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# The Visual-Digital Identity of Corporate Brands: A Study of Neuromarketing in Young People from Spain and Portugal

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*The rise of social networks and brand communication in digital media has led to an update of the corporate visual identity of major brands, including those in traditional sectors in which corporate culture is generally deep-rooted and more reluctant to change. The two-dimensional logos that simulate a volume and depth characteristic of those of three dimensions have been simplified and are now flat for better inclusion in various digital supports so as to improve their legibility and more accurately reflect the current values of the brand's objective. The objective of this research is to determine the cog-*

*nitive processing of young university students of traditional brand logos in relation to the current ones that are simple, flat, and two-dimensional. The neuromarketing techniques used are eye-tracking to measure attention, and galvanic skin response (GSR) to measure the emotion shown by the public. The main conclusion is that young people place more attention and emotion on flat logos with simple lines, which are more integrated into digital media.*

**Keywords:** corporate visual identity, brand, neuromarketing, flat design, digital communication.

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Corporate identity has traditionally been identified as key to build a brand's image into its audience (Capriotti, 2009). Visual identity is part of this, capturing and symbolically translating the brand's essence into a graphic and audiovisual format (Villafañe, 1999), which is portrayed and communicated in a more organized manner through its values, personality (Bernstein, 1986) and corporate culture (Olins, 2009).

Shallow perceptions in the audience, largely influenced by the brand's communication (Villafañe, 1999; 2012), allow the generation of brand associations and links from those elements that make up the visual identity (Costa, 2003). This occurs in an inclusive relationship where a favorably perceived logo implies a favorable perception of its subconstructions, such as naming or typography (Foroudi, Melewar, and Gupta, 2014). These brand associations will be more likely to succeed if they agree with the self-concept of the person exposed to the logo (Bettels and Wiedmann, 2019).

Thus, each activity sector is recognized by the use of color ranges that represent common values characterizing the brands linked to them. The luxury sector, for instance, is distinguished by the cornucopia of black and golden colors as evokers of elegance, sans serif fonts and two-dimensional representations geared toward simplicity and minimalism (Salvador-Rivero and Montes-Vozmediano, 2016).

The most audience-recognizable element in visual corporate identity is a logo. This is a popular definition garnering other, more specific, terms according to the type of logo-symbol composition (García-García, Llorente-Barroso, and García-Guardia, 2010).

Visual corporate identity must be periodically updated to adapt to the organization's evolution, parallel to that of the society in which its activity is carried out. It has been proven that an appropriate logo redesign, positively affects the audience's perception of modernity as well as their attitude and loyalty toward the brand. The audience currently accepts radical logo changes provided they are justified by radical brand changes (Müller, Kocher, and Crettaz, 2013). However, the associations evoked by a new logo are increased when the brand's name is included, especially so when it is recognized. However, the logo contributes to the brand's identification (Riel-Cees and Den-Ban, 2001).

Likewise, logos could provoke negative emotions (Girard, Anitsal, and Anitsal, 2013) when they fail to be memorable (Dubberly, 1995). In fact, a sudden change in a logo stirs a negative reaction in audiences highly familiarized, or fond to it (Grobert, Cuny, and Fornerino, 2016; Walsh, Cui, and MacInnis, 2019). Fearing the effects these changes may cause, a current trend among branding personnel is to modify the space between logo design elements, or Active White Space (AWS), so that it is esthetically modified while preserving existing associations (Sharma and Varki, 2018).

In the last two decades, digital platforms, be it in web, app, or social media format, have completely transformed the way brands communicate and interact with their audiences (Drèze and Husherr, 2003), to the point of having converted digital communication into the fundamental tool for expressing their identities (Abdullad *et al.*, 2013). Visual limitations aching the very first websites had a negative impact on a logo's main components, such as design and colors (Check-Teck, 2001). Nevertheless, a progressive bandwidth and higher resolution quality improvement in devices' screens soon allowed the use of resources employed by logos in other formats.

In spite of it, social networks, apps and other priority brand digital communication channels are increasingly visualized in reduced size devices. This has brought concern to improve user interfaces (UI) by integrating user experience

(UX), and an ease of interaction from a visual point of view (Jiménez-Gómez and Mañas-Viniegra, 2018). Thus arose flat design adaptable to any screen size, which has also become a trend (Gu and Yu, 2016). The tendency has spread to other visual design elements such as logos, featuring two-dimensional, flat and vivid colors, simple shapes, and prominently sized and located fonts, implying a move forward from Bauhaus (Fernández-Rincón, 2019). Additionally, scientific literature attaches increasing importance to the ability of creating a flexible visual identity within brand communication strategies (Kelly, 2017).

There is barely any scientific literature on the efficiency of a brand's logo design (Foroudi *et al.*, 2019). Studies carried out are almost exclusively limited to surveys and qualitative analyses that only collect participants' conscious responses. In this way, a logo has been shown as an element organizations have to improve a brand's identity as well as to contribute the brands' drawing their personality and familiarity near to audiences (Kaur and Kaur, 2019).

Therefore, when a brand is unknown, introducing into the logo textual and visual elements that are descriptive of the product or the company's activity eases up the logo's cognitive processing (Luffarelli, Mukesh, and Mahmood, 2019). However, research on Apple's logo shows that the recognition phase is an easier task than remembering its details, without influence from any emotional attachment to the brand (Iancu and Iancu, 2017). Simple, flat logos promoting the consumption of products of lesser-known brands were also inconclusively evaluated (Bossel, Geyskens, and Goukens, 2019). Moreover, it has been suggested that logotypes not limited by a frame enhance consumer's response (Chen and Bei, 2019).

Regarding visual design elements, four young-audience activating variables have been identified, namely the sense of contemporaneity, aesthetics, style, and a feeling of interest (Zhu, Cao, and Li, 2017). Furthermore, asymmetrical logos have been deemed as the most exciting for audiences (Luffarelli, Stamatiogiannakis, and Yang, 2019), while strip-shaped logos are better visualized than square-shaped ones (Zhong, Wang, and Zhang, 2018). Logos made up of an icon plus brand text were identified as significantly more attractive than those with a single element, regardless of the element itself, even though monochromatic logos were indeed more attractive than multi-colored ones (Bresciani and Ponte, 2017). The latter could be ascribed to the flat design trend.

Nevertheless, no research on unconscious subjects' reactions to renowned brands' logos exists yet in the Web of Science, even less so on flat design logos, which constitute the main object of this study.

## MATERIALS AND METHODS

This research's general objective is to determine the cognitive perception that young university students in Spain and Portugal exhibit toward corporate brand logos inspired in flat design compared with traditional tridimensional logos. To achieve this, applied neuromarketing techniques are employed (Cuesta-Cambra, Niño-González, and Rodríguez-Terceño, 2017).

The specific objectives are:

- To determine fixation and emotional arousal toward stimuli.
- To analyze the areas of interest gathering higher levels of fixation.
- To establish differences between the fixation registered by flat design logos and classic tridimensional logos.
- To identify possible differences that may arise based on subjects' nationalities.
- To verify if there are discrepancies based on participants' gender.

Neuromarketing techniques are relevant in this investigation given their registering and measuring of cognitive processing of stimuli and logos that constitute organizations' visual identity. This is done by combining techniques from Neuroscience, Psychology and Economy (Madan, 2010). These techniques, though still emerging, are fully established in scientific research (Morin, 2011), including brand management, its integrated communication, advertising efficiency and audience behavior (Lee, Broderick, and Chamberlain, 2007; Plassmann, Ramsoy, and Milosavljevic, 2012). Among the benefits these techniques bring to brand research, is highlighted their ability to register participants' unconscious behaviors and perceptions. The aforementioned often display difficulties in consciously reporting through traditional surveys, in-depth interviews and focus groups (Ariely and Berns, 2010).

The two neuromarketing techniques used in this study are eye-tracking and galvanic skin response (GSR). Eye-tracking is a biometrical technique that registers visual fixation to selected areas of interest (AOI) within the stimuli introduced to subjects (Duchowski, 2013). Galvanic skin response (GSR) registers phasic changes in neural activity from electric microdifferences in skin conductance. These registers are useful to collect changes produced in subjects' emotional arousal from provided stimuli visualization (Critchley, 2002).

Cognitive perception research implies the limitation of applying methods that were initially typical of behavioral sciences to decisions that audiences and publics make about products and brands (Baron, Zaltman, and Olson, 2017). By simulating a natural viewing environment, priority is given to the use of non-intrusive equipment. This equipment is less effective than health science equipment in understanding brain activation. However, the equipment combines attention data with emotion data through the neuromarketing techniques applied here (Gabrieli, Ghosh, and Whitfield-Gabrielo, 2015; Plassmann and Karmarkar, 2016). Therefore its ability to predict publicity effectiveness from Neuroscience methods is between 70% y el 80% (Varan *et al.*, 2015).

The research is based on a relevant study sample formed evenly by 30 university students between 18 and 23 years of age who have participated randomly and voluntarily with the filter of being students, urban, young and regular (at least once a day) users of digital media. Among them, 50% attend university in Madrid and the other 50% in Lisbon. Sample size is valid for neuromarketing-based research, as corroborated by previous studies based on neuromarketing techniques' reviews (Kerr-Gaffney, Harrison, and Tcanturia, 2018; Mañas-Viniegra, Veloso and Cuesta-Cambra, 2019). Sample selection is founded on the af-

finity of younger audiences toward digital channels promoting flat design, and on these universities, located in the capital cities of Spain and Portugal, having students of diverse geographical origin. Subjects participated voluntarily and the ethical guidelines in the Declaration of Helsinki were followed. Field work was carried out between May and July, 2019.

Data collection was performed with a GP3HD 150 Hz eye tracker, a GSR Biometrics and the Analysis UX Edition v.5.3.0 software by Gazepoint. The employed GSR's technology allows the conscious statement of emotion by the participants during stimuli visualization. Statistical analysis of data was executed using the SPSS v.25 software.

Stimuli (Figure 1) were randomly presented to each group of subjects and were interspersed with other innocuous stimuli. Each stimulus was limited to 5 seconds of maximum duration with 3 seconds separation between stimuli. This was done to prioritize areas of interest that capture the most attention and emotion, taking into account that the young audiences have greater ability to quickly focus their attention on relevant information of their interest in a given stimulus (Añaños-Carrasco, 2015). For this reason, they were told that they could proceed to visualize the next stimulus when they decided. It is common for research participants who are asked to visualize stimuli to register higher attention than they would in an unobserved environment. However, not knowing which of the visualized stimuli the researchers are interested in, allows for analysis of differences between presented stimuli.

Areas of interest (AOI) were identified in each stimulus to facilitate the comparison between different logo-integrating elements. Renowned brands were selected in both countries meeting the requirements of both having recently had their logos modified under the criteria of flat design, and being comparable, be it because they belonged to an activity sector with affinity for a young audience or because of their world-class brand character in both countries. The affinity towards participants' profile in stimulus selection is relevant, in as much as the brand affinity level is determined by participants' attraction and interest in the brand (Aaker and Lee, 2001). This impacts on the subjects' self-regulatory goal when processing information (Petty and Cacioppo, 1979).

**Figure 1. Areas of interest (AOI) of the stimuli**

			
(a) Stimulus 1 (S1): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(b) Stimulus 2 (S2): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(c) Stimulus 3 (S3): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(d) Stimulus 4 (S4): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).

			
(e) Stimulus 5 (S5): Text (AOI 2), Logo (AOI 4).	(f) Stimulus 6 (S6): Text (AOI 2), Logo (AOI 4).	(g) Stimulus 7 (S7): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(h) Stimulus 8 (S8): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).
			
(i) Stimulus 9 (S9): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(j) Stimulus 10 (S10): Icon (AOI 1), Text (AOI 2), Logo (AOI 3).	(k) Stimulus 11 (S11): Icon/Logo (AOI 1).	(l) Stimulus 12 (S12): Icon/Logo (AOI 1).

Source: Created by the authors.

Independent variables in the study were nationality and gender, since they all fall in the same age range and share similar sociocultural profiles. Dependent variables were fixation and emotional intensity registries. Analysis metrics include the time in seconds from the moment each stimulus AOI visualization begins until the subject registers the first fixation, or time from fixation (TFF), the total fixation duration (TFD), the number of eye fixations, or fixation count (FC), and the GSR peaks, expressed in kOhm, during emotional arousal activation. Emotional intensity non-conscious registers provided by GSR are combined with subjects' conscious statement of positive, negative or neutral emotion shown toward each of the areas of interest with the technological support provided by GSR Gazeport Biometrics. A qualitative content analysis from heat maps generated by fixation registries was also performed.

## RESULTS

### AUTOMOTIVE SECTOR ANALYSIS

Comparative analysis between icons with tridimensional looking automotive brand logos —whether isotypes or isologos— (Table 1) indicated significant differences between registered fixation to Volkswagen with respect to Hyundai, with an earlier time from fixation (TFF=0.01 vs. 0.21;  $p<0.001$ ), greater total fixation duration (TFD=2.04 vs. 1.53;  $p=0.003$ ) and greater fixation count (FC=9.40 vs. 6.57;  $p<0.001$ ). A comparison between the flat versions of Volkswagen and Hyundai's logos also showed significant differences, where the former registered earlier time from fixation (TFF=0.01 vs. 0.51;  $p<0.001$ ), greater fixation duration (TFD=3.69 vs.1.76;  $p<0.001$ ) and greater fixation count (FC=13.67 vs. 5.33;  $p<0.001$ ) with respect to the latter.

**Table 1. U Mann-Whitney test between similar AOI. Note: \*  $p < 0.05$** 

Fixation	S1-AOI 1	S11-AOI 1	p-value	S2-AOI 1	S12-AOI 1	p-value
TFF (Mean)	0.21	0.01	* $<0.001$	0.51	0.01	* $<0.001$
TFD (Mean)	1.53	2.04	*0.003	1.76	3.69	* $<0.001$
FC (Mean)	6.57	9.40	* $<0.001$	5.33	13.67	* $<0.001$

Source: Created by the authors.

Since Volkswagen's greater brand positioning and tradition was apparent in the better fixation results obtained versus Hyundai, a comparison between results of tridimensional and flat logos for each separate brand was carried out (Table 2). In this way, Volkswagen's flat version registered an earlier time from fixation (TFF=0.01 vs. 0.01;  $p=0.088$ ), significantly greater fixation duration (TFD=3.69 vs. 2.04;  $p < 0.001$ ) and greater fixation count (FC=13.67 vs. 9.40;  $p < 0.001$ ) than the tridimensional version. However, Hyundai only obtained better fixation duration registries in the flat version (TFD=1.76 vs. 1.53;  $p=0.183$ ) and in a non-significant manner.

**Table 2. U Mann-Whitney test between similar AOI. Note: \*  $p < 0.05$** 

Fixation	S1-AOI 1	S2-AOI 1	p-value	S11-AOI 1	S12-AOI 1	p-value
TFF (Mean)	0.21	0.51	* $<0.001$	0.01	0.01	0.088
TFD (Mean)	1.53	1.76	0.183	2.04	3.69	* $<0.001$
FC (Mean)	6.57	5.33	*0.047	9.40	13.67	* $<0.001$

Source: Created by the authors.

## TELECOMMUNICATIONS SECTOR ANALYSIS

MEO's logo only has typography, making it unfit to be compared with that of Movistar. Hence the two versions of Movistar's logo were analyzed (Table 3), which threw inconclusive results. This was probably due to the similarity between the two versions. The flat version registered a significantly faster fixation (TFF=0.15 vs. 0.43;  $p < 0.001$ ), it was similar in total duration (TFD=2.53 vs. 2.52;  $p=0.888$ ) and in fixation count (FC=8.83 vs. 9.03;  $p=0.760$ ).

**Table 3. U Mann-Whitney test between similar AOI. Note: \*  $p < 0.05$** 

Fixation	S7-AOI 1	S8-AOI 1	p-value
TFF (Mean)	0.43	0.15	* $<0.001$
TFD (Mean)	2.52	2.53	0.888
FC (Mean)	9.03	8.83	0.760

Source: Created by the authors.

## RENOWNED BRAND ANALYSIS

By comparing two world-class brands that have recently updated their logos, namely Juventus in sports and Pepsi in CPG (Table 4), it is appreciated how the brand with the longest record, Pepsi, registered a faster fixation (TFF=0.75 vs. 0.96;  $p=0.355$ ), significantly greater fixation duration (TFD=1.07 vs. 0.79;  $p=0.014$ ), and greater fixation count (FC=6.10 vs. 3.76;  $p<0.001$ ) than Juventus. Nevertheless, Juventus' flat version, which is the one with the most radical changes among the brands presented as stimuli, manages to revert those results, obtaining a significantly faster fixation (TFF=0.01 vs. 0.34;  $p<0.001$ ), greater total duration (TFD=4.14 vs. 3.55;  $p=0.052$ ), and greater fixation count (FC=15.87 vs. 12.73;  $p=0.005$ ) than Pepsi's flat version.

**Table 4. U Mann-Whitney test between similar AOI. Note: \*  $p<0.05$**

Fixation	S3-AOI 1	S9-AOI 1	p-value	S4-AOI 1	S10-AOI 1	p-value
TFF (Mean)	0.96	0.75	0.355	0.01	0.34	* $<0.001$
TFD (Mean)	0.79	1.07	*0.014	4.14	3.55	0.052
FC (Mean)	3.76	6.10	* $<0.001$	15.87	12.73	*0.005

Source: Created by the authors.

Both brands obtained better fixation results in the flat versions when compared with their tridimensional versions (Table 5). Thus, Juventus registered a significantly faster fixation (TFF=0.01 vs. 0.96;  $p<0.001$ ), greater duration (TFD=4.14 vs. 0.79;  $p<0.001$ ), and greater fixation count (FC=15.87 vs. 3.76;  $p<0.001$ ) in relation to its tridimensional version. Likewise, Pepsi's flat version also registered a significantly earlier fixation (TFF=0.34 vs. 0.75;  $p<0.001$ ), greater total duration (TFD=3.55 vs. 1.07;  $p<0.001$ ), and greater fixation count (FC=12.73 vs. 6.10;  $p<0.001$ ) than its tridimensional version.

**Table 5. U Mann-Whitney test between similar AOI. Note: \*  $p<0.05$**

Fixation	S3-AOI 1	S4-AOI 1	p-value	S9-AOI 1	S10-AOI 1	p-value
TFF (Mean)	0.96	0.01	* $<0.001$	0.75	0.34	* $<0.001$
TFD (Mean)	0.79	4.14	* $<0.001$	1.07	3.55	* $<0.001$
FC (Mean)	3.76	15.87	* $<0.001$	6.10	12.73	* $<0.001$

Source: Created by the authors.

## COLLECTIVE ANALYSIS OF ALL BRANDS

Significant differences were evidenced when comparing tridimensional logos selected in the automotive, telecommunications, and world-class sector brands (Table 6). The fastest fixation was obtained by the automotive brands, especially Volkswagen (TFF=0.01;  $p<0.001$ ), followed by telecommunications and,

lastly, world-class brands. The greatest total fixation duration was produced by Movistar in the telecommunications sector (TFD=2.52;  $p<0.001$ ), followed by the automotive sector, with Volkswagen standing out again (TFD=2.04;  $p<0.001$ ), and finally the world-class brands, where Pepsi obtained the sector's best registry (TFD=1.07). As for fixation count, the automotive sector got the best registry thanks to Volkswagen (FC=9.40;  $p<0.001$ ), followed by Movistar in telecommunications (FC=9.03), Hyundai, again in automotive, (FC=6.67), and the world-class brands were last once again, with Pepsi at the head (FC=6.10).

**Table 6. Kruskal–Wallis test between similar AOI. Note: \*  $p<0.05$**

Fixation	S1-AOI 1	S11-AOI 1	S5-AOI 1	S7-AOI 1	S3-AOI 1	S9-AOI 1	p-value
TFF (Mean)	0.21	0.01	-	0.43	0.96	0.75	* $<0.001$
TFD (Mean)	1.53	2.04	-	2.52	0.79	1.07	* $<0.001$
FC (Mean)	6.57	9.40	-	9.03	3.76	6.10	* $<0.001$

Source: Created by the authors.

The typography present in tridimensional logos (Table 7) registered uneven results with large differences between them ( $p<0.001$ ). While Juventus' logo presented the fastest typography to be seen (TFF=0.29), it was only ahead of Pepsi with the second worst result in fixation duration (TFD=0.94) and fixation count (FC=0.94). Strip shaped logos obtained a greater fixation duration toward their typographies, leading with the telecommunications sector, where MEO obtained the best registry (TFD=2.40 vs. 1.48), which seems logical being a text-only logotype.

**Table 7. Kruskal–Wallis test between similar AOI. Note: \*  $p<0.05$**

Fixation	S1-AOI 2	S11-AOI 2	S5-AOI 2	S7-AOI 2	S3-AOI 2	S9-AOI 2	p-value
TFF (Mean)	0.98	-	0.32	0.30	0.29	0.38	* $<0.001$
TFD (Mean)	1.31	-	2.40	1.48	0.94	0.70	* $<0.001$
FC (Mean)	6.20	-	-	5.80	4.30	3.87	* $<0.001$

Source: Created by the authors.

In flat version logos (Table 8), Juventus is above the rest with a significantly greater fixation ( $p<0.001$ ) in terms of time (TFF=0.01), duration (TFD=4.14), and count (FC=15.87), followed by Volkswagen (TFF=0.01; TFD=3.69; FC=13.67) and Pepsi, though only in terms of total duration (TFD=3.55), and fixation count (FC=12.73). The worst fixation registry falls on Hyundai, for time from fixation (TFF=0.51), total fixation duration (TFD=1.76), and fixation count (FC=5.33).

**Table 8. Kruskal–Wallis test between similar AOI. Note: \* p<0.05**

Fixation	S2-AOI 1	S12-AOI 1	S6-AOI 1	S8-AOI 1	S4-AOI 1	S10-AOI 1	p-value
TFF (Mean)	0.51	0.01	-	0.15	0.01	0.34	*<0.001
TFD (Mean)	1.76	3.69	-	2.53	4.14	3.55	*<0.001
FC (Mean)	5.33	13.67	-	8.83	15.87	12.73	*<0.001

Source: Created by the authors.

MEO stood out in fixation to flat version typographies, considering it was a typography-only logotype, just like its tridimensional version. It registered the fastest time from fixation (TFF=0.33), greatest duration (TFD=4.28), and greatest fixation count (FC=16.70). In second place was Juventus (TFF=0.54; TFD=1.72; FC=8.10). In third place, Pepsi was noteworthy for its total fixation duration (TFD=1.58) and fixation count (FC=6.63), though its time from fixation was the most delayed of all (TFF=1.84). The worst total fixation duration and fixation count registries (TFD=1.38; FC=6.13) belonged to Movistar.

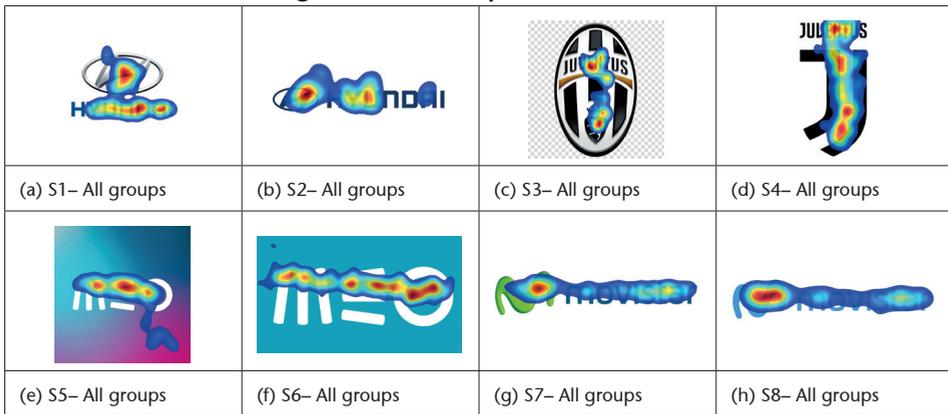
**Table 9. Kruskal–Wallis test between similar AOI. Note: \* p<0.05**

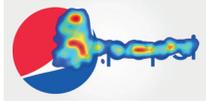
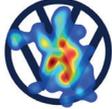
Fixation	S2-AOI 2	S12-AOI 2	S6-AOI 2	S8-AOI 2	S4-AOI 2	S10-AOI 2	p-value
TFF (Mean)	0.63	-	0.33	1.24	0.54	1.84	*<0.001
TFD (Mean)	1.54	-	4.28	1.38	1.72	1.58	*<0.001
FC (Mean)	6.30	-	16.70	6.13	8.10	6.63	*<0.001

Source: Created by the authors.

These data are confirmed by the fixation intensity concentrated in certain AOI (Figure 2):

**Figure 2. Heat maps of the stimuli**



			
(i) S9- All groups	(j) S10- All groups	(k) S11- All groups	(l) S12- All groups

Source: Created by the authors.

## GENDER DIFFERENCES ANALYSIS

Significant differences due to gender in the time elapsed from the stimulus' first appearance to the first fixation were not shown for any AOI. Depending on AOI, there were slight differences occasionally observed in men, and other times in women, with no conclusion able to be drawn.

There was also a great similarity in total fixation duration for both genders. However, significant differences existed in Juventus' tridimensional logo, with greater total duration for women toward the text (TFD=1.12 vs. 0.57;  $p=0.029$ ), while men showed greater fixation duration toward the symbol (TFD=0.90 vs. 0.68;  $p=0.029$ ). Just as important was the difference in greater fixation duration observed in women toward Volkswagen's flat logo, whose only element was the symbol (TFD=2.25 vs. 1.83;  $p=0.013$ ).

As for fixation count, there were only significant gender differences in Juventus' tridimensional logo where women again showed greater fixation to the text (FC=5.00 vs. 3.60;  $p=0.008$ ).

## NATIONALITY DIFFERENCES ANALYSIS

Significant differences due to nationality in relation to time from fixation were observed for Hyundai's tridimensional logo, to which Spaniards showed earlier fixation, both to the icon (TFF=0.06 vs. 0.35;  $p<0.001$ ) and to the complete logo (TFF=0.06 vs. 0.21;  $p=0.004$ ). Spaniards also exhibited significantly faster fixation to MEO's complete logo (TFF= 2.19 vs. 2.73;  $p=0.006$ ), apparently as a consequence of seeing an unknown brand, as it is the equivalent of Movistar in Portugal. Yet Movistar's flat logo registered significantly faster fixations to the text from Spaniards (TFF=0.89 vs. 1.60;  $p=0.037$ ), while the Portuguese did the same with its icon (TFF=0.06 vs. 0.23;  $p=0.041$ ).

Spaniards showed significantly greater fixation duration to Hyundai's tridimensional logo, to the text (TFD=1.56 vs. 1.06;  $p=0.033$ ), to the full logo (3.27 vs. 2.54;  $p=0.029$ ), and the logo's flat version (TFD=3.73 vs. 2.05;  $p=0.004$ ). The same was observed for Juventus' flat logo, both the icon (TFD=4.72 vs. 3.56;  $p=0.007$ ) and the full logo (TFD=3.73 vs. 3.05;  $p=0.004$ ). Lastly, Movistar's flat logo's text (TFD=1.61 vs. 1.15;  $p=0.033$ ).

Portuguese, in contrast, registered significantly greater fixation duration to MEO's tridimensional logo's text (TFD=1.84 vs. 2.95;  $p=0.001$ ), as well as its icon

(TFD=2.98 vs. 2.05;  $p=0.001$ ), and its full logo (TFD=4.37 vs. 3.65;  $p=0.023$ ) compared with Movistar's.

As for fixation count, Spaniards registered a significantly greater number when exposed to Hyundai's full tridimensional logo (FC=13.67 vs. 11.13;  $p=0.045$ ), Hyundai's full flat logo (FC=12.33 vs. 10.33;  $p=0.041$ ), Juventus' full flat logo (FC=27.47 vs. 21.13;  $p<0.001$ ) and its text (FC=18.33 vs. 13.40;  $p=0.001$ ), as well as Movistar's flat logo's text (FC=7.27 vs. 5.00;  $p=0.005$ ).

Portuguese showed significantly greater fixation counts when exposed to MEO's tridimensional logo's text (FC=9.73 vs. 7.20;  $p=0.013$ ), to Pepsi's tridimensional logo's text (FC=4.40 vs. 3.33;  $p=0.016$ ), as well as Movistar's tridimensional icon (FC=10.33 vs. 7.73;  $p=0.004$ ).

## EMOTIONAL AROUSAL ANALYSIS

Subjects' conscious responses were kept neutral for most stimuli, except those for Juventus and Volkswagen's flat logos by both nationalities. MEO's logos (tridimensional and flat) and Pepsi's flat logo also showed neutral responses from the Portuguese, just like Movistar's flat version from Spaniards. Unconscious responses validated this issue, though with less intensity than conscious ones. Participants' greatest emotional intensity GSR peaks were located in Juventus and Volkswagen's flat logos (512,75 kOhm and 495,67 kOhm respectively).

## DISCUSSION AND CONCLUSION

Fixation registered for tridimensional logos has manifested that brands with greater traditions in communication, positioning, notoriety and audience-perceived status obtained the best results. Additionally, these brands obtained the best emotional arousal registries, and conscious declarations of positive emotional responses. Such is the case of Volkswagen versus Hyundai or Pepsi—especially in Portugal—versus Juventus, where the influence of brand associations, when agreeing with a person's self-concept, is confirmed (Bettels and Wiedmann, 2019). Furthermore, these two brands' logos exhibited the most emotionally intense GSR peaks.

As analyzed brands are grouped into sectors, it becomes apparent that logos with the greatest fixation are also related to the affinity of products consumed or aspired to. Thus, the automotive and telecommunications sectors were ahead of the two world-class brands selected.

Although, for the most part, flat logos obtain better fixation registries than their tridimensional versions, it is so in brands with better positioning, like Volkswagen. Here differences are statistically significant, even when the logo is monochromatic, hence confirming previous research by Bresciani and Ponte (2017).

However, though Juventus' flat logo constituted the most radical change in visual identity among presented stimuli, it is also the one with the best fixation registries in line with the theories proposed by Müller, Kocher, and Cret-

taz (2013). A significant difference is obtained when compared with another renowned brand, like Pepsi, whose change was also important in the loss of three-dimensionality while keeping the essence of its visual identity. These results completely change the preconception of Pepsi's tridimensional logo getting significantly more fixation with respect to Juventus'. Nevertheless, the worst fixation data for flat versions were registered when the flat and tridimensional versions were very similar, as with Hyundai. On the contrary, when the difference between the tridimensional and flat logos was not easily spotted due to their similarities, fixation results were uneven.

Strip-shaped logos had greater fixation durations, especially when they are text-only logotypes, thus confirming the research by Zhong, Wang, and Zhanh (2018).

In spite of some occasional, inconclusive, fixation differences, it was not possible to find a different cognitive perception neither based on gender nor geographical origin. This seems logical given the socio-cultural affinity between young Spanish and Portuguese university students. Faster fixation to MEO's logo by Spaniards, due to curiosity for an unknown brand, was indeed important considering it is Movistar's counterpart in Portugal. The Spanish public registered fixation in some AOI focused on flat logos more than the Portuguese public. This suggests that young audiences in Spain might be more familiar with flat design than in Portugal. Thus confirming flat design as a current trend accepted among digital audiences (Gu and Yu, 2016).

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