

Simulated Environments for Food Packaging Design Assessment

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Introduction

Using applied retail research, the purpose of this study is to evaluate the viability of using a simulated environment to conduct packaging design validation tests in order to gain deep insights into the ways in which shoppers make buying decisions. The resultant knowledge will provide empirical data on packaging design for Welsh food Small to Medium Enterprises (SMEs).

Packaged food products are increasing rapidly in choice, and competition is ever more intense (OECD, 2014). More than 70% of consumers make decisions on daily necessities in store, 85% of goods are purchased without picking up an alternative option, and 90% are purchased after examining only the front packaging of a product without having it in their hands (Simmonds and Spence, 2016). Therefore, it is paramount for companies to ensure that their products are eye catching (Clement, 2007; Bandara, 2016).

Eye tracking has proved to be a valuable tool in assessing consumer attention (Wedel & Pieters, 2008; Wedel, 2013), as consumer attention has been shown to be correlated with product preference (Pieter & Warlop, 1999). Large companies such as PepsiCo and Unilever regularly use eye-tracking methods in the development of new packaging and retail strategies to assess consumer attention in shopping environments. However, their facilities are expensive, and their guidelines and results are not available to the public (Wedel and Pieters, 2008; Tonkin, et al., 2011).

In the context of the food industry, Young (2002) emphasises the importance of keeping participants in a shopping context to attain the most relevant results in product testing. Young's research suggests that when a shopper does not connect to a shopping context, they will often remove themselves from a shopping mind-set, and instead assume a more aesthetically critical mentality, turning the experiment into a 'beauty contest' where the most visually appealing product will win – an irregular occurrence that does not correlate with purchase decisions made at the shelf in real life. A simulated environment can replicate external variables (to some extent) to simulate a real-life context in a laboratory setting. The simulated environment is also customisable, it ensures confidentiality, and enables the easy set-up of an array of data recording devices.

The Perceptual Experience Lab

The Perceptual Experience Lab (PEL) is a synthetic reality space developed to allow for customisable low-cost replications of real environments with controlled and monitored conditions.



FIGURE 1 PARTICIPANT IN SIMULATED SUPERMARKET ISLE IN PEL

Six 4K projectors project onto a custom built 5280px by 1980px, 200° wrap around screen, which covers the participants' full field of vision. The sense of immersion can be adjusted and controlled with the manipulation of surround sound, light and temperature control, air flow, smell diffusion, and the capacity for physical props. State-of-the-art observation software linked to high-resolution cameras, eye-trackers, microphones and heart rate variability monitoring equipment allow detailed monitoring and recording of studies - offering high levels of customisation, flexibility, and a broad spectrum of data collection methods.

Aim and Objective

The overall aim of the research is to combine theoretical knowledge of marketing and design, with the practical implications of user testing, to investigate if packaging design can be improved through low-cost simulated environments and increase Welsh food SME sales in the supermarket. As part of this broader area of research, the objective of this experiment is to develop an iterative process to assess one of the packaging designs from the Welsh food company Puffin Produce.

Approach

The first part of the experiment (Condition A) compared the packaging design of Puffin Produce's standard line of potatoes, Blas Y Tir (BYT), with Tesco Every Day (TE), and Tesco Finest (TF) potato packaging. See Figure 2 below.



FIGURE 2 CONDITION A: ORIGINAL PHOTOGRAPH DISPLAYING ORIGINAL BLAS Y TIR, TESCO EVERY DAY, AND TESCO FINEST PACKAGED POTATOES.

The second part of the experiment (Condition B) added an alternate packaging design of Puffin Produce's standard line of potatoes, Blas Y Tir (BYT), with the same two Tesco products. See Figures 3 and 4 below.



FIGURE 3 CONDITION B: ALTERNATE DESIGN ADDED INTO PHOTOGRAPH

Basic elements of the original packaging design were altered and placed in the original photograph, in condition B, to compare how shoppers react to different stylistic choices, and whether it changes perceptions of the same product, and to determine if it has an effect on decision making.

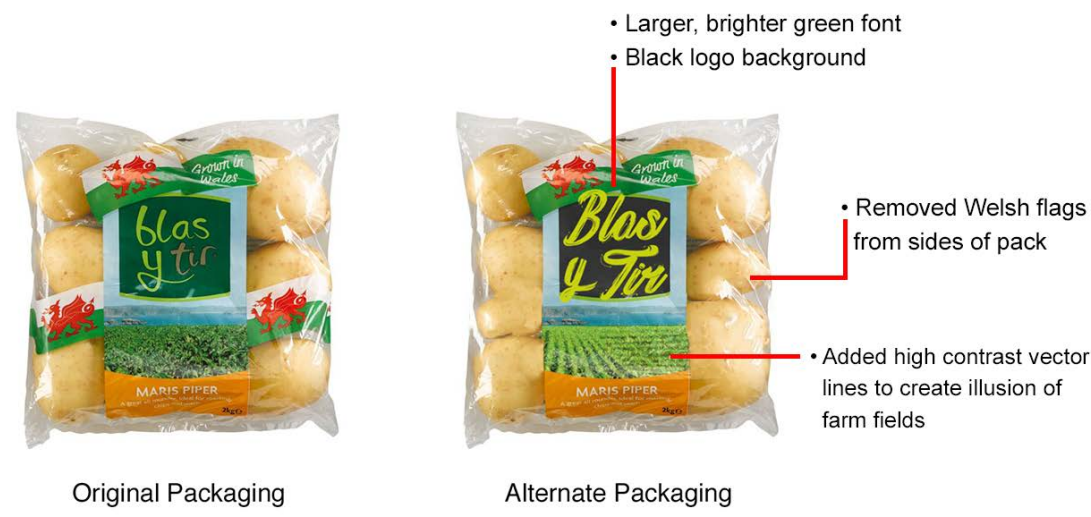


FIGURE 4. ORIGINAL BYT DESIGN COMPARED TO ALTERNATE DESIGN

30 participants took part in the experiment, with participants varying in occupation, gender and age, based on a demographic ratio chosen by the marketing team at Puffin Produce, to represent the target sample of supermarket frequenters. See Figure 5 below.

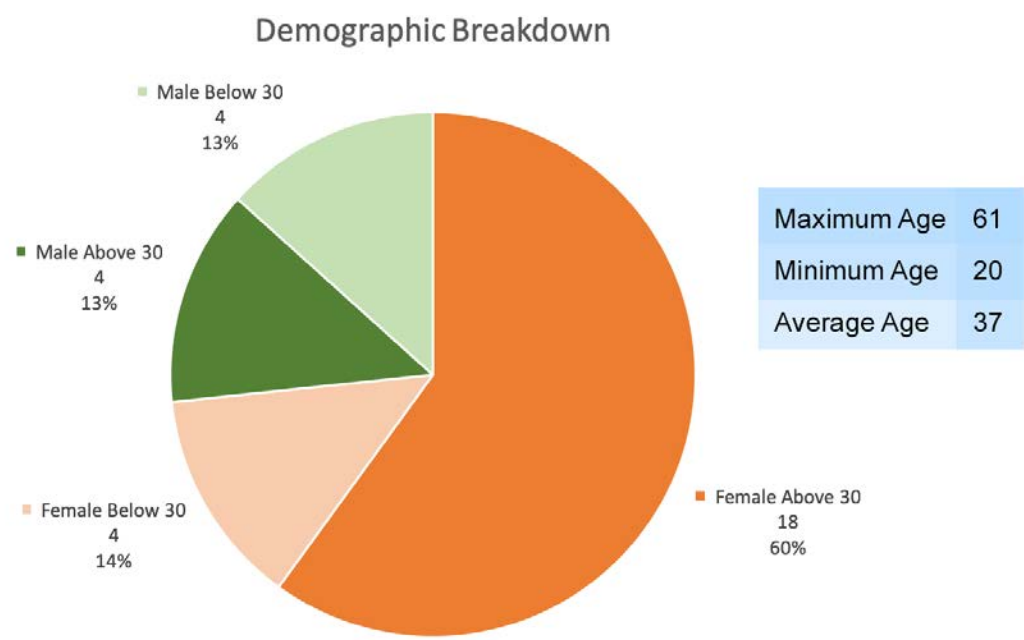


FIGURE 5 EXPERIMENT DEMOGRAPHIC BREAKDOWN BY AGE AND GENDER

Participants and conditions were counterbalanced, so the cumulative increase of stimuli did not yield biased results. The 30 participants were split into two groups. Group 1 viewed conditions in the order of A (original photo) then B (alternate design photo), and Group 2 viewed conditions in the order of B then A. Counterbalancing is a method of experiment design in which, when applied, the researcher can control order effects when using repeated measures (Field, 2013). Using the counterbalancing technique for this experiment, each participant experiences a different order of conditions (either AB or BA, but not both), avoiding the ‘summative’ effect on the different sensory input, and allowing for unbiased results.

It is important to test in an immersive and believable supermarket context to keep results as close as possible to real-life purchases. PEL was set up to imitate a supermarket; previous experiments informed the environmental set up of the simulated space. When photographing the supermarket scene, the camera’s focal point centred between BYT and TE to minimise bias.

Methodology

1. Participants stood in front of the PEL screen to view the first condition wearing head-mounted eye trackers. Eye tracking was used to see what participants fixated on.
2. Gaze data and immediate verbal responses to questions (see below) were recorded in the supermarket scene. The questions were provided by the marketing team at Puffin Produce.
 - Which packaging caught your attention first?
 - Which packaging do you like most?
 - Which packaging do you like least?
 - Which packaging feels more Welsh?
 - Which packaging feels more premium?
 - Which packaging feels more modern?
 - Which packaging feels more fresh?
 - Which product would you buy based purely on packaging, regardless of price?
3. Once all verbal responses were recorded, participants were guided to a questionnaire form where they answered the same questions corresponding to their last viewed condition to record quantitative and qualitative answers.
4. The process was repeated for the second condition.

The Cardiff School of Art and Design’s Research Ethics Committee gave ethics approval for the study. All participants gave their informed consent prior to their inclusion in the study.

Results

The following results are presented corresponding to the question participants were asked in the simulated shopping context; each result section is further divided into two subdivisions. The first shows heat map visualisations of average visit duration captured by Tobii Eye Trackers. The second subdivision shows the quantitative results of participants' answers to the verbal questions asked, and qualitative reasoning behind their decisions. A repeated measure ANOVA analysis is conducted for the quantitative data to reveal any significant results. Reoccurring words and themes found in qualitative feedback were coded and categorised into themes of significance using thematic analysis (Braun & Clarke, 2006) to try and gain deeper insights into shopper decision making. Thematic Analysis was used for its flexibility and accessibility as an inductive approach to analyse the data.

1. Which packaging caught your attention first?

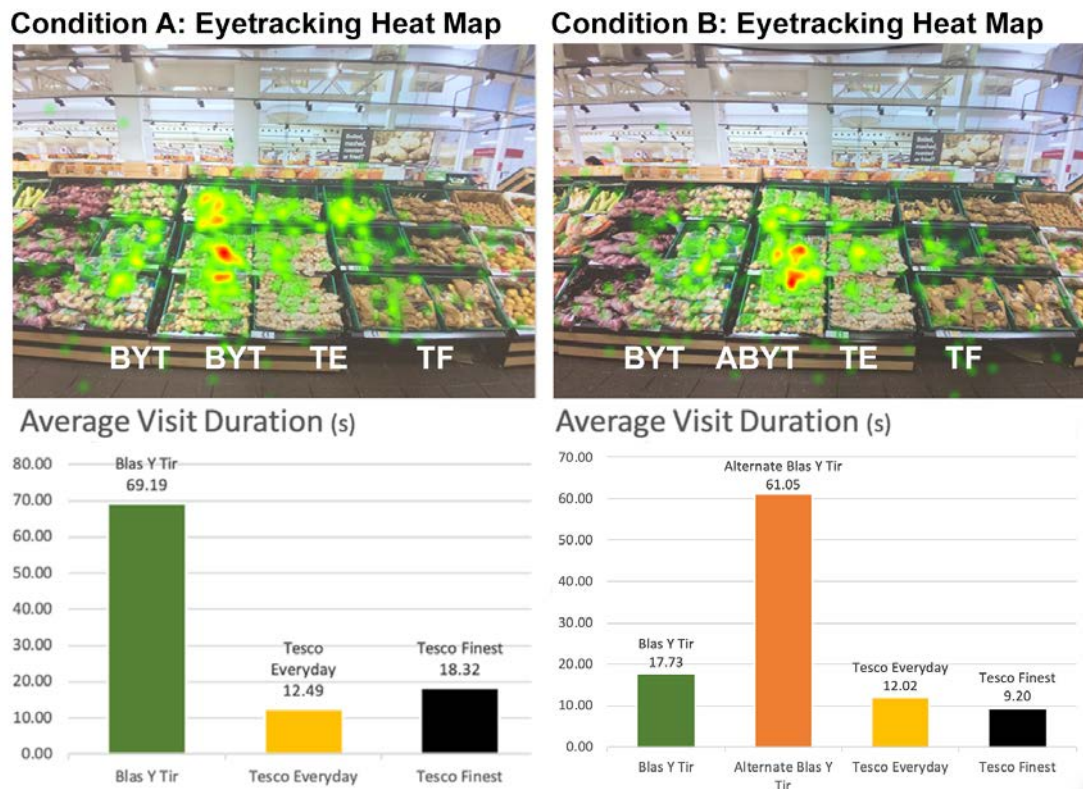


FIGURE 6 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

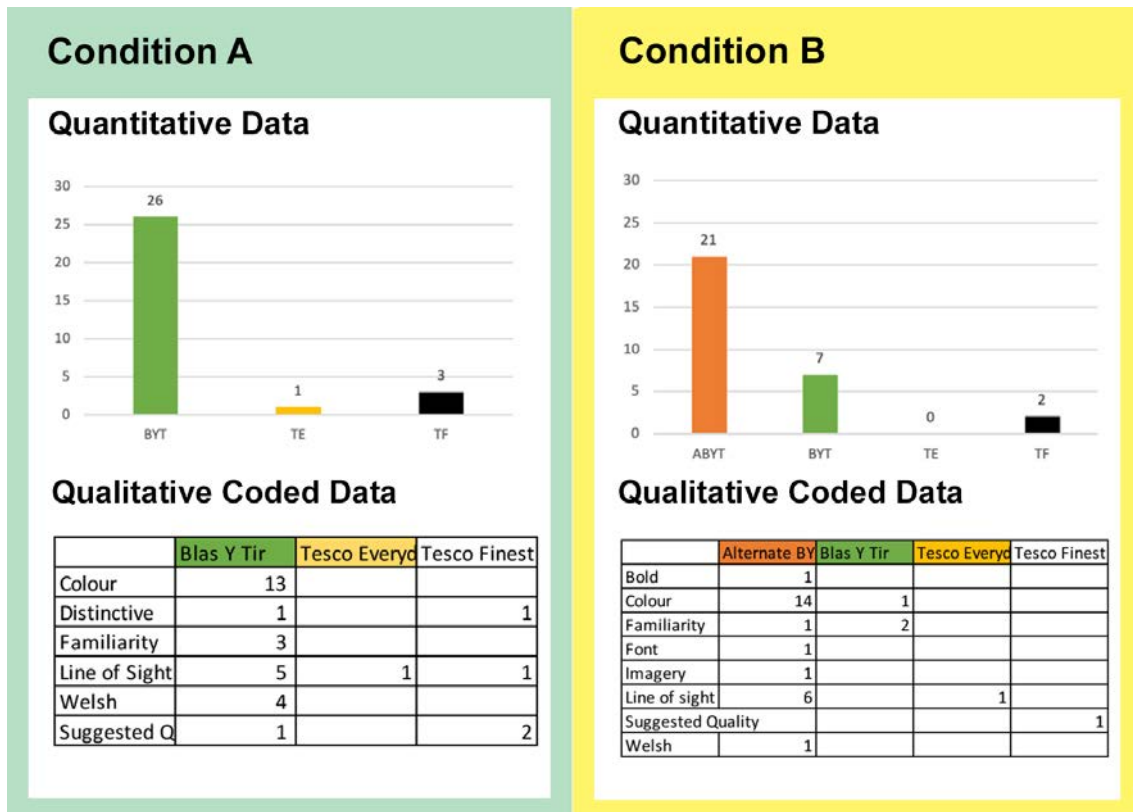


FIGURE 7 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA with a Huynh-Feldt correction showed that BYT packaging caught participant attention significantly more than TE and TF packaging [$F(1.619, 46.942) = 98.193, p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that there was a significant difference ($p < .05$) between the participants' choice of BYT packaging (0.87) and both TE (0.03) and TF (0.10). No other comparisons were significant (all $p > .05$).

B) A repeated measures ANOVA with a Huynh-Feldt correction showed that ABYT packaging caught participant attention significantly more than BYT, TE, and TF packaging [$F(2.57, 74.521) = 32.369, p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that there were significant differences ($p < .05$) between the participants' choice of ABYT packaging (0.70) and BYT (0.23), TE (0.00), and TF (0.07). No other comparisons were significant (all $p > .05$).

2. Which packaging do you like most?

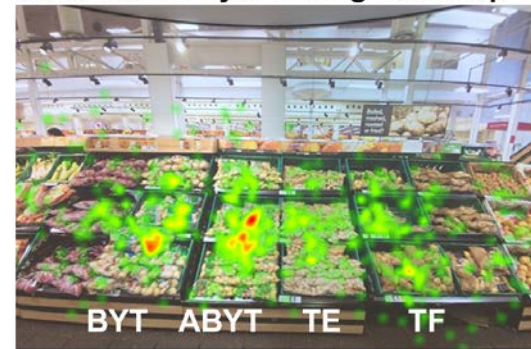
Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

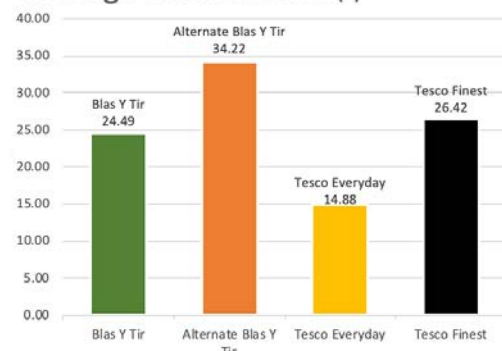
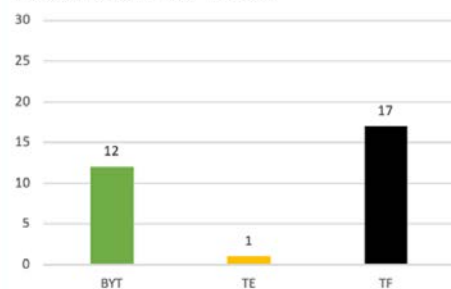


FIGURE 8 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

Condition A

Quantitative Data

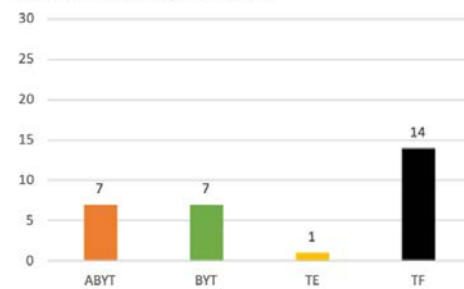


Qualitative Coded Data

	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	7		2
Eco			3
Material			5
Minimalistic			2
Modern			1
Suggested Quality		1	6
Theme	1		1
Visibility	1		1
Welsh	4		

Condition B

Quantitative Data



Qualitative Coded Data

	Alternate BY	Blas Y Tir	Tesco Everyd	Tesco Finest
Bold	3	1		
Bright	3			
Colour	1	3	1	
Imagery	1	2		
Eco				3
Eye Catching	1			
Familiarity	1			
Material				2
Minimalistic		1		1
Suggested Q	1			6
Theme				2
Visibility	2	1		
Welsh	2	2		

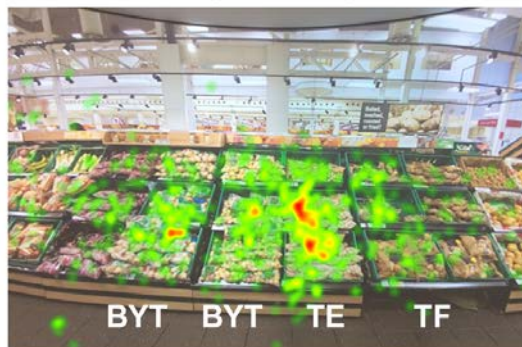
FIGURE 9 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA was conducted, and the Mauchly's Test indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.254$, $p = 0.196$. Post-hoc tests using the Bonferroni correction revealed that participants chose BYT (0.4) and TF (0.57) as the 'most liked' significantly ($p < .05$) more than TE packaging (0.03). No other comparisons were significant (all $p > .05$).

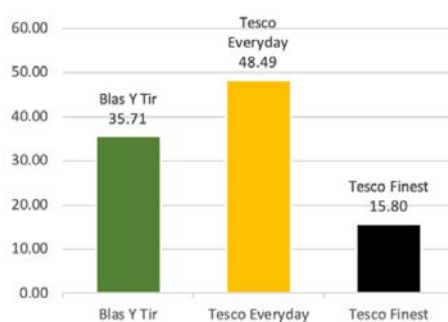
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TF packaging differed significantly to ABYT, BYT, and TE, $[F(1.985, 57.573) = 11.83, p < 0.001]$. Post-hoc tests using the Bonferroni correction revealed that participants chose TF packaging (0.47) as the 'most liked' significantly more times than ($p < .05$) ABYT (0.23), BYT (0.23) and TE (0.03). No other comparisons were significant (all $p > .05$).

3. Which packaging do you like least?

Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

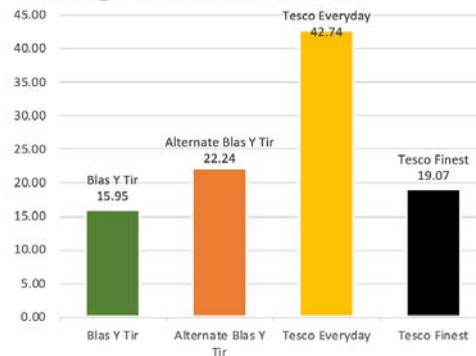


FIGURE 10 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

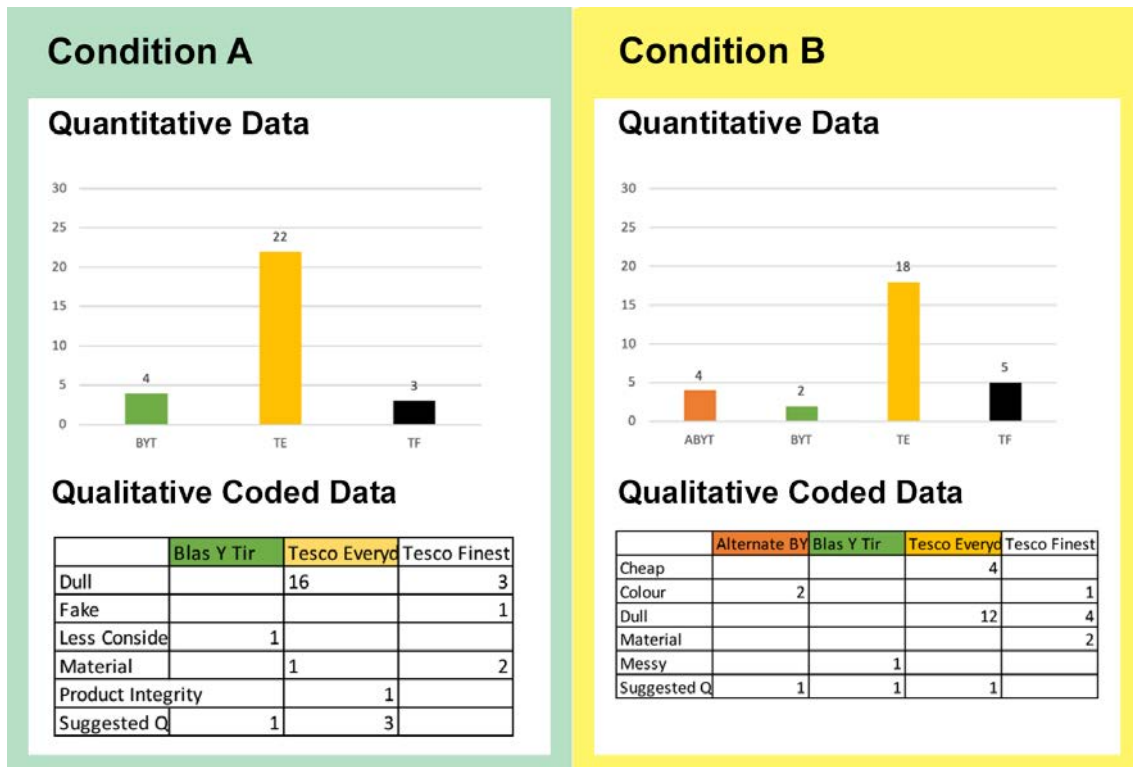


FIGURE 11 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TE packaging differed significantly to BYT and TF packaging [$F(1.209, 35.063) = 43.819$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants' chose TE packaging (0.73) as the 'liked least' significantly ($p < .05$) more than BYT (0.13) and TF (0.10). No other comparisons were significant (all $p > .05$).

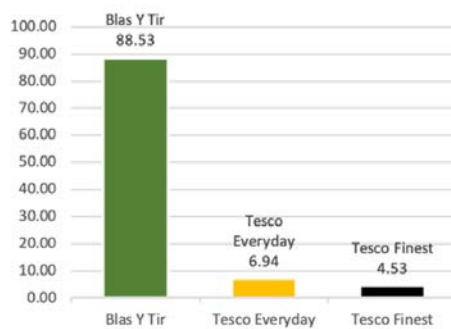
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TE packaging differed significantly to ABYT, BYT, and TF packaging [$F(1.704, 49.409) = 22.054$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants' chose TE packaging (0.60) as the 'liked least' significantly ($p < .05$) more than ABYT (0.13), BYT (0.07), and TF (0.17). No other comparisons were significant (all $p > .05$).

4. Which packaging feels more Welsh?

Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

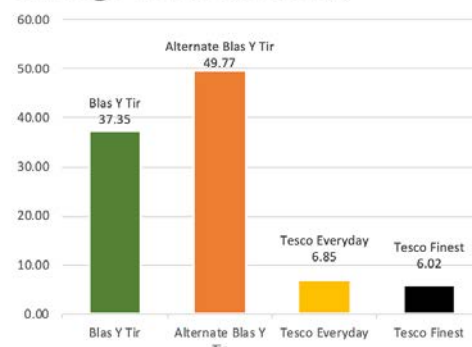
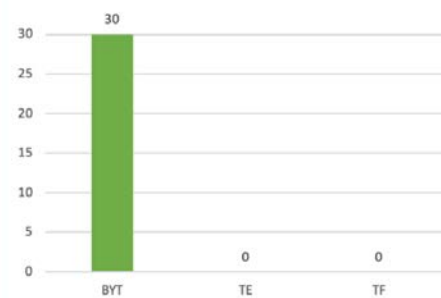


FIGURE 12 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

Condition A

Quantitative Data

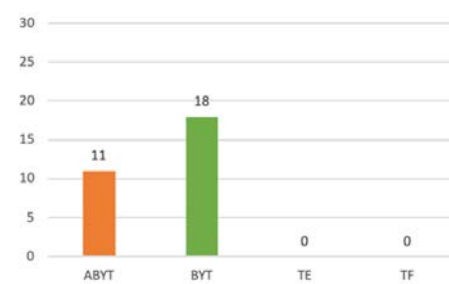


Qualitative Coded Data

	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	7		
Dragon	6		
Flag	19		
Text	9		

Condition B

Quantitative Data



Qualitative Coded Data

	Alternate BY	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	2	6		
Flag	3	24		
Language	2	5		

FIGURE 13 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) 100% of participants chose BYT as the packaging that felt most Welsh.

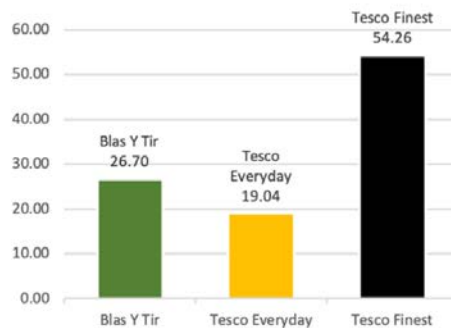
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that BYT packaging differed significantly to ABYT, TE, and TF packaging, and ABYT differed significantly to TE and TF packaging. [$F(1.767, 51.23) = 26.935, p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed participants chose of BYT packaging (0.60) as 'Welsh' significantly ($p < .05$) more than ABYT (0.37), TE (0.00), and TF (0.00). It also shows that ABYT (0.37) was 'more Welsh' than TE (0.00) and TF (0.00). No other comparisons were significant (all $p > .05$).

5. Which packaging feels more premium?

Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

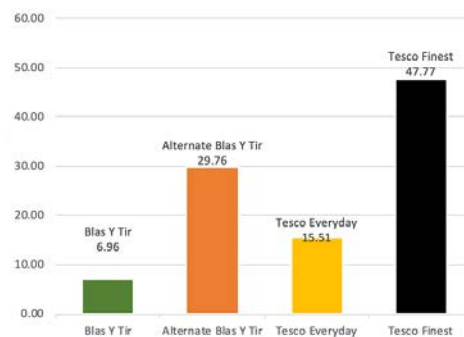


FIGURE 14 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

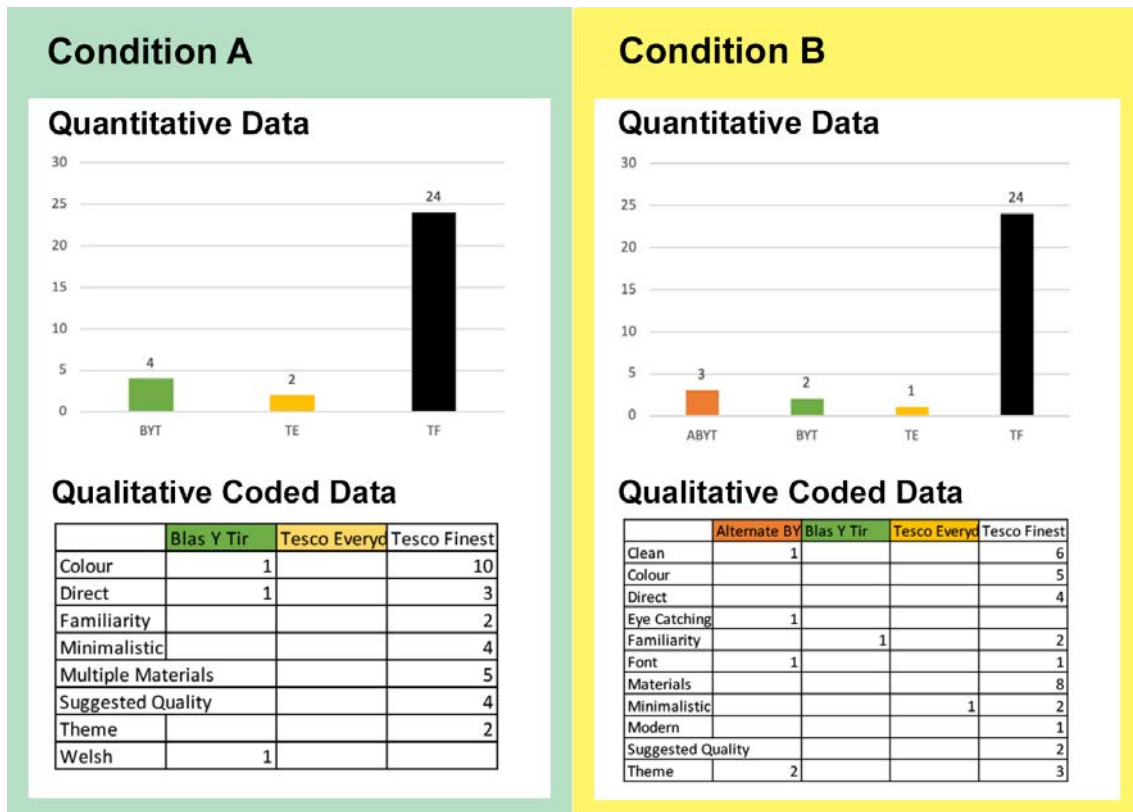


FIGURE 15 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TF packaging differed significantly to BYT and TE packaging [$F(1.0, 29.0) = 58.0, p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants chose TF packaging (0.80) as 'premium' significantly ($p < .05$) more than both BYT (0.13 and TE (0.13). No other comparisons were significant (all $p > .05$).

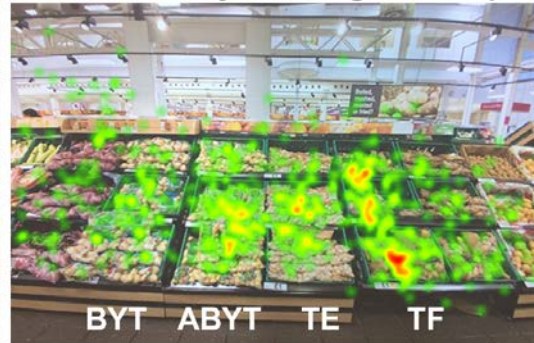
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TF packaging differed significantly to ABYT, BYT, and TE packaging [$F(1.606, 46.575) = 66.156, p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants chose TF packaging (0.80) as 'premium' significantly ($p < .05$) more than ABYT (0.10), BYT (0.07), and TE (0.03). No other comparisons were significant (all $p > .05$).

6. Which packaging feels more modern?

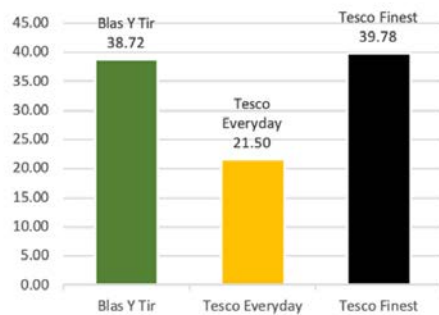
Condition A: Eyetracking Heat Map



Condition B: Eyetracking Heat Map



Average Visit Duration (s)



Average Visit Duration (s)

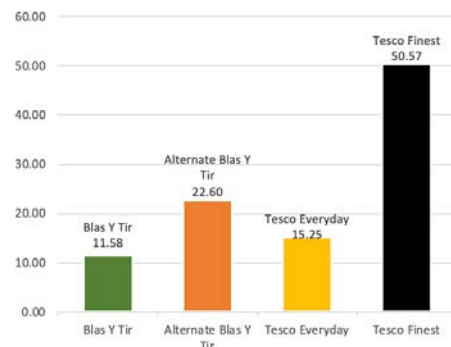
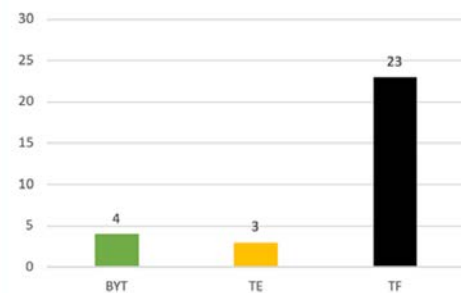


FIGURE 16 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

Condition A

Quantitative Data

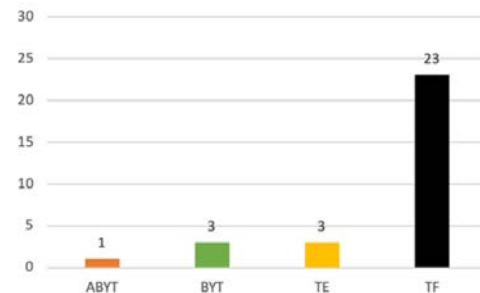


Qualitative Coded Data

	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	3	1	4
Eco			2
Material	1		2
Minimalistic		2	8
Text	1		
Theme			6

Condition B

Quantitative Data



Qualitative Coded Data

	Alternate BY	Blas Y Tir	Tesco Everyd	Tesco Finest
Bold				1
Colour	3	2	1	3
Font	2	1		
Material				4
Minimalistic			2	7
Theme	1			6
Visibility				1

FIGURE 17 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TF packaging differed significantly to BYT and TE packaging [$F(1.217, 35.291) = 50.452$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants chose TF packaging (0.77) as 'modern' significantly ($p < .05$) more than both BYT (0.13) and TE (0.10). No other comparisons were significant (all $p > .05$).

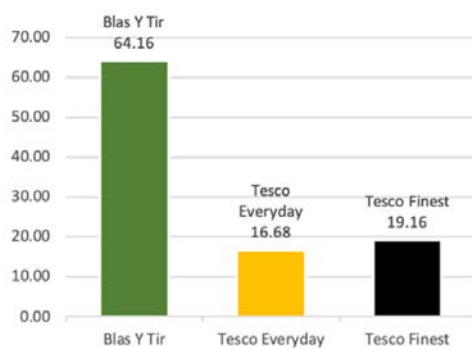
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TF packaging differed significantly to ABYT, BYT, and TE packaging [$F(1.480, 42.931) = 54.459$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants chose TF packaging (0.77) as 'modern' significantly ($p < .05$) more than and ABYT (0.03), BYT (0.10), and TE (0.10). No other comparisons were significant (all $p > .05$).

7. Which packaging feels more fresh?

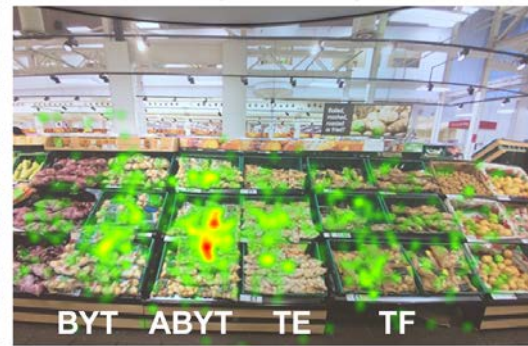
Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

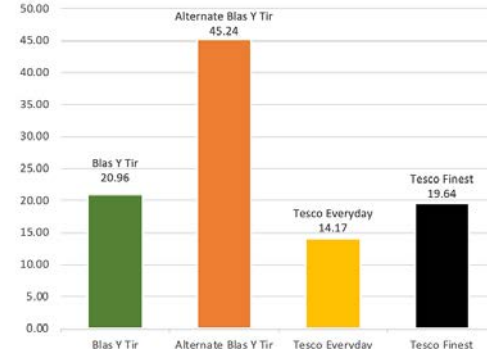


FIGURE 18 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

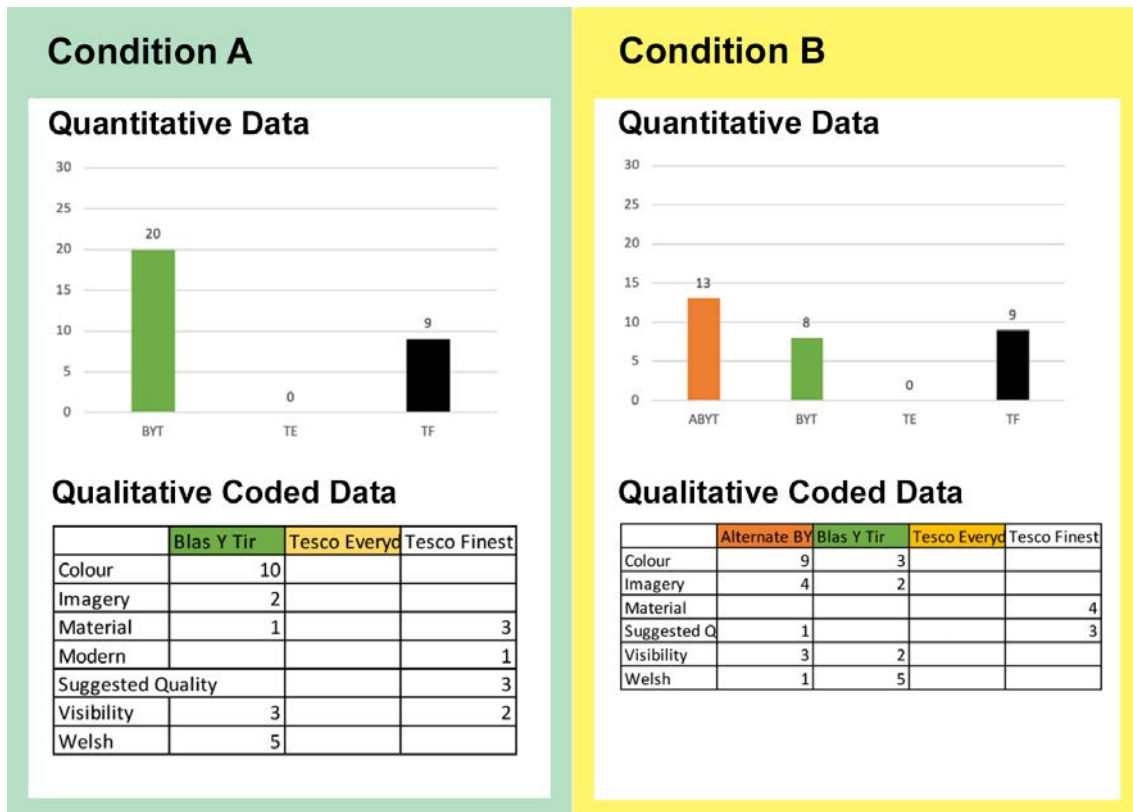


FIGURE 19 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA was conducted, and the Mauchly's Test indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 0.094$, $p = 0.954$. Post-hoc tests using the Bonferroni correction revealed that there was a significant difference ($p < .05$) between all participants' choice of which packaging feels 'more fresh', BYT (0.67), TE (0.00) and TF (0.30).

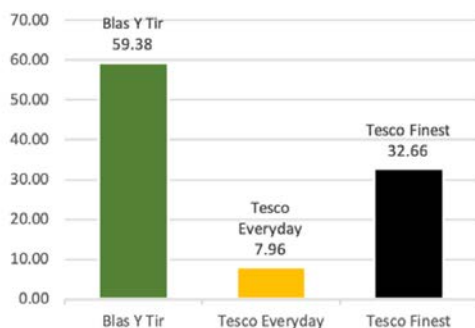
B) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TE packaging differed significantly to ABYT, BYT, and TF packaging [$F(2.108, 61.129) = 12.232$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that TE packaging (0.00) was chosen significantly less than ABYT (0.43), BYT (0.27), and TF (0.30) as 'more fresh'. No other comparisons were significant (all $p > .05$).

8. Which product would you buy based purely on packaging, regardless of price?

Condition A: Eyetracking Heat Map



Average Visit Duration (s)



Condition B: Eyetracking Heat Map



Average Visit Duration (s)

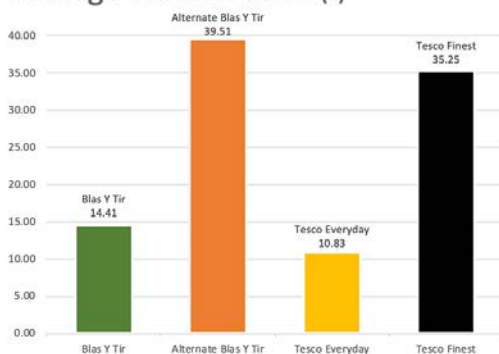
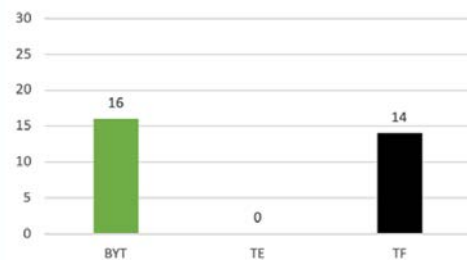


FIGURE 20 EYE TRACKING VISUALISATION AND AVERAGE VISIT DURATION CHART

Condition A

Quantitative Data

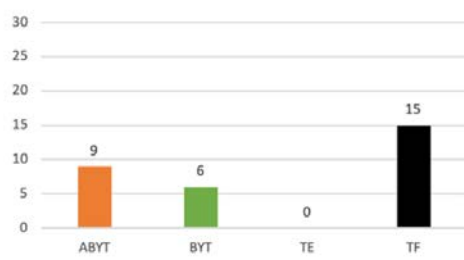


Qualitative Coded Data

	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	4		1
Eco			2
Familiarity	1		
Fresh	2		
Imagery	1		
Minimalistic			1
Suggested Quality			7
Visibility			1
Welsh	10		

Condition B

Quantitative Data



Qualitative Coded Data

	Alternate BY	Blas Y Tir	Tesco Everyd	Tesco Finest
Colour	3			
Eco				2
Imagery	1			
Material				1
Minimalistic				2
Suggested Quality				4
Trustworthy			3	
Visibility		1		
Welsh	8	3		

FIGURE 21 QUANTITATIVE AND QUALITATIVE CODING CHARTS FOR CONDITION A (LEFT) AND CONDITION B (LEFT)

A) A repeated measures ANOVA with a Greenhouse-Geisser correction showed that TE packaging differed significantly to BYT and TF packaging [$F(1.385, 40.154) = 26.238$, $p < 0.001$]. Post-hoc tests using the Bonferroni correction revealed that participants chose to buy BYT (0.53) and TF (0.47) based on packaging significantly ($p < .05$) more than TE packaging (0.00). No other comparisons were significant (all $p > .05$).

B) A repeated measures ANOVA was conducted, and the Mauchly's Test indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 10.453$, $p = 0.064$. Post-hoc tests using the Bonferroni correction revealed that participants chose to 'buy' ABYT (0.30), and TF (0.50) based on packaging significantly ($p < .05$) more than TE packaging (0.00). It also showed participants chose to 'buy' TF (0.50) significantly ($p < .05$) more than BYT (0.20). No other comparisons were significant (all $p > .05$).

A significant result showed 60% of participants preferred the ABYT packaging design compared to the original BYT packaging design. See Figure 24 below.

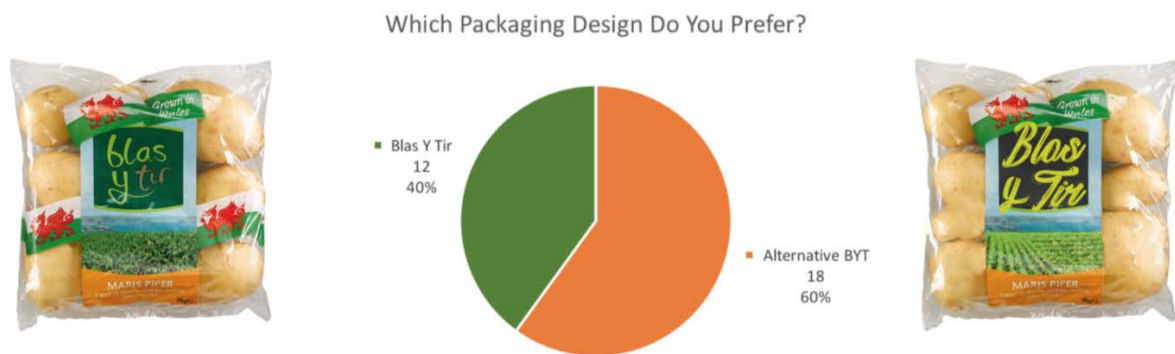


FIGURE 24. SHOWS SHOPPERS' PREFERENCE OF PACKAGING DESIGN

Word clouds were generated by the proportion of reoccurring key themes used to describe each packaging design.



FIGURE 25. KEY DESCRIPTORS OF BLAS Y TIR PACKAGING



FIGURE 26. KEY DESCRIPTORS OF ALTERNATE BLAS Y TIR PACKAGING



FIGURE 27. KEY DESCRIPTORS OF TESCO EVERYDAY PACKAGING



FIGURE 28. KEY DESCRIPTORS OF TESCO FINEST PACKAGING

Discussion

Patterns and keywords that appeared across the qualitative feedback were valued as significant and categorised into themes. This part of the experiment was used in tandem with the quantitative data to gain a deeper understanding of shoppers' perceptions rather than confirming or developing theories.

1. Attention

The quantitative results showed that in condition A, BYT was chosen significantly more over the other packages and in condition B, ABYT was chosen significantly more. This can be explained by positioning, coupled with some answers in the qualitative feedback suggesting that line of sight may be a factor. However, precautions were taken, where the camera's focal point was in the middle between BYT/ABYT and TE to minimise bias.

2. Like Most

In the qualitative results of both condition A and B, TE scored significantly lower than the other packs, and TF scored highest, though there was no significant difference between TF and BYT/ABYT. In condition B, ABYT and BYT were chosen the same amount of times.

3. Like Least

TE was consistently and significantly chosen as the least liked packaging design in both conditions.

4. More Welsh

In condition A, 100% of participants chose BYT as the packaging that felt more Welsh.

In condition B, the quantitative results again showed that BYT felt significantly the most Welsh. This suggests that line of sight is not a factor in decision making when asked targeted questions.

5. More Premium

In both conditions, the packaging chosen significantly more frequently, when asked 'which feels more premium' was TF, which is somewhat expected as it is Tesco's premium line.

6. More Modern

In both condition A and B, TF was chosen as the packaging that felt more modern significantly more than the other packaging designs.

7. More Fresh

In condition A, the results showed that both BYT and TF were chosen significantly more than TE, and BYT was chosen significantly more than TF.

In condition B, although ABYT scored highest, there were no significant differences between ABYT, BYT, or TF. However, they were all chosen significantly more than TE in terms of packaging that felt more fresh.

8. Buy

Shoppers in condition A chose TF and BYT to buy significantly more than TE, however, there was no significant difference between BYT and TF. This is a positive

result for Puffin Produce as BYT is part of their basic line, and it did significantly better than TE. There was also no significant difference between BYT and TF, and this is another positive result for Puffin Produce considering TF is part of the premium line for Tesco.

In condition B, TF scored highest, significantly more so than BYT and TE, but not ABYT. TE was chosen the least again, however, there was no significant difference between TE and BYT. Again, this is a positive result for Puffin Produce as BYT is their basic line and was chosen more than TE. Although ABYT was chosen slightly more than BYT, there was no significant difference.

Limitations

As only 30 participants were involved in this study, the results from this experiment cannot be used to represent the decision choices of the general population. Although steps were taken to minimise line of sight bias, it is still a factor to consider in future studies (for example, to counter balance shelf location).

Ultimately, this experiment was conducted in a simulated environment, so the results cannot be assumed to be the same as if conducted in a real supermarket. Further larger scale studies are required to validate these results.

Conclusion and Future Research

This experiment is a created system in which tests can cheaply, quickly and effectively assess packaging design. The results from the experiment cannot definitively improve packaging design, but rather give guidelines and provide empirical data highlighting perceptions of targeted aspects of design elements. This method can reveal and confirm general perceptions, and which packaging participants are attracted to, based on design. Equipped with this data, companies or design agencies can use this knowledge to inform future designs.

This study has revealed interesting associations between packaging design elements and its link to the perception of the product. The next step will be to develop a new packaging design based on insights gained from this experiment, and to test it against its' predecessors to see if there are any significant differences in scores/perception. In the next study, packaging positioning will be counterbalanced to minimise line of sight bias.

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