EVALUATING PRODUCT PERCEPTION USING EYE-TRACKING AND SEMANTIC SCALES: COMPARING REAL AND VIRTUAL REPRESENTATIONS

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ABSTRACT

The use of 3D virtual representations is a common approach in the modern process of new product development. This work presents a preliminary study with 14 participants about comparing a real and a virtual representation of a product in order to then conduct a perception evaluation analysis. The evaluation is carried out by applying a semantic scale based on four axes: novelty, resolution, style and emotion. Also eye-tracking technology is used to analyze what design features attract participants' gaze. Preliminary results show that both virtual and real objects get similar evaluation from participants using semantic scales. However, eye-tracking results indicate that there are some small differences between gaze patterns.

KEYWORDS: *eye-tracking, semantic scales, perception.*

INTRODUCTION

Currently, there is a growing interest in the connection between neuroscience and disciplines that revolve around the economy and consumption. This link began about a decade ago, when the term "neuroeconomics" was coined (Zak, 2004). The basic aim of this new field was to better understand the decision making process in an economic context, involving cognitive psychology and neuroscience. Following this new approach, other new disciplines have emerged such as "neuromarketing" or "consumer neuroscience", whereby the main goal is the transfer of insights from neurology to research in consumer behavior by applying neuroscientific methods to marketing problems (Touhami et al., 2011).

Packaging and labeling are important tools to capture consumers' attention. Now, a growing body of empirical research has started to focus on the influence of the sensory characteristics of the packaging and covers (Ares, Deliza & Giménez, 2010; Moskowitz et al., 2009). The last few years have seen an explosion of innovation in terms of evaluation, design and shapes of products and packaging. This activity is assisted by other disciplines, which take sensorial elements to bring us information about the preferences of future consumers. In this context, neuromarketing is also related with neuroaesthetics that is aimed at revealing the processes of how we judge the aesthetics and perception of objects (Chatterjee, (2011)

In many markets, packaging gives an important added value; here, aesthetics plays an important role in product differentiation and regardless of the consumption domain, it seems to be a positive factor to trigger some specific responses in consumers such as an immediate desire to buy (Reimann et al., 2010). Based on the work of Osgood, Suci & Tannenbaum (1957), the semantic scale (SC) has become an important instrument in the aesthetic evaluation of products, packaging or labels. Nowadays, SC techniques can be complemented by eye tracking technologies to get a better understanding of the relationship between aesthetic features and product perception by the consumer. Eye movement provides an objective indicator of where a person's overt attention (and usually also their covert attention) is focused (Hoffman & Subramaniam, 1995; Spencer & Driver, 2004). This method serves to filter visual information and potentially help to organize it. As a consequence, several parameters of oculomotor behavior (e.g., saccadic eye movements) are now frequently used; in particular, the locus of an observer's visual fixations is perhaps the single most commonly used parameter when it comes to assessing where a consumer's attention might be focused. Fixations are defined as gaze patterns in which the eyes are relatively immobile, and during which the visual system is assumed to be gathering information (Pertzob et al., 2009). Eye tracking measures can provide an objective and continuous measure of the user's reactions through eye movement and gaze (Djamasbi et al., 2010).

Semantic scales and eye tracking techniques provide somewhat different information with regard to the consumer´s evaluation of a product. Combining these two techniques, we can obtain complementary information about the user perception of the product.

Using virtual prototypes in the product development process is a common approach to shorten development time, increase product quality and improve flexibility and adaptation to market changes. The application of semantic scales and eye tracking techniques using virtual models must be validated to assure that the same feedback can be obtained using stimuli coming from real objects or virtual prototypes. This work is aimed at evaluating the application of both semantic scales and eye tracking for the evaluation of a virtual and real design of a bottle.

MATERIALS AND METHODS

Participants and apparatus

This study was conducted with 14 Spanish voluntary participants (8 female, 6 male) with ages ranging from 22 to 53 years (M = 40 years: SD = 13.65) who did not receive any compensation for it. All participants reported normal corrected vision, and no color-blindness.

An unobtrusive eye tracker that was capable of recording the position of the eyes at a sampling rate of 300 Hz (Tobii TX300, www.tobii.com) was used to assess the participants' visual fixations. This device has a 23" flat HD screen and a sensor bar in the lower part of it. This setup allows participants to make large head movements, and to move freely and naturally in front of the screen. Tobii Studio 3.2.1 software was used to calibrate the eye tracker, to present the stimuli, to record the data, and to extract descriptive statistics.

Stimuli

For this study, two sets of stimuli were used. The first set was made up of studio-quality images where a single bottle is presented on a white background. The second set represented the same image content and background, but using a computer render created with UNITY software instead of real object photography. All the images (648x1080 resolution) were set to equal mean luminance and size. Front and back views of the bottle were used in the study as seen in Figure 1. Additionally other bottle perspectives were prepared (0°, 15°, 35° and 60°).

A semantic scale (SC) combined with eye-tracking measure was used to compare the perception between a real bottle against a virtual one. Semantic Differential is a technique that was proposed by Osgood, Suci & Tannenbaum (1957), to measure people's reactions to stimulus words (or concepts) by means of ratings based on bipolar scales defined with contrasting adjectives at each end (e.g. "good-bad", "tall-short"). In the context of the present work the Creative Product Analysis Model (CPAM) scale (Besemer, 2010) was used with an additional semantic axis. The original axes: novelty, resolution and style are complemented by an emotional axis. The four semantic axes are described by three pairs of bipolar words (see table 1).

Figure 1. Some stimuli shown to participants.

NOVELTY (novedad)	RESOLUTION (resolución)	STYLE (estilo)	EMOTIONAL (emocional)
Antiquated - Fashion (anticuado - de moda)	Female - Male (femenino - masculino)	Stable - Unstable (estable - inestable)	Euphoria - Tranquility (euforía - tranquilidad)
Usual - Unusual (usual - inusual)	Robust - Thin (robusto - delgado)	Wrong-crafted - Well-crafted (mal hecho - bien hecho)	Sadness - Happiness (tristeza - felicidad)
Discreet - Revolutionary (discreto - revolucionario)	Tall - Short (alto - bajo)	Durable - fragile (Durable - fragil)	Empathy - indifference (empatía - indiferencia)

Table 1. Semantic Axes (in blue color the original Spanish terms presented to participants)

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Procedure

Participants had to carry out two tasks that we named A and B. Task A corresponds to the real bottle and task B employs virtual bottles. The tasks were randomly presented to the participants; after finishing A or B, the participant took a break from the other activity for 10-15 minutes, before beginning the remaining task.

The study was conducted in a quiet room under standard illumination conditions. Each participant was seated between 60-70 cm from the eye-tracker system (see figure 2). After calibration the general instructions for the task were presented on the screen for 22 seconds.

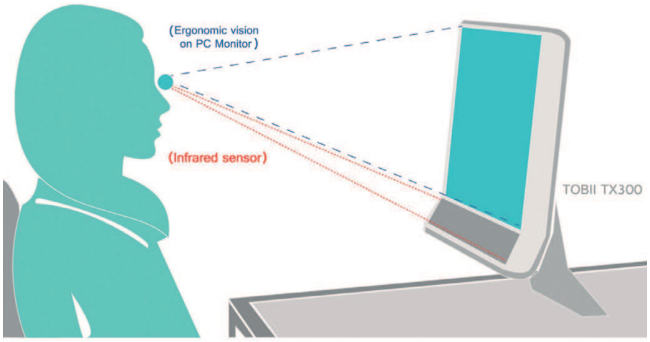

Figure 2. Scheme of the participant in the study.

Task content (presented in figure 3) is organized into four clusters. The first cluster begins with a screen with the text “5 seconds to begin”. Then, two images showing a front and a back view of the bottle are presented consecutively. Each image was shown for 3.5 seconds. Next, a semantic scale is presented on the screen with three questions (three pairs of bipolar words). Participants had 15 seconds to read and verbalize the answer to the choice number for each question (which is codified in a value from 1 to 7). Finally a one second long white screen break is presented before starting the next cluster. The other clusters used other bottle orientations. The clusters and questions are randomly selected for each subject.

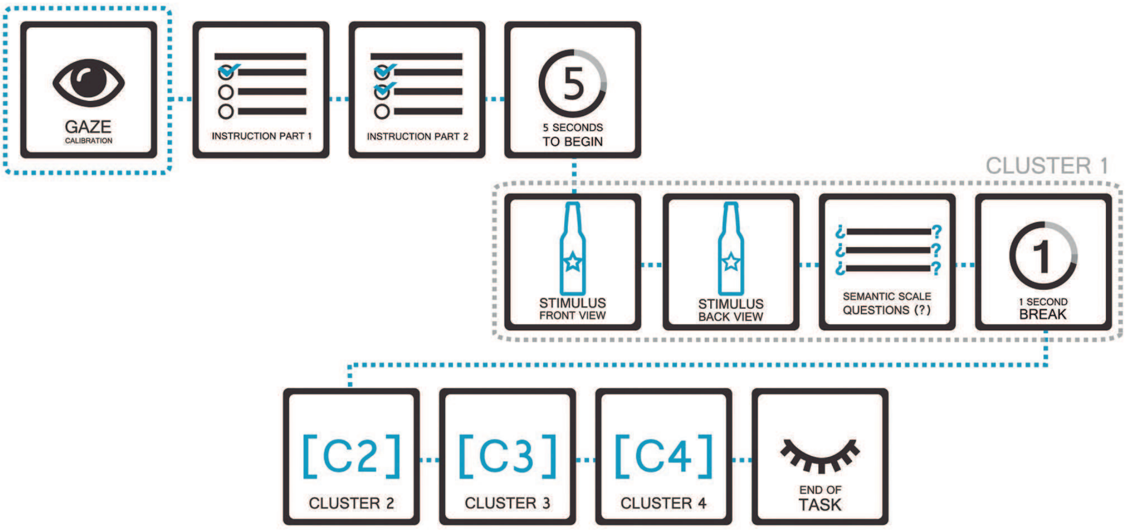

Figure 3. Task description.

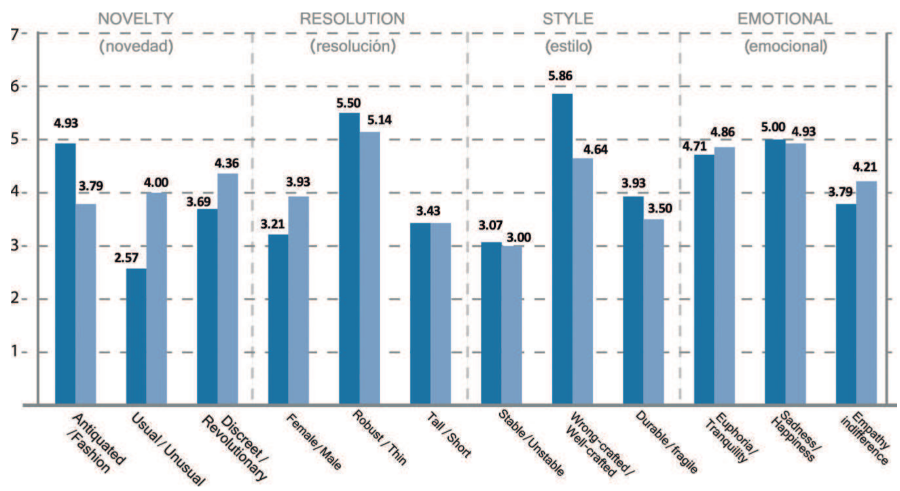

Figure 4. Average scores for semantic axes.

NOVELTY		Mean	Std. Dev.
Antiquated /Fashion	Real	4.929	1.774
	Virtual	3.786	1.968
Usual / Unusual	Real	2.571	0.938
	Virtual	4.000	1.754
Discreet / Revolutionary	Real	3.714	1.069
	Virtual	4.357	1.646

RESOLUTION		Mean	Std. Dev.
Female/ Male	Real	3.214	1.311
	Virtual	3.929	1.592
Robust / Thin	Real	5.500	1.286
	Virtual	5.143	1.292
Tall / Short	Real	3.429	1.604
	Virtual	3.429	1.828

STYLE		Mean	Std. Dev.
Stable/ Unstable	Real	2.786	1.718
	Virtual	3.000	1.468
Wrong-crafted/ Well-crafted	Real	5.857	1.167
	Virtual	4.643	1.865
Durable/ fragile	Real	3.714	1.858
	Virtual	3.500	1. 743

EMOTIONAL		Mean	Std. Dev.
Euphoria/ Tranquility	Real	4.714	1.684
	Virtual	4.857	1.512
Sadness/ Happiness	Real	5.000	1.754
	Virtual	4.929	1.269
Empathy/ indifference	Real	3.786	1.888
	Virtual	4.214	1.672

Table 2. Mean and standard deviation for each attribute

RESULTS AND DATA ANALYSIS

Mean values for each semantic scale are plotted in figure 4, while mean values and standard deviation data are provided in Table 2. Due to a lack of normality in sample data, a Wilcoxon signed-rank test was used to compare each attribute in the four semantic axes. There was no significant difference (α= .05) in the scores for each semantic axis comparing virtual and real representations, except for the pair "usual – unusual" in the novelty axis (Z = -2.052, *p* = .040).

DISCUSSION AND CONCLUSIONS

This is a preliminary study with a reduced sample size in order to obtain experience to conduct a future study with a bigger sample size. Results show that the user responses are very similar in both virtual and real stimuli. Eye-tracking data is usually interpreted using specific graphics representation such as heat maps and gaze plots. Absolute duration heat maps are presented in figure 5. They display the accumulated fixation duration on different locations in the image that is typically related to the amount of attention paid by the observer on specific locations.

Figure 5. Heat maps of frontal and back views (first row, real on the left, render on the right). Stimuli in second row. Color scale is aqua for low fixation time and red for high fixation time.

Eye tracking results show some different gaze patterns when using images from computer renderings or real photos. The main differences in figure 5 correspond to the upper label in the front view image. The virtual bottle shows a move visible text label, which is reflected in the heat map capturing more attention from the observer. In this case, the computer image perhaps excessively simplifies the representation (it does not simulate transparency perfectly) and gives more emphasis to the text label than in the real image.

Future work will try to confirm these preliminary results by including a bigger sample. Additionally, a new experiment will be designed to analyze the impact of render quality in user perception with respect to the real object using both semantic scales and eye tracking technology.

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