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ANALYSIS OF PURCHASE INTENT BASED ON MORPHOLOGICAL COMPARISON WITH LEADING SALES PRODUCT

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A product's formal aspects have more and more weight in the decision-making processes that induce purchasing. Many meanings and decisive symbolic messages are part of a product's shape. The purpose of this paper is to assess the extent to which the morphology of a product can predict its commercial success. In order to do this, a sample of six different models within the same product category are selected. The models are digitized, and then the dissimilarity index with respect to the sample model leading the sales ranking is analyzed. Subsequently, based on the dissimilarities obtained, the compared models are grouped. It is clear from the interpretation of the groups that the best-selling machines are the most morphologically similar to the leading sales model. The correlation between form and purchase intention would allow to predict the success of a model from the early stages of its development.

Keywords: morphological analysis; sales forecasting; conceptual design

ANÁLISIS DE LA INTENCIÓN DE COMPRA A PARTIR DE LA COMPARACIÓN MORFOLÓGICA CON EL PRODUCTO LÍDER EN VENTAS

Los aspectos formales de un producto tienen cada vez más peso en los procesos de toma de decisión que inducen a la compra. La forma de un producto contiene significados y mensajes simbólicos decisivos en los procesos de compra. En el presente trabajo se pretende evaluar hasta qué punto la morfología de un producto puede predecir su éxito comercial. Para ello, se selecciona una muestra de seis modelos distintos dentro de una misma categoría de producto. A continuación, se digitalizan y se analiza el índice de disimilitud de cada una de ellas con respecto al modelo de la muestra que lidera el ranking de ventas. Posteriormente, en función de las disimilitudes obtenidas se agrupan los modelos comparados. De la interpretación de los grupos se desprende que las máquinas más vendidas son las más similares morfológicamente al modelo líder de ventas. La correlación entre forma e intención de compra permitiría predecir el éxito de un modelo desde las fases tempranas de su desarrollo.

Palabras clave: análisis morfológico; predicción de ventas; diseño conceptual

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1. Introduction

User-centered design has grown in importance during the last decades as product developers and designers realized that product function, that is, the capability of the product of serving its main, practical purpose, was not enough to attract buyers of similar products made by competing companies. The ability of incorporating in a controlled way more intangible users' needs into the design has proven to be essential to spark interest in potential buyers (Truong et al., 2014; Kaljun, 2014; Crilly, Moultrie, and Clarkson, 2004). Product design remains an area in need of further research (Truong et al., 2014; Schifferstein and Desmet, 2007). More specifically, product shape is one of the key attributes being able to reflect the user's sensible needs (Wu & Qiao, 2009; Sonderegger and Sauer, 2010), especially in the current context of online commerce (Artacho-Ramírez, Diego-Mas and Alcaide-Marzal, 2008), where the potential interaction between product and user is rather limited, if not only, to the visual domain.

Product Phenetics is a new methodology which has proven itself to be a valid tool for quantifying differences in product morphology and its relationship with user perceptions (Artacho Ramírez et al., 2018). Its high resolution and integral nature, where the product is analysed as a whole, without previous categorization of any product attributes or parts as being more important than others, in computing formal dissimilarity, make it an ideal tool to quantify shape differences objectively in comparison with other, more parametrized approaches (Artacho Ramírez, Arrufat Álvarez, and Alcántara Alcover, 2016).

This work analyses the potential relationships between morphology and the actual market success of industrial products belonging to the same typology sold through an online channel. The starting hypothesis is: as formal dissimilarities between products and the most sold model grow, models' sales decrease. A total of six drilling machines were ranked by their selling numbers in an important online platform. Using the best-selling model as a reference, formal dissimilarity indexes with the rest of the drilling machines were computed. The morphological information was then used to group the different machines, in order to study common qualitative shape attributes and their correlation to sales performance. Despite further works with more product typologies and greater samples seem necessary, the results show that product phenetics could be a valid tool in researching buying intention of products.

2. Material and methods

2.1 Power tool selection and determination of the sales rank

Six different models of power tools which were available through an important online seller were chosen. More specifically, the power tools were corded, non battery-operated drilling machines with power ratings between 500W and 750W. They are shown on Figure 1. The tools were digitized into 3D computer models using a Microscribe 3DX articulated arm digitizer and the Rhinoceros 4 software.

A relative sales rank was established using sales figures published by the online seller. This seller publishes a best sellers rank of the product in the different categories under which the product is sold. The ranking group used to order the drilling machines in this research was 'Power Drills'. The best selling model was selected as the reference model.

Figure 1: Power tools selected for this research

2.2 Morphological analysis

Figure 2 shows all the steps taken to do the morphological analysis. All 3D models were imported into the Solidworks software and aligned in the same 3D environment with respect to a common reference point: the point where the drilling tip meets the machine's rotating head (Artacho Ramírez, Arrufat Álvarez, and Alcántara Alcover, 2016). The models were sliced in 3 mm steps and dissimilarity indexes were computed for all machines along the vertical axis (z axis) with respect to the reference model using a custom implementation of the Procrustes method (Artacho Ramírez, Arrufat Álvarez, and Alcántara Alcover, 2016) under the Matlab software. The implemented algorithm selects the corresponding slices of the two models to be compared at a starting position on the z axis. These two slices are then compared and an index quantifying formal differences between the two is computed (see lower part of Figure 2). This index has a value between 0 and 1, where 0 implies total similarity between shapes, and 1 implies total dissimilarity. The program then shifts to the next position along the z axis and compares two new slices of the models, computing a new dissimilarity index for that position. Once the dissimilarity was computed in all positions, the total dissimilarity along the z axis was calculated according to Equation 1.

$$d_{total} = \frac{\sqrt{d_1+d_2+\cdots+d_n}}{n_z}; \quad (1)$$

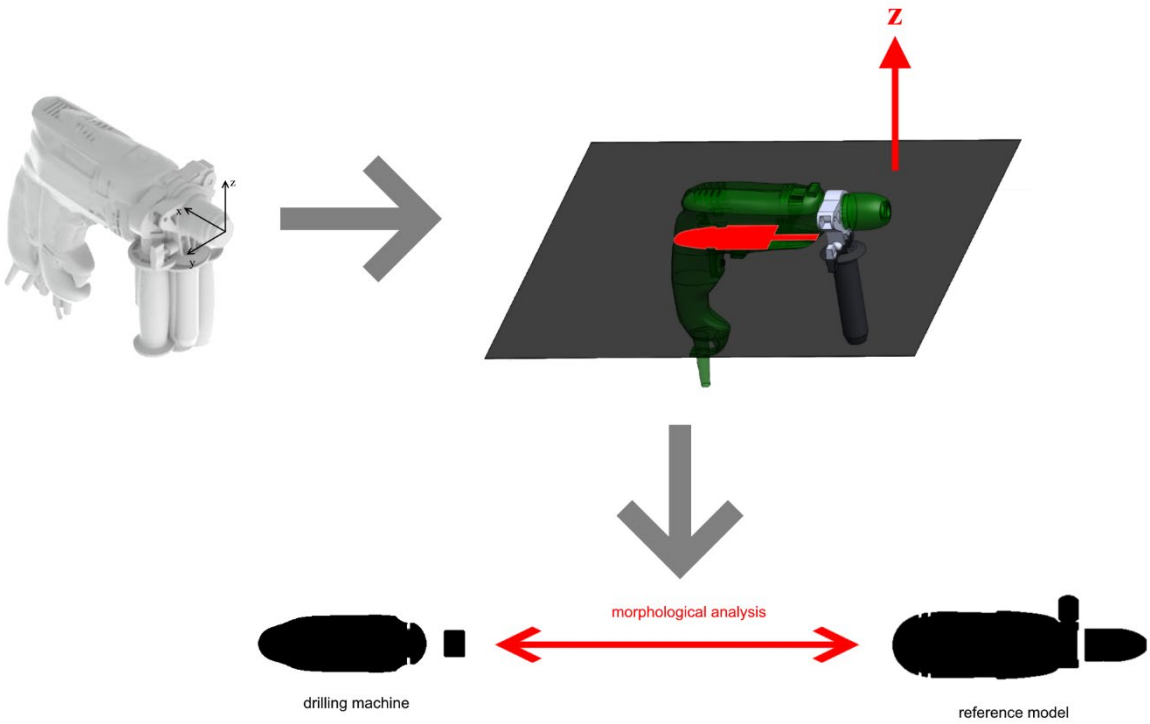
In Equation 1, d_{total} is the total dissimilarity index along the z axis, d_i (where i = 1, 2...) are the dissimilarities computed at each position by comparing the corresponding slices, and n_z is the total number of comparisons made.

2.3 Hierarchical clustering

Using the dissimilarity information computed against the reference model, the machines were grouped using a hierarchical clustering method under the SPSS 16 software. The clustering

method used was furthest neighbor, and the metric used was the Euclidean distance. The variable used was the total dissimilarity as defined in Section 2.2.

Figure 2: Model superposition, model slicing along the z axis, and morphological analysis



3. Results

Figure 3 shows the digitized models of the drilling machines from Figure 1.

Figure 3: Digitized models of the drilling machines

Using the information provided by the online seller on its website, a relative sales rank was obtained under the category ‘Power Drills’ (see Table 1). Tool 1, being the best selling model of the machines available, was selected as the reference model for the morphological comparison.

Table 1: Drilling machines' sales rank

power tool	relative sales rank	sales rank in seller's website
Tool 1 (reference model)	1st	9th
Tool 2	2nd	36th
Tool 5	3rd	53th
Tool 6	4th	73rd
Tool 3	5th	117th
Tool 4	6th	384th

The morphological analysis detailed in section 2.2 yielded the total dissimilarity indexes shown on Table 2.

Table 2: Total dissimilarity index along the z axis (dz)

tools compared	dz
tool 2 vs. tool1	0.032050
tool 3 vs. tool1	0.035082
tool 4 vs. tool1	0.042506
tool 5 vs. tool1	0.029774
tool 6 vs. tool1	0.038499

The dissimilarity values were used as variables in the clustering procedure detailed in section 2.3. The resulting dendogram is shown in Figure 4 together with the iteration used for the determination of the groups, which is shown as a red line.

The clustering process yielded two different tool groups. Tools 2 and 5 formed Group 1, while tools 3, 4 and 6 formed Group 2. Figure 5 summarizes this result together with the evolution of dissimilarity and sales rank for each of the tools.

Figure 4: Clustering dendogram

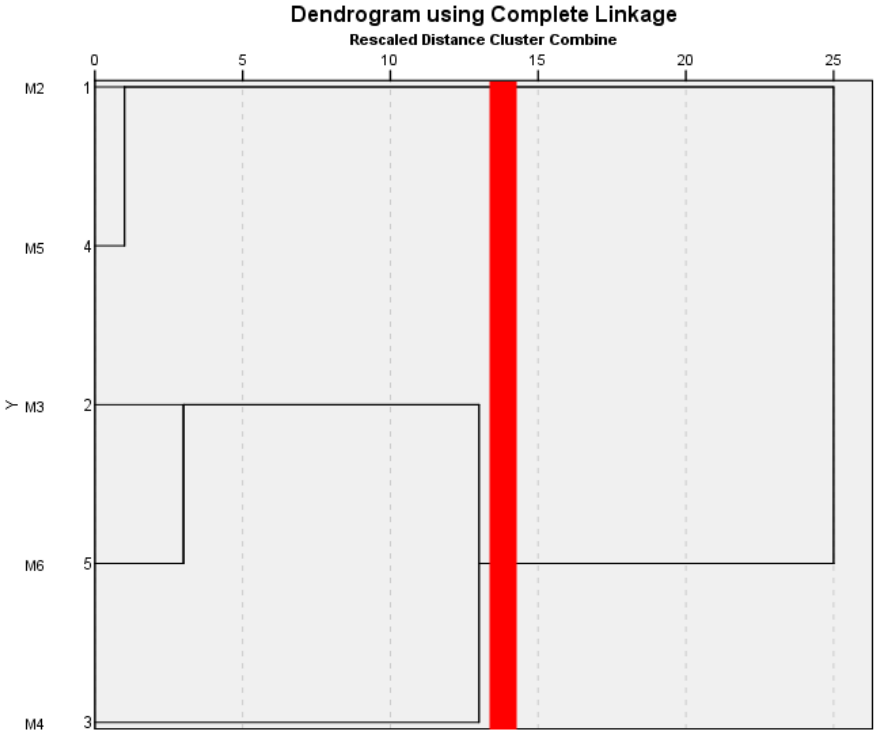


Figure 5: Resulting clusters and evolution of buying intention and dissimilarity

4. Discussion

The results on Table 1 and 2 imply a direct relation of product shape (dissimilarity) with product's success in the market (sales rank). As product dissimilarity, which has been computed taking the best selling model as a reference, increases, so decreases the buying intention of users, which is reflected by a worsening sales rank. Machines in Group 1 have a more similar shape to the reference model and exhibit a greater sales rank by users. Machines in Group 2 have a more different shape, and the users don't buy them as often. Products in

the different groups exhibit qualitatively similar formal characteristics. While the products in Group 1, together with the reference model, have more rounded shapes and seem to have proportional and very contained dimensions, products of Group 2 exhibit shape characteristics which could be described as aggressive design features with more pronounced curved surfaces along their shape and bigger handles. With this information at hand, product phenetics could be seen as a valid approach to relate product success in markets to product morphology.

It is important to stress that this work overcomes the inconveniences that always arise when inferring users buying intention, as authors worked with actual sales. However, findings may be somewhat limited by the fact of computing only morphological dissimilarities along the z axis. Dissimilarities along x and y axes may have an influence on the total dissimilarity index. Moreover, given the small sample size, these results cannot be extrapolated without caution. Further works seem necessary to have a 3D dissimilarity index and to have the method applied to more product typologies. Indeed, there are still many unanswered questions about the influence of other product visual attributes which should be considered in future research, like product colour and surface patterns of changing textures (e. g. rubber vs. plastic) (Huang and Lu, 2016). External factors like brand, price and availability should also be considered when studying the influence of product design over buying intention (Widyasari et al., 2018). Last, but not least, the social effect on buying intention of modern online shops and marketplaces, with the possibility of seeing videos of users testing the products or with users' opinions, who have bought the same product and/or have rated them, available should also be considered in future research (Chen, Chang, and Chen, 2017). In this sense, it can be said that visual product shapes and information seems to be of utmost importance for the online buyer (Artacho-Ramírez, Diego-Mas and Alcaide-Marzal, 2008). As shown by results of present study, it can be concluded that product morphology seems to be among the most dominating factors.

5. Conclusion

This research's results confirm another context in which Product Phenetics approach proves to be useful: the study of buying intention of products in a market segment already populated with similar products. By establishing the most successful model as a reference, morphological analysis provides us with valuable information about how well alternate designs will sell, as well as about product shape features which could be used as guidelines for a successful introduction of a novel product in an already crowded market segment.

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