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RESEARCH ARTICLE

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Face pareidolia in products: The effect of emotional content on attentional capture, eagerness to explore, and likelihood to purchase

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Abstract

Face-like configurations can be perceived in everyday products. This perceptual phenomenon is known as face *pareidolia*. However, few studies have investigated the perception of pareidolic *emotion* in such products and the effect it could have on consumer behaviour. Therefore, in this study, across two experiments, we test the extent to which participants perceive core human emotions in products with pareidolic configurations (Experiment 1), and how this affects key consumer metrics (i.e., likely attentional capture, eagerness to explore, likelihood to purchase; Experiment 2). The findings show that these products do elicit the full range of affective content, with variation in perceived emotional intensity. Products with 'happy', 'angry' and 'surprise' configurations were likely to capture attention/promote product exploration, but only 'happy' products retained this advantage for purchasing decisions. Individual differences in mood and level of loneliness predicted likely engagement with these products. The theoretical and practical implications of these findings are discussed.

KEYWORDS
consumer behaviour, emotion, face perception, individual differences, pareidolia

1 | INTRODUCTION

Faces are a 'special' category of stimuli which exert a unique influence on attention and perception (Carretié, 2014). Infants show preferential perception of faces early in their developmental trajectory, they are processed more rapidly than objects, and they capture our attention even in perceptually demanding contexts (Garvert et al., 2014; Kato & Mugitani, 2015; Keys et al., 2021; Peltola et al., 2018; Ro et al., 2001; Robertson et al., 2017; Wardle et al., 2020, 2022). This perceptual sensitivity is so robust that it extends beyond the processing of human or animal faces (see Jakobsen et al., 2021); in fact, our visual system appears to be primed to detect face representations even in the absence of real facial stimuli——a phenomenon known as *face pareidolia* (Liu et al., 2014). However, while pareidolic configurations, and the emotional content they appear to elicit, are present in a wide range of consumer goods (see Purucker et al., 2014; Wodehouse et al., 2018), there have been few studies that have assessed their impact on product preference and consumer behaviour.

Pareidolic faces appear to be a ubiquitous perceptual phenomenon that are perceived in abstract shapes such as clouds, shadows, and inkblots, and across products, including: vehicles, electrical goods, mobile phones, clothing, foodstuffs, and packaging (Summerfield et al., 2006; Voss et al., 2012; Wodehouse et al., 2018). Importantly, pareidolic faces are thought to engage the same, or similar, preferential cognitive and neural mechanisms as real faces (Akechi et al., 2014; Churches et al., 2009; Kaufmann et al., 2019; Palmer & Clifford, 2020), and consequently, their inclusion in product designs have potentially important implications for product engagement and purchasing decisions. This point is supported by research on the impact of faces on consumer metrics, with studies showing that the presence of *real faces* in advertising, for example, enhances product preference (e.g., Xiao & Ding, 2014).

There is an extensive literature on the effects of anthropomorphism on product perception and buyer behaviour (Epley et al., 2007; Guthrie, 1997; Kim & McGill, 2011; Maeng & Aggarwal, 2018; Wen Wan et al., 2017). However, there has been much less focus on the specific role that *pareidolic face* perception plays in an applied consumer psychology context. In one such study, Guido et al. (2019) reported that advertisements which included pareidolic faces captured consumers' attention, and promoted brand recognition, to a greater extent than adverts which did not. Further studies by Aggarwal and McGill (2007), Landwehr et al. (2011), and Purucker et al. (2014), digitally manipulated the front aspect of car images to generate positive (e.g., 'smiling', 'friendly') and negative (e.g., 'frowning', 'aggressive') emotional pareidolias, and this research generated three important findings. First, that there are individual differences in the extent to which the participants detected a pareidolic face and emotional content in the car fronts (Aggarwal & McGill, 2007; Landwehr et al., 2011). Second, that while negative, compared to neutral, configurations were more likely to capture a person's attention, this was soon replaced by an 'avoidance' strategy which made further exploration of the product unlikely (Purucker et al., 2014). Third, that product preference and sales were higher for pareidolic car fronts that contained prominent features which displayed positive affect (i.e., a central upturned grille; Aggarwal & McGill, 2007; see Landwehr et al., 2011 for more on the effects of positive/negative configuration combinations in this context).

These findings provide a promising platform to further investigate the impact of emotional content, derived from pareidolic product configurations, on consumer behaviour. However, one notable gap in this literature relates to the framing of emotion in broad and general terms (e.g., positive/friendly, or negative/aggressive; Landwehr et al., 2011; Purucker et al., 2014), and therefore it has not yet been established whether the range of core human emotions (i.e., happy, sad, fear, anger, surprise, and disgust; Ekman, 1999a, 1999b) can be detected in pareidolic products. If these core emotions can be detected, then further questions arise as to whether they follow the same pattern in terms of detectability, common attribution, and intensity, as the human equivalent. Similarly, research in this area has only focused on a small range of products (e.g., cars), and therefore it is not clear if such findings, in relation to attentional capture, product exploration, and purchasing decisions, generalise to a wider range of consumer goods.

Moreover, as reported above, research has shown that there are individual differences in the extent to which viewers perceive faces and emotions in products with pareidolic configurations (Landwehr et al., 2011). These individual differences provide an opportunity to examine whether there is a distinct consumer profile (see Akehurst et al., 2012; Jin et al., 2019; McCaffery et al., 2018) that such products are most likely to impact (i.e., by capturing their attention) and appeal to (i.e., as measured by product exploration and purchasing decisions). For example, differences in mood state can influence the ability to search for emotional faces (Frischen et al., 2008); loneliness, or social isolation, can increase the tendency to anthropomorphize non-human objects (Epley et al., 2008); personality traits, such as extraversion, may enhance the ability to detect pareidolic images and to extract emotionally salient content (Canli et al., 2002; Zhou & Meng, 2020); and enhanced emotion detection has been found in those with greater levels of emotional intelligence (Davis et al., 2021). However, it has not yet been established whether such measures might also predict engagement with products that give rise to the perception of emotion, as a consequence of their pareidolic configurations.

Therefore, to address these questions, in Experiment 1, we investigate the extent to which participants perceive emotional pareidolic content across a range of everyday consumer goods (e.g., electrical appliances, kitchen utensils, watches, musical instruments) using the well-established Ekman (1999a, 1999b) categorisations for human emotions (i.e., happy, sad, fear, anger, surprise, and disgust). Our aims in Experiment 1, are to examine the extent to which participants detect these core emotions in the product configurations, the degree of commonality in attributing specific emotions to specific configurations across a group of observers, and whether detection is followed by variation in perceived emotional intensity. If it is the case that the processing of affective content from pareidolias and real faces use similar perceptual and cognitive mechanisms, then we would expect emotion detection that is in line with the core affective labels, common attribution of emotion across observers, and variance in the perceived intensity of the affective content. Such a finding would enhance researchers' understanding of the commonalities in real face and pareidolic face processing, and it would provide those working in applied contexts (e.g., consumer psychology, product design) with empirical data on the robustness of emotion detection in product pareidolias.

In Experiment 2, we examine whether these emotional pareidolic configurations affect participants' product ratings on three key consumer metrics: the extent to which the product would be likely to capture their attention; how eager participants would be to explore the product; and the likelihood that they would purchase it (see Landwehr et al., 2011; Purucker et al., 2014). In addition, to assess whether there is a distinct cognitive profile that predicts which consumers are most likely to engage with these products, we test participants on measures of mood, loneliness, extraversion, and emotional intelligence. As described above, previous findings suggest that these measures may be related to greater sensitivity for real face emotion and greater levels of anthropomorphism, and so here we examine whether they predict likely levels of engagement and preference for products that elicit affective pareidolic content.

2 | EXPERIMENT 1

In Experiment 1, we present participants with images of 140 products which contain a pareidolic face configuration. For each image, we ask

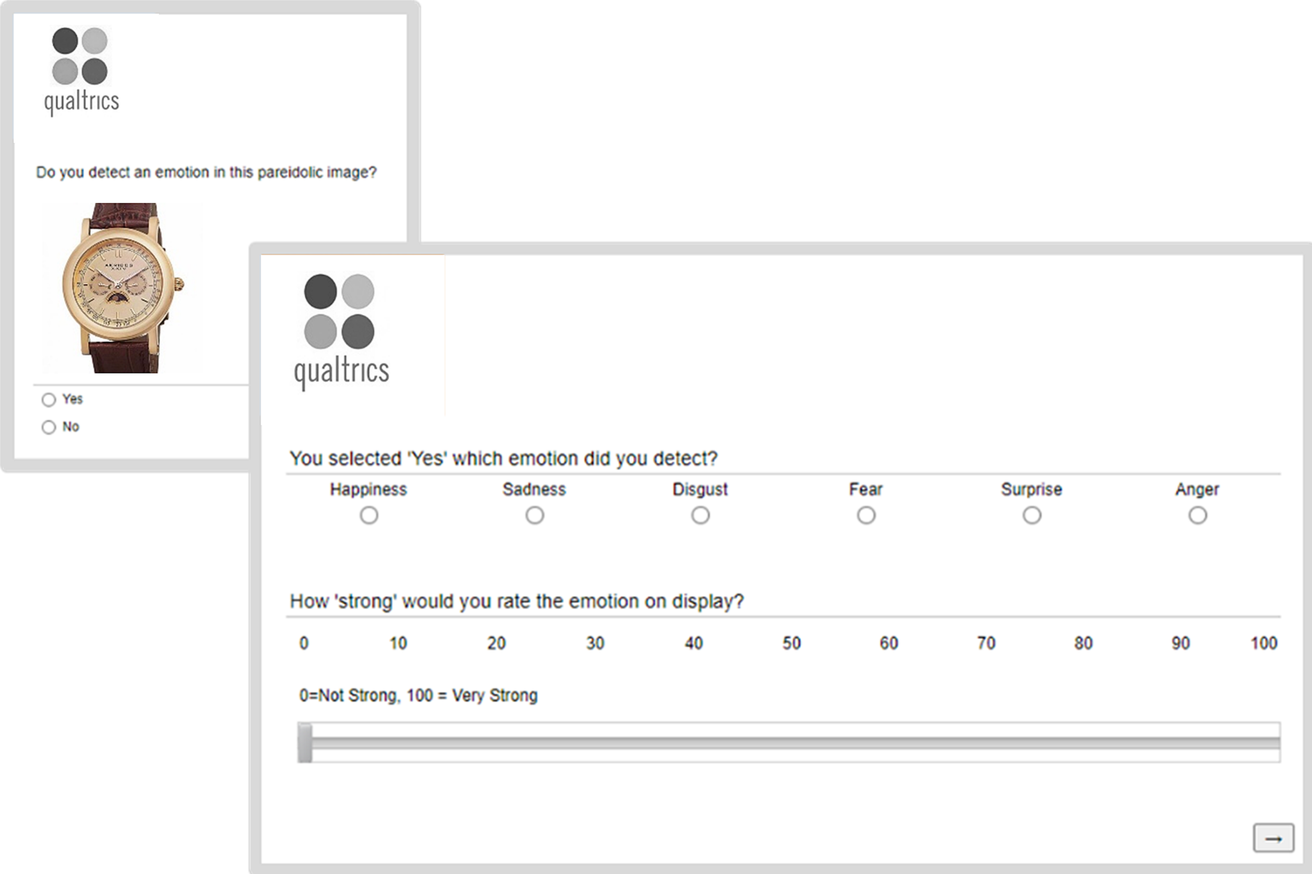

FIGURE 1 Example trial display from Experiment 1. This figure shows an example pareidolic product image and the emotion detection, labelling, and intensity response scales.

the viewer to decide whether they detect an emotion, and if so, to label it and to rate its perceived intensity.

3 | METHODS

3.1 | Ethics and data availability statement

The research reported in this paper received approval from the Ethics Committee of the University of Strathclyde School of Psychological Sciences and Health. The data that supports the findings reported in this study is available from the corresponding author upon reasonable request.

3.2 | Participants

A pre-study sample size calculation was performed using G*Power software 3.1 (see Faul et al., 2007). For the specific values in relation to our design (one-way repeated measures analysis of variance [ANOVA] with 6 levels) we set alpha at .05, power at .80, groups at 1, and number of measurements (i.e., repeated measures) at 6. The G*Power analysis indicated that a minimum sample size of 19 participants would be required to detect a medium effect size (f set at .25). Therefore, we recruited 37 participants with a mean age of 21 years (SD = 6, Range = 17–50; 84% female). The participants were recruited from the Strathclyde Psychology Participant Pool, they reported having normal or corrected-to-normal vision, and each received a course credit on completion of the study.

3.3 | Stimuli and apparatus

A set of 140 pareidolic product images were selected from a Google Image search which included the descriptors: 'pareidolia', 'pareidolic', 'faces in products' and 'faces in objects', as well as each of the six core emotions: 'happy', 'sad', 'fear', 'anger', 'surprise', 'disgust', as well as 'neutral' or no emotion descriptor to generate product images in which the image creator/search engine, and the research team, detected no discernible emotion (20 products per emotion descriptor +20 neutral products; see Figures 1 and 3).

That images were returned for each emotion category provides an initial indication that *individual* observers can detect the range of core emotions in products. However, as reported in the introduction it is not clear whether *other* observers would also perceive the pareidolic faces/emotional content or agree with the affective label that the content creator/search engine has attributed to it (i.e., the level of common attribution). That such images were returned also does not indicate whether pareidolic emotion perception mirrors the human equivalent in detection and intensity. In other words, here, we test whether the detection of pareidolic faces and emotional content, as initially ascribed by the image creator/search engine, is likely to be representative of how they are perceived by consumers in general, and whether such perceptions conform to those reported in the traditional emotion literature.

Product type examples included vehicles, electrical appliances, kitchen utensils, electronic devices, packaging, clothing, bags, clocks, watches, chairs, musical instruments and foodstuffs, and there was, as far as possible, a mix of product types across the emotion categories. Each image was resized to 500 pixels along their main axis of elongation, and they were presented in colour. The online testing platform Qualtrics was used to present the study to participants and to collect the response data.

3.4 | Procedure

On clicking on the Qualtrics link, all participants read an information sheet and provided informed consent. Each participant was then presented with an instruction screen which outlined how to complete the rating task, with an example trial embedded within the display, which we show here in Figure 1. Trial order was randomised, and responses were made using a mouse click. Participants who detected an emotion in a product were then presented with two questions asking them to label it and to rate its 'strength' (i.e., intensity). If no emotion was detected in the product configuration, the task proceeded to the next product image. The task was self-paced, participants were encouraged to take short screen breaks during the session, and it took 45 min, on average, to complete the full study.

4 | RESULTS

For emotion detection, a 'correct' detection here means that the participants ascribed the same emotion label to the product as the image creator/search engine. Participants' mean emotion detection scores and mean emotion strength ratings were entered into separate one-way ANOVAs, with the within-subjects factor of emotion label (happy, sad, fear, anger, surprise, disgust). For both measures, Mauchly's test indicated that the assumption of sphericity had been violated, χ^2 (14) = 26.71, $p = .021$ for detection; χ^2 (14) = 63.93, $p < .001$ for strength, and therefore Greenhouse–Geisser corrected degrees of freedom are reported. As this analysis focuses on the extent of the common attribution of the core emotions to the pareidolias, we report responses to the neutral product set separately.

4.1 | Emotion detection/labelling

The ANOVA on emotion detection scores revealed a main effect of emotion label, $F(4.06, 146.29) = 160.27$, $p < .001$, $\eta_p^2 = .82$. As seen in Figure 2, detection scores were generally high (i.e., suggesting common attribution), and planned follow up paired *t* tests showed that the ability to detect each core emotion in these pareidolic configurations followed a similar pattern to that reported for real faces (Calvo & Lundqvist, 2008; Elfenbein & Ambady, 2002; Guarnera et al., 2018; Rozin et al., 2005; Smith & Rossit, 2018). The follow up tests showed that happiness was the most readily detected emotion ($M = 89\%$), followed by surprise ($M = 72\%$; $t(36) = 6.18$, $p < .001$, $d = 1.01$ for the difference with happy) and sadness ($M = 71\%$; $t < 1$ for the difference with surprise), with anger ($M = 65\%$), fear ($M = 42\%$; $t(36) = 7.22$, $p < .001$, $d = 1.19$ for the difference with anger) and disgust ($M = 17\%$; $t(36) = 7.48$, $p < .001$, $d = 1.23$ for the difference with fear) producing lower detection rates respectively. Except for happy configurations, recognition rates were numerically lower, by around 10%, than those typically reported in the real face emotion literature, but this is to be expected given the greater level of variability in the structure of products in comparison to faces.

Importantly, the findings from Experiment 1 show that consumers are likely to be able to detect a range of core human emotions across a variety of products with pareidolic configurations, and that the initial labelling of these emotional pareidolias is likely to reflect perception across the general population. This is, to our knowledge, the first study to report this finding using the Ekman core emotion labels, and it provides data-driven, rather than anecdotal, evidence of the importance of considering the impact of intentional/unintentional emotional pareidolias in product design.

4.2 | Emotion strength

The ANOVA on mean emotion strength ratings (i.e., perceived emotion intensity) revealed a main effect of emotion, $F(2.64, 94.95) = 19.75$, $p < .001$, $\eta_p^2 = .35$. As seen in Figure 2, while mean emotion strength ratings were consistent across the angry ($M = 69$, Range = 33–100), happy ($M = 66$, Range = 25–99), surprise ($M = 66$, Range = 15–98) and fear emotions ($M = 66$, Range = 30–95; p's ≥ .058 for the differences), strength ratings were slightly, but significantly, lower for the sad pareidolic product set ($M = 62$, Range = 22–94; $t(36) = 2.17$, $p = .037$, $d = .36$ for the difference with fear), and lower still for the disgust set ($M = 51$, Range = 0–92; $t(36) = 4.16$, $p < .001$, $d = .68$ for the difference with sad). This pattern of results and the level of perceived emotional intensity (overall mean here = 63) are in line with findings reported from real faces (see Matsumoto & Ekman, 1989; mean intensity for Caucasian participants = 5.8/9-point Likert scale, as a numerical transformation = 65), and the range of rating scores show that individuals can perceive different levels of emotional intensity from products with pareidolic configurations. This finding provides further data-driven support for the importance of considering pareidolic emotion, and its intensity, in the product design process.

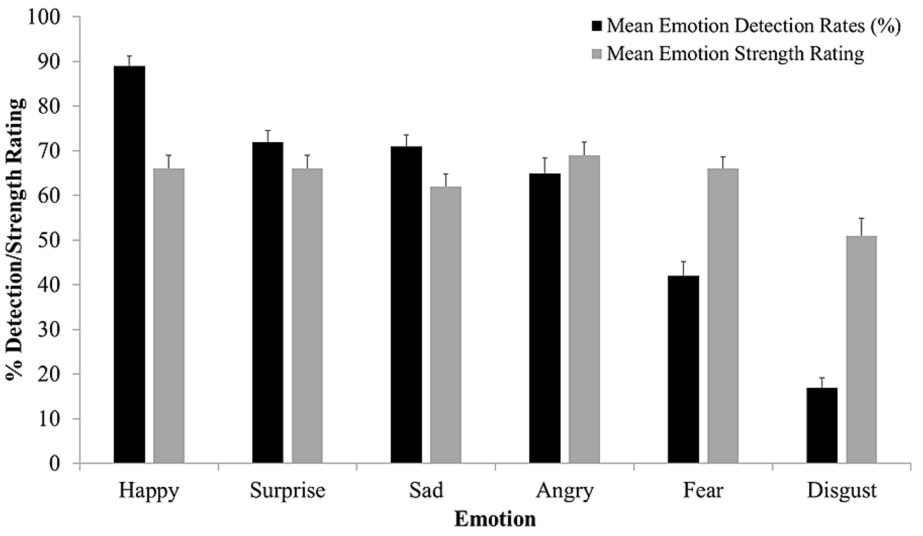

FIGURE 2 Bar graph showing mean pareidolic emotion detection scores and intensity ratings. For emotion detection, a 'correct' detection here means that the participants ascribed the same emotion label to the product as the image creator/search engine (the error bars denote SE of the mean).

4.3 | Neutral pareidolic product set

On average, participants reported that they detected an emotion in half (49%) of the neutral product images across the set. This could highlight the robust detection of emotion in products, even when the configurations suggest that this should not arise. Alternatively, it could reflect the fact that participants have been primed to look out for emotional content in this product set and there is some research on such an effect by Aggarwal and McGill (2007).

4.4 | Summary

In Experiment 1, we show that products with pareidolic configurations did elicit the full range of affective content, with varying levels of emotional intensity attributed to the different emotion categories. The results broadly followed the pattern reported in the real face emotion literature. Next, in Experiment 2, we test whether the emotions elicited by these pareidolic products are likely to affect consumer behaviour.

5 | EXPERIMENT 2

In Experiment 2, we asked a new sample of participants to rate products with pareidolic configurations on three key measures of consumer behaviour. First, to what extent does the product capture their attention? Second, to what extent are they eager to explore the product? Third, how likely is it that the participant would purchase the product? In addition, we test whether individual differences on measures of mood, loneliness, extraversion, and emotional intelligence, each of which have been shown to affect emotion detection and anthropomorphism, are predictive of participants responses to the pareidolic products.

6 | METHODS

6.1 | Participants

A pre-study sample size calculation was performed using G*Power software 3.1 (see Faul et al., 2007), and the multiple linear regression part of our design (it would require the greatest level of statistical power of the statistical tests used). For the specific values in relation to our design, we set alpha at .05, power at .80, and number of predictors at 4. The G*Power analysis indicated that a minimum sample size of 85 participants would be required to detect a medium effect size (f^2 set at .15). Therefore, we recruited 102 new participants from the Strathclyde Psychology Participant Pool and a social media advertisement, with a mean age of 31 years (SD = 15, Range = 17–66; 75% female). Participants reported having normal or corrected-to-normal vision, and student participants were provided with a research participation credit on completion of the study.

6.2 | Stimuli and apparatus

6.2.1 | Pareidolic product task

We selected 70 of the pareidolic product images used in Experiment 1 (10 per emotion label +10 neutral) in which emotion attribution had been most consistent and ratings of emotional intensity had been strongest, we applied the opposite criteria for the selection of the neutral set. For this subset of the stimuli, the emotion recognition accuracy rates, derived from the data collected in Experiment 1, were: 94% for happy; 92% for surprise; 91% for fear; 91% for sad; 89% for angry; 58% for disgust. For each product image, participants were asked to rate the extent to which the product captured their attention, the extent to which they would be eager to explore the product, and the likelihood that they would purchase it (response scale, onscreen slider, 0–100). An example trial with each response scale is shown in Figure 3.

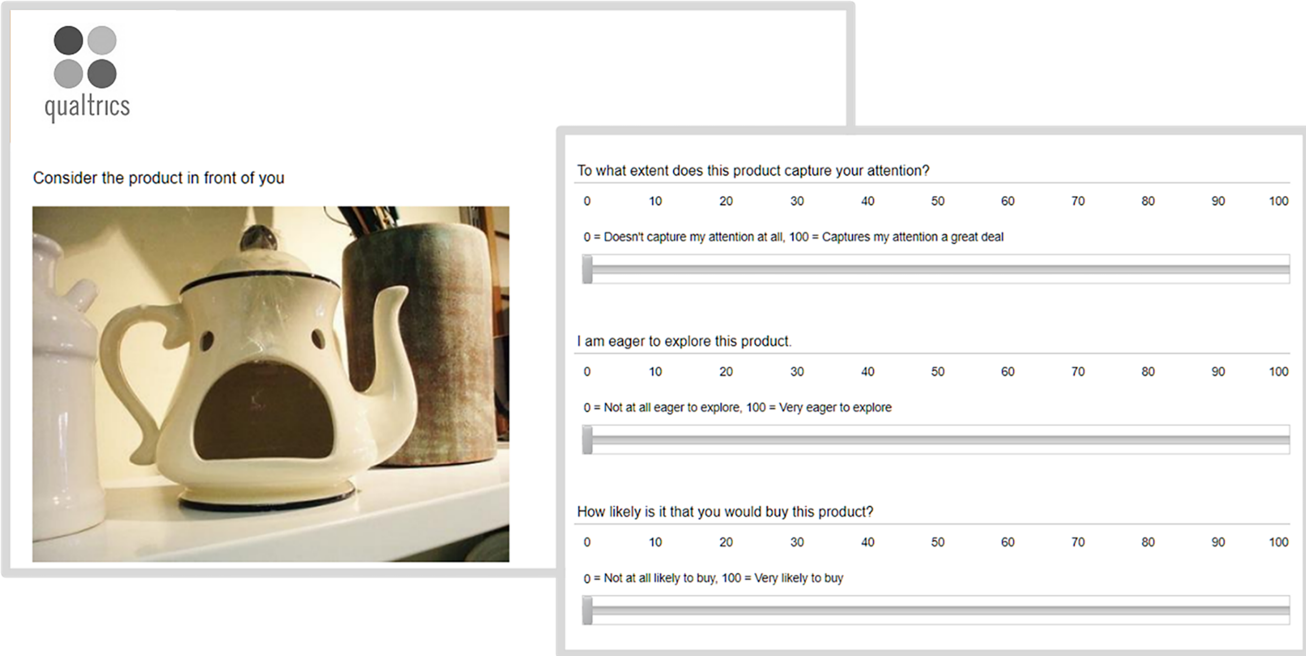

FIGURE 3 Example trial display from Experiment 2. This figure shows an example pareidolic product image and the attentional capture, eagerness to explore, and likelihood to purchase response scales.

6.2.2 | Individual difference questionnaires

Mood

Using the modified Differential Emotions Scale (mDES; Fredrickson, 2013; see also the Brief Mood Introspection Scale for similar items; Mayer & Gaschke, 1988), we presented participants with 20 statements describing different mood states (10 positive and 10 negative). They were asked to indicate the extent to which they had experienced those states within the past 2 weeks. Example items included: 'What is the most joyful, glad, or happy you felt?' (item 14) and 'What is the most disgust, distaste, or revulsion you felt? (item 6). Response options ranged on a Likert scale from 'not at all' (1) to 'extremely' (5). A single score on this measure was calculated by subtracting the total negative item score from the total positive item score. In this way, higher scores indicate greater positivity in mood over the previous 2-week period.

Loneliness

Participants were presented with a short 3-item scale for measuring loneliness, and asked to indicate how often they had felt that way over the past 2 weeks (Hughes et al., 2004). The questions were: 'How often do you feel you lack companionship?'; 'How often do you feel left out?'; and 'How often do you feel isolated from others?'. Response options were presented on a Likert scale, ranging from 'hardly ever' (1) to 'some of the time' (2) to 'often' (3). Total social isolation scores were calculated by summing all items, giving participants a final score out of 9, whereby higher scores indicated greater levels of loneliness.

Extraversion

The Big Five Inventory-10 (BFI-10) is a 10-item questionnaire measuring the OCEAN personality traits (Rammstedt & John, 2007). We selected the two items that related to extraversion: 'I see myself as someone who is outgoing, sociable' (item 6) and 'I see myself as someone who is reserved' (item 1). Response options ranged on a Likert scale from 'disagree strongly' (1) to 'agree strongly' (5), with negative items (i.e., item 1) being reverse scored. Total extraversion scores were computed by summing these items together, giving a final score out of 10, whereby higher scores indicated higher extraversion.

Emotional intelligence

The TEIQue (Trait Emotional Intelligence Questionnaire) Short Form (Petrides & Furnham, 2006) is a 30-item questionnaire measuring global trait emotional intelligence (EI). Participants were presented with 30 statements relating to 15 different facets of EI, including (but not limited to) adaptability, self-esteem, trait empathy and emotion regulation, and were asked to indicate their agreement with each statement. Items included both positive and negative statements related to EI. For example: 'I believe I am full of personal strengths' (item 24) and 'I usually find it difficult to regulate my emotions' (item 4). Response options ranged on a Likert scale from 'disagree strongly' (1) to 'agree strongly' (5), with negative items being reverse scored (e.g., item 4). Total EI scores were computed by summing all items, giving participants a final score out of 150, whereby higher scores indicated higher emotional intelligence.

6.3 | Procedure

In line with Experiment 1, we used Qualtrics to present the study and to collect the response data. On clicking on the Qualtrics link, all participants read an information sheet and provided informed consent. Participants completed the individual difference questionnaires first, in a fixed order: extraversion, emotional intelligence, mood, and loneliness. The questionnaires were followed by the pareidolic product task. Trial order was randomised, and responses were made using a mouse click. An example trial with each question and response scale for this task is shown in Figure 3. The testing session was self-paced, participants were encouraged to take short screen breaks during the session, and it took 1 h, on average, to complete the full study.

7 | RESULTS

7.1 | Consumer response analysis

Participants' mean attentional capture, eagerness to explore, and likelihood to buy ratings were entered into separate one-way ANOVAs, with the within-subjects factor of product emotion (angry, sad, happy, fear, surprise, disgust, and neutral). In contrast to Experiment 1, we include the neutral items in our main analysis as, here, these responses are valid comparators with responses to the emotion categories. For each measure, Mauchly's test indicated that the assumption of sphericity had been violated, χ^2 (20) = 67.23, $p < .001$ for attentional capture; χ^2 (20) = 89.89, $p < .001$ for eagerness to explore; χ^2 (20) = 79.45, $p < .001$ for likelihood to buy, and therefore Greenhouse–Geisser corrected degrees of freedom are reported.

7.1.1 | Attentional capture

The ANOVA on attentional capture ratings revealed a main effect of emotion, $F(4.77, 482.21) = 54.96$, $p < .001$, $\eta_p^2 = .35$. As seen in Figure 4, planned follow up paired t tests showed that happy ($M = 43$), surprise ($M = 42$), and angry ($M = 41$) pareidolic products were most likely to capture consumers' attention (p's ≥ .142 for the differences between these three emotions), followed by fear ($M = 38$; $t(101) = 3.29$, $p = .001$, $d = .33$ for the difference with anger), then by sad ($M = 32$; $t(101) = 6.23$, $p < .001$, $d = .62$ for the difference with fear) and neutral pareidolic products ($M = 32$; $t < 1$ for the difference between sad and neutral), with products displaying the facial configuration of disgust rated as being least likely to capture consumers' attention ($M = 29$; $t(101) = 3.46$, $p = .001$, $d = .34$ for the difference with neutral).

7.1.2 | Eagerness to explore

The ANOVA on the eagerness to explore ratings revealed a main effect of emotion, $F(4.50, 454.81) = 35.93$, $p < .001$, $\eta_p^2 = .26$. As seen in Figure 4, planned follow up paired t tests showed a similar pattern of findings to that reported for attentional capture above, with happy ($M = 30$), surprise ($M = 29$), and angry ($M = 27$) pareidolic products producing the highest eagerness to explore rating (p's ≥ .072 for the differences between these three emotions), followed by fear ($M = 24$; $t(101) = 3.06$, $p = .003$, $d = .30$ for the difference with anger), neutral ($M = 22$) and sad ($M = 21$; p's ≥ .059 for differences between these emotions), with products displaying the facial configuration of disgust rated as being lowest for further intended product exploration ($M = 19$; $t(101) = 2.95$, $p = .004$, $d = .29$ for the difference with sad).

7.1.3 | Likelihood to purchase

The ANOVA on likelihood to buy revealed a main effect of emotion, $F(4.62, 466.88) = 31.11$, $p < .001$, $\eta_p^2 = .24$. However, as seen in Figure 4, while the pattern of findings was consistent with the attentional capture and eagerness to explore ratings reported above, there was a significant preference for the purchase of pareidolic products with a happy configuration ($M = 25$). This is compared with products showing fear ($M = 22$; $t(101) = 3.07$, $p = .003$, $d = .30$ for the difference with happy), followed by lower ratings for surprise ($M = 20$; $t(101) = 2.10$, $p = .038$, $d = .21$ for the difference with fear) and angry products ($M = 19$; $t(101) = 1.58$, $p = .118$, $d = .16$ for the difference between these two emotions). Neutral configurations ($M = 17$; $t(101) = 2.32$, $p = .022$, $d = .23$ for the difference with anger) or configurations giving rise to perceptions of sadness ($M = 15$; $t(101) = 2.88$, $p = .005$, $d = .29$ for the difference with neutral) or disgust ($M = 15$; $t < 1$ for the difference with sadness) were rated as the products that are least likely to be purchased.

7.2 | Consumer response summary

Taken together, our consumer response findings show that the type of emotional pareidolic content perceived had specific effects across the three key metrics. Products which displayed happy, angry, and surprised emotions were more likely to capture attention and promote further interest than the other emotion categories. However, for the key purchase decision, consumers showed a significant preference for happy product pareidolias and an aversion to products displaying sadness and disgust.

7.3 | Individual differences

Summary statistics and correlations for each of the individual difference measures are presented in Table 1. Here we examine whether there is a distinct consumer profile that emotional pareidolic products are likely to affect and appeal to. To that end, for each pareidolic product emotion, we use participants mean ratings for attentional capture, eagerness to explore, and likelihood to purchase as the dependent variable in separate multiple regression analyses, and

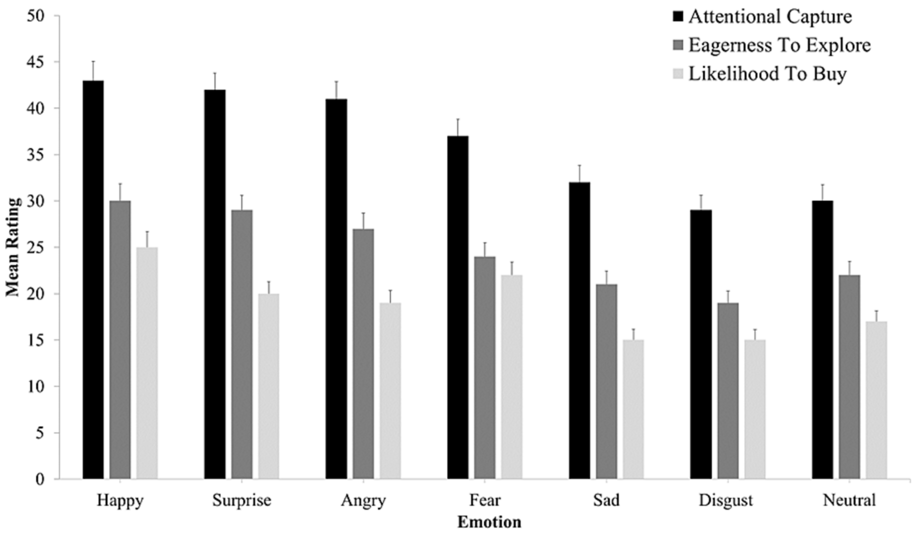

FIGURE 4 Bar graph showing mean responses to the three key consumer metrics. Mean consumer responses to the attentional capture, eagerness to explore, and likelihood to purchase questions, presented as a function of the pareidolic product emotion (the error bars denote SE of the mean).

TABLE 1 Summary statistics and correlations for the individual difference measures.

	Mean	SD	Range	1	2	3	4
1. Mood	6.89	10.71	−21 to 35	-	−.500**	.334**	.700**
2. Loneliness	5.69	1.81	3–9		-	−.413**	−.578**
3. Extraversion	6.35	1.68	2–10			-	.513**
4. Emotional intelligence	105.98	15.85	60–142				-

Note: This table shows the range of scores on the individual difference measures used to examine whether there might be a specific consumer 'profile' that products with emotional pareidolic configurations might affect (i.e., through attentional capture) or appeal to (i.e., product exploration, purchasing decisions).
**Correlation is significant at $p \leq .001$ (two-tailed).

scores on the individual difference questionnaires as the predictor variables.

7.3.1 | Data preparation

To examine any violations of multicollinearity among the predictor variables, we applied the established exclusion criteria: $r \geq .800$ correlation, VIF > 10, tolerance < .2, condition index > 30 (Bowerman & O'Connell, 1990; Kim, 2019; Menard, 2002; Myers, 1990). While emotional intelligence did not exceed the correlation ($r = .700$ with mood; see Table 1), VIF (2.57), or tolerance (.39) thresholds, it did violate the condition index (32.03) multicollinearity check, and so it was removed from the analysis. None of the remaining individual difference measures violated any of the thresholds for multicollinearity, confirming that they captured enough unique variance to be retained as independent predictor variables.

7.3.2 | Attentional capture

As seen in Table 2, the models were significant for happy and fearful product configurations, with scores on the questionnaires accounting for 11.9% and 10.2% of the variance in attentional capture ratings respectively. Higher scores on the loneliness scale predicted higher attentional capture by the happy and fearful configurations, while a more positive mood state was also associated with a greater likelihood that happy pareidolias would capture attention. While there were trends in similar directions for the other emotions, none of the other models reached significance.

7.3.3 | Eagerness to explore

As seen in Table 3, the models were significant for happy, sad, and surprised product configurations, with scores on the questionnaires accounting for 9.8%, 8.8%, and 7.8% of the variance in eagerness to explore ratings respectively. For each emotion, higher scores on the loneliness scale and a more positive mood state were significantly associated with a greater likelihood of intended product exploration. The models for the remaining emotions were not significant.

7.3.4 | Likelihood to purchase

As seen in Table 4, only the model for happy product configurations was significant, with scores on the questionnaires

TABLE 2 Regression statistics for attentional capture.

	R^2	*F*	*p*
Happy configurations	11.9%	4.39	.006*
	β	*t*	*p*
Mood	.245	2.20	.030*
Loneliness	.400	3.48	.001*
Extraversion	.144	1.36	.177
	R^2	*F*	*p*
Sad configurations	6.9%	2.42	.071
	β	*t*	*p*
Mood	.211	1.85	.068
Loneliness	.301	2.55	.012
Extraversion	.074	.678	.500
	R^2	*F*	*p*
Fearful configurations	10.2%	3.70	.014*
	β	*t*	*p*
Mood	.182	1.63	.107
Loneliness	.384	3.32	.001*
Extraversion	.119	1.12	.267
	R^2	*F*	*p*
Angry configurations	7.2%	2.52	.063
	β	*t*	*p*
Mood	.151	1.32	.189
Loneliness	.310	2.63	.010
Extraversion	.152	1.40	.163
	R^2	*F*	*p*
Surprised configurations	6%	2.08	.109
	β	*t*	*p*
Mood	.177	1.54	.126
Loneliness	.271	2.28	.025
Extraversion	.129	1.18	.240
	R^2	*F*	*p*
Disgusted configurations	7.3%	2.56	.060
	β	*t*	*p*
Mood	.196	1.72	.088
Loneliness	.290	2.46	.016
Extraversion	.154	1.42	.159

Note: This table shows the multiple linear regression statistics for the attentional capture measure, presented as function of emotion configuration (dependent measure) and the individual difference measures (predictor variables). Statistics are shown for each overall model (i.e., whether the model predicts likely attentional capture ratings for each of the emotional pareidolic product configurations), and for each predictor variable.
*$p < .05$.

TABLE 3 Regression statistics for eagerness to explore.

	R^2	*F*	*p*
Happy configurations	9.8%	3.56	.017*
	β	*t*	*p*
Mood	.270	2.41	.018*
Loneliness	.341	2.94	.004*
Extraversion	−.009	−.082	.934
	R^2	*F*	*p*
Sad configurations	8.8%	3.14	.029*
	β	*t*	*p*
Mood	.306	2.72	.008*
Loneliness	.268	2.92	.024*
Extraversion	−.057	−.529	.598
	R^2	*F*	*p*
Fearful configurations	5.7%	1.97	.123
	β	*t*	*p*
Mood	.212	1.85	.068
Loneliness	.237	1.99	.049
Extraversion	−.055	−.501	.617
	R^2	*F*	*p*
Angry configurations	3.8%	1.29	.281
	β	*t*	*p*
Mood	.208	1.79	.076
Loneliness	.161	1.34	.183
Extraversion	.047	.426	.671
	R^2	*F*	*p*
Surprised configurations	7.8%	2.77	.046*
	β	*t*	*p*
Mood	.300	2.64	.010*
Loneliness	.254	2.16	.033*
Extraversion	.007	.066	.947
	R^2	*F*	*p*
Disgusted configurations	4.2%	1.44	.235
	β	*t*	*p*
Mood	.230	1.99	.049
Loneliness	.156	1.29	.197
Extraversion	−.047	−.424	.673

Note: This table shows the multiple linear regression statistics for the eagerness to explore measure, presented as function of emotion configuration (dependent measure) and the individual difference measures (predictor variables). Statistics are shown for each overall model (i.e., whether the model predicts eagerness to explore ratings for each of the emotional pareidolic product configurations), and for each predictor variable.
*$p < .05$.

accounting for 8.8% of the variance in likelihood to purchase ratings. Higher scores on the loneliness scale and greater positivity in mood predicted an increased likelihood that participants would purchase products with happy pareidolic configurations. The models for the remaining emotions were not significant.

TABLE 4 Regression statistics for likelihood to purchase.

	R^2	F	p
Happy configurations	8.8%	3.15	.028*
	β	t	p
Mood	.234	2.07	.041*
Loneliness	.330	2.83	.006*
Extraversion	−.011	−.101	.920
	R^2	F	p
Sad configurations	3.7%	1.26	.294
	β	t	p
Mood	.168	1.45	.151
Loneliness	.117	.974	.332
Extraversion	−.130	−1.17	.243
	R^2	F	p
Fearful configurations	1.9%	0.627	.599
	β	t	p
Mood	.056	.476	.635
Loneliness	.144	1.18	.239
Extraversion	−.029	−.257	.798
	R^2	F	p
Angry configurations	2.5%	0.850	.470
	β	t	p
Mood	.121	1.04	.301
Loneliness	.159	1.32	.190
Extraversion	−.047	−.425	.672
	R^2	F	p
Surprised configurations	5.0%	1.73	.166
	β	t	p
Mood	.174	1.51	.134
Loneliness	.225	1.89	.062
Extraversion	−.063	−.578	.565
	R^2	F	p
Disgusted configurations	1.0%	0.209	.890
	β	t	p
Mood	.055	.471	.639
Loneliness	.049	.398	.692
Extraversion	−.059	−.523	.602

Note: This table shows the multiple linear regression statistics for the likelihood to purchase measure, presented as function of emotion configuration (dependent measure) and the individual difference measures (predictor variables). Statistics are shown for each overall model (i.e., whether the model predicts the likelihood to purchase for each of the emotional pareidolic product configurations), and for each predictor variable.
$^*p < .05$.

7.4 | Individual differences summary

Taken together, the findings from this section show that higher scores for loneliness and positivity in mood state appear to be significant predictors of the extent to which participants would engage with, and purchase, products with specific emotional configurations. There was a consistent effect for happy product pareidolias across the three outcome measures, with participants who scored higher on loneliness and mood positivity, more likely to attend to, engage with, and purchase such products.

8 | DISCUSSION

Pareidolic face configurations are present in a wide variety of consumer products (Summerfield et al., 2006; Voss et al., 2012; Wodehouse et al., 2018), but there has been little focus on the perception of emotional content from these illusory faces, and the effect that this could have on key consumer metrics. In this study, we sought to assess the extent to which there was a common attribution of core human emotions to a range of everyday pareidolic products. The findings show that the full range of core human facial emotions could be perceived in the product set, as could variability in emotional intensity, with the pattern of findings largely mirroring that reported for real faces (Ekman, 1999a, 1999b). These effects provide support for previous work which has suggested that both real and pareidolic face processing tap similar cognitive processes (e.g., Garvert et al., 2014; Palmer & Clifford, 2020), and here we extend this to include the perception of emotion.

Importantly, we also examined the impact of the perception of pareidolic emotion on product salience, engagement, and likelihood to buy. Our findings show that products judged to have 'happy', 'angry' and 'surprised' configurations were most likely to capture attention and promote product exploration. This attentional effect is supported by research from the real face literature which reports an automatic orienting effect to threat stimuli (see Belopolsky et al., 2011), and a suprathreshold preference for positive affective stimuli (see Gupta et al., 2016). While both 'happy' and 'surprised' configurations retained a preference for further product exploration, this was also the case for the 'angry' condition. This contrasts with previous work on the 'avoidance' of pareidolias displaying negative affect (see Purucker et al., 2014), and suggests that in some cases such configurations can promote consumer interest beyond the initial attentional capture phase. However, only 'happy' configurations retained the consumer preference when it came to the critical purchasing decision. Similarly, the individual difference measures were only consistently predictive of responses to 'happy' product configurations, with our consumer profile indicating that people who rated themselves positively for mood (Frischen et al., 2008) and negatively for loneliness (Epley et al., 2008), were more likely to attend to, engage with, and purchase products which showed 'happy' configurations.

This preference for 'happy' product pareidolias might be underpinned by the fact that observing a facial emotion can cause the observer to automatically mimic it (i.e., a 'contagious' smile; see Ekman & Davidson, 1993; Wild et al., 2003). Should these 'happy' products generate this effect then they are also likely to create feelings of happiness or pleasure in the consumer (Kemp & Kopp, 2011), and research has shown this leads to a greater amount of time spent in the retail space and more money being spent on products (Dezecache et al., 2015; Donovan et al., 1994; Norman, 2004; Whelan & Zelenski, 2012; Winkielman et al., 2005). Moreover, Kumar and Garg (2010) reported that consumers ultimately prefer product aesthetics which balance both activation (e.g., arousal; emotional intensity; novelty) and pleasantness, which may explain why the happy, angry, and surprised pareidolic content captured attention and interest (i.e., activation) but only happiness (activation + pleasantness) retained a purchase decision advantage.

In contrast to the intended inclusion of pareidolic configurations, the current findings are equally important for designers who do not wish their products to evoke such effects. For example, the products included in our stimuli set, and those which generate the greatest impact in terms of sharing behaviour on social media, tend to be 'unintended' pareidolias. In other words, the developers have not chosen to create pareidolic configurations in their products, but the consumers have nonetheless perceived faces and emotion in them (e.g., 'look at this happy microwave'; 'this sad alarm clock'; 'this surprised bag'). This is particularly important when the products inadvertently give rise to emotions that lead to negative consumer behaviours. For example, studies have shown that product preference and likelihood to purchase is lower for pareidolic products with negative affective content (e.g., Landwehr et al., 2011; Purucker et al., 2014).

It would be key, therefore, to try and establish a 'perceptual threshold' for face pareidolias and pareidolic emotions, that is, the point at which the configuration of product features give rise to the perception of a face and facial emotion (see Calvo et al., 2016; Mori et al., 2012; Windhager et al., 2008 for related work on car fronts). Such a threshold would minimise the unintended perceptions of pareidolias in products before they get to market. This threshold could also be informative to those seeking to incorporate pareidolias as a design choice, by ensuring that they generate the correct response between aesthetically pleasing and 'kitsch' (Cieraad & Porte, 2006) within the wider consideration of 'product personality' (Govers & Schoormans, 2005; Johnson & Stewart, 2017; Kardes, 1996). In short, going forward, product design teams should consider face pareidolias during development, either to maximise their effects, or minimise any unintended impact on consumer perceptions (see Yoon et al., 2012, 2021).

In this paper, we provide new data on emotional pareidolias in products, however, as noted above, there are currently few studies on this topic. Therefore, in addition to addressing the limitations of the present study there is also considerable scope for further research on product pareidolia and emotion (e.g., using different affective dimensions; see Russell, 1980). For example, in this study while mood and loneliness yielded significant individual difference effects; research should now look to other measures to help generate a more comprehensive consumer profile for these products (see Credé et al., 2012; Mamiya et al., 2016). In addition, for Experiment 2, recognition accuracy, as established from the subset selection procedure, was consistent across all emotional configurations apart from disgust (see Elfenbein & Ambady, 2002), this could explain why such items were ranked lowest across the outcome metrics. Future studies should aim to include, or create, items showing disgust which are as recognisable as the other emotions in the set.

To further maximise ecological validity, the product set included a range of current everyday consumer goods; however, it was not possible to create a product set in which each emotion was shown on an identical product (i.e., the same teapot showing each emotion configuration). Therefore, the key test for product designers following this research is to assess consumer responses to their singular product having manipulated it to elicit different emotions (see Landwehr et al., 2011). We also used self-report as a measure of the extent to which these products would be likely to capture attention, research should now seek to replicate our findings using a more objective measure such as a visual search attentional capture task (see Calvo & Nummenmaa, 2008). Finally, our consumer sample consisted largely of young students, and so future research must also assess these effects across a more diverse participant group (see Matsumoto & Ekman, 1989), with a larger range of ages and level of purchasing power.

To conclude, despite the ubiquity of face-like configurations in everyday products, there have been few research studies that have assessed the specific perception of pareidolic emotion in products, and the effect this could have on consumer behaviour. In this study, we show that the detection of emotion from pareidolic products is robust, it mirrors real face effects, and that 'happy' configurations show an advantage for attentional capture, product exploration, and likelihood to purchase. These findings contribute to the growing psychological science literature on similarities in the processing of real and pareidolic faces, and they provide practical applications for those working in a product design and consumer behaviour context.

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CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

The data that supports the findings reported in this study is available from the corresponding author upon reasonable request.

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