The impact of social media visual features on acceptance of meat substitute

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Abstract

There is a growing demand for meat substitutes among consumers, given that excessive meat consumption is associated with negative consequences for personal health and the environment. However, the market shares of such meat substitutes remain low, thus highlighting the need to further investigate how to increase consumer acceptance of meat substitutes. The present research investigates social media data of plant-based meat brands and explores how visual features could lead to a high number of likes, which is a numerical representation of social acceptance. The findings of this research show that social media posts with warm color, vertical symmetry, and horizontal symmetry receive a higher number of likes. Further, there is a joint effect between warm color and vertical symmetry, such that vertical symmetry would strengthen the positive effect of warm color on the number of likes. These findings offer a more nuanced understanding of how to increase consumer acceptance of meat substitutes and how to promote plant-based meat brands in social media.

Keywords
plant-based meat, meat substitute, consumer acceptance, social media, visual symmetry, warm color

Introduction

Meat overconsumption can lead to negative impact on personal health, animal ethics and the environment (Godfray et al., 2018; González et al., 2020; McAfee et al., 2010). As a result, there is a growth of flexitarian, vegan, and vegetarian diets (Veganz, 2020) and there is a growing demand for meat substitutes among consumers (He et al., 2020; Schösler et al., 2012; Tziva et al., 2020). Indeed, the plant protein market is expected to grow from $9.1 billion in 2018 to $13.9 billion by 2023 with a compound annual growth rate of 8.8% (Laxmi, 2020). This consumer demand drives different brands and companies to incorporate meat substitutes in their product offerings (Keeve, 2021). Yet, many barriers have been identified which prevent consumers from trying meat substitutes such as lack of trust (Kerslake et al., 2021), cooking knowledge/experience (Tosun et al., 2021), and cultural acceptance (i.e., not part of traditional diet) (Cheah et al., 2020). Thus, despite the effort from different brands and companies (Curtain & Grafenauer, 2019), the market shares of such meat substitutes remain low (Gravely & Fraser, 2018; Van Loo et al., 2020). Studies report that plant-based meat substitutes present a market share around 16% in the U.S. (Van Loo et al., 2020), whereas the market share in Canada is around 21% (Slade, 2018). Surprisingly, there is little research investigating how to increase consumers' acceptance and preference for meat substitutes (Ye & Mattila, 2021).

Acceptance of food is usually influenced by sensory properties, effects of ingestion, and ideational concerns (Rozin & Fallon, 1980). However, food evaluations are also impacted by other visual or spatial cues (Manippa et al., 2022). For instance, food advertisement studies have investigated the impact of advertising messages on adults' snack choice (Dovey et al., 2017) and advertising format on consumer expectations for apples (Jaeger & MacFie, 2001). Moreover, the effect of imagery is also important as it has been found to have an impact on product attitudes towards plant-based protein biscuits (Banovic & Otterbring, 2021) and also perceived risk and purchase intent of insects (Baker et al., 2016). Other studies have shown location of images on food packaging (Valenzuela & Raghubir, 2015) and left versus right display of healthy and unhealthy food (Romero & Biswas, 2016) can influence perceptions (i.e., quality, healthiness). Thus, scholars are urged to examine ways to best advertise, especially via imagery as research has shown the first sensory exposure to food is usually visual (Wadhera & Capaldi-Phillips, 2014), to promote sustainable and healthy eating behaviors (Manippa et al., 2022).

The present research investigates the social media posts of plant-based meat brands to establish the role of two important visual features – color and symmetry – on acceptability of plant-based meats. In the next section, we will discuss the conceptual development of our hypotheses. We then present our findings and discuss the main contributions of our study.

Consumer acceptance of meat substitutes

Previous studies have extensively explored different factors that could influence consumer acceptance of meat substitutes and various strategies that could be employed to increase consumer acceptance. These studies show that various factors drive consumer acceptance of meat substitutes, including attitudes toward meat substitutes (Hoek et al., 2011; Lemken et al., 2017) such as consumption motives (Siegrist & Hartmann, 2019; Vainio et al., 2016), familiarity with meat substitutes (Hoek et al., 2011, 2013), food neophobia (Hoek et al., 2011; Krings et al., 2022), and disgust (Chan, 2019; Siegrist & Hartmann, 2019).

Other research has identified different demographic factors that can influence consumer acceptance of meat substitutes, including age (Grasso et al., 2019), gender (Gómez-Luciano et al., 2019), education (Birch et al., 2019), and political ideology (Wilks et al., 2019). In this regard, individuals who are younger and have higher levels of education seem to be more willing to accept meat substitutes (Birch et al., 2019; Gómez-Luciano et al., 2019; Grasso et al., 2019). Moreover, females seem to be more accepting of plant-based meat substitutes than males (Gómez-Luciano et al., 2019; Melendrez-Ruiz et al., 2019). Overall, all these studies urge food marketers and social marketers to communicate and persuade consumers to transition towards sustainable and healthy plant proteins.

However, most research examining various strategies that could be employed to increase consumer acceptance did not examine consumer responses in real-world context (Kwasny et al., 2021; Onwezen et al., 2021). Generally, the measures used as a proxy of consumer acceptance were intentions to try, willingness to buy, or self-reported behavior (Onwezen et al., 2021). However, the is a large attitude-behavior or intention-behavior gap in sustainable consumption (Schäufele & Hamm, 2018). Moreover, such studies often investigated the role of informational-claims (Onwezen et al., 2021), which is a typical and direct approach to influence consumer food choices (Guthrie et al., 2015). However, information claims alone are not always able to persuade consumers to purchase novel food such as meat substitutes (Siegrist et al., 2018; Wilks et al., 2021). Consequently, further research is needed to provide real-world support on how to increase consumer acceptance via a less direct method.

Advertising meat substitutes

Advertising of food products can occur on various mediums: online advertising, television, print, Point-of-Purchase displays, on packaging, and many more. The present research focuses on social media as most brands are present and spend a significant amount of effort and money on advertising on the likes of Facebook, Instagram, and TikTok (Voorveld, 2019). In fact, while global ad spend fell by $63 billion in 2020, the spending on online media increased by $29 billion (i.e., 9.4% increase from the previous year) (WARC, 2021). Internet and social media also play a significant role in consumer decision making (Bronner & de Hoog, 2014; Gascoyne et al., 2021; Hajli, 2014; Utami et al., 2021). Specifically, we examine the social media posts of plant-based meat brands.

This data collection method also allows us to address the gaps in the extant literature. First, we can leverage unstructured big data from social media to examine consumer responses in real-life settings (Erevelles et al., 2016). In this regard, social media websites provide information of 'likes', which is a numerical representation of social acceptance (Rosenthal-von der Pütten et al., 2019). In other words, using the number of likes as the focal dependent variable, we can explore the effectiveness of social media features associated with plant-based meat brands in enhancing social acceptance. For instance, Gascoyne et al. (2021) conduct a cross-sectional survey and find that a higher frequency of engagement (likes, sharing) with social media content was associated with a high intake of unhealthy food and drinks.

Second, social media platforms (e.g., Instagram, Facebook, Snapchat) allow users to add images in addition to texts (Appel et al., 2020; Ji et al., 2019). Consistent with the old idiom, "a picture is worth a thousand words", images can influence consumer judgment process through different visual features (Li & Xie, 2020). As such, the examination of visual features would help us to explore the potential of other approaches (e.g., emotion; Loureiro et

al., 2019), apart from typical informational-claims (Grasso et al., 2022; Guthrie et al., 2015; Onwezen et al., 2021), to leverage consumer acceptance of plant-based meat. Communications which are well-liked by consumers are more likely to entice consumers to attend to information, and develop more positive attitudes and higher purchase intentions for products and brands (Huhmann & Albinsson, 2012). Thus, food marketers of meat substitutes must adopt marketing techniques and tools which enhance the appeal of their novel products.

Visual features – Color hue and visual symmetry

In the current research, we examine the role of two important visual features – color and symmetry. This is consistent with past research demonstrating how these features can significantly influence consumer evaluations of a brand (Bettels & Wiedmann, 2019; Kostyk & Huhmann, 2021; Labrecque & Milne, 2012) as well as with research on imagery in food perceptions (Manippa et al., 2022; Romero & Biswas, 2016; Valenzuela & Raghubir, 2015). Among a wide range of color features, prior research has investigated the role of color hues, which reflect the wavelength of light within the visible spectrum (Labrecque, 2020; Labrecque et al., 2013), in influencing consumer decision making (Choi et al., 2020; Ettis, 2017; Hsieh et al., 2018).

In line with the literature in this area, we focus on examining the effect of color hue. In particular, past research has established thermal-hue correspondences, such that long (vs. short) wavelengths are associated with warming (vs. cooling) sensations (Fenko et al., 2010; Ho et al., 2014; Motoki et al., 2019). In this regard, warm (vs. cool) color could elicit higher levels of arousal (Bagchi & Cheema, 2013; Küller et al., 2009; Sokolik et al., 2014). Such arousal could then activate "hot cognition" (Brand, 1985), which is associated with decision making process that is intuitive and highly influenced by emotions (Kret & Bocanegra, 2016; Lodge & Taber, 2005).

Linking this argument in the case of consumer acceptance of meat substitutes, recent research has suggested that psychological mechanisms associated with consumer acceptance seem to be grounded in emotional processing (Wilks et al., 2019, 2021). Specifically, these studies found positive associations between disgust sensitivity and negative attitudes toward cultured meat (Wilks et al., 2019) and between disgust sensitivity and the view that cultured meat is unnatural (Wilks et al., 2021). Interestingly, the tendency to prefer natural things was not associated with attitudes toward cultured meat (Wilks et al., 2019). These findings suggest that consumers might have intuitive disgust associated with cultured meat (Wilks et al., 2021). While such studies examined the context of cultured meat, since prior research has also linked food neophobia (Hoek et al., 2011; Krings et al., 2022) and disgust (Siegrist & Hartmann, 2019) with plant-based meat, we have reasons to believe that consumer acceptance of plant-based meat should also be grounded in affective mechanisms.

These findings suggest that warm (vs. cool) color can activate emotional processing. Because consumer acceptance of plant-based meat is also driven by an intuitive and emotional processing, we propose that:

- H1. Warm (vs. cool) color associated with social media posts of plant-based meat brands would lead to a higher number of likes.

We also propose that visual symmetry can further influence the effect of warm color. Symmetry is defined as "self-similarity under a class of transformations [such as]

translations, rotations, and reflections" (Wagemans, 1997, p. 346). In the context of this research, we examine symmetry within social media images, in which a symmetrical object would have "at least one symmetry axis […] that splits the object into two identical but mirror-inverted halves" (Treder, 2010, p. 1512). For instance, the letters "D" or "E" reflect a mirror symmetry around the horizontal axis (i.e., horizontal symmetry), while the letters "A" or "V" reflect a mirror symmetry around the vertical axis (i.e., vertical symmetry) (Kostyk & Huhmann, 2021; Treder, 2010).

Generally, consumers prefer symmetrical objects than non-symmetrical ones (Creusen et al., 2010; Kostyk & Huhmann, 2021; Wang & Hsu, 2020). For instance, consumers report a higher liking for symmetrical (vs. non-symmetrical) watch (Wang & Hsu, 2020). In addition, symmetrical photos associated with a brand receive more favorable evaluations (Kostyk & Huhmann, 2021). Notably, preference for symmetry is inherent and strong (Creusen et al., 2010). Symmetry is also processed via effortless and intuitive processing (Treder, 2010; Wagemans, 1997), even though vertical symmetry seems to be processed easier than the horizontal one (Pecchinenda et al., 2014; Wagemans, 1997).

These findings highlight that visual symmetry can lead to favorable consumer evaluations, and it is driven by an intuitive processing. In a similar vein, because consumer acceptance of plant-based meat is also influenced by an intuitive processing, we expect that social media posts of plant-based meat brands would receive a higher number of likes when such posts have horizontal or vertical symmetry (H2). Moreover, because both warm color and visual symmetry can lead to positive effects, we could further propose joint effects between warm color and visual symmetry (H3). Formally stated:

- H2. Increasing (a) vertical symmetry or (b) horizontal symmetry associated with social media posts of plant-based meat brands would lead to a higher number of likes.
- H3. Increasing (a) vertical symmetry or (b) horizontal symmetry would strengthen the effect of warm color on the number of likes.

Methods

To test visual features such as warm color and vertical symmetry, we analyzed 1779 posts from the Instagram account of Impossible Foods and Beyond Meat, which are the two (arguably) biggest brands on plant-based meat (Craft, 2021; Keeve, 2021). Given the focus of our research is the effect of an image, we collected Instagram posts because Instagram is one of the most used social media among image-dominant platforms (Socialbakers, 2016; Yu et al., 2020). Both companies aim to provide consumers with plant-based food to feed a sustainable future (Thompson, 2021), and sell diverse plant-based products from burger patties to sausage to chicken (Ho, 2021). In their Instagram accounts, they display a variety of their own plant-based foods

Visual features

We employed OpenCV (http://opencv.org) to extract warm color from each photo. OpenCV measures whether each pixel of a photo has warm hue or not. The level of warm color at a photo level, ranging from 0 to 1, is the proportion of warm color (e.g., red, orange, yellow) pixels in a photo (Wei-Ning et al., 2006); thus, a higher score means a warmer hue.

Using the OpenCV, we also extracted vertical symmetry, which is mirror symmetry around the vertical axis (Wang et al., 2013; Zhang & Luo, 2021). The algorithm (Wang et al., 2013) initially finds centers of salient segments (e.g., faces or products) in a photo, then weighting them to calculate an overall center. The vertical asymmetry is calculated as the horizontal distance between the weighted center and the vertical axis which divides the photo into two equal left and right parts; thus, a higher distance means a more asymmetric image. A photo with perfect vertical symmetry has an overall center in the vertical axis, leading to zero distance. Finally, vertical symmetry is measured as a negative of the vertical asymmetry measure, which is −1 times vertical asymmetry. A higher score in a vertical symmetry variable therefore means a higher symmetry around vertical axis. Similarly, horizontal symmetry is measured based on a horizontal axis which divides the photo into two equal top and bottom parts (Wang et al., 2013; Zhang & Luo, 2021). A higher score in a horizontal symmetry variable means a higher symmetry around horizontal axis. Table 1 shows the summary statistics of each analyzed variable outlined above.

Table 1. Summary Statistics

Variables	Mean	SE	Min	Median	Max
DV = ln (Like Count)	7.02	1.63	3.04	7.09	11.32
Color Feature					
Warm	0.67	0.25	0.00	0.73	1.00
Visual Symmetry					
Vertical Symmetry	-67.54	52.97	-540.00	-57.00	0.00
Horizontal Symmetry	-73.78	53.03	-540.00	-65.00	0.00
Textual Features					
Text Sentiment	0.40	0.39	-0.84	0.46	0.99
Text Length	121.79	55.23	1.00	20.00	148.00

Table 2 shows the number of posts and the average number of likes by the level of warmth and symmetry and its combination. For making descriptive figures, we categorized posts to two groups by the level of warmth and symmetry. If the level of warmth is greater (less) than 0.5, it is warm (cool) color (Wei-Ning et al., 2006). As seen in Table 2, warm colors were more frequently depicted in the posts and received more likes on the average than cool colors. For symmetry variables, we categorized them to high and low group using the median value as the cutoff. While the number of posts with high vertical symmetry is similar with that with low vertical symmetry, high vertical symmetry obtained more likes on the average than low vertical symmetry. The same pattern applies to horizontal symmetry.

Table 2. The Number of Posts and Average Number of Likes

		The Number of Posts	Average number of likes
Warm vs Cool Color	Warm	1355	1180
	Cool	424	930
Vertical Symmetry (VS)	High	901	1236
	Low	878	1003
Horizontal Symmetry (HS)	High	890	1602
	Low	889	775
Warm & VS	Warm & VS_High	681	1357
	Warm & VS_Low	674	1025
Cool & VS	Cool & VS_High	220	925
	Cool & VS_Low	204	935
Warm & HS	Warm & HS_High	666	1809
	Warm & HS_Low	689	780
Cool & HS	Cool & HS_High	224	1116
	Cool & HS_Low	204	935

Turning to its combination between warm color and each symmetry variable, the pattern of the average number of likes between vertical and horizontal symmetry is different. While high vertical symmetry received more likes than low vertical symmetry in the context of warm color, the difference is almost gone in the context of cool color. It suggests that vertical symmetry may increase the effect of warm color on the number of likes. However, high horizontal symmetry received bigger average number of likes than low horizontal symmetry in both warm and cool context. This may suggest that there is only a main effect of horizontal symmetry, but not its interaction effect with warm color. We will test this descriptive pattern in the next section.

Textual features

Length and sentiment of text description in the caption were also measured and included as control variables. This is because prior research suggests that text sentiment can influence the number of likes (Li & Xie, 2020). For text length, we counted the number of words in a caption. In terms of sentiment, we leveraged Valence Aware Dictionary and sEntiment Reasoner (VADER), which is a lexicon and rule-based sentiment analysis tool (Hutto & Gilbert, 2014). VADER processes not only negative and positive words, but also the emoji, slang, and emoticons that are ubiquitous in social media. The sentiment scores range between −1 (strongly negative) and 1 (strongly positive).

Model

We first tested Hypotheses 1, 2a, and 2b, such that whether a post with a higher level of warm color, vertical symmetry, and horizontal symmetry would receive a higher number of likes. Following prior social media research (Li & Xie, 2020), we adopted a log-linear model. In addition to textual variables – sentiment and length, we also controlled for brand effect by including account dummies because Beyond Meat has about 3 times more followers than Impossible Foods (about 1 million vs. 0.3 million).

In addition, we controlled for time effects. This is because posting time has great potential in affecting the number of likes (i.e., earlier posts have longer exposure than the later posts). Moreover, there may be more popular days or times of the day for social media usage. To address this, we included a rich set of time dummies for year, month-of-year, day-of-week, and time-of-day. Following Kanuri et al. (2018), we included dummies for time-of-day as night (12 - 5:59 AM), morning (6 - 11:59 AM), afternoon (12 – 5:59 PM), and evening (6 – 11:59 PM).

Therefore, the number of likes that a post i received at brand j's account is

$$ln\left(Like\ Count_{ij}\right) = \beta_0 + \beta_1 Warm\ Color_i +$$

$$\beta_2 Vertical\ Symmetry_i + \beta_3 Horizoncal\ Symmetry_i +$$

$$\beta_4 Text\ Sentiment_i + \beta_5 Text\ Length_i + \mu_j + \tau_t + \varepsilon_i$$

Where
- $\beta_1 \sim \beta_3$: captures the core coefficients of interest for hypothesis about warm color, vertical symmetry, and horizontal symmetry
- $\beta_4 \sim \beta_5$: the coefficients for textual control variables
- β_0: an intercept
- Warm Color, Vertical Symmetry, Horizontal Symmetry, Text Sentiment, and Text Length are defined above
- μ_j: Instagram account fixed effect
- τ_t: year, month-of-year, day-of-week, times-of-day fixed effects of posting time
- ε_i: a random error

Next, we tested whether vertical and horizontal symmetry would moderate the effect of warm color on the number of likes (H3a and H3b). Thus, we made the following function for the effect of warm color and plugged it into the previous equation.

$$\beta_1 = \alpha_0 + \alpha_1 Vertical\ Symmetry_i + \alpha_2 Horizontal\ Symmetry_i$$

Where
- α_0: baseline effect
- α_1, α_2: captures the core coefficients of interest for the moderator of warm color
- Vertical Symmetry and Horizontal Symmetry are defined above.

Results

Table 3 shows the empirical result of the main effect of warm color, vertical symmetry and horizontal symmetry on the number of likes. The coefficient for warm color was significant and positive (b = 0.444, SE = 0.056, $p < 0.001$), suggesting that a post with warmer color received a higher number of likes. This result supports our Hypothesis 1. Moreover, the coefficients of two visual symmetry features were also significant and positive (b = 0.001, SE = 0.0003, $p = 0.095$ for vertical symmetry, and b = 0.001, SE = 0.0003, $p < 0.001$ for horizontal symmetry), suggesting that a more vertical and horizontal symmetric image received more likes. These results supported Hypotheses 2a and 2b.

Table 3. Results for Main Effect

	Estimate	Significance	SE
Warm	0.444	***	0.056
Vertical Symmetry	0.001	**	0.0003
Horizontal Symmetry	0.001	***	0.0003
Text Sentiment	-0.055		0.039
Text Length	0.001		0.001
Constant	4.210	***	0.085
Instagram Account Dummies		YES	
Time Dummies		YES	
R-squared		0.880	

Dependent variable is log(Like Count).
Unit of observation is Impossible Foods & Beyond Meat Instagram post.
The number of observations is 1,779.
Fixed effects: Instagram Accounts; Year, Month-of-Year, Day-of-Week, Time-of-Day
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 4 shows the results of moderators for the warm color effect on the number of likes. Consistent with the previous analyses, we found significant and positive main effects of warm color, vertical symmetry, and horizontal symmetry. However and more importantly, we focused on the interaction effects of the warm color in the first two rows. The coefficient of the interaction term with vertical symmetry was positive and significant (b = 0.002, SE = 0.001, $p = 0.043$), suggesting that vertical symmetry enhanced the effect of warm effect on the number of likes. This supported Hypothesis 3a. However, the coefficient of the interaction term with horizontal symmetry was non-significant (b = 0.0003, SE = 0.0010, $p = 0.712$), suggesting that Hypothesis 3b was not supported.

Table 4. Results for Moderators

	Estimate	Significance	SE
Warm × Vertical Symmetry	0.002	*	0.001
Warm × Horizontal Symmetry	0.0003		0.001
Warm	0.452	***	0.056
Vertical Symmetry	0.001	**	0.0003
Horizontal Symmetry	0.001	***	0.0003
Text Sentiment	-0.053		0.039
Text Length	0.001		0.001
Constant	4.380	***	0.069
Instagram Account Dummies		YES	
Time Dummies		YES	
R-squared		0.880	

Dependent variable is log(Like Count).
Unit of observation is Impossible Foods & Beyond Meat Instagram post.
The number of observations is 1,779.
Fixed effects: Instagram Accounts; Year, Month-of-Year, Day-of-Week, Time-of-Day
$*p < 0.05$; $**p < 0.01$; $***p < 0.001$

Discussion

Despite the growing demand of meat substitutes in the face of environmental and health issues associated with excessive consumption of meat (Godfray et al., 2018; González et al., 2020; McAfee et al., 2010), the market shares of such meat substitutes remain low (Gravely & Fraser, 2018; Van Loo et al., 2020). The present research explores how to increase social acceptance of meat substitutes by examining the social media data of two big brands of plant-based meat (i.e., Impossible Foods and Beyond Meat). We focus on the imagery of meat substitutes as it is an important part of food marketing and the first sensory exposure to food is usually visual and contributes significantly to consumer perceptions (Wadhera & Capaldi-Phillips, 2014). Notably, the findings of our research add to the literature on consumer acceptance of meat substitutes in three meaningful ways.

First, we examine consumer responses in real-world setting, in which we use the number of likes as a numerical representation of social acceptance (Rosenthal-von der Pütten et al., 2019). This is significant because even though a large body of literature has investigated consumer acceptance of meat substitutes, most research was not performed in real-life settings (Kwasny et al., 2021; Onwezen et al., 2021). In this regard, the outcome measures that were typically used as a proxy of consumer acceptance were intentions to try, willingness to buy, or self-reported behavior (Onwezen et al., 2021). Thus, we were able to overcome some issues associated with the attitude-intention and intention-behavior gap (Schäufele & Hamm, 2018). As such, by leveraging social media data, we provide evidence of consumer responses in real-life settings (Erevelles et al., 2016). In turn, we are able to offer insight into

the types of images in meat substitute advertisements that attract more 'likes', enabling greater appeal to consumers.

Second, prior studies often test the effectiveness of informational-claims in driving consumer acceptance of meat substitutes (Onwezen et al., 2021). While such messaging strategies have been commonly used to influence consumer food choices (Guthrie et al., 2015), we extend this literature by testing the potential of a less direct approach, such as visual features. This is meaningful given the increasing trend of image-dominant social media platforms, such a Instagram and Snapchat (Appel et al., 2020; Ji et al., 2019). The visual appeal of food is also very important to consumer perceptions (Wadhera & Capaldi-Phillips, 2014). Our research is in line with other recent studies on food imagery and packaging placement effects on perceptions such as healthiness and quality (Manippa et al., 2022; Romero & Biswas, 2016; Valenzuela & Raghubir, 2015), suggesting that utilizing cognitive bias is a lucrative way to nudge and promote sustainable and healthy eating behaviors (Manippa et al., 2022). Notably, the findings of this research show that the use of warm color, vertical symmetry, and horizontal symmetry would increase the number of likes of a post (i.e., social acceptance) associated with plant-based meat brands. We thus add to the emerging literature on social media marketing and how associated images can influence consumer responses (Kostyk & Huhmann, 2021), especially in the food context.

Third, we also find a joint (i.e., interaction) effect between warm color and vertical symmetry, such that the positive effect of warm color would be stronger when the image also has vertical symmetry. However, while some studies find that horizontal and vertical symmetry have similar effects (e.g., Kostyk & Huhmann, 2021), we note that we do not find support for the joint effect between warm color and horizontal symmetry. Thus, we add to theory on symmetry in imagery. It is plausible that this is because vertical symmetry seems to be processed easier than the horizontal one (Pecchinenda et al., 2014; Wagemans, 1997); hence, the joint effect may emerge for vertical (but not horizontal) symmetry. Nonetheless, this premise needs further examinations.

Our findings have implications for marketers of meat substitutes. Gaining approval and attracting new customers is of great importance to meat substitute companies. This is because the plant protein market is expected to grow exponentially (Laxmi, 2020). Yet, barriers have been identified which prevent consumers from buying meat substitutes such as lack of trust, perceived high price (Kerslake et al., 2021), poor sensory qualities (McBey et al., 2019), lack of convenience (Collier et al., 2021), lack of cooking knowledge/experience (Tosun et al., 2021), and lack of cultural acceptance (Cheah et al., 2020).

In order to overcome these barriers, perceptions about meat substitutes could be enhanced via advertisements and social marketing campaigns. Our study demonstrates that social media images portraying meat substitutes with warm color, vertical symmetry, and horizontal symmetry receive a higher number of likes and thus be perceived more positively by consumers. Further, the joint effect between warm color and vertical symmetry makes the image of a meat substitute even more appealing. Overall, our study adds to the limited research which has been conducted on how to increase meat substitute appeal via advertisement (Ye & Mattila, 2021).

Limitations and future research

As with all research, our study has limitations which provide avenues for future research. Notably, while we examine consumer responses in real-life settings in the social media context, we note that this research does not offer causal evidence to the findings and only tests correlational relationships. Future research could extend the study into an experimental design but we acknowledge this would lessen its external validity. Also, situation factors such as cooked (vs. uncooked) food might moderate the warm color effect. For example, warm (cool) color might be more effective for cooked (uncooked) meat substitutes; this is an important research direction for future research (i.e., examining moderators). In addition, we also develop our arguments and hypotheses by building on recent research suggesting that consumer acceptance of meat substitutes is grounded by intuitive and emotional mechanisms (Wilks et al., 2019, 2021). Hence, it would be important for future research to provide evidence associated with this argument and further test the mediating variables driving the effects of visual features identified in the current research. Furthermore, successful advertising of meat substitutes is important to enhance its appeal to the general population; therefore, we call on other researchers to explore how appeal can be increased through various marketing and communication mediums such as menus (Ye & Mattila, 2021), grocery aisle location (Kerslake et al., 2021), alternative locations (i.e., butchery) (Vandenbroele et al., 2021), television advertisements, and Point-of-Purchase displays, and focusing on message framing and advertising appeals. Finally, meat substitutes represent an emerging new technology; as such, it would thus be of interest to extend our findings in the case of consumer acceptance of other new technologies (Wang, 2017).

In conclusion, despite increased uptake of flexitarian, vegetarian and vegan diets, many consumers are still hesitant to buy or trial meat substitutes. Our research investigates social media data of plant-based meat brands and examined how visual features could lead to a high number of likes. The findings demonstrate that social media images with warm color, vertical symmetry, and horizontal symmetry receive a higher number of likes. Further, enhanced appeal is achieved by a joint effect between warm color and vertical symmetry, such that vertical symmetry strengthens the positive effect of warm color on the number of likes. These findings offer a more nuanced understanding of how to increase consumer acceptance of meat substitutes and how to promote plant-based meat brands in social media.

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