional appeal and country-based emotion: The moderating role of country-
5 of-origin”. *Journal of Retailing and Consumer Services*, Vol. 52, pp. 101916.
6
7

8
9
10 Silva, S. M. D., Lazzari, F., Milan, G. S., & Eberle, L. (2015). O efeito país de origem e o
11 comportamento do consumidor em relação a vinhos. *REAd. Revista Eletrônica de*
12 *Administração (Porto Alegre)*, 21(1), 89-112.
13
14

15
16
17 Spence, C. (2019). Do men and women really live in different taste worlds?. *Food Quality*
18 *and Preference*, Vol.73, pp.38-45
19
20

21
22 Tavares, M. C., Eng, M., & Biomédica, E. (2011). Eeg e potenciais evocados–uma
23 introdução. *Contronic Sistemas Automáticos Ltda*, 1-13.
24
25

26
27 Usunier, Jean-Claude (2011). “The shift from manufacturing to brand origin: suggestions for
28 improving COO relevance”. *International Marketing Review*, Vol. 28 No 5, pp. 486-496.
29
30

31
32 Veale, Roberta and Quester, Pascale (2008). “Consumer sensory evaluations of wine quality:
33 The respective influence of price and country of origin”. *Journal of Wine Economics*, Vol. 3
34 No 1, pp. 10-29.
35
36

37
38 Veale, Roberta and Quester, Pascale (2009). “Do consumer expectations match experience?
39 Predicting the influence of price and country of origin on perceptions of product quality”.
40 *International business review*, Vol. 18 No 2, pp.134-144.
41
42

43
44 Vecchiato, Giovanni, Toppi, Jlenia, Astolfi, Laura, Fallani, Fabricio De Vico, Cincotti, Febo,
45 Mattia, Donatela, Bez Francesco and Babiloni, Fabio (2011). “Spectral EEG frontal
46 asymmetries correlate with the experienced pleasantness of TV commercial advertisements”.
47 *Medical & biological engineering & computing*, Vol. 49 No 5, pp. 579-583.
48
49

50
51 Verlegh, Peeter W. and Steenkamp, Jan-Benedict. (1999). “A review and meta-analysis of
52 country-of-origin research”. *Journal of economic psychology*, Vol. 20 No. 5, pp. 521-546.
53
54

55
56 Verlegh, P. W., Steenkamp, J. B. E., & Meulenberg, M. T. (2005). Country-of-origin effects
57 in consumer processing of advertising claims. *international Journal of Research in*
58 *Marketing*, 22(2), 127-139.
59
60

1
2
3 Veselá, Jitka and Zich, Robert (2015). "The Country-of-Origin Effect and its Influence on
4 Consumer's Purchasing Decision". *Acta Universitatis Agriculturae et Silviculturae*
5 *Mendelianae Brunensis*, Vol.2, No.63, pp.667-673.
6
7

8
9 Wang, Hainan and McCluskey, Jill J. (2010). *Effects of information and country of origin on*
10 *Chinese consumer preferences for wine: an experimental approach in the field.*
11
12

13
14 Wijaya, Tony (2020). "Country of Origin As Antecedents On Consumer Quality Perceptions
15 and Purchasing Decisions". *Benefit: Jurnal Manajemen dan Bisnis*, Vol. 4, No. 2, pp. 116-127.
16
17

18 Yağci, M. I., Kuhzady, S., Balik, Z. S., & Öztürk, L. (2018). In Search of Consumer's Black
19 Box: A Bibliometric Analysis of Neuromarketing Research. *Tüketici ve Tüketim Araştırmaları*
20 *Dergisi= Journal of Consumer and Consumption Research*, 10(1), 101-134.
21
22

23
24 Yang, Chen and Yun, Gi Woong (2020). "Online partisan news and China's country image: an
25 experiment based on partisan motivated reasoning". *Asian Journal of Communication*, pp. 1-
26
27
28 18.
29

30 Yuan, 2019. Available in: <http://yuan-lyu.com/portfolio/emotiv.html>. Access in: 11.07.2020.
31
32

33 Yücel, N., Yücel, A., Yılmaz, A. S., Çubuk, F., Orhan, E. B., Şimşek, A. İ., & İhsan, A. (2015).
34 Coffee tasting experiment from the neuromarketing perspective. In *The 2015 WEI International*
35 *Academic Conference*.
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
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54
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Table 1 - Emotional brain responses for men of Brazilian and French origins –
delta wave

	France (SPD)	Brazil (SPD)	P-value	Mann-Whitney U	Z
AF3	-43.82	-39.65	0.029	21.000	-2.192
AF4	-35.53	-32.64	0.481	40.000	-0.756
F3	-41.51	-40.52	0.796	46.000	-0.302
F4	-37.27	-35.77	0.912	48.000	-0.151

Table 2 - Emotional brain responses for low involvement consumers of Brazilian and French origins – delta wave

	France (SPD)	Brasil (SPD)	P-value	Mann-Whitney U	Z
AF3	-43.55	-40.75	0.011	17.000	-2,495
AF4	-36.21	-34.62	0.481	40.000	-0.756
F3	-43.23	-39.92	0.023	20.000	-2.268
F4	-39.63	-36.85	0.353	37..000	-0.983

Table 3 - Emotional brain responses for low involvement consumers of Without information and French origins – delta wave

	Without (SPD)	Information France (SPD)	P-value	Mann-Whitney U	Z
AF3	-38.90	-43.55	0.011	27.000	-2.518
AF4	-31.89	-36.21	0.371	54.000	-.9370
F3	-38.73	-43.23	0.031	33.000	-2.166
F4	-33.47	-39.63	0.036	34.000	-2.108

Table 4 - Emotional brain responses for low involvement consumers of Without information and French origins – beta wave

	Without information (SPD)	France (SPD)	P-value	Mann-Whitney U	Z
AF3	-60.98	-66.39	0.013	28.000	-2.460
AF4	-56.70	-60.03	0.371	54.000	-0.937
F3	-61.87	-64.67	0.036	34.000	-2.108
F4	-58.89	-63.00	0.042	35.000	-2.049