How Consumer Ethnocentrism Modulates Neural Processing of Domestic and Foreign Products: A Neuroimaging Study

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Abstract

Consumer services literature offers substantial evidence that ethnocentric consumers tend to prefer domestic over foreign products. Yet no research to date has delved into the question how consumer ethnocentrism (CE) modulates the neural processing of products. This is the first study resorting to neuroimaging to explore to what extent CE levels affect the processing of domestic (Spain) and foreign (USA and China) products. The brain data yielded by neuroimaging reveal that highly ethnocentric consumers experience a greater degree of activation in brain regions linked to self-reference and reward when considering to purchase domestic products and a greater activation in brain regions related to risk in the case of foreign products.

Keywords: consumer ethnocentrism; neuroimaging; consumer neuroscience; country of origin

1. Introduction

In the retail field, where more and more players compete with one another, consumers encounter every day with a wide variety of product information, supplied through packaging, branding or advertising. Information such as taste, product design, brand name, warranty or country of origin can play important roles in consumer evaluations of products (Balabanis and Diamantopoulos, 2004). One of the oldest concerns of retailing and consumer services is whether the "foreignness" labeling of a product will make it more or less preferable to consumers in different countries (Verlegh and Steenkam, 1999). An extensive corpus of literature has reported that a bias against foreign products and in favor of domestic ones does, in fact, exist (Lin and Chen, 2006; Sharma, 2011). Consumer ethnocentrism (henceforth CE), which refers to the tendency of consumers to perceive domestic products as superior to foreign alternatives (Cheah et al., 2016; Shimp & Sharma, 1987), is grounded in the belief that it is not right to purchase foreign-made goods as it may harm domestic economy or provoke job loss (Chan et al.,2010; Siamagka & Balabanis, 2015). As reported by Siamagnka and Balabanis (2015), many well-known international firms such as Walmart (USA) or Marks & Spencers (UK) have even exploited ethnocentrism by launching "buy domestic" promotional campaigns with the aim to defend national identities and appeal to ethnocentric consumers.

The CE phenomenon is one of the most widely studied fields in marketing and consumer services research. Studies on consumer behavior have traditionally explored how the origin of a product (country of origin, COO henceforth), either domestic or foreign, can serve as an extrinsic attribute leading to a consumer preference or rejection (Herz & Diamantopoulos, 2017; Ramkumar & Ellie Jin, 2019). Because of the higher quality and stronger emotional attachment of domestic products among ethnocentric consumers, local products are preferred over imports, often without a rational basis (e.g., when the foreign products are cheaper). By means of traditional self-report measures (questionnaires, focus groups…), previous consumer services research has assessed under which circumstances consumers show biases in their judgments and preferences for domestic products over foreign alternatives (i.e., show ethnocentric behaviors). An extensive corpus of empirical research posits that consumers report greater willingness to pay, intention of purchase and credibility for domestic as opposed to foreign products, regardless of their category and brand (Gineikiene, and colleagues, 2016; Schnettler et al., 2008; Zeugner-Roth, Žabkar, & Diamantopoulos, 2015; (Balabanis & Diamantopoulos, 2004, 2016; Supphellen & Rittenburg, 2001)

Recent studies assessing CE dimensions (De Nisco, Mainolfi, Marino, & Napolitano, 2016; Sharma, 2015; Vida & Reardon, 2008) conclude that domestic bias results from affective (emotional and often implicit affinity for domestic products and aversion for foreign products), cognitive (superiority, strength, and virtues of own group compared to others) and behavioral reactions (rejection of foreign products and acceptance of domestic products, as well as purchase repetition and positive word of mouth). Some studies even go further and confirm that emotional dimensions have the greatest impact on ethnocentric consumers and that involuntary, automatic

and unconscious processes may underlie their greater preference (rejection) of domestic (foreign) products (Raciti & Dagger, 2011; Vida & Reardon, 2008).

Despite the extensive literature evaluating CE effects on attitudes, intentions or perceptions of domestic or foreign products, no research to date has explored "how" ethnocentrism triggers such effects and modulates the processing of products. Traditional self-report tools can only partially approach these goals as they are only able to report on preferences or real purchase behaviors (Author1, Van der Laan & Author2, 2018). The involuntary, emotional and unconscious role of ethnocentrism (Raciti & Dagger, 2011; Vida & Reardon, 2008) render insufficient this type of study only by means of questionnaires. Moreover, these techniques may be insufficient as they are susceptible to social desirability and subjectivity, do not capture lower-order emotions (e.g. fear, anger), may include sensitive issues (e.g. culture, religion, race) and not recognize cognitive and affective unconscious processes present during the evaluation of labelled products (Author1, Dimoka, & Author2, 2019; Solnais, Andreu-Perez, Author2, & Andréu-Abela, 2013).

The combination of more objective and precise techniques deriving from neuroscience, psychology and marketing has recently led to the development of a new marketing sub-discipline identified as *consumer neuroscience*, which studies the neural conditions and processes that underlie consumption, their psychological meaning, and their behavioral consequences. Using neuroimaging in the field of CE offers valuable insight into the psychological and neural mechanisms by which CE affects the processing of domestic and foreign labels. Otherwise stated, neuroimaging techniques offer evidence of the underlying psychological mechanisms by which consumer ethnocentrism affects the processing of local or foreign products. Therefore, while traditional self-report tools give answer "to what extent consumer ethnocentrism affects

the processing of COO labels", neuroscientific techniques respond to "how" that influence is created. And this latter constitutes a key piece in the understanding of CE, as it sheds light on the nature and underlying characteristics of the emotional and cognitive dimensions of the CE (De Nisco et al., 2016; Lee et al., 2017).

The current paper therefore makes headway as it constitutes the first study to resort to neuroimaging (functional magnetic resonance imaging, fMRI) to elucidate the underlying psychological mechanisms (i.e., the neural roots) by which CE levels influence the processing of product labeling. Specifically, this study presents findings of a fMRI analysis carried out in Spain. 29 Spanish participants were scanned while exposed to technological products accompanied by domestic "Made in Spain" and foreign "Made in USA" and "Made in China" labels equated to cultures similar and dissimilar to Spain. Pinpointing how the different levels of ethnocentrism modulate the neural responses when facing domestic and foreign products constitutes a step forward in corroborating the findings of previous consumer services research. It also represents advances in the understanding of the neural mechanisms by which the individual characteristics of consumers (that is, their levels of ethnocentrism) affect the processing of product labeling.

This paper is structured as followed: next, we present the theoretical background including the concept of the country of origin, consumer ethnocentrism and the modulator role of this latter variable on the neural analysis of domestic or foreign products. Then we state the hypotheses development based on previous neuroimaging research implemented in the field of retailing and consumer behavior. Following that, we describe the methodological section, which covers criteria of participant recruitment, experimental design and analysis procedures. After ex-

posing the neuroimaging findings, we discuss the main contributions to the field of retailing and consumer services, and finally conclude with limitations and implications for future research.

2. Theoretical Background

2.1. Country of origin labeling

Consumer behavior literature largely coincides that where a product is made can have an influence on consumer evaluation and purchase decision (Balabanis & Diamantopoulos, 2004; Eng, Ozdemir, & Michelson, 2016; Koschate-Fischer, Diamantopoulos, & Oldenkotte, 2012). As in the case of nutrition or fair-trade labels (Enax, Krapp, Piehl, & Weber, 2015; Linder et al., 2010), country of origin (COO) serve as an extrinsic informational cue for consumers' perceptions and evaluations of a product.

Research on COO indicate that a product's origin acts as a signal of product quality. Accordingly, consumers may use a country's reputation to predict the quality of their products (Nath Sanyal & Datta, 2011). Those who perceives Samsung as a Japanese brand, for example, may have a favorable attitude toward products manufactured by Samsung based the image of Japan as a source of high-technology innovation (Anholt, 2010). Consumers associating Samsung with South Korea, in turn, may have a less favorable image toward the brand based on associations of this country with an "emerging market, low price, and below-average quality" (Anholt, 2016). COO labels can consequently affect consumer perception of risk and value, depending on the image of the country manufacturing the product (Chao & Phau, 2008).

Consumer behavior research also highlights that COO affects consumer willingness to pay and likelihood of purchase. Hu and Wang (2010), for example, examined whether consumers are willing to pay different prices for an online product in function of the origin of the retailer. The results reveal that American retailers are able to command a premium, which "appears to stem from country-of-origin equity instead of trading risk or product quality." Koschate-Fischer et al., (2012) corroborated these findings for French (vs. Austrian) providers of mineral water. Along the same line, a substantial body of research concluded that COO can be a predictor of customer preference and purchase decision (Chen & Lin, 2006; Visbal, Herrera-Mendoza, Orozco-Acosta, & Herzberg, 2017).

2.2. Consumer ethnocentrism

Despite COO literature pointing to higher preferences, prices and attitudes toward products manufactured in countries benefiting from positive images, a vast amount of research posits consumer inclination to purchase domestic, as opposed to foreign, products regardless of country of origin image (Usunier & Cestre, 2007). These positive domestic and negative foreign biases are indeed based on consumer ethnocentrism, "… the beliefs held by the consumers about appropriateness, indeed morality, of purchasing foreign-made products" (Shimp & Sharma, 1987). Ethnocentric consumers tend to perceive domestic products as superior to foreign alternatives due to the pride and reward triggered by local products, and their contempt and aversion to foreign goods (Gürhan-Canli & Maheswaran, 2000). An ethnocentric consumer has a negative view of importing products from other countries as he/she deems it unpatriotic and

detrimental to the domestic economy and employment (Jiménez-Guerrero, Gázquez-Abad, & Linares-Agüera, 2014). Consumers with high levels of ethnocentrism inherently desire to purchase products from one's own country rather than from other countries (Zeugner-Roth, Žabkar, & Diamantopoulos, 2015). Moreover, research in consumer behavior clearly indicates that the more ethnocentric a consumer, the more willing to pay, purchase and credibility afforded to domestic products (De Nisco et al., 2016; Loureiro & Umberger, 2003; Yildiz, Heitz-Spahn, & Belaud, 2018).

Assessing the levels of CE is key to strategic decision making in the global marketplace as it provides decision makers with an "… indication as to where standardization is possible and specialization necessary" (Siamagka & Balabanis, 2015). Consumer ethnocentrism is also important to international branding (Supphellen & Rittenburg, 2001), international positioning (Westjohn, Singh, & Magnusson, 2012) and market entry mode choice (Fong, Lee, & Du, 2014).

The operationalization of CE is based on the widely applied consumer ethnocentrism tendencies scale (CETSCALE) developed by Shimp and Sharma in 1987. It was initially designed to represent the beliefs of American consumers regarding the appropriateness of purchasing foreign products. Since 1987, the CETSCALE has widely served in studies analyzing aspects related to consumer ethnocentric tendencies in different countries, such as China (Lobo, Qing, & Chongguang, 2012), Russia (Thelen, Ford, & Honeycutt, 2006), United Kingdom (Balabanis & Diamantopoulos, 2004) and Spain (Luque-Martínez, Ibáñez-Zapata, & del Barrio-García, 2000). Recent CE research focuses on unveiling the origin of the CE modulation and highlights that CE is based on affective (emotional and often implicit affinity for domestic products and aversion for foreign products), cognitive (superiority, strength, and virtues of own

group compared to others) and behavioral reactions (rejection of foreign products and acceptance of domestic products, as well as purchase repetition and positive Word of Mouth). Certain authors indeed advance that the CE modulation may be primarily rooted in affective, "soft" and automatic processes that remain inaccessible to consumer consciousness (Raciti & Dagger, 2011; Vida & Reardon, 2008).

2.3. Consumer ethnocentrism as a neural modulator of product labeling

Traditional self-reported studies have long explored the effects of domestic products in the perceived healthiness (Gineikiene, and colleagues, 2016), attitudes (Schnettler et al., 2008) and price willing to pay by consumers, over foreign goods (Zeugner-Roth, Žabkar, & Diamantopoulos, 2015). Yet to the best of our knowledge "how" ethnocentrism triggers such effects and modulates the processing of products has not been investigated so far. Traditional self-report techniques can only moderately face these aims as they rely on subjective reports and opinions of consumers (Weber et al., 2015). They are insufficient, therefore, to capture the involuntary, emotional and unconscious role of ethnocentrism (Raciti & Dagger, 2011; Vida & Reardon, 2008). The combination of more objective and precise techniques deriving from neuroscience, psychology and marketing has recently led to the development of a new marketing sub-discipline identified as *consumer neuroscience*, which studies the neural conditions and processes that underlie consumption, their psychological meaning, and their behavioral consequences (Hubert, 2010). Recent studies in consumer neuroscience reveal, for example, the neural origin by which consumers process sustainable product labels (Enax et al., 2015), online payment methods (Author1, Author4, Author2, 2018) and aesthetic packages (Reimann, Zaichkowsky, Neuhaus, Bender, & Weber, 2010).

Using neuroimaging in the field of CE offers valuable insight into the neural mechanisms by which CE affects the processing of domestic and foreign labels. Say differently, neuroimaging tools can explain how (i.e., the underlying psychological mechanisms) consumer ethnocentrism affects the processing of local or foreign products. In other words, while traditional self-report tools give answer "to what extent consumer ethnocentrism affects the processing of COO labels", neuroscientific techniques respond to "how" that influence is produced. And this latter constitutes a key piece in the understanding of CE, as it sheds light on the nature and underlying characteristics of the emotional and cognitive dimensions of the CE (De Nisco et al., 2016).

The current research therefore represents an advance as it is the first study to resort to neuroimaging (functional magnetic resonance imaging, fMRI) to elucidate the underlying psychological mechanisms (e.g., the neural root) by which CE levels influence the processing of product labeling. Along these lines, pinpointing how the different levels of ethnocentrism (according to the CETSCALE; Luque-Martínez et al., 2000) modulate the neural responses when facing domestic and foreign products would constitute a step forward.

3. Research Model and Hypotheses

The theory on the CE concludes that ethnocentric consumers overvalue domestic products and report higher attitudes and willingness to purchase toward them (Zeugner-Roth, Žabkar, & Diamantopoulos, 2015). Miquel et al. (1993), for example, investigated the influence of COO label on the attitudes toward products manufactured in five European countries. Interestingly for this project, the findings revealed that 65% of Spanish consumers overvalue

domestic products regardless of their image of domestic and Foreign countries. As Gürhran-Canli and Maheswaran (2000) report this bias could stem from a higher trust, positive valuation and reliability that consumers may show toward domestically labeled products. Foreign products, in turn, could be underestimated and evaluated as more negative, threatening and dangerous because they may be thought to hurt domestic economy or provoke a loss of jobs.

The higher value and trust conferred to domestic products by more ethnocentric consumers may convey positive information and hence lead to an involvement of brain regions linked to increased value and reward. Previous neuroimaging studies have associated the inferior parietal lobe (Cole, Yoo, & Knutson, 2012; Nieuwenhuis et al., 2005), ventral striatum (Bartra, McGuire, & Kable, 2013) and middle temporal gyrus (Matthews, Simmons, Lane, & Paulus, 2004) with the anticipation of pleasant and secure circumstances. More ethnocentric consumers may also experience greater closeness and personal interest with domestic products due to their greater similarity and identification with products from own country (Dreu et al., 2011). It is therefore reasonable that local products elicit stronger brain activations within the self-referential system, a neural network responsible for the processing of stimuli strongly linked to the individual. Another neural study identified activation of the ventral region of the prefrontal cortex (vmPFC) when evaluating personality traits of individuals of similar or dissimilar age (Ebner et al., 2013). Similar conclusions were observed by Cunningham, Raye, & Johnson (2005) among white citizens while processed black as opposed to white faces. Therefore, we formally propose that:

Hypothesis 1: The more ethnocentric a consumer, the greater the activations in brain regions linked to reward and self-referential systems when considering domestic labeled products.

By contrast, the stronger rejection and aversion toward foreign products experienced by more ethnocentric consumers may elicit brain activations traditionally associated with emotional distrust or disgust in regions such as the thalamus (Aleman & Swart, 2008) or the amygdala (Iidaka et al., 2002; Liddell et al., 2017). Therefore, it is expected that:

Hypothesis 2: The more ethnocentric a consumer, the greater the activations in disgust/distrust related-areas of the brain when considering foreign labeled products.

4. Materials and Methods

4.1. Participants

Fifteen male and fifteen female, right-handed, Spanish subjects were selected to participate in the fMRI study via social networks and the institutional website of the University of Granada (Spain). They were all healthy and averaged 22.06 (SD: 3.21) years of age. All provided written informed consent prior to the scanning sessions. All participants also had to be in good health, not be on medication or afflicted by any neurological disease, not abuse drugs, and have normal (or corrected to normal) vision and hearing. The experiment also applied the common fMRI exclusion criteria of claustrophobia, pregnancy, and metal implants in the body. The participants were informed that the examination could potentially reveal delicate medical information and were asked, if this were the case, if they should be informed of it. The study was approved by the local ethical committee as it follows the norms of the protocol of the World

Medical Association Declaration of Helsinki (2013). In the end the results of one of the fMRI analyses was excluded (reducing the total to 29) due to the participant's excessive number of movements.

4.2. Experimental Design

Participants arrived at the laboratory one hour prior to the fMRI task. After receiving instructions and verifying that all study procedures were understood, they completed an informed consent questionnaire. During the fMRI scanning, participants viewed 70 technological products displayed for 5 sec. Each product was followed by a short (1-3 s) fixation cross. Then a series of fMRI stimuli lasting about 8 minutes were displayed via E-Prime Professional 2.0. The timing of each trial was adapted from previous fMRI analyses (Author1 et al. 2018).

Specifically, technological products (i.e., tangible goods that have been designed by people and developed through technological practice to serve particular functions) were selected as main stimuli of interest and included items such as pen drives, photo camera, computer mouse or computer keyboard. All products were reported to be highly familiar for all participants. We chose technological products as the COO labeling effect tends to be stronger with this category (Ahmed et al., 2004). Previous research indirectly support that CE effects could be stronger when a consumer has to decide between a domestic product (e.g. Spanish) and a product from a culturally dissimilar country (e.g. China), rather than that of a culturally similar country (e.g. USA), regardless of the consumer's image of the countries (Watson and Wright, 2000). Spain was chosen as a domestic country as it is the country where the current study was carried out. USA and China were chosen as the foreign countries of comparison. Therefore, one half of the

technological products (35 products) were accompanied by a text indicating their Spanish origin "Made in Spain". The other half *depicting* exactly the same products was accompanied by labels indicating American COO "Made in USA" or Chinese COO "Made in China".

After the process of scanning, participants responded to a questionnaire adapted from a traditional CETSCALE developed by Luque-Martínez et al. (2000) comprising a 7-Likert scale including 17 items designed to measure their general level of CE. They were required to qualify the following questions: "Spanish people should always buy Spanish-made products instead of imports," "It is not right to purchase foreign made products" and "Spanish people should not buy foreign products, because this hurts Spanish business and causes unemployment." Participants also had to state their purchase attitudes and intentions by responding to the questions: "After seeing this Spanish/American/Chinese product, what is your attitude/intention toward the purchase of this product?" with 1 = I would not buy it at all and 7 = I would definitely buy it).

4.3. Research Setting

Participants in the current study were Spanish so that Spain was chosen as the domestic country of comparison. Spain achieves a high value for 2018 in the Human Development Index (HDI), namely .89 (United Nations, 2018). The HDI is a metric developed by the United Nations to assess the social and economic development levels of countries. Consequently, Spain is considered a developed country. Given that previous literature concluded that consumers in developed countries tend to give more value to domestic as opposed to foreign countries (i.e., they show ethnocentric behaviors, Sharma, 2011), the current research assumes that Spanish consumers exhibit ethnocentric behaviors. Precedent research also corroborated such reasoning

(Miquel et al. (1993). According to the World Population Review (2019), Spain is also included in the Western Countries' 2019 list.

USA and China were chosen as the foreign countries of comparison. Both countries exhibit similar levels of development with regard to Spain, as shown in their HDI scores (.92 for USA and .76 for China) (United Nations, 2018). The three countries are, consequently, conceived as developed countries and their products may be comparable. As in the case of Spain, USA is included in the Western Countries' 2019 list (World Population Review, 2019). In turn, China represents the Eastern culture and society (Koschate-Fischer et al., 2012; Laforet & Chen, 2012). Therefore, participants in the current research analyze domestic and foreign products manufactured in countries with similar levels of development, but belonging to different cultures (i.e., Western and Eastern).

4.4. Image Acquisition and Analysis

MRI scanning was carried out in a 3 Tesla Trio Siemens Scanner equipped with a 32-channel head coil. Functional scans were acquired by a T2*-weighted echo-planar imaging (EPI) sequence (TR = 2000 ms, TE = 25 ms, FA = 90°, slices = 35, thickness = 3.5 mm, slice order = descending). The distance factor was 20% and the slice matrix was of 64 x 64 mm.

Aiming to remove any noise present during the MRI scanner, the functional images were preprocessed and analyzed by a Statistical Parametric Mapping program (SPM12, http://www.fil.ion.ucl.ac.uk/spm/software/spm12/) run with MATLAB R2012a software. Statistical maps were generated for each participant by fitting a boxcar function to the time series convolved with the canonical hemodynamic response function. This resulted in the estimation of

a general linear model (GLM) for each participant with the following regressors of interest: (i) an onset picture in the Spanish products (DOM) and (ii) an onset picture in products labeled as foreigners (FOR). Furthermore, each GLM included a constant session term, six covariates to capture residual movement-related artifacts, and fixation crosses as regressors of no interest (first-level analysis). To identify the brain regions where Domestic label activation varies with individual differences in ethnocentrism's levels, the contrast images of DOM was entered into a one-sample t-test in the second level random effect analyses with as covariate the consumer's ethnocentrism levels. Similarly, to identify the brain regions where Foreign label activation varies with individual differences in ethnocentrism's levels, the contrast image FOR was entered into a one-sample t-test in the second level random effect analyses with as covariate the individual levels of ethnocentrism. This procedure constitutes a common practice in neuroscience research in the realm of Social Sciences, and marketing in particular (Author1 et al., 2018; Gearhardt, Yokum, Stice, Harris, & Brownell, 2014).

Random effect statistical analyses were run using small volume correction (SVC) as implemented in SPM. The use of SVC allows researchers to conduct principled correction resorting to the Gaussian Random Field Theory within a predefined region of interest (Bennett, Wolford, & Miller, 2009). Specifically, the authors created a mask containing spheres measuring 10 mm in radius based on a priori anatomical coordinates gleaned from previous studies analyzing the processing of reward, self-referential and distrust/disgust. Particularly, the authors followed the lines of the study by Batra et al. (2013) for reward, Ebner et al. (2013) for self-reference and Liddell et al. (2017) for disgust and aversion. Exploratory whole-brain analyses were also implemented. The Appendix section specifies the steps for replicating and conducting

further functional Magnetic Resonance Imaging (fMRI) studies in the arena of retailing and consumer services.

5. Results

The findings of the descriptive statistics gleaned from a 7-point scale suggest a medium-high level of ethnocentrism (mean = 4.26; SD = 1.80) for the Spanish sample. The results of the internal consistency analysis (Cronbach's alpha) of the ethnocentrism scale report an acceptable level of $\alpha = .85$. Paired-samples t-tests (Wilcoxon due to the sample size) indicate that attitudes toward Spanish products (mean = 5.82, SD = 1.14) yielded significantly greater positive scores than those toward foreign products (mean = 4.34, SD = 1.15) among all subjects ($Z(28) = 5.03$; $p < .001$). Purchase intentions followed a similar behavioral pattern as the values of the intention to buy Spanish products (mean = 5.44, SD = 1.46) yielded significantly greater scores than those of foreign products (mean = 4.14, SD = 1.09) across the subjects ($Z(28) = 3.63$; $p = .001$).

Activation in the ROI mPFC, as well as other whole-brain regions during the evaluation of Spanish products, revealed a significant (positive) covariance ($r = .56$; $p < .001$) among individual ethnocentrism levels. Furthermore, the whole-brain analysis revealed that activation in the bilateral thalamus while viewing foreign products was highly linked (positive) ($r_{right} = .64$; $r_{left} = .67$; $p < .001$) to the participant's individual levels of ethnocentrism. Thus, participants with higher tendency to impart more importance to their own group and view it as superior to others experienced a significantly greater amount of activation in the mPFC while viewing Spanish products and in the bilateral thalamus while viewing foreign products (see Table 1 and Figure 1).

Table 1. Brain regions of which activation while viewing Spanish vs. non-labeled and Foreign vs. non-labeled products positively covary with levels of ethnocentrism.

Ethnocentrism	Peak MNI coordinates (mm) x	y	z	Cluster size	T	Z	Effect size [d]
Spanish > Foreign							
ROI [a]							
mPFC	-6	30	-6	2	3.57	3.20	.60
Whole brain [b]							
Inferior parietal gyrus	-15	32	2	11	4.54	3.88	.72
Precentral gyrus	-43	-7	58	13	4.22	3.66	.68
Middle temporal gyrus	52	7	-20	15	4.18	3.64	.67
Cerebellum	38	-74	-20	20	4.11	3.63	.67
Foreign > Control							
Whole brain [c]							
Thalamus	6	-7	2	8	4.17	3.63	.61
Thalamus	-8	-7	5	5	4.00	3.51	.65

[a] Peaks reported are significant at $p < .05$ FWE-corrected on ROI level.
[b] Peaks of clusters significant at $p < .001$ uncorrected, $k > 10$ voxels are reported.
[c] Peaks of clusters significant at $p < .001$ uncorrected, voxel level are reported.
[d] Effect Size = $Z/\sqrt{N}$

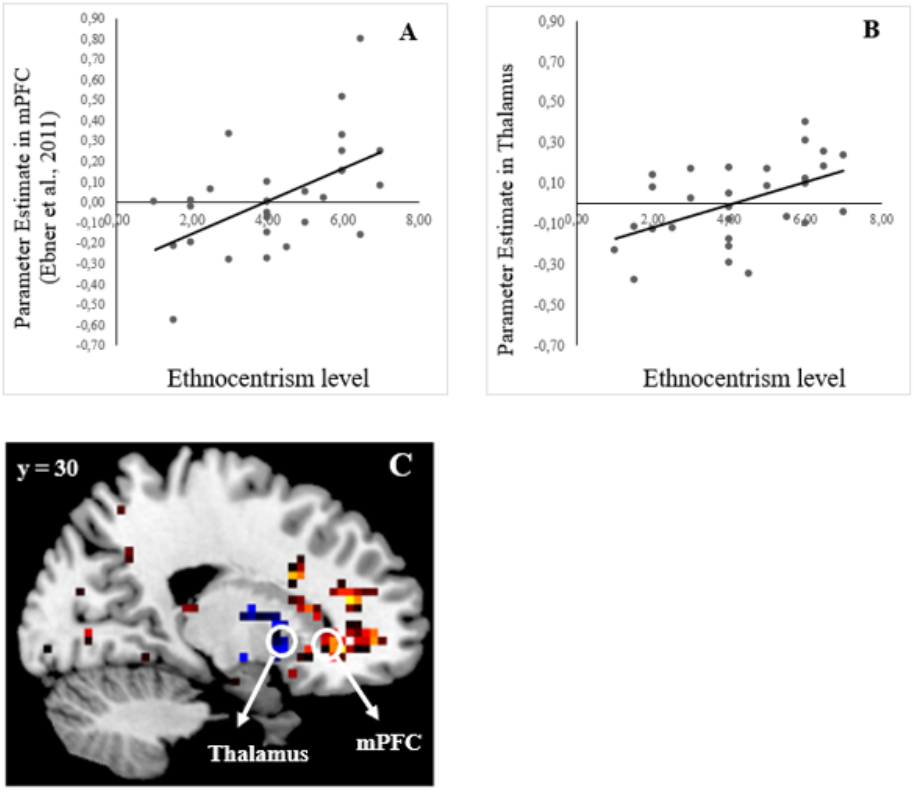

Figure 1. Activation in the mPFC and thalamus while respectively visualizing Spanish and Foreign products with covariance of ethnocentrism levels. **(A)** Plot illustrating the correlation between parameter estimate of the cluster and the individual ethnocentrism levels of Spanish vs. non-label products in the mPFC (Ebner et al., 2013); **(B)** Plot illustrating the correlation between parameter estimate of Foreign vs. non-label products in the thalamus cluster and the individual ethnocentrism levels; **(C)** Brain regions in which activation while visualizing Spanish products covaries with ethnocentrism levels (orange). Brain regions in which activation while visualizing Foreign products covaries with ethnocentrism levels (blue). Circles indicate mPFC and thalamus clusters. For purposes of visualization, the fMRI-results are thresholded at $2 > T > 3$.

6. Discussion and Conclusions

Everyday, consumers encounter with a wide variety of product information, such as taste, product design, brand name, warranty or country of origin. Consumer ethnocentrism, which refers to a preference among consumers of domestic over imported products regardless of their

origin, has seen a resurgence in recent years. Consumer behavior literature indicates that higher individual CE levels trigger a greater willingness to pay, intention of purchase and credibility for domestic as opposed to foreign products (De Nisco et al., 2016; Loureiro & Umberger, 2003; Yildiz et al., 2018). Yet no consumer research to date has focused on how CE levels affect the neural processing of domestic and foreign labeled products. This is the first study that resorts to neuroimaging to attempt to identify the brain areas where activation when viewing domestic and foreign labeled products covaries with self-reported CE levels. Brain data reveals that more ethnocentric consumers experience stronger activation in brain regions linked to self-reference and reward while viewing products manufactured in their own country. Consumers reporting higher levels of ethnocentrism, in turn, reveal a greater amount of activation in brain regions related to disgust and distrust when processing foreign labeled products.

The medium-high ethnocentrism levels of Spanish participants in this study are consistent with the findings of previous research (Luque-Martinez et al., 2000) and corroborate a high inherent desire of the consumers of developed countries to purchase products from one's own country rather than those from other countries (Laforet & Chen, 2012).

In line with *Hypothesis 1*, the neuroimaging findings reveal that subjects with higher levels of ethnocentrism display stronger activation when exposed to Domestic (vs. Foreign) products in several brain regions, including the mPFC, inferior parietal lobe, ventral striatum and middle temporal gyrus. Apart from its role in reward processing (Ferenczi et al., 2016), the vmPFC responds specifically, according to Murray, Schaer, & Debbané (2012), to the importance attached to the self-view group stimuli (one’s emotive investment). ‑The peak level serving for the current study was reported by Ebner and colleagues (2013) who identified activation in this

area when participants evaluated personality traits among own-age vs other-age individuals. Their neural reward circuit was also more strongly stimulated, as evidenced by the activations of the inferior parietal lobe (Cole et al., 2012; Nieuwenhuis et al., 2005), ventral striatum (Bartra et al., 2013) and middle temporal gyrus (Matthews et al., 2004). The findings of previous studies exploring product preferences indicate, for example, that the ventral striatum is activated during anticipation of a pleasant primary taste reward (O'Doherty, Deichmann, Critchley, & Dolan, 2002), during the visual inspection of preferred foods (Stoeckel et al., 2008) as well as during the visualization of aesthetic packages (Reimann et al., 2010). Therefore, the findings of this study suggest that consumers characterized by greater ethnocentricity experience not only higher levels of neural reward but also stronger points of neural relevance when processing products manufactured in their own country.

Participants with higher levels of ethnocentrism also display a greater activation in the bilateral thalamus when viewing Foreign (vs. Domestic) product, thus bolstering *Hypothesis 2*. The thalamus is traditionally associated with risky and negative tasks (Author1 et al., 2018; Preuschoff, Quartz, & Bossaerts, 2008) and emotional contempt and disgust (Aleman, & Swart, 2008; Phillips et al., 1997). Taken together, participants with higher CE levels appear to confer from the neural standpoint more relevance and reward to domestic products and stronger revulsion to foreign ones. All in all, these results disclose for the first time that the mPFC and thalamus constitute two key brain areas similarly and strongly associated with ethnocentric behaviors, and thus are responsible for modulating product label valuation based on the levels of CE.

Theoretically, the current findings contribute to the line of thought challenging the explanations of how CE affects the processing of national and international products. Previous research suggests that CE modulates the price willing to pay, purchase intention and credibility conveyed to domestic as opposed to foreign products (De Nisco et al., 2016; Loureiro & Umberger, 2003; Yildiz et al., 2018). For example, Lee et al. (2016) found that regiocentric/ethnocentric tendencies in the Western Australian metropolitan area positively influenced consumers' willingness to buy products from their own region. This study sheds light on the way (i.e., the neural mechanisms) in which such modulation is produced and reveals that cognitive and affective processes related to self-interest and reward are responsible for the overvalue toward domestic products, and that risk-related brain activations are experience by the most ethnocentric consumers when evaluating foreign products. Recent studies even reconceptualize the construct of CE and afford more weight to the affective and automatic role of CE in molding product evaluations (Raciti & Dagger, 2011; Sharma, 2015; Siamagka & Balabanis, 2015). This study represents a step forward at this regard as it constitutes the first study to approach the psychological and (automatic) neural processes by which CE affects the evaluation of domestic and foreign labels. The implication of brain regions strongly related to emotional processes (such as reward and risk) strongly supports the importance given by previous research to the affective role of CE (Gineikiene, and colleagues, 2016). In other words, we corroborate at the neural level that that the origin of the product cannot be explained entirely by a quality signaling process. It can also have a symbolic meaning, so that when linked to a national identity, the COO can carry with it strong emotional attachment towards certain trademarks and products (Yildiz, Heitz-Spahn & Belaud, 2018).

This paper also offers a new perspective in the application of neuroimaging tools to explore consumer processing of product stimuli (*consumer neuroscience*). Previous research in this field resorted to neuroimaging to explore the influence of organic labeling on food valuation and choice (Linder et al., 2010), the neural effects of nutrition labels on value computation (Enax et al., 2015) or the neural reactions toward aesthetic packages (Reimann et al., 2010). Lajante and Ladhri (2018), indeed, call for a peripheral psychophysiology approach in order to fully unlock the potential of affective neuroscience in retailing and consumer services. This study, by contrast, makes headway as it unveils the neural mechanisms by which CE modulates consumer processing of domestic and foreign products.

6.1. Managerial implications

The findings of the current study should be taken into account in the market segmentation export strategies adopted by businesses as they unveil that higher attitudes toward domestic products reported by consumers with high ethnocentric profiles stem from neural rewards and self-relevance processes experienced during visualization of local products. This is a key element as previous consumer behavior research found that perceived rewards during the purchase process are central in attracting potential customers (Siau & Shen, 2003) and encouraging repetition of purchase (Ashraf & Thongpapanl, 2015). These results also encourage local companies to use the relevance and reward for the citizenship as arguments to strongly appeal to ethnocentric consumers (even at their neural unconscious level) in their communication campaigns, thus supporting the rationale followed by Siamagnka and Balabanis (2015).

Furthermore, the current findings suggest that, regardless of the country of comparison, consumers with higher levels of ethnocentricity from the neural perspective perceive foreign products with more disdain and as riskier than their domestic counterparts. Potential collaborations or brand alliances with local firms could be a way to reduce such an aversive neuroimaging process (Li & He, 2013). Interestingly, the results of the current paper do inspire domestic firms to use risk arguments (for the local economy, for example) in their communication campaigns. In doing so, they will strongly provoke aversion in the local consumers, achieving high levels of negative feelings among those with highest ethnocentric motivations.

6.2. Limitations and future research

It must be noted that the current study is restricted to measuring self-reported attitudes and not authentic purchase decisions. Further research in the field of retailing and consumer services should assess the modulator role of CE in actual buying behaviors. Moreover, the conclusions of this article should be received with caution as it focuses on technological products and the study population is limited to Spain. Corroboration of the current findings therefore requires further research in the framework of a broader range of products and countries (e.g., emerging vs. highly developed). The exploratory nature and the reasonably acceptable sample size of the current research encourage further research in retail and consumer services to apply fMRI to larger sample sizes. Despite, previous impactful studies applying neuroimaging methods tend to use samples ranging from 10 to 30 participants. These include, for example, Hubert et al (2018) or Ramsøy, Skov, Christensen, & Stahlhut (2018). Indeed, Solnais and colleagues (2013) concluded that a sampling of 20 participants is the most used for high-impact social neuroscience

studies. Majority of our analyses focus on brain responses across all 29 participants, using apriori regions of interest analyses. Additionally. each participant is exposed to multiple repetitions within each condition, which further increases the statistical power for the analyses reported in this manuscript. Finally, prospective studies should make us of neuroimaging techniques in assessing how other variables, such as animosity, age or gender, affect the neural evaluation of domestic and foreign products.

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Appendix

The analysis of fMRI data here implemented aims at identifying the location and level of functional activation of the brain areas activated by the experimental stimuli specified in the fMRI protocol (e.g., domestic and foreign alternatives). The following steps should be followed when analyzing fMRI data: (1) pre-processing of fMRI data and (2) statistically analyzing fMRI data (Dimoka et al., 2012).

Preprocessing

Before fMRI data are ready for statistical analysis, they should be preprocessed to remove noise, increase the signal-to-noise ratio, and allow comparisons across subjects'anatomically different brains. The main steps in this phase are:

(i) Realignment: During an fMRI study, subjects spend 5 to 30 minutes inside the fMRI scanner, and some head movement is likely to occur, resulting in spatial changes in terms of where specific voxels correspond. Realignment aims to correct head movements during the images acquisition. Realignment is usually conducted by estimating the parameters of an affine rigid-body transformation that minimizes the sum of squared differences among each scan and a reference scan using the transformation by resampling the data with a certain interpolation.

(ii) Co-registration: During the spatial co-registration process, the whole-brain images are realigned to each other because there may be systematic differences in the images across whole-brain scans. Specifically, images are aligned to each other by aligning all subsequent images of each brain volume to the first image of the brain volume.

(iii) Normalization: Since the brains of various people differ in size and shape, to compare brain activations across subjects, their brains should be spatially normalized to a template(average) brain to account for structural differences in each subject's brain. One of the most standard coordinate space is The Montreal Neurological Institute (MNI) coordinates, which are indeed used in the current study.

(iv) Smoothing: The Smooth function is used as a final step in spatial pre-processing to blur the functional images. The reason to do this is to correct for slight remaining functional/anatomical differences between subjects.

Data Analysis

GLM

fMRI results are usually reported in terms of activation maps, images that are derived from statistical tests at each individual voxel (i.e., 3D pixels created by MRI scanning software's to represent the brain) level for each condition of interest (e.g., domestic or foreign products) and for each subject. fMRI studies usually make use of the general linear model (GLM) in statistical tests.

As explained by Author1 et al. (2018), a GLM attempts to find the set of experimental parameters (β) for a design matrix (G) that best accounts for the original data (Y), by minimizing the unexplained error (e). The Y variable of the GLM corresponds to the data, i.e. the measured time course of a single voxel. The voxel time course is "explained" by the terms on the right side of the equation. The design matrix contains the indicator variables that encode the experimental tasks. Specifically, it includes onset vectors, duration vectors or other regressors such as movements parameters. The value of β0 typically represents the signal level of the baseline condition and is also called intercept. The other predictors (β1, β2, etc) represent the expected time courses of different conditions (e.g. domestic product course). The beta weight of a condition predictor quantifies the contribution of its time course in explaining the voxel time course. While the exact interpretation of beta values depends on the details of the design matrix, a large positive (negative) beta weight typically indicates that the voxel exhibits strong activation (deactivation) during the modeled fMRI reading relative to baseline. All beta values together characterize a voxels "preference" for one or more fMRI readings.

Individual and Group Analyses

Following the guidelines outlined by Dimoka (2012) and Author1 (2018), data analysis are first be conducted separately for each subject to obtain individual brain activation images (the so-called *first-level analysis*). The individual activations are then aggregated by combining the normalized brain activations of all subjects in the sample (called as *second-level analysis*) to generalize the results to the whole population (e.g., Frackowiak et al. 2004). The second-level analysis aggregates the effects of the first-level analysis to infer whether the results are stable and common across the population. This second-level analysis across subjects is implemented by using the identified T-levels from the first-level analysis. This is because the absolute comparative levels are much different across subjects because of intersubject physiological variations, and thus not readily comparable. Such intersubject physiological differences are difficult to overcome due to the relatively small sample size of fMRI studies. Therefore, individual-level data are often analyzed with fixed-effects models, and group data with random-effects models to account for intersubject variability.

fMRI Results

fMRI results are quite often reported with figures that graphically show the activated brain areas using a thresholded color-coded statistical map that specifies the intensity of brain activations and illustrates the number of activated voxels along the whole sample (e.g., Figure 1). fMRI results are also commonly reported in tables to precisely specify the location of brain activations in the MNI space, number of voxels in each activated area, activation statistics of each brain area along with anatomical labels (e.g., Table 1).