International Journal of Information Technology & Decision Making
(2022)

DOI: 10.1142/S0219622022500766

Conjoint Analysis Models of Digital Packaging Information Features in Customer Decision-Making

Marta Płonka[*,‡], Jerzy Grobelny[†,§] and Rafał Michalski[†,¶]

[*]*Faculty of Interior Architecture*
Design and Stage Design
The Eugeniusz Geppert Academy of Art and Design
Generała Romualda Traugutta 19/21, 50-416 Wrocław, Poland

[†]*Faculty of Management*
Wrocław University of Science and Technology
Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland
[‡]*m.plonka@asp.wroc.pl*
[§]*jerzy.grobelny@pwr.edu.pl*
[¶]*rafal.michalski@pwr.edu.pl*

Received 29 March 2022
Revised 26 September 2022
Accepted 26 September 2022
Published 2 November 2022

Product packaging has a great influence on customers' decision-making and shapes purchase intentions. The graphic message is the crucial component of this impact. Digital presentations of goods are ubiquitous, therefore understanding how graphical features influence customer decisions is of enormous theoretical and practical importance. Despite the interest, the role of specific factors and their combinations is still unclear, especially if medium-involvement products are concerned. Since only a few studies have considered this context, this research examines how eight variants of a digital presentation of cordless kettle packaging influence purchase willingness, which was derived from pairwise comparisons using eigenvectors. The experimental conditions differed in three factors: the existence of a product graphical context, a brief or extended product description, and white or black packaging background color. Results of analyses of variance and conjoint analyses revealed a significant role of all examined effects, with the background color being the least influential. The best-rated designs included graphical context and extended textual information. There were also some meaningful gender-related differences revealed by conjoint analyses. The black background color was much more important for females than males. The outcomes broaden our knowledge on people's perception of packaging design graphical factors, and their impact on purchase decisions.

Keywords: Electronic commerce; decision-making; visual processing; digital package perception; purchase preferences; conjoint analysis.

[¶]Corresponding author.

1. Introduction

The graphic message is an important element of communication in various spheres of human activity. Visual communication also plays a key role in human interaction with digital systems. On the one hand, it facilitates control over these systems and, on the other hand, it is a means of conveying information. Studies on factors that shape the graphical message have a long history (e.g., Refs. 1 and 2) and aim to recognize the relationships between graphical features and the reactions they evoke in humans (e.g., Refs. 3 and 4). In recent years, there have even been attempts to develop algorithms involving artificial intelligence that relate visual design and the cognitive process of making purchase decisions (e.g., Refs. 5–8).

More than 70% of the decisions on the purchase of everyday and choice goods are estimated to be made at the real or virtual place of purchase.[9] Therefore, the communication between the producer and the customer through the packaging is of particular importance. The purpose of packaging design is to attract the attention of the consumer and evoke a positive attitude toward the offered product. Many studies show that product packaging has a great influence on shaping purchase intentions. Confirmation of these observations can be found, for example, in the recent studies by Sook-Fern *et al.*[10] or Rebouças *et al.*[11] Researchers obtain similar findings for both physical packaging and virtual designs presented on screens of all types. The packaging of everyday goods (low-involvement) and choice goods (medium-involvement[12]) has been one of the main research trends in the area over the last two decades. For example, laboratory studies using virtual reality technology by Underwood *et al.*[13] revealed that attention increased if the packaging contained a graphic image of the product. Underwood and Klein[14] showed that the presence of a picture on the packaging positively affects the brand assessment and increases the evaluation of the packaging itself. Vriens *et al.*[15] compared verbal information and digital presentation of three-dimensional (3D) car stereo sets, and showed the significant influence of graphic information on understanding the attributes of product design. Deliza *et al.*[16] found that the presence of graphics has a significant positive effect on the liking of passion fruit juice.

These research results show the positive and multifaceted role of graphic information about the product. Image attributes can be considered hierarchically and scientists examine both low-level items such as color, size, texture, and high-level factors aggregated according to different criteria or general theories (e.g., abstraction, complexity, symmetry, naturalness).[17] Studies demonstrate that the influence of the image on a person is a complex psychological process. The presence of the image affects people by shaping their attitude toward the product, and from the cognitive point of view, allows for a better understanding of product design parameters and provides predictions of sensory experiences. Since these investigations often deal with the influence of specific attributes on purchase decisions, they fit well with the main theoretical developments elaborated and systematically extended for more than 50 years, such as the theory of buyer behavior (TBB),[18] the theory of

planned behavior (TPB),[19] and the theory of utility (TOU) which is the basis of conjoint analysis (CA).[20]

In this paper, we continue the research in these directions and focus specifically on examining the influence of selected, digitally presented packaging graphical features on customer buying willingness and the resulting purchase decisions. The packaging examined differs by three independent factors, namely graphical context, description type, and background color. The stimuli include the cordless kettle as a representative of medium-involvement products, which have rarely been studied. The product is very popular and available in all home appliance stores. Moreover, it was relatively easy to design an appropriate unambiguous graphical context and provide an extended description that is understandable and familiar to all subjects. The additional rationale for choosing these specific factors lies in including both low- and high-level factors in our study. To the best of our knowledge, this factor composition has not yet been investigated, and it would be interesting to examine possible interactions with some more common graphical attributes. While some studies involved similar factors, as far as we know, none included all of them in a full-factorial experiment in the context presented. Although several investigations involve the CA framework, very few of them employ pairwise comparisons of carefully designed 3D medium-involvement product packaging. Our study differs also from most studies in this area in that it takes advantage of eigenvectors to compute relative weights for compared objects, which are then used in the CA.

In the remainder of the paper, first, we describe the theoretical frameworks that constitute the basis of our research (Secs. 2.1–2.3). Section 2.4 contains a review of studies on selected factors that shape the visual appearance of the physical and digital packaging. In Sec. 3, we provide details of the conducted experiment together with motivation and rationale for choosing specific factor levels. Section 4 presents the obtained results, and their formal statistical analyses along with the elaborated CA and purchase models. In the discussion (Sec. 5), we provide possible explanations of the results and compare them with previous studies. In addition, we outline theoretical and practical applications and propose directions for further research. We end the paper by summarizing the results and providing conclusions.

2. Theoretical Background

Customer purchase behaviors have been of theoretical and practical interest since the beginning of the human market activity. Consumer purchasing decisions are undoubtedly a complex process that is a conglomeration of the influence of many social, psychological, economic, and cultural factors. The structure of knowledge in this area is reflected in theories of consumer behavior that have been developed since the early 1960s.[21] Among the most popular are TBB,[18] TPB,[19] and CA[20] based on TOU. The purpose of these constructs is to build tools for understanding and predicting purchase behavior.

2.1. *Theory of buyer behavior*

Howard and Sheth[18] seem to have made the most comprehensive proposal in this area. Their TBB depicts the sequence of information processing in the consumer's purchase decision process. The course and effects of this process are the result of the integration of factors of a social, psychological, and marketing nature.[18,22] Figure 1 presents the general idea of the simplified TBB.

Outputs include the consumer's final decision sequence, which is the result of complex decision-making processes described by hypothetical concepts and relationships linking market (inputs), external (social, cultural, etc.) and internal (psychological) variables. The key sequence of outputs corresponds to the earlier attention, interest, desire, action (AIDA) influence model.[23] The final link in this sequence is the decision to purchase a product. The formulation of attitudes to objects, which is the result of the produced (in the complex processes of the hypothetical constructs block) hierarchy of objects considered (predisposition), attention, and comprehension, precedes this decision. Social interactions (e.g., word of mouth) trigger the processing that takes place in the hypothetical constructs block. Market messages about the attributes of the offered products contained in the inputs block also influence this processing.

The complexity of the TBB makes it probably one of the most complete descriptions of buying behavior available in the literature. On the other hand, it is difficult to use it in its entirety for practical marketing analysis.[24] Particular difficulties are posed by the operationalization of hypothetical constructs.[25] In such pragmatic applications, the TPB and its modifications proposed in the works of Ajzen[19,26,27] are more common.

2.2. *Theory of planned behavior*

The use of TPB to analyze purchasing behavior, as in TBB, involves predicting a decision to purchase a product or service. A simplified diagram of this approach is shown in Fig. 2.

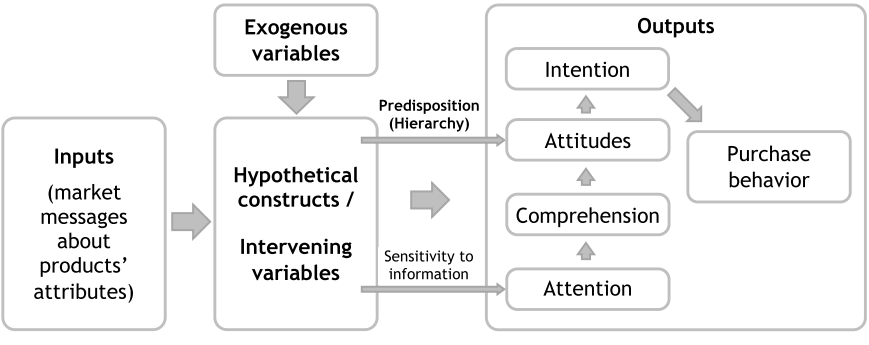

Fig. 1. The processing path within the simplified model of the TBB adapted from Refs. 18 and 22.

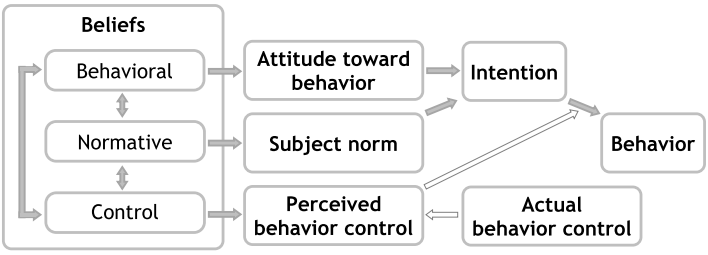

Fig. 2. Simplified and modified model of the TPB adapted from Refs. 19 and 26.

The central factor here, as in TBB, is purchase intention, determined mainly by attitude toward behavior. However, the notion of beliefs, as a subjective variable in the latest version of the model,[28] allows the use of survey data on opinions expressed in specific contexts by consumers in practical analyses. The attitude level is ultimately determined as proportional to related attributes by formula (1):

$$A \sim \sum_{i=1}^{n} b_i \cdot e_i, \tag{1}$$

where b_i is the strength of belief that a product has attribute i, and e_i is the subjective weight of the ith attribute. Thus, TPB reduces the complex processes described by TBB to a simpler approach of identifying input–output relationships that link object attributes with the buying behavior. The search for detailed forms of quantitative relationships from the model in purchase situations of specific products or services dominates TPB applications. Factor analysis and path models are typically the methodological basis. They employ validated questionnaires to study the relationships of factors composed of specific questions called items.

For example, George[29] proposed an overall structure of the TPB path model to predict online shopping intentions. The result of the study is the following relationship: "attitude depends mainly on internet trustworthiness beliefs." Hansen[30] showed a model of the influence of selected values represented by the consumer on attitude defined as willingness to buy groceries online. This study of Swedish consumers aimed at identifying a relationship in the form of a path model between selected factors describing "consumer values" and the level of attitude. Chen and Tung[31] similarly investigated the relationships that shape the intention of visiting green hotels. Beldad and Hegner[32] developed a path-based TPB model for factors that determine the level of intention to purchase fair trade products. In this proposal, the inclusion of the moderating influence of the gender variable extends the classic TPB relationships. Maksan *et al.*[33] suggested an extension of the TPB by including the ethnocentrism variable in the analysis of consumer attitudes toward different types of wine. Recently, Wu and Song[34] presented a hybrid correlation model in the analysis of elderly people's online shopping propensity combining TPB with a technology acceptance model. In this model, the perceived ease of use and usefulness shape the level of attitude toward online shopping.

One can see from the sample studies presented above that determining the level of attitude toward a shopping behavior is a key element of their goals. It can be said that the parameters of the relationship and TPB formula (1) were identified in one way or another.

2.3. *Theory of utility and conjoint analysis*

A similar perspective on purchase propensity analysis has been proposed in CA, which has been evolving along with TBB and TPB since the 1960s.[20] The primary source of the CA concept is the TOU, which originated in the field of economic science and dates back to the seminal work of Neumann and Morgenstern.[35] Utility in this area is understood as subjective satisfaction experienced by the consumer that reflects a certain consumption structure, also called the "basket of goods". Since direct satisfaction measurement is difficult to carry out, the concept of preference was introduced that quantifies utility according to the ordered basket of goods. The numerical function corresponding to this relationship is called the utility function. Of the many detailed quantitative approaches to determine this function, analysts most often use the part-worth model.[36] It is obtained by conducting full-factor experiments. For P attributes and J-rated objects, a linear combination of individual utilities represents the respondent's preference for the jth object. This can be expressed as in formula (2):

$$U_j = \sum_{p=1}^{P} f_p \cdot y_{jp}, \tag{2}$$

where U_j is the total utility of the object, f_p is the part-worth for the y_{jp} level of the p attribute.

In this context, it is also believed that people tend to maximize the global utility when making purchasing decisions. What distinguishes the CA methods from other TOU approaches is their decompositional nature. In conjoint-based analyses, object feature utilities are calculated from the overall utility retrieved from customers. In compositional methods, it is the other way round, the total utility is derived from the partial utilities of object components. In CA, we discover preferences for attribute levels, which are called part-worths along with determining the relative importance of these attributes.[20,37]

Quantitative identification of the discussed relationships allows its practical use in simulations of consumer reactions to changes in existing products and purchase attitudes toward new proposals. Preferences for attribute levels are obtained for individual subjects, so they can be the basis for the heterogeneity analysis of subjects. This, in turn, may serve to segment the population in terms of specific design solutions.[38] Another important advantage of CA-type approaches is the ability to compute the purchasing probabilities of variants according to various models. Relatively easy-to-access computational tools have led to significant development of CA applications. A broad overview of the applications of various versions of CA surveys

in the marketing area was compiled and described in detail in the works of Refs. 36, 39, and 40.

Although CA in its basic assumptions is based on slightly different sets of variables than TBB and TPB, the approach to determine utility–attribute relationships seems to coincide with the main concepts of these two theories of market behavior. The key concept of attitude toward objects that shape purchase intentions in practical applications of both theories results from differently defined object attributes. The utility function determined in CA studies, whose parameters reflect preferences, in principle, coincides with a function specified by Eq. (1). Traditional research schemes even use consumer response scales named probability of purchase while retrieving overall preferences or utilities of objects.[39] It seems that this approach is almost identical to the concept of purchase intention or expresses attitude toward object. Therefore, CA as a tool that analyzes the attribute–attitude relationship can be used for operationalization purposes of the TPB and TBB components.

The choice-based version of CA seems to be particularly suitable for research on the properties of packaging and products. In this technique, subjects make a simulated product selection instead of assessing the utility of all proposals in the set, as in the traditional version. The practical advantage of this approach is demonstrated in the experiments of Jaeger *et al.*[41] They showed the compliance of the obtained results for the products selected, in fact, with the results of realistic evaluation of photographs. These results are a rational basis for applying the CA approach in the investigation of virtual objects used in contemporary visual communication tools such as digital signage. Computer-generated images of products and packaging are increasingly often the subject of experiments, see, e.g., Refs. 15, 16, and 42. Many of the previously discussed studies adopted the CA perspective. Silayoi and Speece[43] determined the relative importance of food packaging factors for Thai consumers. Based on these indicators, they segmented the study group. CA was used similarly in the work of Refs. 16, 44, and 45.

The use of eigenvectors to determine consumer preferences in the context of CA, for complex products, was proposed in the work of Scholz *et al.*[46] The authors highlight the most significant advantages of pairwise comparisons over traditional CA approaches in retrieving preferences. In this approach, the comparison of only two objects at a time does not overburden the respondent cognitively. The authors documented in two experiments the superiority of using this approach over adaptive CA and the self-depicted weighted approach for complex products with 10–15 attributes. Moreover, subjective pairwise comparisons have been shown to provide better approximations of the relations of real objects than direct ratings of all alternatives.[47] Given these results, it is not surprising that the use of such an approach has become more and more popular. For instance, in the study,[48] this framework was employed to identify preferences toward nine versions of the digital signage screen layout profiles differentiated by two factors. Then, they were utilized as overall utilities in CA. In the work,[49] binary pairwise comparisons within the CA

framework were also used to retrieve preferences for objects that varied with the location of the brand name, typography, and background color.

Recent methodological developments further extend the approach of retrieving subjective priorities from pairwise comparisons (e.g., Ref. 50). Some of them can be applied even when the number of alternatives is large and the comparison matrix is only partly available (e.g., Refs. 51 and 52). Other extensions deal with problems where group decision-making takes place (e.g., Refs. 53 and 54).

In the research presented in this paper, we used the classical part-worth CA model to identify the factors of Eq. (2) in the context of the influence of the graphic attributes of virtual packaging on the purchase preferences of potential consumers. In the study, we also use the approach involving the eigenvector technique to determine purchase propensity preferences based on pairwise comparisons of digitally represented packaging designs. The preference vectors obtained in this way were used as utilities in identifying the parameters of Eq. (2) for each subject.

It can be noted that our research can be regarded as a practical application of the components of the TBB and TPB theories to explain the purchase behavior of consumers. Obtaining specific values for Eq. (2) can be an important extension and practical addition to both models for the analyzed context. In the TPB model, the identified relationship (2) attributes–attitudes makes it possible to practically predict purchase intentions and, consequently, behavior. Especially because the product under study belongs to the category of medium-involvement products. The TPB model in such a context is not very sensitive to the factors of subjective norms (other people's views, social pressure, etc.). Behavioral control, understood as the perception of the ease of performing the behavior for the situation studied, is full. Defining this relationship in terms of part-worths seems to be completely consistent with the concept of studying attitude (Eq. (1)) despite the terminological differences and other theoretical perspectives. In the TBB model, relation (2) can serve as a method for operationalizing the concept of information processing on the key path of this model: Inputs: Product attributes → hypothetical constructs: Predisposition (hierarchy) → output: Attitudes. Since in this study we used the factorial design for the conducted experiment, the terms graphical attributes, features, and factors are used interchangeably.

2.4. *Factors (attributes) shaping the packaging visual appearance-related literature*

Packaging conveys visual information to the customer and may be regarded as specific graphics. Apart from the product image discussed so far, the other attributes of the packaging also have a visual character. Many works over the past two decades have reported the examination of these features and their impact on consumer perception. As mentioned above, the design factors determining the final shape of the packaging are complex and often exhibit a hierarchical structure. Therefore, two different research perspectives can be found in the relevant literature, namely, the

higher-order factor approach and the low-level factor (constructive) approach.[17] The main difference between them is that the former relates to general mechanisms of the human image processing system, frequently of an abstract nature, while the latter is focused on the impact of specific, directly observable, and contextually determined features of the graphic message. Of course, the two categories are not disjoint. Often, the specific implementation of a visual message is a consequence of considering higher-order factors at the design stage. It may also happen that the results of the study of specific graphical designs can be interpreted or explained in terms of higher-order mechanisms or factors.

2.4.1. *Higher-order factor approach*

The analysis of the dependencies based on complex factors has its roots in the field of anthropology and cognitive psychology. Studies on graphical information processing have been carried out for a long time in these areas. The knowledge obtained is organized in the form of theories and/or hypotheses. Since they are related to the general mechanisms of the human image processing system, they also operate on rather general factors that characterize the visual message. Gestalt psychologists,[1] for example, elaborated several principles that govern the image construction in the human brain. They were based on empirical research on abstract graphic messages. Generally, these rules rely on the automatic grouping of image components. The process is based on several criteria, such as geometric proximity, shape similarity, contrast, or symmetry. Research conducted in this spirit since the 1980s led to the formulation of preattentive perception theories (e.g., feature integration theory[3]). They assume that visual processing begins with the phase of automatic and unconscious ordering of image components based on their specific features (e.g., color). Only in the second stage does conscious recognition of the meaning of the image occur.

With this approach, graphic information design can be assessed by examining the degree of fulfillment of the principles developed within these theories. If the rules are met, the graphical message will be more effective and efficient because it will be better suited to the processing mechanisms. However, the general principles of gestalt or preattentive processing are quite difficult to translate into specific designs, and, in practice, their operation may be limited. For example, it has been shown in Ref. 55 that color-evoked preattentivism works correctly for specific computer graphical interfaces only to a limited extent. Too detailed color-based breakdowns of interface items make it difficult to retrieve information and reduce cognitive processing efficiency.

The higher-order design factors approach was presented in the research on packaging by Orth and Malkewitz.[56] The purpose of the study was to determine the rules for building packaging that trigger the appropriate responses. These customer reactions were to be consistent with the brand owner's intentions. The opinions gathered from experienced designers allowed the authors to obtain five basic types of holistic packaging, that is, massive, contrasting, natural, delicate, and nondescript.

Based on empirical research, each type of packaging was assigned the most appropriate dimension of brand personality from Aaker's typology.[57] Although the authors showed examples of packaging belonging to particular holistic types, it seems that in a specific context, the construction of the correct packaging and even the assignment of a given design to a specific type is not a simple matter. The image perception analysis from the perspective of higher-order factors is also the subject of basic research in psychology and art. Lindell and Mueller[58] presented a review of studies on art appreciation. The works discussed in this review show that this type of investigation has a long history. Systematic experiments were already carried out in the 1960s. The general results of various analyses indicate that complex factors such as abstraction, form, complexity, prototypicality, and symmetry determine the level of perceived beauty of a painting.

Research in the area of neural science presented by Capó *et al.*[59] identified the physiological foundations of previous judgments that combined affective and cognitive processes play a significant role in shaping aesthetic preferences. From this point of view, packaging design should be treated as creating a message that shapes people's perceptions. This, in turn, requires a detailed examination of lower-order design factors. The relationships of such easily interpretable factors with the customer-induced reactions can create a practical knowledge base for designers.

2.4.2. *Low-level factors research*

Knowledge from psychology, physiology of vision, or anthropology inspires many studies on visual information conveyance, including marketing research on product packaging. From the perspective of constitutive factors, these investigations often aim at verifying to what extent the general theories developed work in practical projects, what their limitations are, and how to translate these theories into design rules in practice.

An example of such a trend is research into the implications of cerebral lateralization[60] for packaging design. The basic factor studied in this area is the relative position of the picture and the text on the packaging or the locations of individual picture components. Since the right hemisphere is better suited to process pictorial information and the left one is more logical and verbal, placing the image on the left side of the textual information favors the processing of all information. Many studies on marketing messages have confirmed the significant influence of the lateralization mechanism on the evaluation of packaging design. For example, Rettie and Brewer[9] demonstrated a better level of recalling information in a structured message according to the phenomenon discussed. Previous studies described in Ref. 2 also showed that the composition of an image, in which the most important information is on the right, scores higher aesthetic scores. However, the effect of lateralization is not unequivocal. In a study of pictures of different natures, Ishii *et al.*[61] showed a significant change in aesthetic preferences for the Japanese in relation to the English. In general, the English rated drawings with left–right directionality prettier but the

Japanese vice versa. The way of reading that differs between the two nations is a probable modifier of the phenomenon. Interestingly, other cultural factors can modify the operation of the lateralization mechanism. This is indicated by the results obtained in Ref. 43, in which the Bangkok residents preferred the right–left orientation of the picture in relation to the inscription on the food package. In the study of bottles with water and vodka, Westerman *et al.*[62] also obtained higher preferences for the orientation of the description–graphics contrary to the principles of brain laterality. Experiments presented in Togawa *et al.*[63] revealed the relationship between the place where the image of food products is located and the perceived taste of the products. The product images presented on the computer screen, placed in the lower part of the packaging design, showed a greater tendency to buy, but also more intense taste sensations of the tested samples.

An interesting trend, although not extensively followed, in research on the graphic message of packaging regards product image characteristics. The visual quality of the image was the subject of an investigation by Farooq *et al.*[64] The high reproduction quality of the product image (photorealistic) raises the degree of confidence in the high quality of the product. The structure of biscuits and snack packaging was studied by Vergura and Luceri.[17] The analysis of products shown in the context that include ingredients and spices and without additional elements showed greater emotional acceptance of the former designs. The two design approaches did not differentiate the purchasing intentions of potential consumers.

Anthropological and cultural inspirations became the basis for studies on the influence of curved and sharp-edged shapes. Psychological investigations on abstract and real graphic objects with rounded and straight shapes are reported in Ref. 65. They show that the latter are assessed negatively. The authors formulated the hypothesis that sharp shapes are associated with danger and trigger negative bias. In practical experiments on packaging marketing message factors, the shape is one of the basic attributes analyzed. The shape of the packaging itself was analyzed, among others, in Refs. 42, 43, and 45. While in the first of these studies, the analyzed shape of food packaging with rounded edges caused negative opinions, in other cases, curved shapes influenced higher ratings of the examined aspects of the information message. The influence of visual variables of beverage packaging on purchase intentions was also shown by Purwaningsih *et al.*[66] The main results of the research indicate the most important role of the attractiveness of the packaging shape and the colors used.

Research on graphical aspects of packaging also involved their relative importance to verbal information in shaping consumer reactions. The study by Vriens *et al.*[15] on the attitudes of consumers toward a newly designed car stereo equipment revealed a comparable role for graphic and verbal information in designer–customer communication. The basic role of textual information in the selection of the type of coffee was demonstrated in a simple study that included interviews with consumers in stores.[67] Information about the geographical production place along with the packaging form influenced the purchase decision.

Written information and its graphical representation can also significantly influence consumer perceptions such as perceived quality of information or usability of the product. These aspects were subject to investigation by Theetranont *et al.*[68] who tried to combine a multiattribute preference theory with a product visualization tool in the context of online shopping. Flavián *et al.*[69] carried out another investigation in this area. They investigated the influence of different product presentation modes on consumer perceptions of the quality of the website content. A significant increase in the positive website perception was obtained for product information presented in the form of a list or table.

The study of the importance of textual information in the context of other packaging design factors was presented, among others, in Ref. 43. The authors documented the positive effect of precise and expanded information versus the vague one on the likelihood of purchasing the food product. The relative weight obtained from the CA places this information third among the five factors tested. In Ref. 16, extended information was shown to be the most important factor, in addition to background color, that affects the sensory expectations of consumers of passion fruit juice. Interactions with other package design factors can modify the role of textual information. Piqueras-Fiszman *et al.*[45] showed in the example of a jam jar that text can lower the level of willingness to try. However, interaction with the ridged texture of the jar itself changes the effect of textual information to a positive one.

Color fulfills many functions in a graphic message. It is one of the factors that organize image processing of the visual message recipient. The preattentive function of color in graphical interface design has been investigated, among others, in Ref. 70. This work shows that color distinctions support searching for objects, but also that there are limitations to the positive effect of color in this respect. Generally, too small areas distinguished by different colors make it difficult to search and cancel the color preattentive advantage.

In research on food product packaging, it was demonstrated that colors can evoke various sensory associations. Ngo *et al.*[71] showed, for example, a clear predominance of blue in representing the respondents' experience in relation to still and sparkling water. Deliza *et al.*[16] in the analysis of passion fruit juice packages noted the high importance of the orange and white package background color in shaping sensory expectations. A study of the influence of food package color on the probability of purchase was presented in Ref. 43. The authors examined two levels of the color factor, namely, classic and colorful, among Asian consumers. Classic colors had a positive effect on the willingness to buy, as opposed to colorful, which lowered this index. To some extent, a similar result is shown in Ref. 56, where a negative correlation was reported between the assessment of the wine brand and the number of colors used in the label design. A recent study by Lidón *et al.*[72] indicates that product image colors are related to the phenomenon of cross-modality. In the experiment, two colors of apples were used on the juice packaging, which significantly influenced the perceived taste parameters of the juice.

2.4.3. *Other packaging-related factors*

In addition to the purely visual aspects of the packaging, technical and social factors also play an important role in shaping the consumer's attitude toward the product. Packaging material, convenience of use, nature of the brand, price, and environmental impact (recyclability) were examined in Ref. 44. The results of this experiment on yoghurts showed that many people are sensitive to the environmental impact of packaging. As many as 1/3 of the participants considered the possibility of packaging recycling as the most important factor in product selection. The applied grouping divided the surveyed consumers into the following segments: green packaging, price sensitive, convenience, and brand loyal. Krah *et al.*[73] presented similar findings. They examined the reaction of consumers to the ecolabel that indicated the level of sustainability of the packaging. The impact of material quality turned out to be an important factor in shaping purchase intentions in the experiment of Ref. 74.

Individual differences in responding to visual features are important in evaluating the visual message conveyed by packaging. Therefore, the segmentation of consumers according to design factors is also of interest to researchers. For instance, in the study of food packaging in the Thai consumer community, Silayoi and Speece[43] classified this market into three general segments, that is, convenience-oriented, image- and information-seeking.

One of the basic aspects that differentiates the overall reactions from visual attributes of messages is the individual aesthetic sensitivity. Bloch[75] proposed a systematic approach to assess this sensitivity. In an empirical study, the author showed that customers with a high degree of visual sensitivity rate products with high aesthetic quality much better than people with low sensitivity. They are also more decided as to purchase intentions.

3. Materials and Methods

The previously characterized results of research on the factors that shape subjects' preferences require appropriate research methods and techniques. Since people are the source of knowledge and, at the same time, the subject of research, identifying the influence of individual factors on participants' reactions involves the analysis of their subjective stimulus assessments. Various methods allow for obtaining this information. For example, one may directly ask about the significance of each of these factors individually. However, since the actual reception of the message carried by the packaging depends on the selection of a specific object, methods including this approach seem to better reflect the actual behavior of consumers. This belief was confirmed in the work of Mueller and Szolnoki.[42] The research therefore usually involves factorial experiments where a specific set of factors, along with definitions of their interesting levels, are defined. The participants' responses that arise from the combination of the presented variants' levels are then recorded.

For research on graphic marketing messages, the responses are usually preferences, attitude, likelihood of purchase, while the product variants pertain to specific visual features of the packaging, such as those discussed above (e.g., shape, size, layout, color, etc.). In most studies, the results of experiments obtained from factorial designs are analyzed using classical statistical methods such as analysis of variance and regression analysis, e.g., Refs. 56, 62, and 71. However, investigators increasingly often take advantage of some other, more complex approaches. Among them, the CA group of methods plays a progressively more important role in the discussed area, e.g., Refs. 16, 38, and 41.

3.1. *Experimental design and procedure*

We investigate the visual design of the cordless kettle packaging. It is a popular device, widely used, often purchased, relatively inexpensive, and generally available in stores. Thus, this type of product seems to be suitable to establish a relationship between marketing and psychological aspects of packaging perception. The digital version of its packaging allows you to eliminate other aspects of product purchase decisions, such as shape, weight, or dimensions.

Although the chosen research subject is not a message experienced as often as the packaging of food, decisions to purchase such medium-involvement products are also frequently made at the place of purchase. This place is more often e-Commerce portals. We designed 3D virtual images of packaging in a graphic program. The obtained results based on such stimuli can probably be transferred to real objects — this was suggested, for example, by Jaeger *et al.*[41] However, it is also important to gain insight into the factors that influence the assessment of preferences for the virtual objects themselves, for example, for the sake of a product presentation in electronic advertisements, catalogs of online stores,[76] or in digital signage systems.[48] The positive impact of 3D visualization of food packaging on purchasing intentions has been convincingly documented recently, for example, by Petit *et al.*[77] In view of the results of research on packaging of food, it is interesting if these relations between graphic design features and shopping preferences can be transferred to the sphere of household products. The confirmation of such a relationship for virtual models of telephone packaging is presented in Ref. 49.

The tested packaging variants presented products of a nonexistent Elektro company. While designing the experiment, we took into account the limited human visual perception and the duration of the survey. Therefore, we decided to manipulate three factors: the graphical context, description type, and background color. Each of these three independent variables was specified on two levels. The rationale of choosing them is as follows.

The results of Underwood *et al.*[13] constituted a particular motivation for our research. They documented the increase in consumers' attention level through packaging designs containing the appropriate graphic image of the product. Significant dependencies were observed only for little-known brands and products with a

relatively high degree of perceptive benefit. In other words, the graphical product presentation should induce appropriate cognitive processing and expectation of product sensory experience. This result, together with the previously mentioned cross-modality effects,[63] were an inspiration to check if the context of use related to the cordless kettle has any impact on customers' perception. Therefore, in this study, we present the product either surrounded by a cup of tea and a cookie or without such a graphical context.

Suggestions from research on the role of text in shaping the evaluation of food packaging are included, among others, in the works.[43,67] In particular, Silayoi and Speece[43] showed the positive impact of extended and precise information in relation to the vague one on the likelihood of purchase. Being inspired by this finding, we also examine this effect in the present investigation. The product description was either concise — only basic information was presented, or extended — with some product details provided.

In the previously mentioned study on virtual images of passion fruit juice packaging,[16] the background color turned out to be one of the key factors that influence participants' sensory perception. Very complex relations regarding the influence of colors on subjects' experiences prompted us to examine only simplified monochrome background designs for the varieties of virtual packaging tested. White and black colors were used as they minimize the difficulty of controlling very diverse associations between colors and affective responses.[71]

We designed eight packaging variants in the 3D Max software for research purposes. They corresponded to all combinations of the investigated factor levels and are shown graphically in Fig. 3.

We employed a full factorial, within-subjects experimental design. Each participant evaluated all eight packaging variants by means of pairwise comparisons. There were 28 different pairs, and the task was to assess to what extent a given digital packaging variant is more persuasive in terms of the purchase decision. Subjects responded to the following question: "Which product packaging encourages you more to buy the product?" The default web browser displayed horizontally two experimental conditions at a time. Participants provided answers by selecting the appropriate radio button that corresponded to one of the following five scale items: decidedly left, rather left, no preference, rather right and decidedly right. The order of appearance of the comparisons was random. The entire procedure took about 15 min.

We used relative weights computed based on the outcomes of the pairwise comparisons as the dependent measure of the participants' purchase willingness. The software derived relative weights by calculating the eigenvector associated with the maximum eigenvalue of the matrix with the results of pairwise comparisons from each subject. The eigenvector was then standardized in such a way that the sum of its components equals 1. These eigenvector elements are interpreted as relative weights for the assessed variants. The bigger the value of the relative weight, the higher the preference.

Fig. 3. All eight experimental conditions differed in background color, description type, and graphical context.

Such an approach is widely used.[78,79] For example, in Ref. 80 one may find a detailed description of its classical version and a rich overview of the applications of this method in various decision-making spheres. Davies[81] proposed the concept of including AHP in marketing knowledge-based support systems and discussed the application of this method in making marketing decisions since the 1980s. Among the relatively few marketing applications, the approach to the selection of advertising strategies is noteworthy, as shown, e.g., in the work of Kwak *et al.*[82] In Kwong and Bai,[83] pairwise comparisons were used to determine the importance of weights for planning the product of a hair dryer. Wang *et al.*[84] proposed a similar method for the design of a new pencil in the context of quality function deployment (QFD). Possibly the first application of the approach discussed in the domain of visual communication search was put forward in Ref. 48. In this work, the authors used pairwise comparisons to retrieve preference vectors for various types of screen design in digital signage.

The essence of determining the hierarchy of assessed objects in this approach lies in comparing them in pairs, which simplifies the cognitive demands placed on decision-makers by restricting the pool of possible options at a given time.[79] Furthermore, there is some evidence that simultaneously evaluating only two variants increases the quality and precision of the obtained data.[47] Although the effect of comparisons in the experimental study is the vector of priorities for individual objects, the evaluation itself is also, in a sense, a choice-based technique in which a choice is made in each comparison between two objects.

Table 1. Characteristics of 82 participants who correctly filled in the questionnaires.

Variable	Category	Value	Percentage
	Females	59	73%
	Males	23	27%
Age	18–25 years	16	20%
	26–35 years	43	52%
	36–45 years	18	22%
	>45 years	5	6%
Monthly net income	$<2{,}000$ PLN (≈ 500 €*)	12	14.6%
	2,000–2,999 PLN (≈ 750 €)	17	20.7%
	3,000–3,999 PLN ($\approx 1{,}000$ €)	18	22.0%
	$\geq 4{,}000$ PLN	35	42.7%
Education	Secondary	10	12%
	Higher	72	88%

Notes: *Approximated values in Euros were calculated with a simplified exchange rate of 1 € $\approx$ 4 PLN. One should keep in mind that income in various countries has different purchasing power.

The external company sent an email invitation to potential participants asking them to take part in the survey. The respondents did not receive any payment for their participation. The invitation email content included a direct hyperlink to the web page prepared on the https://www.webankieta.pl/platform. This system collected and stored sociodemographic data and pairwise comparison results. After all subjects completed the experiments, the raw data were sent to the authors as an MS Excel file. A custom software implemented in MS Visual Basic processed the data received to calculate relative weights based on comparison matrices. We imported these results along with sociodemographic data into the TIBCO Statistica version 13.3 software for formal statistical analysis. The weights calculated for all participants were also imported to custom modules implemented in Matlab R2019a to obtain CA results and perform all product choice simulations and prepare purchase models.

3.2. *Participants*

The target group was customers of retail chains. A hired external company collected the data. Overall, 100 people completed the survey. After the verifying of the data received from the company, 82 questionnaires were qualified for further research and analysis. The investigators rejected questionnaires with errors that they could not fix. Of the 82 properly completed questionnaires, women represented 73% (59) and men — 27% (23). Table 1 includes the characteristics of the respondents.

4. Results

This section consists of two subsections. In the first, we provide basic descriptive statistics of the results, obtained experimental condition rankings, and formal

statistical analyses of the differences between the examined factors. The second subsection includes results of the performed conjoint analyses along with the purchase probability models.

4.1. *Relative preferences*

4.1.1. *Descriptive statistics*

The basic descriptive statistics of the relative preference weights for all participants examined are included in Table 2. Minimum scores ranged from 0.013 to 0.033, while maximum values were between 0.222 and 0.386. Medians were smaller than means as the skewness was positive, except for the case with black background with graphical context and an extended description for which we observed negative skewness. The kurtosis values were decidedly the highest (>5) for the two variants with a concise description: with the graphical context on the white background and without the graphical context on the black background. Standard errors did not exceed 0.1 under any experimental condition. The mean preference weights were noticeably the highest for the two variants with the graphical context and extended descriptions. The least influential packaging designs involved concise descriptions without accompanying graphical context.

Basic descriptive statistics for the relative weights computed individually for women and men are put together in Tables A.1 and A.2, respectively, in Appendix A. Mean relative weights for all examined packaging variants are graphically presented in Fig. 4 separately for the female and male participants. The graph shows some gender variations, however, mean standard errors shown as vertical bars suggest that these discrepancies may not be meaningful. A standard two-way analysis of variance (experimental condition $\times$ gender) was employed to verify if differences in relative weight means between men and women for the conditions examined are statistically significant. The results are put together in Table A.3 revealed that experimental conditions, in general, significantly differentiated mean relative scores [$F(7,640) = 22.7$, $p < 0.0001$, $\eta^2 = 0.20$], whereas the gender effects along with the gender $\times$ experimental condition interaction were statistically meaningless ($p > 0.5$).

Table 2. Descriptive statistics of relative preference weights for 82 subjects (69 females, 29 males).

Background color	Description	Context	Mean	Median	Min	Max	Std. error	Skewness	Kurtosis
White	Concise	Yes	0.106	0.098	0.020	0.386	0.059	1.75	5.53
		No	0.063	0.042	0.019	0.222	0.041	1.41	1.79
	Extended	Yes	0.194	0.183	0.030	0.372	0.099	0.20	−1.08
		No	0.110	0.085	0.031	0.380	0.080	1.65	2.40
Black	Concise	Yes	0.127	0.115	0.018	0.369	0.079	0.95	0.88
		No	0.079	0.060	0.013	0.345	0.063	2.09	5.03
	Extended	Yes	0.192	0.208	0.033	0.371	0.098	−0.14	−1.03
		No	0.129	0.108	0.026	0.375	0.081	1.48	1.67

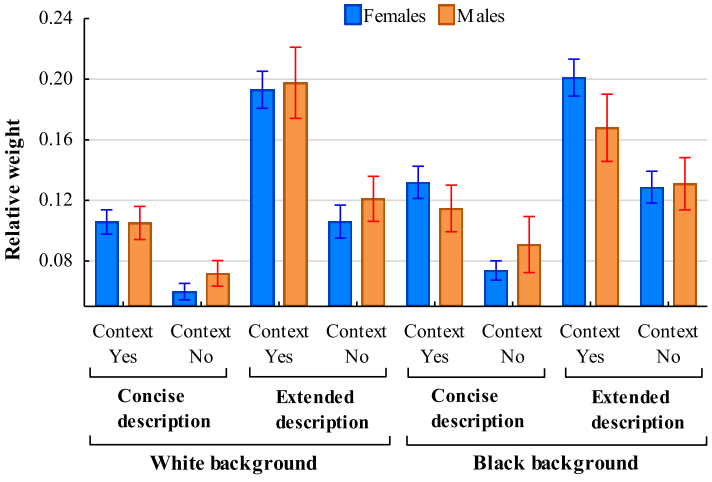

Fig. 4. Mean preference weights for all experimental conditions, including gender differences. Whiskers denote mean standard errors. The effect of experimental condition was significant [$F(7,640) = 22.7$, $p < 0.0001$, $\eta^2 = 0.2$], the gender and the interaction of experimental condition × gender were insignificant ($p > 0.5$).

Table A.4 from Appendix A contains LSD Fishers' *post-hoc* tests for all pairs of examined experimental conditions. It shows that only between seven out of 28 pairs of packaging designs, the discrepancies were statistically irrelevant. No differences were noticed between variants with the graphical context, including the concise description and the item without context but with the extended description. The situation occurred for both backgrounds ($p > 0.7$). Another four statistically insignificant discrepancies were noted between variants differing only in the background color.

4.1.2. *Ranking of experimental conditions*

To determine the ranking of all packaging variants examined, we used relative preference weights. The best-rated design was assigned rank one, whereas the worst variant was associated with rank eight. In addition to the overall ranking, we also derived the rankings for females and males. In Fig. 5 we present graphically the outcome of this procedure. The results clearly show that conditions with both graphical context and extended descriptions were decidedly the best, whereas variants without graphical contexts and additional descriptions were the last in the rankings in all cases. One may also notice some differences between males and females. Women seem to rank variants with black backgrounds slightly higher.

The overall ranking can be analyzed in conjunction with the *post-hoc* tests from Table A.4. The first- and second-best variants differ only in the background color and the discrepancy in their mean relative weights is statistically irrelevant ($p = 0.83$). The third element of this ranking is like the fourth and fifth variants ($p = 0.85$ and $p = 0.11$, respectively). There is also no statistical difference between the fourth and

Fig. 5. Rankings for all experimental conditions including gender differences.

fifth ranks ($p = 0.16$), fifth and sixth ($p = 0.70$), as well as between the seventh and eighth ($p = 0.20$) ones. In the next subsection, we present further formal factorial analysis.

4.1.3. *Analysis of variance for relative weights of the examined factors*

We formally examined the relative preferences by means of a classical three-way analysis of variance that involved the background color, description type, and context type variables. As the gender effect did not have any significant impact on preferences, we have excluded it from the analysis. The ANOVA results are given in Table 3. They show the statistical significance of the background color factor

Table 3. Three-way ANOVA results for the influence of background color (BC), description type (DT), and graphical context (GC), on mean preference weights.

Effect	SS	*df*	MSS	*F*	*p*	η^2
Background color (BC)	0.0294	1	0.0294	4.93	0.0267*	0.0075
Description type (DT)	0.6469	1	0.6469	108.60	<0.0001**	0.1435
Graphical context (GC)	0.5777	1	0.5777	96.97	<0.0001**	0.1302
BC × DT	0.0042	1	0.0042	0.71	0.40	
BC × GC	0.0025	1	0.0025	0.43	0.52	
DT × GC	0.0316	1	0.0316	5.30	0.0216*	0.0081
BC × DT × GC	0.0079	1	0.0079	1.33	0.25	
Error	3.86	648	0.0060			

Notes: *$\alpha < 0.05$; **$\alpha < 0.0001$.

$[F(1,648) = 4.93, p = 0.0267, \eta^2 = 0.0075]$, however, the effect size measured by eta squared, according to Cohen's interpretation,[85] is considered small. The effects of description type and context type were also statistically meaningful $[F(1,648) = 108.60, p < 0.0001, \eta^2 = 0.1435; F(1,648) = 96.97, p < 0.0001, \eta^2 = 0.1302$, respectively]. The size effects of these factors can be classified as large. The only significant interaction observed was between description type and context type, but its size effect was small $[F(1,648) = 5.30, p = 0.0216, \eta^2 = 0.0081]$.

Figures 6–9 graphically illustrate all statistically meaningful differences. Subjects, on an average, better rated conditions with black background than white background. They decidedly better assessed variants including extended descriptions than those with a basic description. The involvement of the graphical context resulted in a considerable increase of mean relative preference scores in comparison to packaging without such a context.

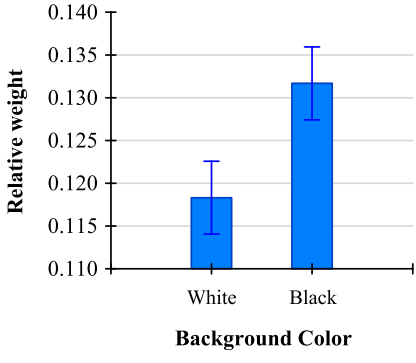

Fig. 6. Effect of background color on mean preference weights. Whiskers denote mean standard errors $[F(1,648) = 4.93, p = 0.0267, \eta^2 = 0.0075]$.

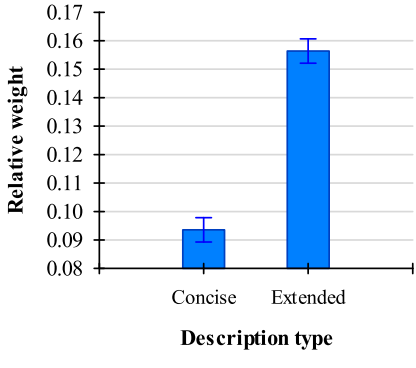

Fig. 7. Effect of description type on mean preference weights. Whiskers denote mean standard errors $[F(1,648) = 108.60, p < 0.0001, \eta^2 = 0.1435]$.

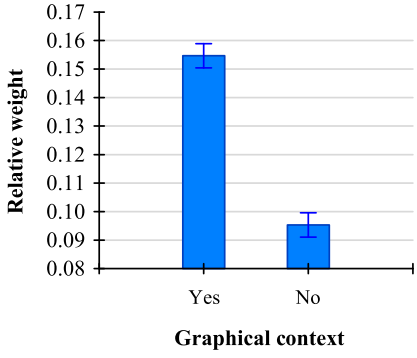

Fig. 8. Effect of graphical context on mean preference weights. Whiskers denote mean standard errors. [$F(1,648) = 96.97$, $p < 0.0001$, $\eta^2 = 0.1302$].

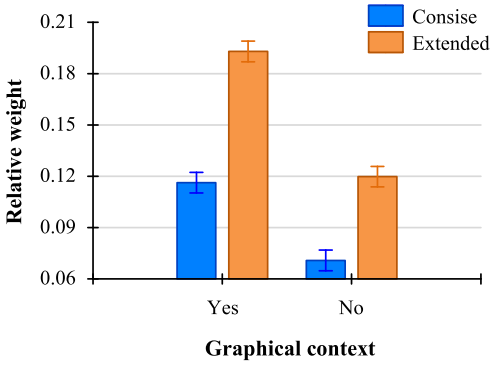

Fig. 9. Effect of description type × graphical context interaction on mean weights. Whiskers denote mean standard errors [$F(1,648) = 5.30$, $p = 0.0216$, $\eta^2 = 0.0081$].

The significant interaction description type × graphical context suggests that adding an extended description increases the assessment of variants with a context larger than conditions without context (Fig. 9). We further examined this interaction by performing Fisher's LSD *post-hoc* pairwise comparisons. The results are summarized in Table 4 and show that there is only an insignificant difference between the

Table 4. Fisher's LSD *post-hoc* pairwise comparisons for the description type × graphical context interaction effect.

Description	Context	Concise Yes	Concise No	Extended Yes
Concise	Yes	×		
Concise	No	< 0.0001**	×	
Extended	Yes	< 0.0001**	< 0.0001**	×
Extended	No	0.685	< 0.0001**	< 0.0001**

Notes: **$\alpha < 0.0001$.

variant with a context and a concise description and the option without a context but including an extended description.

4.2. *Conjoint analyses*

4.2.1. *Overall results*

We conducted CA for all participants and separately for males and females to check if there were differences between those two groups. Relative weights along with the examined factors were used for performing dummy-based regressions while calculating conjoint results. The aggregate-level relative importance and part-worth estimates for all participants and the investigated groups are given in Table 5.

The data for all subjects clearly show that the description type factor was deemed as the most valuable one with the relative importance larger than 46%. The graphical context feature of the packaging was only slightly better (almost 44%), while background color markedly impacted the participant's decisions the least, with a relative importance of about 10%. These conjoint relative importance are in concordance with the effect sizes obtained within the formal analysis of variance approach and provide additional insight into the relative dependencies between the examined factors.

Since we have employed dummy variable-based linear regression approach, the consecutive utilities for all experimental conditions, that is, examined versions of packaging, can be easily calculated by simply adding up partial utilities corresponding to the factor levels of a given variant. Negative values of partial utilities suggest a decrease, whereas positive ones suggest an increase in the overall utility for a given factor level. In particular, white background color, concise description type, and lack of graphical context negatively affect the total utility. On the other hand, the black background color, the extended description, and the inclusion of the graphical context had a positive effect on the variant total utility. These findings, in general, correspond quite well to the mean relative weights of Figs. 6–9.

Table 5. Conjoint analyses results.

Factors and factor levels	Partial utilities and relative importance		
	Females	Males	All subjects
Background color	12.0%	2.1%	9.9%
White	−0.00886	−0.00111	−0.00669
Black	0.00886	0.00111	0.00669
Description type	43.5%	56.7%	46.3%
Concise	−0.03219	−0.02939	−0.03140
Extended	0.03219	0.02939	0.03140
Graphical context	44.5%	41.1%	43.8%
Yes	0.03293	0.02132	0.02967
No	−0.03293	−0.02132	−0.02967

Similarly, as in the case of relative weight formal analysis, we examined whether the conjoint results for female and male subjects exhibit differences. Given the statistically insignificant effect of gender on the overall results presented in Sec. 4.1.3, we did not expect any impact. Surprisingly, the conjoint relative importance appeared to be considerably different for women and men.

The results presented in Table 5 indicate that background color is considerably less important for males than females — 2% versus 12%, although the partial utilities were positive for black and negative for white colors in both genders. Moreover, the description type feature was decidedly the most significant for men (almost 57%) whereas according to women, this factor was only in the second place (43.5%), just after graphical context (44.5%).

4.2.2. *Purchase models — product choice simulations*

Calculated within the conjoint framework, partial utilities can be used for predicting purchase choices made by potential customers. Various approaches in this regard are available. In this section, we present the application of the maximum utility model (also known as the first-choice model), and two probability-based approaches, that is, Bradley–Terry–Luce,[86,87] and logit probability models. The results obtained by performing simulations according to these methods are put together in Table 6. As in the previous section, here we also provide calculations for all participants as well as separately for males and females.

The first-choice model in our research shows how often a specific package variant would incline customers to make the purchase. More specifically, what is the percentage of giving the top priority to the variant while buying? Figure 10 graphically demonstrates these results. They show a considerable discrepancy between the two variants, including graphical context with extended descriptions on white or black backgrounds, and the rest of the experimental conditions. Packaging including a graphical context with more textual details about the product will constitute either about 30% (on the white background) or almost 40% (on the black background) of the customers' first buying choices. Excluding the graphical context results in a drastic drop of the first-choice percentages down to less than 10%. The simulation model shows that conditions with a white background and concise descriptions will seldom be selected as the first. The graph also shows some meaningful differences between the first choices made by females and males. Women tend to select variants with the extended description and graphical context more often if the background is black. For men, such a discrepancy does not exist. Furthermore, the condition with the extended description and without the graphical context was rated better by females than by males if the background was white. For the black background, the situation was reversed: the bigger percentage of men chose this packaging variant.

Figure 11 illustrates the results of the Bradley–Terry–Luce purchase probability model. The outcomes agree with the first-choice model and show the highest probability of purchase decisions for variants with an extended description and graphical

Table 6. Purchase model simulations.

Background color	Description	Context	First-choice maximum utility model			Bradley–Terry–Luce probability model			Logit probability model		
			Females	Males	All	Females	Males	All	Females	Males	All
White	Concise	Yes	1.7%	0%	1.2%	0.1165	0.1154	0.1162	0.1238	0.1237	0.1237
		No	0%	0%	0%	0.0545	0.0749	0.0602	0.1162	0.1187	0.1169
	Extended	Yes	28.8%	34.8%	30.5%	0.1791	0.1736	0.1776	0.1319	0.1313	0.1317
		No	11.9%	4.3%	9.8%	0.1152	0.1305	0.1195	0.1237	0.1256	0.1242
Black	Concise	Yes	6.8%	4.3%	6.1%	0.1350	0.1170	0.1299	0.1262	0.1239	0.1255
		No	1.7%	8.7%	3.7%	0.0709	0.0805	0.0736	0.1182	0.1195	0.1186
	Extended	Yes	40.7%	34.8%	39.0%	0.1966	0.1751	0.1906	0.1343	0.1314	0.1334
		No	8.5%	13.0%	9.8%	0.1322	0.1330	0.1324	0.1257	0.1259	0.1258

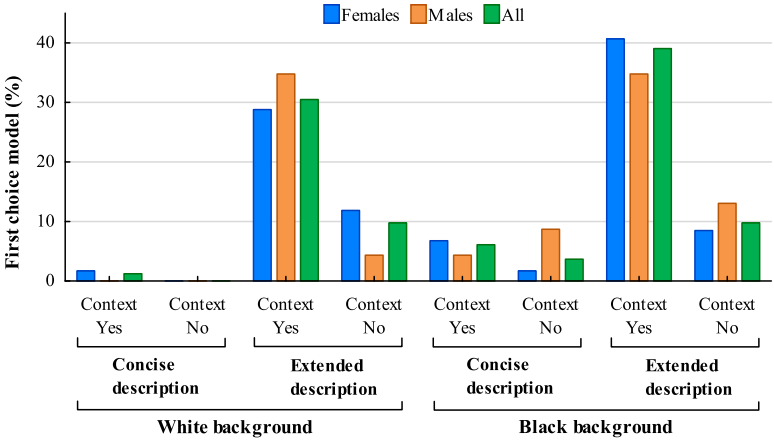

Fig. 10. First-choice purchase probability model.

context. For other experimental conditions, the differences were not as distinct as in the first-choice model. The purchase probabilities for the following four digital packages were similar: the concise description with the graphical context, both for black and white backgrounds, and two variants with extended descriptions and without graphical contexts also for black and white backgrounds. The smallest probability of purchase was obtained for items including only a brief description and without a context, however, the values were bigger compared to the previous model. As far as gender differences are concerned, one may observe that in the three conditions without the graphical context, the probabilities for males were greater than for females. In three other cases in which the graphical context was used, the probabilities for women were higher than for men. Generally, differences in probabilities between women and men were less noticeable than in the first-choice model.

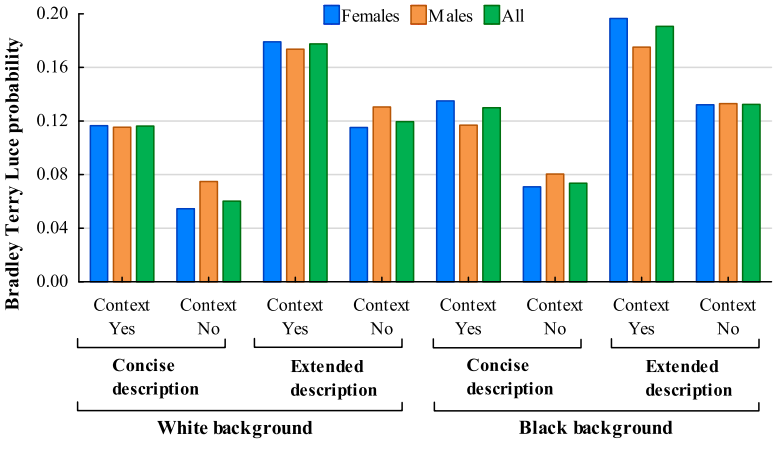

Fig. 11. Bradley–Terry–Luce purchase probability model results.

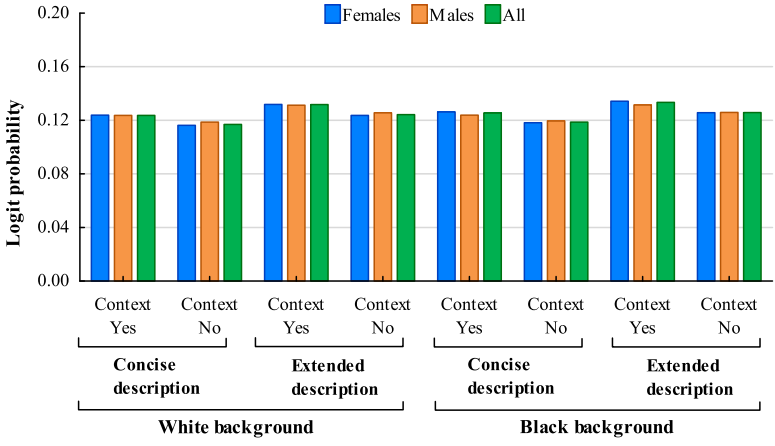

Fig. 12. Logit probability model of purchase decision results.

In Fig. 12 we graphically present the simulations according to the logit probability model. In general, the results show much less evident differences among the conditions examined. One can see that customers, the most likely, will purchase the variants with extended description and graphical context. The purchase probabilities for all other variants differed only slightly. The data, at large, show no meaningful discrepancies between women and men as well.

5. Discussion

5.1. *Summary of the results and explanations*

In this research, we focus on the influence of medium-involvement product packaging on the customers' perceptive willingness to buy. More specifically, we examine three graphical characteristics of a digital presentation of a cordless kettle package. Two of them were the so-called low-level factors, that is, the background color and product description type, and one high-level factor, the product graphical context. Based on these three features specified on two levels, each of eight digital graphical packaging designs was elaborated and investigated. The presented findings show a statistically significant impact of all examined effects on the subjects' willingness to buy, which according to the presented purchase probability models would translate to real-life customer behavior. The analysis of variance effect sizes and conjoint relative importance indicates that the surrounding graphical context and the description type were considerably more influential than the background color. As a result, packaging variants with the additional graphical context and extended descriptions, involving both white and black backgrounds, scored the highest.

Although the extended text on graphical stimuli was barely visible and difficult or even impossible to read, the willingness to buy of such products was considerably greater. It seems that for medium-involvement goods, the potential thorough

description is enough even though they are not able to read and analyze the textual content. Such detailed information may indicate the professional approach of the manufacturer to provide broad information to customers about technical features. Furthermore, despite not being able to read and assess the product additional information, customers may value the possibility to refer to it later, e.g., after purchasing the product.

The result indicating the role of extended textual information is especially compatible with the research on the packaging factors of food products. For example, in the study,[43] the assessment of purchase propensity examined with the conjoint technique, extended text information on packaging exhibited the relative importance comparable to those for color, graphics and packaging shape, and higher than the layout parameter.

The expanded textual information in experiments where participants are required to study its content plays the most important role. This applies to both virtually presented technical products in Ref. 15, and food.[16] In the work of Safrizal *et al.*,[67] in turn, direct interviews showed the primary role of textual information on the actual coffee packaging in real purchases. In this context, the results obtained in our research indicate the existence of an additional potential value resulting from the very fact of placing extended textual information even if it is independent of the substantive content.

The provision of the graphical context in the packaging constitutes another essential factor that significantly influences the buying decisions of customers. Presenting a product surrounded by objects related to typical positive situations of its usage probably evokes associations and triggers positive emotions. This, in turn, may translate to a higher inclination to buy it, which was revealed in our purchase probability model. The effect in this study was strong and is in concordance with other research involving product usage context, e.g., Refs. 16 and 72. This influence seems to be related to the phenomenon of cross-modality. In the previously mentioned study by Vergura and Luceri,[17] the presentation of a biscuit context in the form of selected product ingredients did not influence the willingness to buy. However, it should be emphasized that the context chosen by the authors was of a more informational and analytical character, while in our experiment, placing a cup of tea and a cookie probably evoked emotional associations. Thus, most likely as in the experiments of Deliza *et al.*[16] or Lidón *et al.*,[72] this context triggers the positive sensory expectation.

While statistically significant, the relative importance of the packaging background color effect turned out to be the smallest in all analyses performed. Thus, it may be treated as a supplementary and secondary factor that affects customer decisions. Despite that, in the face of strong competition in a given market, it may make a difference if other more influential factors are on a similar level.

Generally, subjects scored considerably better packaging with black background than white, which was confirmed by both analysis of variance and CA. This result might be related to some psychological associations of the black color. There exist

some bad connotations with black like, e.g., death, evil, or aggression,[88] however, in this study, the participants must have focused on positive associations such as power (judges, priests), attractiveness, sophistication, and elegance. Black dominates on several various exclusive brand logos or luxury vehicles. Some investigations have also shown that black is a preferable color for clothing, especially for women.[89] People in black (or red) were shown to be perceived as more attractive[90] and our results suggest that a similar situation occurs for household appliances demonstrated on a black packaging background. This may result from the fact that clothing can be classified, like cordless kettles, as medium-involvement products.

Although classical statistical approaches did not reveal any gender-related differences, the conducted CA suggest a substantial discrepancy between relative importance for the background color feature. It seems that the background color in our study was decidedly more important for females than for males. This finding might be of use when planning a separate marketing campaign for women and men.

5.2. *Theoretical and practical implications*

This study provides several implications that can be useful in better understanding and further developments of the customer purchasing behavior. The research fits well to the main and well-established theoretical approaches in this area, that is, TBB, TPB. The obtained results contribute to the extension of detailed knowledge regarding relations between object attributes and their relations with purchase propensity. These can be incorporated into models developed under the TBB and TPB frameworks.

Referring to the utility theory that underlies the CA concept, our study provides additional insights on partial utilities of the investigated factors and their levels within the context of medium-involvement products. Since the outcomes presented involved a full-factorial design, they can constitute a basis for prospective research that excludes observed insignificant interactions. This will allow researchers to include other potentially interesting factors or increase the number of factor levels examined.

From a practical point of view, the partial utilities along with factor relative importance obtained within the CA framework give information that can be translated into specific guidelines while graphically designing packaging for medium-involvement products. In particular, the results presented show that there is a significant positive influence of the graphical context on the customer preferences. This can be directly taken advantage of by including an additional graphical context that is related with the given product use, into the description presented in web-based retail platforms. For instance, e-shops may consider presenting cordless kettles accompanied by a cup of tea and a cookie as in our experiments. The same recommendation can be followed while designing other marketing graphical messages used in more classical places such as billboards or advertisements in paper magazines. Similarly, they should consider providing extended textual information on the

product package, since, according to our findings, it considerably increases the customer preferences.

Because we performed CA separately for both women and men, one can practically use the results to develop product packaging specifically adjusted to the given gender. Then, these different graphical designs can be used, for instance, in marketing campaigns involving e-mail messages, which are directed to appropriate target recipients. On the same principle, banners on websites can be tailored for registered users of the electronic shop for whom the specific gender is known. The same applies to conducting marketing campaigns on social media and search engines of various kinds. The gender can also be determined by facial recognition software that takes advantage of recent developments in artificial intelligence algorithms and computer vision technology.[7] Thus, it is feasible to create or change the graphical message content dynamically depending on whether a man or woman is looking at it. Such solutions could be applied in places where advertisements are presented digitally and a video camera with the appropriate software is available. Some examples include large screens in public spaces or computer monitors that are currently used often at supermarket checkout counters or in elevators. It is also possible to place an appropriate version of the advertisement in locations where a specific gender is known to be predominant, such as women in beauty or hairdressing salons. Similarly, we can use the results of this study to decide which version of the product packaging should be used in TV commercials before, during and after programs devoted primarily to the specific gender.

Furthermore, the simulations presented of purchasing behavior for all examined experimental conditions provide a direct notion of how the derived partial utilities influence product buying probabilities. In this case, the distinct behavior predicted for men and women can also be taken advantage of in practical situations, for instance, while making simulations and predictions about specific product demands.

5.3. *Limitations and future research directions*

As in any experimentally-based research, several issues should be considered while drawing conclusions from the presented data and extending them to the whole population. The sample used in this study might not be representative, e.g., there is a large proportion of subjects with high education and all subjects were Poles. Thus, the presented findings require further examination involving bigger samples and more comprehensive systematic control of a number of sociodemographic and economic variables.

There are some limitations and problems usually related to the application of CA approaches, such as the complexity and versatility of these techniques in relation to other methods.[36,39] Despite the significant effort to correctly apply and calculate the necessary parameters, it is still possible that the measurements do not reflect the real views of the respondents adequately. Furthermore, CA research that involve factorial experiments, such as the one employed in this study, are quite limited and

troublesome as the number of experimental conditions grows very quickly with the number of factors and their levels. There exist some recommendations and methods for limiting the number of experimental conditions, such as the use of fractional factorial designs, or dynamically changing the number of variants assessed based on the previous decisions of respondents.[91,92] Unfortunately, in some cases, the application of these proposals may lead to giving up on some potentially important insights like the identification of attributes' interactions. Even by employing these techniques, scientists finally must restrict their interest to selected subsets of the variables of interest.

Another problem that complicates research is the complex psychological and sociocultural mechanisms of image perception. Affective processes influencing image assessment are integrated with cognitive processes and it is often difficult to control all aspects and variables in a given context in experiments.[59] Especially since, as shown, inter alia, in the work of Bloch *et al..*,[75] the phenomena discussed also differ between individuals. Therefore, most of the works presented here include rather limited ranges of variables and problems. It seems, however, that a constant increase in the number of examined fragments of reality, in addition to the practical usefulness of the acquired knowledge, also allows us to better understand the universal laws governing visual communication.

Despite the above-mentioned problems, future research should also involve other products to verify if this study's outcomes hold for different medium-involvement goods. It may be especially important since, from the specific e-Commerce perspective, there might be a possible misalignment between the chosen product along with its packaging and the web site-related purchase context. In general, our experimental setup refers to broadly understood digital signage, such as advertisements used in digital outdoor billboards or pictures presented on screen monitors in elevators or at supermarket cashiers. However, in the context online shopping, it should also be taken into account that graphical factors influencing the online purchase decisions, examined in this study, may be perceived differently depending on the type of device, e.g., mobile phones, tablets, or desktop computers.[93] This aspect should also be addressed in future studies with additional control of the customer emotional state resulting from the effort required to find the information.[94]

Comparative experiments including different categories of products would be interesting as well. Additional directions of further research could include, other than those used in this paper, low- and high-level factors. Moreover, this study can motivate researchers to conduct similar new experiments in which they will use videos of the product and its packaging instead of static graphical messages. All the more that such videos are especially persuasive and are more and more commonly used to present products.[95,96]

One can also consider the inclusion of qualitative studies to account for the observed differences. Another possible extension of this investigation may involve eye-tracking devices to assess the subjects' visual activity while making purchase

decisions. This could facilitate drawing some inferences about perceptual strategies and their relations with buying products.

6. Conclusions

Graphical digital presentation is ubiquitous in the modern world, and we meet digital product representations not only on our smartphones, tablets, and computers, but also outdoors, in shopping malls, ATMs, or even elevators. Therefore, understanding if and in what way such a marketing message affects people is of great interest both for scientists and practitioners. Our research tried to add some more insight into this problem. The results obtained confirm that digitally demonstrated packaging plays an important role in shaping customer purchase decisions.

We examined a medium-involvement product packaging differed by a combination of factors and interactions between them that have not been previously studied. Both low-level (constitutive) attributes and the high-level factor were involved. The presented outcomes extend our knowledge about how people perceive various variants of packaging design, and how it may influence their purchase decisions. The results may be used for extending and providing more detailed classical models of purchasing behavior, that is, TBB and TPB.

From a methodological point of view, we combined the relative weight extraction based on eigenvectors with the CA. This proved to be an interesting approach that allowed us to make more in-depth analyses and led to the development of purchase probability models that predict the real-life buying behavior of customers. Due to this approach, we were also able to detect considerable differences between females and males, which were not obvious while applying classical statistical methods.

Using the CA approach, we identified the relative importance of the examined factors — it will help the designers focus on the most relevant features first. This information may be useful while designing product packages and presenting products in a digital form in various contexts.

Acknowledgments

We would like to thank the four anonymous reviewers for providing their opinions, valuable comments, and suggestions for the earlier version of the paper. We are certain that the changes made in response to them resulted in a significantly better paper. This research was partially financially supported by Polish National Science Centre under Grant No. 2017/27/B/HS4/01876.

Appendix A

Table A.1. Descriptive statistics for 69 females and all experimental conditions.

Background color	Description	Context	Mean	Median	Minimum	Maximum	Std. error	Skewness	Kurtosis
White	Concise	Yes	0.106	0.098	0.020	0.386	0.062	2.01	6.61
		No	0.060	0.042	0.019	0.222	0.041	1.79	3.38
	Extended	Yes	0.193	0.190	0.031	0.372	0.094	0.22	−1.01
		No	0.106	0.082	0.031	0.380	0.084	1.98	3.47
Black	Concise	Yes	0.132	0.119	0.018	0.369	0.082	1.07	1.29
		No	0.074	0.056	0.016	0.247	0.049	1.60	2.95
	Extended	Yes	0.201	0.210	0.033	0.371	0.094	−0.20	−0.76
		No	0.129	0.108	0.035	0.344	0.081	1.54	1.73

Table A.2. Descriptive statistics for 29 males and all experimental conditions.

Background color	Description	Context	Mean	Median	Minimum	Maximum	Std. error	Skewness	Kurtosis
White	Concise	Yes	0.105	0.106	0.033	0.234	0.053	0.60	−0.12
		No	0.072	0.058	0.021	0.154	0.040	0.58	−0.98
	Extended	Yes	0.198	0.169	0.030	0.372	0.112	0.14	−1.31
		No	0.121	0.113	0.031	0.250	0.071	0.54	−1.08
Black	Concise	Yes	0.115	0.091	0.025	0.242	0.074	0.48	−1.37
		No	0.091	0.062	0.013	0.345	0.089	1.82	2.68
	Extended	Yes	0.168	0.174	0.035	0.345	0.106	0.10	−1.50
		No	0.131	0.110	0.026	0.375	0.083	1.41	2.25

Table A.3. Two-way ANOVA results for all experimental conditions and gender.

Effect	SS	*df*	MSS	*F*	*p*	η^2
Experimental condition (EC)	0.95	7	0.136	22.7	$< 0.0001^{**}$	0.20
Gender	0	1	0	0	1	
EC × Gender	0.034	7	0.0049	0.824	0.57	
Error	3.83	640	0.0060			

Notes: $^{**}\alpha < 0.0001$.

Table A.4. LSD Fishers' *post-hoc* tests for all experimental conditions.

No (Rank)	Back-ground color	Description	Context	1 (6)	2 (8)	3 (1)	4 (5)	5 (4)	6 (7)	7 (2)
1 (6)	White	Concise	Yes	×						
2 (8)			No	$< 0.0001^{**}$	×					
3 (1)		Extended	Yes	$< 0.0001^{**}$	$< 0.0001^{**}$	×				
4 (5)			No	0.702	$< 0.0001^{**}$	$< 0.0001^{**}$	×			
5 (4)	Black	Concise	Yes	0.075	$< 0.0001^{**}$	$< 0.0001^{**}$	0.162	×		
6 (7)			No	0.026^{*}	0.203	$< 0.0001^{**}$	0.009^{*}	$< 0.0001^{**}$	×	
7 (2)		Extended	Yes	$< 0.0001^{**}$	$< 0.0001^{**}$	0.833	$< 0.0001^{**}$	$< 0.0001^{**}$	$< 0.0001^{**}$	×
8 (3)			No	0.049^{*}	$< 0.0001^{**}$	$< 0.0001^{**}$	0.113	0.850	$< 0.0001^{**}$	$< 0.0001^{**}$

Notes: $^{*}\alpha < 0.05$, $^{**}\alpha < 0.0001$, values in brackets denote ranks of variants.

References

1. K. Koffka, Perception: An introduction to the Gestalt-Theorie, *Psychological Bulletin* **19**(10) (1922) 531–585, doi: 10.1037/h0072422.
2. J. G. Beaumont, Lateral organization and aesthetic preference: The importance of peripheral visual asymmetries, *Neuropsychologia* **23**(1) (1985) 103–113, doi: 10.1016/0028-3932(85)90048-X.
3. A. M. Treisman and G. Gelade, A feature-integration theory of attention, *Cognitive Psychology* **12**(1) (1980) 97–136, doi: 10.1016/0010-0285(80)90005-5.
4. A. Treisman, Perceptual grouping and attention in visual search for features and for objects, *Journal of Experimental Psychology: Human Perception and Performance* **8**(2) (1982) 194–214, doi: 10.1037/0096-1523.8.2.194.
5. E. Hopkins, Machine learning tools, algorithms, and techniques in retail business operations: Consumer perceptions, expectations, and habits, *Journal of Self-Governance & Management Economics* **10**(1) (2022) 43–55, doi: 10.22381/jsme1012023.
6. T. Kliestik, K. Zvarikova and G. Lăzăroiu, Data-driven machine learning and neural network algorithms in the retailing environment: Consumer engagement, experience, and purchase behaviors, *Economics, Management, and Financial Markets* **17**(1) (2022) 57, doi: 10.22381/emfm17120224.
7. T. Kliestik, E. Kovalova and G. Lăzăroiu, Cognitive decision-making algorithms in data-driven retail intelligence: Consumer sentiments, choices, and shopping behaviors, *Journal of Self-Governance & Management Economics* **10**(1) (2022) 30–42, doi: 10.22381/jsme1012022.
8. E. Nica, O.-M. Sabie, S. Mascu and A. G. Luţan (Petre), Artificial intelligence decision-making in shopping patterns: Consumer values, cognition, and attitudes, *Economics, Management, and Financial Markets* **17**(1) (2022) 31, doi: 10.22381/emfm17120222.
9. R. Rettie and C. Brewer, The verbal and visual components of package design, *Journal of Product & Brand Management* **9**(1) (2000) 56–70, doi: 10.1108/10610420010316339.
10. Y. Sook-Fern, T. Cheng-Ling, L. Kah-Boon and K. Yong-Hwi, Product packaging: Impact on customers' purchase intention, *International Journal of Business and Society* **21**(2) (2020) 857–864, doi: 10.33736/ijbs.3298.2020.
11. M. C. Rebouças, M. D. C. P. Rodrigues, B. B. A. Ferreira and S. M. D. Freitas, Evaluation of the effect of label attributes over the purchase intention of a cashew nut functional beverage using conjoint analysis, *Food Science and Technology International* **27**(2) (2021) 164–171, doi: 10.1177/1082013220942434.
12. P. Kotler and K. L. Keller, *A Framework for Marketing Management*, 5th edn. (Prentice Hall, 2011).
13. R. L. Underwood, N. M. Klein and R. R. Burke, Packaging communication: Attentional effects of product imagery, *Journal of Product & Brand Management* **10**(7) (2001) 403–422, doi: 10.1108/10610420110410531.
14. R. L. Underwood and N. M. Klein, Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand, *Journal of Marketing Theory and Practice* **10**(4) (2002) 58–68, doi: 10.1080/10696679.2002.11501926.
15. M. Vriens, G. H. Loosschilder, E. Rosbergen and D. R. Wittink, Verbal versus realistic pictorial representations in conjoint analysis with design attributes, *Journal of Product Innovation Management* **15**(5) (1998) 455–467, doi: 10.1111/1540-5885.1550455.
16. R. Deliza, H. Macfie and D. Hedderley, Use of computer-generated images and conjoint analysis to investigate sensory expectations, *Journal of Sensory Studies* **18**(6) (2003) 465–486, doi: 10.1111/j.1745-459X.2003.tb00401.x.

17. D. T. Vergura and B. Luceri, Product packaging and consumers' emotional response. Does spatial representation influence product evaluation and choice?, *Journal of Consumer Marketing* **35**(2) (2018) 218–227, doi: 10.1108/JCM-12-2016-2021.
18. J. A. Howard and J. N. Sheth, *Theory of Buyer Behavior* (John Wiley & Sons, New York, 1969).
19. I. Ajzen, From intentions to actions: A theory of planned behavior, in *Action Control: From Cognition to Behavior*, eds. J. Kuhl and J. Beckmann (Springer, Berlin, Heidelberg, 1985), pp. 11–39, doi: 10.1007/978-3-642-69746-3_2.
20. R. D. Luce and J. W. Tukey, Simultaneous conjoint measurement: A new type of fundamental measurement, *Journal of Mathematical Psychology* **1**(1) (1964) 1–27, doi: 10.1016/0022-2496(64)90015-X.
21. J. N. Sheth, A review of buyer behavior, *Management Science* **13**(12) (1967) B-718, doi: 10.1287/mnsc.13.12.B718.
22. D. L. Loudon and A. J. D. Bitta, *Consumer Behavior: Concepts and Applications* (McGraw-Hill, New York, Auckland, 1993).
23. E. K. Strong, *The Psychology of Selling and Advertising* (McGraw-Hill, New York, 1925), https://catalog.hathitrust.org/Record/000475708.
24. J. U. Farley and L. W. Ring, An empirical test of the Howard-Sheth model of buyer behavior, *Journal of Marketing Research* (1970), doi: 10.1177/002224377000700401.
25. H. T. Manuere, L. Chikazhe and J. Manyeruke, Theoretical models of consumer behaviour: A literature review, *International Journal of Education Humanities and Social Science* **5**(22) (2022) 105–112, https://doi.org/10.54922/IJEHSS.2022.0368.
26. I. Ajzen, The theory of planned behavior, *Organizational Behavior and Human Decision Processes* **50**(2) (1991) 179–211, doi: 10.1016/0749-5978(91)90020-T.
27. I. Ajzen and M. Fishbein, The influence of attitudes on behavior, in *The Handbook of Attitudes*, eds. D. Albarracin, B. T. Johnson and M. P. Zanna (Erlbaum, Mahwah, NJ, 2005), pp. 173–221.
28. E. Ulker-Demirel and G. Ciftci, A systematic literature review of the theory of planned behavior in tourism, leisure and hospitality management research, *Journal of Hospitality and Tourism Management* **43** (2020) 209–219, doi: 10.1016/j.jhtm.2020.04.003.
29. J. F. George, The theory of planned behavior and Internet purchasing, *Internet Research* **14**(3) (2004) 198–212, doi: 10.1108/10662240410542634.
30. T. Hansen, Consumer values, the theory of planned behaviour and online grocery shopping, *International Journal of Consumer Studies* **32**(2) (2008) 128–137, doi: 10.1111/j.1470-6431.2007.00655.x.
31. M.-F. Chen and P.-J. Tung, Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels, *International Journal of Hospitality Management* **36** (2014) 221–230, doi: 10.1016/j.ijhm.2013.09.006.
32. A. Beldad and S. Hegner, Determinants of fair trade product purchase intention of Dutch consumers according to the extended theory of planned behaviour, *Journal of Consumer Policy* **41**(3) (2018) 191–210, doi: 10.1007/s10603-018-9384-1.
33. M. T. Maksan, D. Kovačić and M. Cerjak, The influence of consumer ethnocentrism on purchase of domestic wine: Application of the extended theory of planned behaviour, *Appetite* **142** (2019) 104393, doi: 10.1016/j.appet.2019.104393.
34. J. Wu and S. Song, Older adults' online shopping continuance intentions: Applying the technology acceptance model and the theory of planned behavior, *International Journal of Human–Computer Interaction* **37**(10) (2021) 938–948, doi: 10.1080/10447318.2020.1861419.
35. J. Neumann and O. Morgenstern, *Theory of Games and Economic Behavior* (Princeton University Press, Princeton, 1944), http://archive.org/details/in.ernet.dli.2015.215284.

36. P. E. Green and V. Srinivasan, Conjoint analysis in consumer research: Issues and outlook, *Journal of Consumer Research* **5**(2) (1978) 103–123, doi: 10.1086/208721.
37. D. H. Krantz and A. Tversky, Conjoint-measurement analysis of composition rules in psychology, *Psychological Review* **78**(2) (1971) 151–169, doi: 10.1037/h0030637.
38. P. E. Green and A. M. Krieger, Segmenting markets with conjoint analysis, *Journal of Marketing* **55**(4) (1991) 20–31, doi: 10.1177/002224299105500402.
39. P. E. Green and V. Srinivasan, Conjoint analysis in marketing: New developments with implications for research and practice, *Journal of Marketing* **54**(4) (1990) 3–19, doi: 10.2307/1251756.
40. P. E. Green, A. M. Krieger and Y. Wind, Thirty years of conjoint analysis: Reflections and prospects, in *Marketing Research and Modeling: Progress and Prospects: A Tribute to Paul E. Green*, eds. Y. Wind and P. E. Green (Springer US, Boston, MA, 2004), pp. 117–139, doi: 10.1007/978-0-387-28692-1_6.
41. S. R. Jaeger, D. Hedderley and H. J. H. MacFie, Methodological issues in conjoint analysis: A case study, *European Journal of Marketing* **35**(11/12) (2001) 1217–1239, doi: 10.1108/EUM0000000006474.
42. S. Mueller and G. Szolnoki, The relative influence of packaging, labelling, branding and sensory attributes on liking and purchase intent: Consumers differ in their responsiveness, *Food Quality and Preference* **21**(7) (2010) 774–783, doi: 10.1016/j.foodqual.2010.07.011.
43. P. Silayoi and M. Speece, The importance of packaging attributes: A conjoint analysis approach, *European Journal of Marketing* **41**(11/12) (2007) 1495–1517, doi: 10.1108/03090560710821279.
44. J. Rokka and L. Uusitalo, Preference for green packaging in consumer product choices - Do consumers care?, *International Journal of Consumer Studies* **32**(5) (2008) 516–525, doi: 10.1111/j.1470-6431.2008.00710.x.
45. B. Piqueras-Fiszman, C. Velasco, A. Salgado-Montejo and C. Spence, Using combined eye tracking and word association in order to assess novel packaging solutions: A case study involving jam jars, *Food Quality and Preference* **28**(1) (2013) 328–338, doi: 10.1016/j.foodqual.2012.10.006.
46. S. W. Scholz, M. Meissner and R. Decker, Measuring consumer preferences for complex products: A compositional approach based on paired comparisons, *Journal of Marketing Research* **47**(4) (2010) 685–698, doi: 10.1509/jmkr.47.4.685.
47. W. W. Koczkodaj, Testing the accuracy enhancement of pairwise comparisons by a Monte Carlo experiment, *Journal of Statistical Planning and Inference* **69**(1) (1998) 21–31, doi: 10.1016/S0378-3758(97)00131-6.
48. J. Grobelny and R. Michalski, Various approaches to a human preference analysis in a digital signage display design, *Human Factors and Ergonomics in Manufacturing & Service Industries* **21**(6) (2011) 529–542, doi: 10.1002/hfm.20295.
49. J. Grobelny and R. Michalski, The role of background color, interletter spacing, and font size on preferences in the digital presentation of a product, *Computers in Human Behavior* **43** (2015) 85–100, doi: 10.1016/j.chb.2014.10.036.
50. J. Zhang, G. Kou, Y. Peng and Y. Zhang, Estimating priorities from relative deviations in pairwise comparison matrices, *Information Sciences* **552** (2021) 310–327, doi: 10.1016/j.ins.2020.12.008.
51. H. Wang, G. Kou and Y. Peng, An iterative algorithm to derive priority from large-scale sparse pairwise comparison matrix, *IEEE Transactions on Systems, Man, and Cybernetics: Systems* **52**(5) (2022) 3038–3051, doi: 10.1109/TSMC.2021.3049604.
52. X. Chao, G. Kou, T. Li and Y. Peng, Jie Ke versus AlphaGo: A ranking approach using decision making method for large-scale data with incomplete information, *European Journal of Operational Research* **265**(1) (2018) 239–247, doi: 10.1016/j.ejor.2017.07.030.

53. C. Lin, G. Kou, Y. Peng and F. E. Alsaadi, Aggregation of the nearest consistency matrices with the acceptable consensus in AHP-GDM, *Annals of Operations Research* **316**(1) (2022) 179–195, doi: 10.1007/s10479-020-03572-1.
54. Y. Li, G. Kou, G. Li and Y. Peng, Consensus reaching process in large-scale group decision making based on bounded confidence and social network, *European Journal of Operational Research* **303**(2) (2022) 790–802, doi: 10.1016/j.ejor.2022.03.040.
55. R. Michalski, The influence of color grouping on users' visual search behavior and preferences, *Displays* **35**(4) (2014) 176–195, doi: 10.1016/j.displa.2014.05.007.
56. U. R. Orth and K. Malkewitz, Holistic package design and consumer brand impressions, *Journal of Marketing* **72**(3) (2008) 64–81, doi: 10.1509/jmkg.72.3.64.
57. J. L. Aaker, Dimensions of brand personality, *Journal of Marketing Research* **34**(3) (1997) 347–356, doi: 10.1177/002224379703400304.
58. A. K. Lindell and J. Mueller, Can science account for taste? Psychological insights into art appreciation, *Journal of Cognitive Psychology* **23**(4) (2011) 453–475, doi: 10.1080/20445911.2011.539556.
59. M. À. Capó, C. J. Cela-Conde, E. Munar, J. Rosselló and M. Nadal, Towards a framework for the study of the neural correlates of aesthetic preference, *Spatial Vision* **21**(3–5) (2008) 379–396, doi: 10.1163/156856808784532653.
60. R. W. Sperry, Cerebral organization and behavior: The split brain behaves in many respects like two separate brains, providing new research possibilities, *Science* **133**(3466) (1961) 1749–1757, doi: 10.1126/science.133.3466.1749.
61. Y. Ishii, M. Okubo, M. E. R. Nicholls and H. Imai, Lateral biases and reading direction: A dissociation between aesthetic preference and line bisection, *Brain and Cognition* **75**(3) (2011) 242–247, doi: 10.1016/j.bandc.2010.12.005.
62. S. J. Westerman *et al.*, The design of consumer packaging: Effects of manipulations of shape, orientation, and alignment of graphical forms on consumers' assessments, *Food Quality and Preference* **27**(1) (2013) 8–17, doi: 10.1016/j.foodqual.2012.05.007.
63. T. Togawa, J. Park, H. Ishii and X. Deng, A packaging visual-gustatory correspondence effect: Using visual packaging design to influence flavor perception and healthy eating decisions, *Journal of Retailing* **95**(4) (2019) 204–218, doi: 10.1016/j.jretai.2019.11.001.
64. S. Farooq, S. Habib and S. Aslam, Influence of product packaging on consumer purchase intentions, *International Journal of Economics, Commerce and Management* **3**(12) (2015) 538–547.
65. M. Bar and M. Neta, Humans prefer curved visual objects, *Psychological Science* **17**(8) (2006) 645–648, doi: 10.1111/j.1467-9280.2006.01759.x.
66. I. Purwaningsih, S. Surachman, P. Pratikto and I. Santoso, Influence of packaging element on beverage product marketing, *International Review of Management and Marketing* **9**(6) (2019) 205–210, doi: 10.32479/irmm.8831.
67. Safrizal R. Fadhil and D. Nurba, Packaging strategies in Gayo arabica ground coffee, *IOP Conference Series: Earth and Environmental Science* **644**(1) (2021) 012041, doi: 10.1088/1755-1315/644/1/012041.
68. C. Theetranont, P. Haddawy and D. Krairit, Integrating visualization and multi-attribute utility theory for online product selection, *International Journal of Information Technology and Decision Making* **06**(4) (2007) 723–750, doi: 10.1142/S0219622007002691.
69. C. Flavián, R. Gurrea and C. Orús, The effect of product presentation mode on the perceived content and continent quality of web sites, *Online Information Review* **33**(6) (2009) 1103–1128, doi: 10.1108/14684520911011034.

70. R. Michalski and J. Grobelny, The role of colour preattentive processing in human–computer interaction task efficiency: A preliminary study, *International Journal of Industrial Ergonomics* **38**(3–4) (2008) 321–332, doi: 10.1016/j.ergon.2007.11.002.
71. M. K. Ngo, B. Piqueras-Fiszman and C. Spence, On the colour and shape of still and sparkling water: Insights from online and laboratory-based testing, *Food Quality and Preference* **24**(2) (2012) 260–268, doi: 10.1016/j.foodqual.2011.11.004.
72. I. Lidón, R. Rebollar, I. Gil-Pérez, J. Martín and J. L. Vicente-Villardón, The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences, *Packaging Technology and Science* **31**(10) (2018) 689–697, doi: 10.1002/pts.2407.
73. S. Krah, T. Todorovic and L. Magnier, Designing for packaging sustainability. The effects of appearance and a better eco-label on consumers' evaluations and choice, *Proceedings of the Design Society: International Conference on Engineering Design* **1**(1) (2019) 3251–3260, doi: 10.1017/dsi.2019.332.
74. A. F. Asri, C. T. Chik, M. H. M. Rais and N. Othman, SME product packaging: How to attract consumers?, *The International Journal of Business Society* **4**(7) (2020) 102–109, doi: 10.30566/ijo-bs/2020.23.
75. P. H. Bloch, Seeking the ideal form: Product design and consumer response, *Journal of Marketing* **59**(3) (1995) 16–29, doi: 10.2307/1252116.
76. D. A. Griffith, R. F. Krampf and J. W. Palmer, The role of interface in electronic commerce: Consumer involvement with print versus on-line catalogs, *International Journal of Electronic Commerce* **5**(4) (2001) 135–153, doi: 10.1080/10864415.2001.11044219.
77. O. Petit, A. Javornik and C. Velasco, We eat first with our (digital) eyes: Enhancing mental simulation of eating experiences via visual-enabling technologies, *Journal of Retailing* (2021) S0022435921000336, doi: 10.1016/j.jretai.2021.04.003.
78. T. L. Saaty, A scaling method for priorities in hierarchical structures, *Journal of Mathematical Psychology* **15**(3) (1977) 234–281, doi: 10.1016/0022-2496(77)90033-5.
79. T. L. Saaty, *The Analytic Hierarchy Process* (McGraw Hill, New York, 1980).
80. F. Zahedi, The analytic hierarchy process—A survey of the method and its applications, *Interfaces* **16**(4) (1986) 96–108, doi: 10.1287/inte.16.4.96.
81. M. Davies, Adaptive AHP: A review of marketing applications with extensions, *European Journal of Marketing* **35**(7/8) (2001) 872–894, doi: 10.1108/EUM0000000005729.
82. N. K. Kwak, C. W. Lee and J. H. Kim, An MCDM model for media selection in the dual consumer/industrial market, *European Journal of Operational Research* **166**(1) (2005) 255–265, doi: 10.1016/j.ejor.2004.02.016.
83. C. K. Kwong and H. Bai, Determining the importance weights for the customer requirements in QFD using a fuzzy AHP with an extent analysis approach, *IIE Transactions* **35**(7) (2003) 619–626, doi: 10.1080/07408170304355.
84. H. Wang, M. Xie and T. N. Goh, A comparative study of the prioritization matrix method and the analytic hierarchy process technique in quality function deployment, *Total Quality Management* **9**(6) (1998) 421–430, doi: 10.1080/0954412988361.
85. J. Cohen, *Statistical Power Analysis for the Behavioral Sciences* (Routledge, 2013), doi: 10.4324/9780203771587.
86. R. A. Bradley and M. E. Terry, Rank analysis of incomplete block designs: I. The method of paired comparisons, *Biometrika* **39**(3/4) (1952) 324, doi: 10.2307/2334029.
87. R. D. Luce, *Individual Choice Behavior: A Theoretical Analysis* (Courier Corporation, 2005).
88. M. G. Frank and T. Gilovich, The dark side of self- and social perception: Black uniforms and aggression in professional sports, *Journal of Personality and Social Psychology* **54**(1) (1988) 74–85, doi: 10.1037/0022-3514.54.1.74.

89. I. Bakker, T. V. D. Voordt, P. Vink, J. D. Boon and C. Bazley, Color preferences for different topics in connection to personal characteristics, *Color Research & Application* **40**(1) (2015) 62–71, doi: 10.1002/col.21845.
90. S. C. Roberts, R. C. Owen and J. Havlicek, Distinguishing between perceiver and wearer effects in clothing color-associated attributions, *Evolutionary Psychology* **8**(3) (2010) 147470491000800320, doi: 10.1177/147470491000800304.
91. M. Steiner and M. Meißner, A user's guide to the galaxy of conjoint analysis and compositional preference measurement, *Marketing ZFP* **40**(2) (2018) 3–25, doi: 10.15358/0344-1369-2018-2-3.
92. D. Naous and C. Legner, Leveraging market research techniques in IS: A review and framework of conjoint analysis studies in the IS discipline, *Communications of the Association for Information Systems* **49**(1) (2021) 126–155, doi: 10.17705/1CAIS.04906.
93. S. Barta, C. Flavián and R. Gurrea, Managing consumer experience and online flow: Differences in handheld devices vs PCs, *Technology in Society* **64** (2021) 101525, doi: 10.1016/j.techsoc.2020.101525.
94. C. Flavián-Blanco, R. Gurrea-Sarasa and C. Orús-Sanclemente, Analyzing the emotional outcomes of the online search behavior with search engines, *Computers in Human Behavior* **27**(1) (2011) 540–551, doi: 10.1016/j.chb.2010.10.002.
95. C. Orús, R. Gurrea and C. Flavián, Facilitating imaginations through online product presentation videos: Effects on imagery fluency, product attitude and purchase intention, *Electronic Commerce Research* **17**(4) (2017) 661–700, doi: 10.1007/s10660-016-9250-7.
96. C. Flavián, R. Gurrea and C. Orús, The influence of online product presentation videos on persuasion and purchase channel preference: The role of imagery fluency and need for touch, *Telematics and Informatics* **34**(8) (2017) 1544–1556, doi: 10.1016/j.tele.2017.07.002.