Tasting pictures -
an evaluative review
of product packaging
methodology

Researcher: Bennett Hofland - s2275481

Supervisor: DR. T.J.L. Van Rompay

Department: Communication Sciences

Date of hand-in: 01.07.2022

University of Twente

Faculty of Behavioural, Management

and Social Sciences

Abstract

While there is much research dedicated to allow new food and beverage products to enter the market, many new products are still drowned out by competition. This study explores the effects of the realism of product packaging stimuli on participant evaluations and assessment characteristics, specifically for coffee packaging, to identify potential areas to increase validity of current methodologies. Based on previous research, photorealistic rendering and consumption context were determined as two factors which make up realism in product packaging stimuli, because they both contextualise a product and its packaging features, assisting the participant in accurately interpreting the stimuli. Both factors were tested in a 2x2 design for effects on package appeal, imaginary product usage and participant confidence in their sensory evaluations. Data was collected via an online survey. Results indicate that contextual realism has an effect on packaging appeal and rendering can influence participant confidence in their evaluations. The effects of realism on imaginary product usage were found to be insignificant. Lastly, this paper presents implications for future research and allows current researchers to more closely consider the implications of their stimuli.

Table of contents

1. Introduction

Each and every year, thousands of new food and beverage products are introduced to the market (Dong, 2021). However, many of these are not able to survive due to the market being saturated with competition. In such a competitive environment, brands need to be able stand out and grab the attention of consumers before they even have a chance to taste their product. Through carefully designed product packaging informed by research, companies allude consumers to specific tastes and smells of their product, purely through its outside appearance. But regardless of these efforts, many products still fail unexpectedly. Possibly, the results that are gathered from product packaging research are not as foolproof as we thought.

Where product packaging research aims to measure product evaluation based on design dimensions of their packaging, the stimuli wherein these are visualised might require more careful attention than has been considered thus far. Research in the field of product packaging has shown how elements like material, shape, or colour hue of packaging can have significant effects on visual, and even the sensory evaluations people assign to the product inside (Becker et al., 2011 ; Fenko et al., 2016 ; Martinez et al., 2018). These evaluation assessments are gathered by exposing participants to stimuli of packaging and surveying their opinions. Different groups of participants are shown stimuli with varying design features, thereby allowing researchers to compare results and identify the effects of each individual design feature on the overall product's evaluation. However, this paper questions this methodology, since it may be prone to gather invalid results. This is because, across the field of research, there exists a large variety in the quality of product packaging stimuli that is being used, yet there has not been any research on whether these differences have an effect on product evaluation. To clarify, some researchers are able to invest in professional graphic designers or companies to create highly detailed visualisations of product packaging, to ensure that participants can evaluate stimuli that feels 'real'. On the other hand, different researchers in the field carry out the same procedures, but use stimuli that they created themselves, which look simpler and less realistic in many cases.

Authors in the field frequently acknowledge low realism of their stimuli to be a limitation in their studies and identify it to be an important area for future research (Fenko et al., 2016 ; Spence & Velasco, 2018 ; Van Rompay et al., 2016). This paper explores this assumption, and poses that stimuli realism may influence participant's evaluations of products, regardless of their packaging designs. Specifically, it was tested to which degree realism affected initial product impressions, imaginary product usage and participant's confidence in their sensory expectations. If the degree of realism indeed does influence product evaluation, the presumed effects from packaging in previously conducted research might not have been isolated properly, deeming them less valid. Additionally, the outcome of this research has implications on designing more robust stimuli for future research, allowing researchers to take the effect of realism into consideration.

In this paper, the degree of realism was manipulated through two separate factors; rendered realism and contextual realism, which this paper defines as follows. Rendered realism is the extent to which the represented product package accurately reflects real life lighting and

textures. This also includes lighting interactions between surfaces, reflections and high resolution imagery. Stimuli with low rendered realism generally disregard accurate real-life lighting conditions and consequently look rather flat. Contextual realism is defined as the degree to which the stimuli is placed in a setting that reflects the standard setting in which the product is used. This can either or both be expressed through the background of the stimuli (for example; a picture of a bar behind a bottle of beer), or by including elements which are generally required for product usage (for example; a bowl and spoon next to a cereal box). Stimuli which are regarded to have low contextual realism are stimuli wherein the represented product package is shown on a white or neutral backdrop.

With these terms defined, this paper investigates to which extent the degree of rendered and contextual realism of product packaging stimuli can effect the affected the initial product impressions, imaginary product usage and participant's confidence in their sensory expectations of the product. This paper hypothesises that stimuli with low degrees of realism negatively influence participant's capabilities to evaluate them authentically, thereby carrying the risk of garnering responses which inaccurately reflect people's true perceptions. In order to test this hypothesis, a 2x2 experiment was carried out, using rendered- and contextual realism as stimuli manipulations. This research provides an opportunity for academics in the field of product packaging to gain a broader insight in the effects of their stimuli design, and more closely consider the implications of using pictorial stimuli at large.

2. Theoretical framework

When it comes to the test procedures of current research, researchers are often interested in the degree to which product packaging shapes the sensory qualities of a product based on its packaging, occasionally involving a taste sample. In doing so, many researchers in the field expose participants to their test stimulus of the product packaging in a similar way. Participants are shown a 2D image on either paper or a monitor screen, after which they are asked evaluate either the expected or actual sensory qualities, depending on whether a taste sample is involved (Fenko et al., 2016 ; Huang, L., & Lu, J., 2015 ; Mead & Richerson, 2018 ; Martinez et al., 2018 ; Thijssen et al., 2017 ; Van Rompay et al., 2016). However, García-Segovia et al. (2015) mention how these current methods of academic product packaging research may not garner accurate consumer responses because of the "highly standardised and controlled test conditions" (p.2) they are subjected to, meaning that product evaluation is purely based on the test stimuli, and product evaluations may be different in real life settings (Fenko et al., 2016 ; Huang & Lu, 2015 ; Spence & Velasco, 2018).

Yet, there is no academic framework available for how 2D stimuli should be created. Hence, product packaging stimuli in literature widely vary in terms of graphic rendering, the angle at which the product is displayed, backgrounds, and various other elements, which produce a variety in the realism of stimuli. Some researchers themselves acknowledge these shortcomings, and reflect that the stimulus in their respective studies was not realistic enough, but occasionally have trouble pinpointing which elements in their stimuli made them regarded as unrealistic.

For example, Van Rompay et al. (2016) purposefully aimed to conduct research featuring realistic stimuli, but did not provide an elaborate explanation of which elements in their stimuli specifically made them regarded as realistic. Fenko et al. (2016) stated that results may be impacted with higher degrees of realism, such as including nutrition details for example. Spence & Velasco (2018) identified how across product packaging literature, stimuli vary in terms of realism, outlining the potential implications of presenting participants with low-realism stimuli. Specifically, they state how the design dimensions tested "might have [had] a more pronounced effect on people's product expectations [if] more realistic examples of packaging [had] been evaluated," (Spence & Velasco, 2018, p. 231). Despite these speculations surrounding the realism of stimuli, there are currently no studies which report the effects of varying realistic stimuli in product packaging research specifically. However, research in other fields have been able to report significantly improved study results by increasing realism of their test materials.

2.1. The effects of increased realism
Wang et al., (2018) aimed to conduct Michotte's launching effects study with 'physical realism', using 3D shapes in a VR environment. However, Meding et al. (2020), did not regard their stimuli materials as realistic, suspecting that this impeded their findings. Upon repeating the experiment using more realistic stimuli, they found found that it positively affected the results. Similarly, Barlett & Camba (2021) criticised traditionally used stimuli in spatial skills tests, deeming it too

outdated and unrealistic in nature. Spatial skill measures the ability to apprehend and translate 2D visualisations of shapes into mental representations of its forms, in order to mentally perceive and manipulate them as 3D objects. Stimuli for such tests had long remained unchanged, but after adjusting the stimuli to be more realistic, which reduced ambiguity, participants were found to score higher in their spatial skill results (Barlett & Camba, 2021).

In order to quantify the effects of realism in product packaging research, realism first needs to be made measurable. Therefore, this paper views realism in 2D stimuli to consist out of two main factors; rendered and realism. The following section defines these separate terms and gives context for why they are individually believed to affect stimuli perception.

2.2. Rendered realism

As aforementioned, this paper defines rendered realism as the degree to which a visual representation accurately reflects real life lighting and textures in a high resolution image. Bellazzi et al. (2022) explain how some studies still yielded positive results by exposing participants to photorealistic environment images on a screen, as opposed to suspension in a VR environment. In other words, participants held the capability to suspend themselves in the environment, because of the realistic lighting settings of the on-screen images, despite not being fully enveloped in it through VR (Belazzi et al., 2022). This study shows how 2D images can come across as realistic as long as they have high degrees of rendering. The findings by Barlett and Camba (2021) give more context as to why this is the case. They explain how flat looking 2D images can be ambiguous and therefore require a certain 'graphical interpretation' from participants. This graphical interpretation factor is ambiguous and can therefore lead to misinterpretation. However, when they reduced ambiguity by increasing the physical realism of stimuli, it was reported to have a positive effect on interpretation and provided more reliable results (Barlett & Camba, 2021).

2.3. Contextual realism

Both in product packaging design and other fields of research have academics acknowledged the positive effects of meaningful context on the perception of stimuli. Biederman (1972) criticised laboratory studies on perceptual recognition for their lack of realistic representation. He described how many of these studies were lacking meaningful context, stating that their stimuli "rarely appear in the real world as [it typically appears] in the laboratory" (p.78). Aiming to decrease this discrepancy, Biederman's research reports how context has the potential to positively effect the ways in which stimuli are perceived and recognised (Biederman, 1972). Heatherly (2019) takes a similar stance, and explains how its important to test and measure the reception to visual interactions with real-world stimuli, since "objects are almost always perceived in some setting or context that can play a substantial role in how the food attributes are perceived" (p.402). In the case of García-Segovia et al. (2015), matching their stimulus to a realistic context significantly influenced the perception of food when compared to a typical laboratory setting. Similarly, Maier and Dost (2018) showed how the addition of contextual backgrounds behind products increases their appeal. According to Zhang et al. (2020), displaying contextual backgrounds with the

product presentation has a positive effect on mental imagery and product evaluation. Additionally, when the information that the background presents is congruent with the consumer's expectation for the featured product, mental imagery becomes more easily accessible and consumption-related activities will come to mind (Zhang et al., 2020). For example, placing a beer in front of a picture of a beach or a pub with people may evoke very different consumption-related activities and emotions. Elder and Krishna (2012) define this effect as embodied mental stimulation, where the visual cue of a familiar contextual object primes the viewer to imagine performing a familiar action associated with that object. Additionally, embodied mental stimulation even has the potential to increase the object's evaluation. This paper redefines the concept of embodied mental stimulation as imaginary product use, since this term more accurately captures what participants go through when assessing product packaging stimuli.

2.4. Interaction between rendered- and contextual realism:
In the experiment by Meding et al. (2020), they found that solely increasing rendered realism had negative effects on the perception of causal relationships. However, when they increased added realistic physics alongside it, perceptions rose significantly. Meding et al. (2020) resembled this effect to the uncanny valley, where a strong feeling of unnaturalness is evoked if realism is almost, but not quite attained. A similar effect is expected for the unrendered-context condition. In this condition, the background is more detailed relative to the product packaging stimulus. Hence, it might evoke a similar feeling of unnaturalness and reflect this in the results.

2.5. Imaginary product usage
Imaginary product usage is an important factor in product packaging research. This is because current methodology requires participants to imagine using a product based on a stimulus, and assess its sensory qualities based on this imagination. However, this methodology is not robust, and becomes inaccurate if people have low imaginary product usage. If the stimulus fails to engage a participant in imagining the product's usage, their assessments are not an accurate reflection of their evaluations if they were to truly use the product. Hence, regardless of any manipulations that might be carried out across multiple stimuli, inaccurate results will still collected. The research by both Meding et al. (2020) and Barlett & Camba (2021) found that increased realism allowed people to better translate 2D shapes as 3D mental representations. This same skill is required for product packaging research, the stimuli that participants respond to is in essence a 2D picture of its packaging. Hence it is expected that the same positive effects of increasing realism will carry over and will increase imaginary product usage.

      Imaginary product usage is in part- but not entirely similar to embodied mental stimulation defined by Elder and Krishna (2012). Embodied mental stimulation specifically describes how contextually realistic stimuli can prime participants into performing a familiar action associated with the presented product. However, in sensory evaluation, assessing an expected smell or taste does not require a participant to imagine performing specific actions with the product. Hence, imaginary product usage also encapsulates the degree to which participants can imagine a product's sensory qualities. Regardless, it is expected that realistically contextual stimuli will be

able to both increase the degree to which participants will be able to imagine the physical, but also sensory qualities of the product presented in the stimuli.

H1. High (vs) low rendered realism will positively influence imaginary product usage

H2. High (vs) low contextual realism will positively influence imaginary product usage

2.6. Confidence in expected sensory evaluation

Confidence in expected sensory evaluation is another very important factor to take into consideration during product packaging research. When participants are surveyed about their sensory expectations of products, it is assumed that their answers are a valid indication of their opinions. However, this may not always be the case. Inevitably, some participants will need to assess a product that they do not consume on a regular basis, so they will have a tougher time evaluating its sensory qualities. However, in the same realm as imaginary product usage, a higher degree of realism may increase participant's confidence in their sensory evaluations, because it will allow them to better visualise the presented product.

H3. High (vs) low rendered realism will positively influence confidence in expected sensory evaluation

H4. High (vs) low contextual realism will positively influence confidence in expected sensory evaluation

2.7. Packaging appeal

Finally, packaging appeal is expected to be influenced by the realism of stimuli. This factor captures the degree to which participants like the looks of the package and to which degree it appeals to them personally. Maier and Dost (2018) found realistically contextual backgrounds to increase product appeal, because it increases the fluency with which the image can be processed by the viewer. Additionally, they mentioned how in the field of e-commerce, customers identified high quality images to be a very important factor in their purchase decisions (Maier & Dost, 2018).

H5. High (vs) low rendered realism will positively influence initial product impressions

H6. High (vs) low contextual realism will positively influence initial product impressions

3. Method

Two factors of realism were identified, which were hypothesised to create stimuli with the highest degree of realism when combined. In order to test this, a 2x2 experiment was used.

3.1. Stimuli

Four stimuli materials were created, all featuring the same coffee packaging design from fictitious coffee and tea brand 'Beans & Leaves' (figure 1). Coffee was chosen as a product because its taste purely stems from the beans, and not any additives in the product. Besides, its smell is familiar to many, also allowing less frequent coffee drinkers to assign sensory expectations. Between each stimulus, the only alterations that were made, were to the background or lighting conditions. Two designs were created which feature flat lighting, without any texture or lighting variations amongst them (*a & c*). The second dimension that was tested was the degree of realistic context, expressed through a kitchen in the background and a table and mug in the foreground (*c & d*). In addition, for the realistic context manipulations, the degree of lighting on the product packaging was carried over to the mug and table in the foreground to create more congruent images.

Figure 1. Stimulus materials

a) low rendered- and contextual realism
b) high rendered- and low contextual realism
c) low rendered- and high contextual realism
d) high rendered- and low contextual realism

3.2. Participants and procedure

A total of 161 people volunteered to participate in the final survey conducted via Qualtrics, out of which 38 responses were excluded because of incomplete answers or non-consent to participating. Participants were aged between 16 and 63 [(M = 24.98; SD = 10.19). Of the sample, 57 were Males, 65 Females and 1 identified more closely with "other". From the sample, 91 were Dutch, 22 German, and 10 of another nationality.

Participants were randomly assigned to one of the experimental conditions (see Table 1). Only age of participants significantly differed between experimental conditions (p = .015). However, for the experimental conditions Coffee frequency, Gender, Nationality and dominant hand, demographic characteristics of participants did not significantly differ (all p's > .05).

The convenience sample was recruited through snowball sampling. The Qualtrics survey was distributed via social media and participants were invited to share the survey, to collect a larger sample and broader audience. At the start of the survey, participants were informed of the treatment of their data and asked for their participation consent. Upon agreement, the survey asked them to observe the stimuli and fill out a list of questions to measured their expected tastes and smells of the product *(e.g., "If I imagine drinking this coffee, I think that this coffee would taste... sweet/sour/bitter")*. These were implemented to give participants ample opportunity to closely consider the stimuli and be able to judge their confidence in these evaluations later on.

Table 1. Distribution of Sample Characteristics

		Unrendered		Rendered	
Non-context	Age [a)]	M = 28.24 / SD = 13.6		M = 27.52 / SD = 12.68	
	Coffee frequency [b)]	M = 3.06 / SD = 1.46		M = 3 / SD = 1.66	
	Gender [c)]	Male	45%	Male	56%
		Female	52%	Female	44%
		Other	3%	Other	0%
	Nationality [d)]	Dutch	76%	Dutch	70%
		German	15%	German	19%
		Other	9%	Other	11%
	Dominant hand [e)]	Right-handed	85%	Right-handed	93%
		Left-handed	12%	Left-handed	7%
		Ambidextrous	3%	Ambidextrous	0%

Context	Age [a]	M = 22.91 / SD = 6.14		M = 21.29 / SD = 2.87	
	Coffee frequency [b]	M = 2.66 / SD = 1.39		M = 2.79 / SD = 1.31	
	Gender [c]	Male	37%	Male	50%
		Female	63%	Female	50%
		Other	0%	Other	0%
	Nationality [d]	Dutch	68%	Dutch	82%
		German	29%	German	7%
		Other	3%	Other	11%
	Dominant hand [e]	Right-handed	94%	Right-handed	96%
		Left-handed	6%	Left-handed	4%
		Ambidextrous	0%	Ambidextrous	0%

a) Mean + SD of self reported age

b) Mean + SD Of self reported coffee drinking frequency

c) Percentage of division Male / Female / Other

d) Percentage of division Dutch / German / Other

e) Percentage of division Right-handed / Left-handed Ambidextrous

3.3. Measures

Outside of the priming questions at the start of the survey, each item was measured on a 7-point Likert scale (scale anchors: strongly disagree - strongly agree).

3.3.1. Packaging appeal

Upon first exposure to the stimuli, participants were asked to judge the degree to which the packaging appealed to them through five items. *(e.g., "The look of this packaging is pleasing to me")*. For each of these items, participants were asked the extent to which they agreed/disagreed with them (alpha = .87).

3.3.2. Imaginary product usage

Imaginary product usage was initially measured using an eight-item scale. A factor analysis revealed these should be split into two separate factors (table 1). Based on this analysis and referring to the theory, the following factors were constructed. For both of the below-listed factors, the same hypotheses for imaginary product usage carry over.

3.3.2.1 Imaginary product usage - Sensory experience

Sensory experience captures the degree to which participants could imagine the sensory qualities of the coffee and was comprised of five items *(e.g., "I feel like I can easily imagine how the coffee tastes").* Participants answered the degree to which they agreed/disagreed with the statements (alpha = .83).

3.3.2.2 Imaginary product usage - Physical experience

Physical experience aimed to measure the extent that participants could imagine physically handling the product, measured by a total of three items *(e.g, "Based on the product presentation, I can imagine myself holding this coffee packaging").* Ratings were handled the same (alpha = .82)

Table 2. Rotated component Matrix of imaginary product usage	Component	
	1	2
6 IMAG I feel like I can easily imagine how the coffee smells	.839	.109
4 IMAG I feel like I can easily imagine how the coffee tastes	.857	.233
5 IMAG I can easily imagine myself smelling the coffee	.700	.389
1 IMAG I can easily form an impression of this product	.618	.148
2 IMAG I am confident in my ability to evaluate this coffee	.553	.408
7 IMAG Based on the product presentation, I can imagine myself holding this coffee packaging	.178	.866
8 IMAG Based on the product presentation, I can imagine myself opening this coffee packaging	155	.862
3 IMAG I can easily imagine myself tasting the coffee	361	.732

3.3.3. Confidence in expected sensory evaluation

This scale aimed to measure the degree to which participants were confident in the taste and smell expectations they described at the start of the survey. The scale was comprised of 2 items *(e.g., "I am confident in my above ratings of the coffee's taste")* to which participants indicated to which extent they agreed/disagreed with the statements (alpha = .92).

3.3.4. Stimuli realism

This measure was implemented as a manipulation check, to gauge whether the conditions with rendered- and/or contextual realism were indeed found to be more realistic by participants. The scale was comprised of four items *(e.g., "The coffee packaging looks realistic")* to which participants indicated to which extent they agreed/disagreed with the statements (alpha = .79)

3.4. Covariates

Participants were asked to rate the frequency with which they drank coffee and whether they were left/right handed or ambidextrous. Coffee frequency was deemed an important measure because it would indicate participant familiarity with both sensory qualities of the product and aesthetic qualities of the packaging packaging. Dominant hands were asked about because it was hypothesised to influence the degree of imaginary physical experience, similar to the research by Elder and Krishna (2012). Considering the stimuli showed a mug with the handle on the left, left handed people might report a higher imaginary physical experience.

4. Results

Data was analysed using a 2 (rendered realism: low/high rendered) x 2 (contextual realism: non-contextual/contextual background) between subjects design. Univariate analyses were conducted to examine the effect of rendered and contextual realism on the defined measures. A cut-off score of .05 was applied, where p-values < .05 were regarded as significant. In the analysis of each measure, coffee drinking frequency was regarded as a covariate. Dominant hand was only regarded as a covariate in analysing the imaginary physical experience.

4.1. Manipulation checks

To test whether the realism manipulations were indeed regarded as realistic by participants, an ANOVA was conducted with rendered- and contextual realism as independent variables and realism of stimuli as dependent variable. The main effects of both rendered- and contextual realism on imaginary product use did not reach significance (both F's(1, 117) < 1, ns), indicating that neither the degree of rendering or context impacted the degree to which participants perceived the stimuli as realistic.

4.2. Packaging appeal

For packaging appeal, the main effect of rendering came out as insignificant (F(1, 117) < 1, ns). However, the main effect of context was found to be significant at (F (1, 118) = 5.36, p = .02, η^2 = 6.33). This means that the addition of context significantly increased the overall liking of the product packaging.

4.3.1. Imaginary product usage - Sensory experience

In the analysis of imaginary sensory experience, neither the main effect of rendered realism nor contextual realism was found to have a significant effect (both F's(1, 117) < 1, ns), indicating that neither condition affected the imaginary sensory experience of participants.

4.3.2. Imaginary product usage - Physical experience

For the analysis of imaginary physical experience, the dominant hand of participants was regarded as a covariate in the analysis. Similarly, the main effect of rendered realism and contextual realism on imaginary physical experience did not reach significance (both F's(1, 117) < 1, ns), indicating that realism did not influence the degree to which people could tangibly imagine the product packaging. The covariate dominant hand did not reach significance (F(1, 117) < 1, ns), but coffee drinking frequency did, at (F(1, 117) = 7.40 , p = .01 η^2 = 11.53). Regardless, since neither main effect reached significance, this does not alter the outcome of the analysis.

4.4. Confidence in expected sensory evaluation

In the univariate analysis of variance with confidence in expected sensory evaluation as dependent variable, the main effect of rendering yielded a significant effect of (F (1, 118) = 6.17, p = .014, η^2 = 11.42). Similarly to imaginary product usage, this effect contradicted the hypothesis and came out as negative. Hence, higher degrees of rendering significantly decreased participant's confidence in their expected sensory evaluations of the presented product. The main effect of context was found to be insignificant (F(1, 117) < 1, ns).

5. General discussion

The findings presented suggest that realism of product packaging impacts the way in which participants assess the packaged product. More specifically, the results show how contextual realism increase the degree to which the product packaging was found to be appealing, in-line with the research by Maier and Dost (2018). It's important for academics to acknowledge these effects that context can have on the perception of stimuli, for any future research into realistic displays of product packaging stimuli.

Furthermore, the results revealed rendered realism to negatively influence participant's confidence in their sensory evaluations, contrary to the hypothesis. Possibly, this can be explained by the need for a 'graphical interpretation factor' that Barlett and Camba (2021) identify for 2D, ambiguous stimuli. The low-rendered condition was a more ambiguous image and therefore left more room for interpretation from participants. It may be the case that participants have more confidence in their own interpretations than if they are left to evaluate a less ambiguous image. In a way, the increased rendering might make participants believe that the packaging is so realistic that the coffee inside it has a specific taste and smell which can be described 'correctly', instead of being given the freedom to determine these qualities for themselves. However, future research is necessary to confirm these suspicions.

When it comes to the remaining hypotheses, the predicted effects of contextual- and rendered realism on imaginary product usage, for both sensory and physical experience were not significantly reflected in the results. Possibly, this could be because the actual coffee beans shown in the stimuli drove imaginary product usage, instead of the package overall. In each manipulation, the coffee beans could be seen through a clear window of the packaging, each with the same degree of rendering. If imaginary product usage was driven by these beans as a reference, then it is understandable why there is no significant difference between each manipulation. The results may have been different if the packaging presented in the stimuli did not have a clear window showing the product through the package, but this calls for future research. Additionally, for the imaginary physical experience, none of the conditions included a significant number of left-handed participants to validly test whether embodied mental stimulation was in effect.

For the manipulation check, testing whether participants perceived the stimuli as realistic, no significant difference was found between the conditions either. This may be for the same reason as was the case with imaginary product usage. If participants judged their assessments based on the coffee beans which are similarly rendered throughout the conditions, it is explicable why no significant difference was found. However, it may also be that participants were marginally more focussed on assessing realism of the visual branding of the packaging itself, not the conditions surrounding it, being rendering and context. Similarly, since the design of the packaging was the same across all conditions, no significant difference would be observed in this case either. Lastly, a few participants reached out after they had completed the survey. They expressed how they had a tough time imagining the coffee was a realistic product because the

branding has a moose as a logo, and coffee beans doesn't grow in the same places that moose live natively. However, this branding element was consistent across the conditions. Hence, although this element may have reduced the overall means, it would not impact significant differences across conditions.

Considering the distribution of sample characteristics, although the age between conditions differed significantly, this is not expected to have impacted the results. Despite that different age groups may potentially have different coffee consumption patterns, this factor was covered by coffee drinking frequency, which did not significantly differ between conditions.

With regards to practical implications, the most interesting result for designing future product packaging studies is how participant's confidence of their sensory evaluation was found to be negatively influenced by high degrees of stimulus rendering. Confidence of evaluation is an interesting concept that should be held in right regard during product packaging research, since it gives a small insight into the degree to which participant attitudes are accurately translated into data collection. Considering that confidence of expected sensory evaluation was as affected by the stimuli, there is a need for more research into the ways in which stimuli or surveys can be designed to authentically capture participant's expected sensory evaluations of products. Understanding how sensory expectations can accurately be translated into data collection will increase both validity and accuracy of future product packaging research.

However, there are still more opportunities for future research. When it comes to rendering this paper sees opportunities for future research to test the effect of photorealistic rendering on product packaging stimuli in different ways. First of all, the stimuli could be constructed as to not feature a clear window showing the actual product, since this potentially threw off results. Second, the effect of rendering might be more pronounced for differently textured packaging. For packing which feature ridges, bumps, or metallic elements, photorealistic rendering might be able to reduce ambiguity (when compared to a low-rendered condition) to a larger degree and thereby produce more noticeable effects. As for context, this is very dependent on the product featured in the study. Similar to what Maier and Dost (2018) identified, some product types might be effected more or less by the addition of context. Additionally, it would be interesting to test potential differences between a multitude of realistic contexts for a product, since the same product may be responded to differently based on the contextual background Zhang et al. (2020). This study chose to investigate a realistic at-home consumption context, but there is also the potential to create stimuli featuring a realistic shopping context, where the stimuli displays the product packaging on supermarket shelves.

Concluding, this study shows how increased realism of product packaging stimuli may affect participant's evaluation of a product overall, regardless of the design of the packaging itself. In addition, it was found to have an effect on the participant's confidence in their assessments of the product featured in the stimuli. Future research may strengthen these connections, but until then these findings will allow product packaging researchers to more closely consider the stimuli they present to their participants and the implications attached to them.

6. List of References

Bartlett, K.A. & Camba, J.D. (2021). The role of a graphical interpretation factor in the assessment of Spatial Visualization: A critical analysis, Spatial Cognition & Computation, https://doi.org/10.1080/13875868.2021.2019260

Becker, L., van Rompay, T.J.L., Schifferstein, H.N.J., Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference, 22*(1), 17-23. https://doi.org/10.1016/j.foodqual.2010.06.007

Bellazzi, A., Bellia, L., Chinazzo, G., Corbisiero F., D'Agostino P., Devitofrancesco, A., Fragliasso F., Ghellere, M., Megale, V. & Salamone F. (2022) Virtual reality for assessing visual quality and lighting perception: A systematic review. *Building and Environment, 209*. https://doi.org/10.1016/j.buildenv.2021.108674

Biederman, I., (1972). Perceiving real-world scenes. *Science, 177*, 77-80. https://doi.org/10.1126/science.177.4043.77

Dong, X. (2021, December 22). *New products.* USDA. https://www.ers.usda.gov/topics/food-markets-prices/processing-marketing/new-products.aspx

Elder, R.S. & Krishna, A. (2012). The "Visual Depiction Effect" in Advertising: Facilitating Embodied Mental Simulation through Product Orientation. *Journal of Consumer Research*, *38*(6), 988–1003. https://doi.org/10.1086/661531

Fenko, A., Lotterman, H. & Galetzka, M. (2016). What's in a name? The effects of sound symbolism and package shape on consumer responses to food products. *Food Quality and Preference, 51*, 100-108. https://doi.org/10.1016/j.foodqual.2016.02.021

García-Segovia, P., Harrington, R.J. & Seo, H.S. (2015). Influences of table setting and eating location on food acceptance and intake. *Food Quality and Preference, 39*, 1-7. https://doi.org/10.1016/j.foodqual.2014.06.004

Heatherly, M, Dein, M., Munafo, J.P. & Luckett, C.R. (2019). Crossmodal correspondence between color, shapes, and wine odors. *Food Quality and Preference, 71*, 395-405. https://doi.org/10.1016/j.foodqual.2018.08.019

Huang, L., & Lu, J. (2015). Eat with your eyes: Package color influences the expectation of food taste and healthiness moderated by external eating. *The Marketing Management Journal, 25*(2), 71–87.

Maier, E., Dost, F., (2018). The positive effect of contextual image backgrounds on fluency and liking. *Journal of Retailing and Consumer Service, 40,* 109-116. https://doi.org/10.1016/j.jretconser.2017.09.003

Martinez, L.M., Silva, M., Martinez, L.F., Abreu, A.M. (2018). Colour contrast in packaging and consumer product perception. Proceedings of the International Colour Association (AIC) Conference, 353-360.

Mead, J.A. & Richerson, R. (2018). Package color saturation and food healthfulness perceptions. Journal of Business Research, 82, 10-18. https://doi.org/10.1016/j.jbusres.2017.08.015

Meding, K., Bruijns, S.A., Schölkopf B., Berens, P. & Wichmann, F.A. (2020). Phenomenal causality and sensory realism. *i-Perception, 11*(3), 1-16. https://doi.org/10.1177/2041669520927038

Schifferstein, H.N.J., Fenko, A. Desmet, P.M.A., Labbe, D. & Martin, N. (2013). Influence of package design on the dynamics of multisensory and emotional food experience. *Food Quality and Preference, 27*(1), 18-25. https://doi.org/10.1016/j.foodqual.2012.06.003

Spence, C. & Velasco C. (2018). On the multiple effects of packaging colour on consumer behaviour and product experience in the 'food and beverage' and 'home and personal care' categories. *Food Quality and Preference*, *68*, 226-237. https://doi.org/10.1016/j.foodqual.2018.03.008

Tijssen, I., Zandstra E.H., De Graaf, C. & Jager, G. (2017). Why a 'light' product package should not be light blue: Effects of package colour on perceived healthiness and attractiveness of sugar- and fat-reduced products. *Food Quality and Preference, 59*, 46-58. https://doi.org/10.1016/j.foodqual.2017.01.019.

Van Rompay, T.J.L., Deterink, F. & Fenko, A, (2016). Healthy package, healthy product? Effects of packaging design as a function of purchase setting. *Food Quality and Preference, 53*, 84-89. https://doi.org/10.1016/j.foodqual.2016.06.001

Wang, D., Kubrlcht, J., Zhu, Y., Lianq, W., Zhu, S. C., Jiang, C., & Lu, H. (2018). Spatially perturbed collision sounds attenuate perceived causality in 3D launching events. *IEEE Conference on Virtual Reality and 3D User Interfaces,* 259–266

Zhang, Y., Xiao, S.H., & Nicholson, M. (2020) The effects of dynamic product presentation and contextual backgrounds on consumer purchase intentions: perspectives from the load theory of attention and cognitive control. *Journal of advertising*, *49*(5), 592-612. https://doi.org/10.1080/00913367.2020.1789014

7. Appendix

Appendix 1. Complete list of survey questions

1 IM I like the look of this coffee packaging

2 IM The look of this packaging is pleasing to me

3 IM This package appeals to my personal tastes

4 IM Based on the packaging, I would enjoy the taste of this coffee

5 IM Based on the packaging, I would enjoy the smell of this coffee

1 PRIME TASTE If I imagine drinking this coffee, I think this coffee would taste

2 PRIME SMELL If I imagine drinking this coffee, I think this coffee would smell

1 IMAG I can easily form an impression of this product

2 IMAG I am confident in my ability to evaluate this coffee

3 IMAG I can easily imagine myself tasting the coffee

4 IMAG I feel like I can easily imagine how the coffee tastes

5 IMAG I can easily imagine myself smelling the coffee

6 IMAG I feel like I can easily imagine how the coffee smells

7 REAL Based on the product presentation, I can imagine myself holding this coffee packaging

8 REAL Based on the product presentation, I can imagine myself opening this coffee packaging

1 REAL The coffee packaging looks realistic

2 REAL The coffee packaging looks professional

3 REAL The product packaging suggests a high quality product

4 REAL I could see this packaging amongst other products in the supermarket

1 CONF I am confident in my above ratings of the coffee's taste

2 CONF I am confident in my above ratings of the coffee's smell