

## **Liking and not liking – understanding the package preference with eye-tracking**

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# **Liking and not liking – understanding the package preference with eye-tracking**

The objective of this research was to elucidate consumer preferences concerning food packaging, specifically comparing opaque plastic packaging with its transparent counterpart. The study engaged 34 young students, whose gaze patterns were recorded utilizing eye-tracking technology as they viewed mock-up representations of food packaging. After their visual assessment participants evaluated the two packaging styles utilizing a seven-point Likert scale. Previous evidence within the literature has predominantly shown a consumer preference favoring transparent packaging. However, in the current study the non-transparent packaging garnered more favorable ratings regarding perceptions of quality, appeal, perceived costliness, and environmental friendliness. This preference may be attributed to an adverse association with the evidently plastic content of the transparent packaging. Eye-tracking data disclosed a pattern where participants consistently engaged in more prolonged fixations on the upper section of the opaque packaging, suggesting an effort to infer the nature of the material.

Keywords: Eye-tracking; Package preference; Packaging design; Food products

## **1 Introduction**

Packaging is a much-neglected area of marketing communications, yet, packages carry important functional and emotional properties. Indeed, packaging has often been referred to as ‘the silent salesman’ or ‘the part of clothing a product wears’. From the MarCom perspective, a package needs to be attractive and recognizable; the material has to fulfill the required needs to protect and often also hold the product and keep it fresh, as is the case in frozen products, for instance, but it can also affect consumers’ willingness to buy the product. The use of non-biodegradable packaging materials has raised concern over landfill disposal and recycling availability, particularly among the younger consumers (Copley, 2014).

This study investigates consumer preferences for food packaging, recognizing its strategic role in capturing attention, creating positive associations, and shaping expectations,

ultimately influencing product selection. The investigation of this study entailed a comparative analysis of two packaging alternatives of a perishable food item crafted from potato and shaped into doughnuts, sold frozen but designed to be served hot. The product was derived from vegetables that would typically be discarded due to aesthetic imperfections or surplus production. The product has a shelf life of five days and necessitate shielding from oxygen, moisture, and lipid contamination. The packaging design alternatives were developed ensuring the product's protection during the physical distribution and warehousing phases. The initial design comprised a transparent, self-supporting pouch fabricated from polypropylene (PP) with an inherent resistance to freezing temperatures. This pouch could be sealed using either a metallic or plastic fastener. Transparency has emerged as a preferred choice within the food and beverage sector, spanning an array of product categories. This aligns with a consumer expectation favoring visual transparency, allowing them to evaluate the content before purchase (Sabo et al., 2017; Simmonds et al., 2018; Simmonds & Spence, 2016). This effect persists even when identical products are presented in both transparent and opaque formats, with the transparent option consistently eliciting stronger purchase intentions and a higher likelihood of selection (Billeter et al., 2012; Chandran et al., 2009; Simmonds & Spence, 2016).

Conversely, the second design proposed a similar self-standing pouch, which was enveloped in a white print that rendered it opaque. The objective of this printed layer was to augment the package's protective barrier against ultraviolet (UV) radiation and to bestow upon it an aesthetic reminiscent of paper as recent trends in consumer behavior signal an ecological pivot. Surveys indicate that in the UK and USA, eco-friendly packaging solutions and the avoidance of plastic were deemed paramount in the pursuit of sustainable consumption. Particularly representatives of Generation Z, defined as individuals born between 1996 and 2011, have been recognized for their commitment to sustainability (Le et

al., 2022; Statista, 2021, 2023c). Despite the environmental challenges, the advantages of plastic packaging materials are undeniable: They are cost-effective and lightweight, offering a diverse range of physical and optical properties (Marsh & Bugusu, 2007). The purpose of this research is to investigate what kind of packages (opaque or transparent) young consumers prefer.

## **2 Methods and material**

The study comprised two phases and methodological approaches. Eye-tracking technology was applied to measure participants' fixations, defined as intervals of relative ocular immobility, and the 'fixation time,' denoting the length of these intervals (Barbierato et al., 2023; Du, 2016; Pieters & Warlop, 1999; Puurtinen et al., 2021). The correlation between these fixation points and brand preference is well-documented; items that garner prolonged attention typically are the ones selected in the end (Barbierato et al., 2023; Du, 2016; Pieters & Warlop, 1999; Van Loo et al., 2021). The measurements were undertaken within a controlled research laboratory environment, utilizing the Tobii Pro X3-120 eye tracker. Subsequently, a questionnaire was administered to delve into the self-reported predilections of the participants to gain a deeper understanding of the motivations underpinning these preferences.

### **2.1 Hypotheses**

To examine young consumers' preferences for food packaging, three hypotheses were formulated:

H1. Participants prefer a transparent packaging over opaque packaging.

H2. The perceived eco-friendliness of the packaging has a positive impact on the willingness to purchase.

H3. The participant's aversion to plastics has a negative impact on the willingness to purchase.

Hypothesis 1 posited that consumers exhibit a preference for packaging solutions that offer visibility of the product within. This was predicated on extant literature that consistently highlights a marked preference among subjects for the ability to view the actual food product (Billeter et al., 2012; Chandran et al., 2009; Deng et al., 2013; Simmonds et al., 2018; Simmonds & Spence, 2016).

Hypothesis 2 conjectured that the perceived environmental friendliness of packaging significantly influences consumer purchase intent. This assumption aligned with the observable shift in consumer behavior towards eco-consciousness, with a preference for products and brands that embody environmental and ethical values and package preference (Ketelsen et al., 2020; Prakash & Pathak, 2016).

Hypothesis 3 was formulated based on the growing consumer inclination for sustainability, particularly the tendency to avoid plastic in food purchases. This inclination was supported by the substantial generation of plastic packaging waste from food and beverage consumption, prompting manufacturers to innovate more sustainable product and packaging solutions (Frommeyer et al., 2023; Magnier & Cri e, 2015; Nguyen et al., 2019; Simmonds & Spence, 2016; Statista, 2023a, 2023b).

## ***2.2 Stimulus material preparation***

Two prototype images of product packaging were generated with AUTOCAD software displaying identical potato rings, a product purportedly from a non-existent brand and company to nullify any brand associations. The mock-up packages were congruent in shape and size, yet they diverged in terms of the transparency: One version making the contents visible, while the alternative version presenting an obscured view (see Figure 1).



Figure 1. Visual stimuli of the study.

The images were prepared with Tobii Pro Lab 1.181.37603 software. Five different areas of interest (AOIs) were manually generated for stimulus and labeled as “Top”, “Closing”, “Left Side”, “Center”, and “Right side” according to their locations as depicted in Figure 2.



Figure 2. AOIs defined for the packages. The areas are for calculating quantitative eye movement measures.

Identifying Areas of Interest (AOIs) enables the measurement of total fixation duration, providing a gauge of participants’ visual attentiveness to different segments.

### ***2.3 Measurements and data analysis***

The participants comprised 34 students from the Turku University of Applied Sciences specializing in the same academic discipline. With a degree of freedom of 30, the t-distribution is regarded as equaling the normal distribution, according to the central limit theorem (Kwak & Kim, 2017). The participants were both male (18) and female (16) with ages spanning from 19 to 33 years (mean age of 23.6 years, standard deviation of 2.90). Homogenous convenience sampling technique was employed to minimize the in-group variation and to enhance the recognition of the phenomenon under investigation (Jager et al., 2017).

First, each participant underwent a calibration process with the system to guarantee the precision of the eye-tracking measurements. Thereafter, participants received a set of instructions for the task as on-screen guidance and verbally. The participants were individually exposed to singular images in a sequence determined by randomization. Participants were allotted a ten-second interval to view each image presented centrally on a 23-inch monitor. Following the visual presentation, participants were prompted to articulate responses to a battery of questions designed to assess the packaging's agreeableness, perceived expense, quality, ecological soundness, intriguing nature, affordability, attractiveness, and the propensity for purchase. In addition, participants answered questions independent of the images regarding their perceptions of product packaging quality and price, preferences for product packaging materials, and food waste purchase intentions (as detailed in the Appendix B and Table 2). The participants' responses were gauged on a 7-point Likert scale to rate the degree to which they agree or disagree with a statement, ranging from 1, indicating 'completely disagree', to 7, denoting 'completely agree' (Norman, 2010; Sullivan & Artino, 2013). The data was exported to the statistical computing environment R for further post-processing and statistical analysis (see also Appendix A).

The study adhered to ethical standards set by the Research Ethics Committee of the Turku University of Applied Sciences (Ethical review number 08032022-1). Due to the sensitivity of eye tracking data, it remains confidential, as outlined in the Ethical Statement, and cannot be shared. Participation was voluntary, based on informed consent, and limited personal data (sex and age) was collected with no monetary incentives provided.

### 3 Results

The change in the transparency of the packaging produced statistically significant difference in only one AOI.

Table 1. Fixations on AOIs and their differences.

Area of Interest	Measure	Mean opaque	Mean clear	Sd opaque	Sd clear	T-test p-value	Significance
Top	Total duration of fixations	520.3	250.6	487.4	313.0	0.0088	**
Closing	Total duration of fixations	633.8	867.6	676.0	559.4	0.1252	
Center	Total duration of fixations	4518	4676	1828.4	1728.7	0.7153	

Left Side	Total duration of fixations	755.7	771.9	675.0	769.2	0.9269	
Right Side	Total duration of fixations	234.9	252.0	365.4	575.9	0.8844	

The response distributions for the individual items within the questionnaire are graphically represented in Figure 3. The estimation of these distributions, indicated by red lines, has been generated through the application of the loess function—Local Polynomial Regression Fitting—utilized within the R statistical software. The subfigures are labeled to distinguish between the two types of packaging, with 'O:' denoting opaque packaging and 'T:' indicating transparent packaging. Additionally, the degree of the participants' aversion to plastics was quantified via a discrete inquiry, the responses to which were numerically denoted (1: 9 responses, 2: 15 responses, 3: 6 responses, 4: 3 responses, 5: 0 responses, 6: 1 response, 7: 0 responses). The precise queries from the questionnaire are catalogued within the Appendix B.

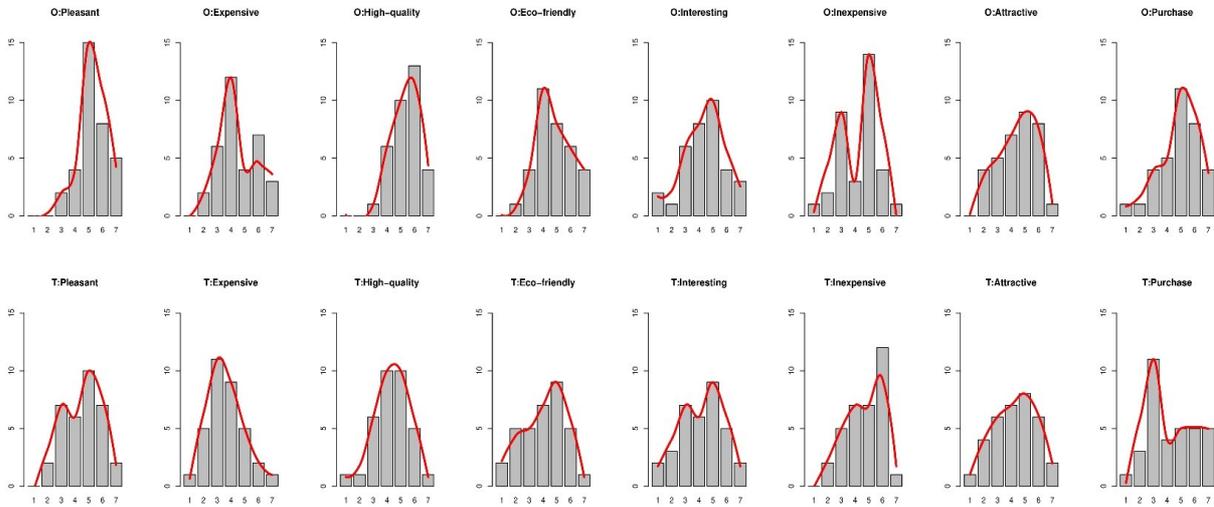


Figure 3. Barplot presentation of the answers. The figure illustrates the distribution of the questionnaire answers.

While the distributions in Figure 3 appear to be relatively similar, statistical analysis reveals differences, as evidenced in Table 2. Among the various attributes assessed—pleasantness, perceived cost, quality, and eco-friendliness—differences are statistically significant.

Notably, the perceived quality attribute has the most significant difference.

Table 1. The comparison of the individual questions.

Variable	Mean opaque	Mean clear	Sd opaque	Sd clear	T-test p-value	Significance
Pleasant	5.29	4.56	1.06	1.35	0.0153	*
Expensive	4.50	3.65	1.40	1.32	0.0120	*
High quality	5.38	4.35	1.02	1.28	0.0005	***
Eco-friendly	4.76	4.03	1.30	1.57	0.0394	*
Interesting	4.38	4.18	1.52	1.59	0.5863	
Inexpensive	4.26	4.74	1.38	1.33	0.1570	
Attractive	4.44	4.26	1.40	1.54	0.6227	
Purchase	4.88	4.29	1.45	1.73	0.1341	

The correlation matrices representing the responses are illustrated in Figure 4, where they exhibit marked visual disparities. To evaluate the extent of these differences, the Jennrich test for similarity of correlation matrices was employed. The outcomes of the Jennrich test substantiated the dissimilarity between the matrices, with the results yielding a Chi-square

value of 74.01109 and a highly significant p-value of 0.00019, thereby confirming that the matrices are statistically distinct.

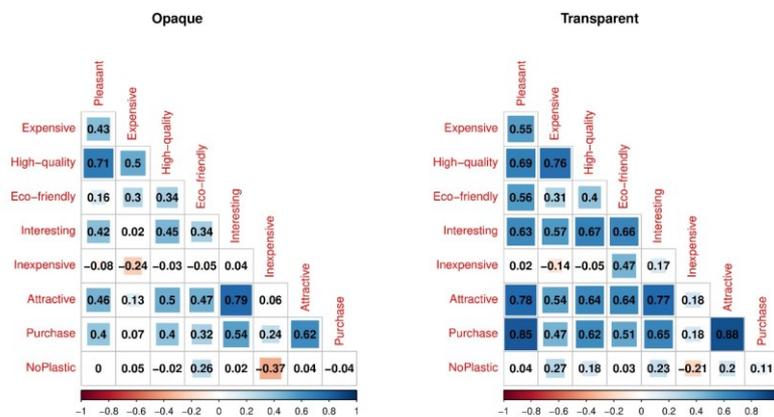


Figure 4. Correlation matrices of the answers. The difference in preference between opaque and transparent package.

The participants' aversion to plastics, denoted as 'NoPlastic', exhibited a significant correlation with the aggregate fixation duration on the top Area of Interest (AOI) of the opaque package. Pearson's product-moment correlation coefficient yielded a value  $r=0.5827$  (95% CI [0.3045, 0.7692]), and a  $p=0.0002996$ . This implies that an increased aversion to plastics among participants was associated with a longer total fixation time on the top AOI of the opaque package.

Conversely, no statistically significant correlation was detected between the participants' aversion to plastics and their willingness to purchase for either type of packaging. Nonetheless, a notable correlation was observed between the perceived eco-friendliness and the willingness to purchase regarding the transparent package ( $r=0.5103$ , 95% CI [0.2080, 0.7236],  $p=0.002045$ ), a correlation that did not hold for the opaque package ( $r=0.3211$ , 95% CI [-0.0191, 0.5947],  $p=0.06405$ ).

The divergent levels of attention directed to the top AOI, the variations in responses to individual questions, and the pronounced disparity in the correlation matrices collectively

suggest that the opacity of the packaging material exerts a significant influence on the participants' perceptions.

#### **4 Discussion**

The data revealed participants' inclination towards opaque packaging, which was accorded comparatively higher evaluations across several metrics within the questionnaire (See Table 2). Participants attributed greater appeal, cost, quality, and eco-friendliness to the opaque packaging variant. The application of t-test confirmed the statistical significance of these differences ( $p < 0.05$ ). These results stand in opposition to Hypothesis 1, which posited a consumer preference for food presented in transparent packaging. This preference may be attributed to an adverse association with transparent packaging, particularly in relation to plastics. This inference could be derived from the environmental awareness among young students.

Contrary to expectations, Hypothesis 2 yielded ambiguous results. Although the opaque packaging was deemed more eco-friendly, this did not translate into a significant impact on purchase intent. Conversely, for the transparent option, a distinct correlation was observed between its perceived eco-friendliness and the willingness to purchase. These findings suggest that Hypothesis 2 was only partially corroborated, potentially attributable to the limited participant sample size.

Incongruities were also present in relation to Hypothesis 3; the anticipated correlations between an aversion to plastics and purchase willingness did not attain statistical significance, thus failing to lend support to Hypothesis 3. The findings delineated in Table 1 elucidate a pronounced principal effect of packaging opacity on fixation duration revealing that the participants directed their gaze to upper section of the opaque package for an average of 0.2697 seconds longer than they did to the corresponding area on the transparent package.

It is surmised that participants tried to discern the contents of the packaging, especially as the upper section of the opaque package hinted at a plastic material. A correlation was observed between the extended fixation time on the Top AOI and the participants' aversion to plastic materials.

#### ***4.1 Managerial implications***

The study's insights into consumer preferences for product packaging have significant implications for the food industry. Recognizing the link between packaging attributes and consumer preferences can provide companies with crucial information for designing effective packaging strategies; the package should add on the brand image and enhance the willingness to buy the product, not inhibit the purchase. Incorporating opaque features into packaging may help products stand out in a competitive market. For young consumers, who are expected to dominate the market in the future, the perception of non-plastic packaging could significantly enhance product preference, especially considering their aversion to plastic. Brands may benefit from strategically adopting opaque packaging materials.

#### ***4.2 Limitations and avenues for future studies***

This investigation is subject to certain limitations that future research might address. The inferences drawn herein are based upon the evaluation of a fictitious product and packaging within a singular category of food products. Subsequent studies should extend the scope of inquiry to encompass a diversity of product categories, examining the preferences for opaque packaging across a broader spectrum of consumer goods.

Moreover, the data was garnered within a laboratory setting from 34 higher education students. Subsequent research might assess whether these findings persist in real-life conditions, such as in-situ evaluations of products from participants from different age

groups. A further limitation pertains to the binary nature of the packaging transparency ranging from completely transparent to entirely opaque. Prospective investigations could benefit from examining a gradient of transparency to ascertain the effects of varying degrees of opacity on consumer preferences.

#### Declaration of interest statement

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## 5 Appendices

### 5.1 Appendix A

The measurement device used in this study was Tobii Pro X3-120 eye-tracker, the measurement software used was Tobii Pro Lab 1.181.37603. The statistical analysis software used was R version 4.2.1. The display used was Dell P2319H. The algorithm used for detecting fixations and other types of eye movement was Tobii I-VT. The metrics generated by Tobii Pro Lab was used for actual analysis.

### 5.2 Appendix B

Answer the following questions regarding the package in the image.

The package looks pleasant (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks expensive (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks high-quality (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks environmentally friendly (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks interesting (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks inexpensive (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

The package looks attractive (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

I would purchase the product in this package (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

### **Background questions**

A high-quality package indicates that the product inside it is also of high quality.

(1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

A cardboard package is more environmentally friendly than a plastic package. (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

I always choose the cheaper product if I don't notice any difference in the content.

(1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

I like to buy products made of food waste because I know it is environmentally friendly.

(1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

I do not buy products in plastic packaging. (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

Since food product made from food waste is in a fancy package, it must also taste good.

(1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7

Food made from food waste ingredients is as safe and good as food made from regular ingredients. (1=completely disagree, 7=completely agree)

1      2      3      4      5      6      7