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The Influence of Emotional Cues and Anthropomorphism on Product Temperature Expectations

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Abstract

Throughout seven experiments (six pre-registered), we found that embodying a product with emotional content, by using emoji facial expressions, influences its expected temperature in online settings. A negative valence, low arousal expression on the receptacle of a hot chocolate beverage and hot coffee leads to a lower expected temperature than a positive valence, high arousal expression and a control without any expression. Moreover, a positive valence, high arousal expression on a cup of hot coffee leads to a higher expected temperature. The influence of the emoji expression is enhanced by higher anthropomorphism (i.e., making individuals focus on the emotions of the product). Our results suggest that these effects are driven by the product embodying the emotional connotation of the expressions and subsequently their respective associated temperatures. Our research adds to the literature on embodied cognition and consumer behavior and has applications related to sensory expectations and energy savings.

Public Significance Statement

This research shows that emotional cues in products can influence the expected temperature of food products. These effects are augmented by higher anthropomorphism tendencies. The present research has practical implications related to sustainability, online food ordering, and immersive technologies.

Keywords: emotions, temperature, embodied cognition, anthropomorphism, negativity bias, basic tastes.

The Influence of Emotional Cues and Anthropomorphism on Product Temperature Expectations

Researchers and practitioners have recognized the importance of emotions in marketing strategies for virtually all product categories (Bagozzi et al., 1999). Marketers widely use emotion-laden stimuli to influence consumer behavior throughout the customer journey (Andrade, 2015). Here it is critical to distinguish between affect and emotions. According to the theory of constructed emotions, the former refers to basic processes representing interoceptive sensations (pleasantness and activation), whereas the latter refers to situated conceptualizations of affect, sensory information, and physiological changes (Barrett, 2017). Many marketing campaigns, including those in events like the Super Bowl (where a 30-second commercial costs on average USD 5.6 million; Smith, 2021) rely on emotional appeals. For example, *Budweiser's Lost Dog* commercial, presents the emotional story of a puppy that gets separated from its owner and is later brought back home by Clydesdales horses after facing a wolf.

An aspect tightly linked to emotions that has increasingly received attention from academia is temperature, as evidenced by concepts like emotional warmth (Aaker et al., 1986; Barsalou, 2010). Temperature also plays an important role in product evaluations (Hadi & Block, 2019; Park & Hadi, 2020; Zwebner et al., 2014), and it is especially critical for foodstuffs. Indeed, previous research has identified a myriad of ways in which temperature can impact the expectations and perception of foods and beverages. For instance, the physical temperature of food and drinks can influence their acceptance (Brown & Diller, 2008; Stokes et al., 2016) and perceived flavor intensity and texture (Engelen et al., 2003). Furthermore, relevant to the present study, the temperature of food products can impact consumers' emotional responses to these products (Pramudya & Seo, 2018; Singh & Seo, 2020).

Despite the importance and multidimensional influences of temperature on consumers' emotions and behaviors highlighted by the literature so far, to the best of our knowledge, no research has examined how emotional cues may impact product temperature expectations, especially for foodstuffs. In the present research, we aimed to address this by building on the theory of embodied cognition (Barsalou, 2010; Lakoff & Johnson, 1980) to investigate the effects of the emotional content of stimuli on expected product temperature. In particular, we leverage people's associations between temperature and emotions concepts and their underlying affective dimensions (Barbosa Escobar et al., 2021), and we imbue products with emotional content through emoji facial expressions and anthropomorphism, a phenomenon that has gained increasing attention in research and practice (Epley, 2018). We propose that the main mechanism of these effects lies in the product embodying the emotions represented by specific emotional cues (e.g., emotional facial expressions) and in turn other dimensions associated to these emotions (e.g., temperature). In addition, we propose that an alternative mechanism underpinning these effects may be a change in individuals' emotional state, as the emotional cues can influence people's emotional states and hence impact their evaluation of products. This research contributes to the literature on embodied cognition and consumer behavior by demonstrating that the associations between non-concrete (e.g., emotions) and concrete (e.g., temperature) concepts go beyond mere associations and can influence product expectations about concrete properties. In addition, we contribute to the literature by investigating potential underlying mechanisms for these effects, whether they relate to the product embodying emotions and their respective temperature associations or to changes in consumers' emotional state, as well as other alternative mechanisms. Furthermore, the present study provides relevant insights for practitioners, as it presents a novel way for marketers to leverage emotional cues in products to influence expectations and highlight specific sensory features. Our work has relevant implications in terms of sustainability, online food ordering, and immersive technologies.

Theoretical Background and Hypotheses Development

Temperature and Emotions

Previous literature has shown multiple causal effects between temperature and consumers' emotions. On the one hand, extreme temperatures negatively impact individuals' emotional states (Noelke et al., 2016). On the other, people's emotions can influence thermal perception of the environment and thermal comfort (Wang & Liu, 2020). Another link between temperature and emotions can be found in the concept of emotional warmth, defined as a "positive, mild, volatile emotion involving physiological arousal and precipitated by experiencing directly or vicariously a love, family, or friendship relationship" (Aaker et al., 1986). Relevant to the present study, people from different countries associate different emotion adjectives with temperature concepts (Barbosa Escobar et al., 2021). Temperatures of 0 °C and 10 °C are associated with negatively valenced, low arousal emotions. Temperatures of 20 °C and 30 °C are associated with positively valenced, low-to-medium and high-arousal emotions, respectively; and a temperature of 40°C is associated with high-arousal and either positively or negatively valenced emotions. These results showed a positive linear relationship between temperature and arousal and an inverted U-shaped relationship between temperature and valence.

Main Proposed Mechanism: Embodiment

The theories of embodied cognition (Barsalou, 2010; Lakoff & Johnson, 1980), constructed emotions (Barrett, 2006), and sensation transference (Cheskin, 1957; Motoki et al., 2020) may help explain, in a lockstep fashion, the associations between temperature and emotions, as well as the potential effects of emotional cues and anthropomorphism on product temperature expectations. First, the theory of grounded cognition provides a framework to examine how individuals internalize abstract concepts through concrete ones. For instance, as this theory suggests, abstract concepts (e.g., emotions; although see Xu et al., 2017), who suggest emotions are a unique conceptual category different from both abstract and concrete concepts) are grounded in concrete experiences (e.g., temperature) through conceptual metaphors used to understand the world, as the latter help unify reason and imagination (Kövecses, 2020). More specifically, metaphors help more abstract concepts, which are less easily accessible, be conceptualized as more tangible ones, which are more easily accessible. For instance, people often associate love and warmth, as exemplified in terms like "warm love". Furthermore, following the theory of constructed emotion, these associations seem to come from the creation of emotion categories based on embodied knowledge and past experiences to label sensations that occur together with specific temperatures (Barrett, 2006; Waggoner, 2010). Finally, the sensation transference theory can help explain how these associations can influence products' sensory features. According to this theory, the properties of extrinsic stimuli can transfer to objects and alter consumers' evaluations of said objects (Cheskin, 1957; Motoki et al., 2020).

The associations between temperature and emotions extend from the self to the social realm. As Fiske et al. (2007) suggested, warmth and competence are the fundamental components of social cognition, with which individuals form immediate (and automatic) impressions of other individuals and groups. The evaluation of a person as warm or cold serves to inform impressions, feelings, and behaviors of people and to guide daily interactions (Cuddy et al., 2008; Nauts et al., 2014). In addition, perceptions of warmth of other people can be influenced by embodied sensory experiences of physical warmth or coldness, such as imagining holding a cup of hot or cold coffee (Macrae et al., 2013). Importantly, there is a tight link between social warmth and physical warmth. For instance, holding a warm object has been found to increase self-reported feelings (and neural activity) of social connection to close others compared to holding a room-temperature object and a cold one (Inagaki & Ross, 2021). Moreover, exposure to tactile warmth can eliminate the need for greater social affiliation under cold ambient temperatures (Fay & Maner, 2020). Furthermore, in terms of relationships with brands, (IJzerman et al., 2015) found that thinking positively (vs. negatively) about communal brands can increase estimates of ambient temperature.

Facial Features, Emotions, and Temperature

A critical way people form social impressions, including warmth, lies in facial features and expressions (Lee et al., 2021; Todorov et al., 2008; Willis & Todorov, 2006). Facial expressions can communicate broad affective dimensions (e.g., valence, arousal), as well as complex emotion categories (Liu et al., 2022). One of the most predominant facial features used to judge others' warmth is the smile. People with smiling facial expressions are perceived as warm, and those with broader smiles are perceived as warmer (Wang et al., 2017).

The communication of emotions through faces and facial expressions is not limited to human ones. For instance, emojis are an effective way to convey emotional information (Novak et al., 2015). Emojis are single graphic symbols that represent facial expressions, concepts, ideas, and emotions, and they are widely used in marketing communications (Das et al., 2019). Moreover, emojis especially designed to convey specific emotions can do so better than other modes of expression, including humans' facial expressions (Cherbonnier & Michinov, 2021). Relevant to the present study, facial expressions from emojis can imbue products with the emotions they represent and consequently transfer the temperature associations of these emotions to the product. Indeed, emojis have been shown to increase inferential processing of emotions and consequently trigger empathy (Erle et al., 2022). Furthermore, emoji-like facial expressions (similar to the ones used in the present study) used in an anthropomorphic context can trigger congruent emotional reactions and increase trustworthiness (Song et al., 2023). In digital communications, emojis can convey different sender mental and emotional states. (Pfeifer et al., 2022).

Anthropomorphism

In recent decades, a tactic that has gain attention from marketers and academics to imbue products with emotions relates to anthropomorphism (Epley et al., 2007; Han et al., 2019). The latter entails individuals' tendency to attribute human-like characteristics (e.g., having a rational mind and emotions) to nonhuman entities (Epley et al., 2007). Some of the main means by which anthropomorphism can be triggered are facial features and descriptions involving human-like features (Chandler & Schwarz, 2010; Puzakova & Aggarwal, 2018). As Epley (2018) suggested, an important mechanism behind anthropomorphism relates to the similarity of a target to a human agent based on observable features. This mechanism is based on the activation of a human schema (knowledge about human agents) when the target invokes a person. In other words, individuals can attribute emotional traits to anthropomorphized objects. For example, anthropomorphism can lead to higher perceptions of warmth (Kim & Yoon, 2021).

Based on the associations between emotions and temperature, as well as the theoretical considerations of the communication of emotions, it is possible to construe that a product with anthropomorphic attributes (i.e., emoji facial expressions) that convey specific emotions and affective dimensions (i.e., valence and arousal) will embody the corresponding emotions and the associations they carry (e.g., with temperature). Consequently, we propose that, whether a product is intrinsically hot or cold, these associations will influence individuals' sensory expectations of the product in the corresponding direction (see Figure 1). For example, in our study, a hot chocolate beverage in a receptacle with a broad smile would be perceived as being happy/excited (i.e., positive valence, high arousal). Thus, the beverage would be expected to be at a higher physical temperature since positive valence, high arousal emotions are associated with high temperatures, although notice that ceiling effects may be found, whereby the beverage is already hot, so the emoji expression does not impact temperature expectations. Moreover, the extent of this temperature modulation effect may depend on how human-like the products are perceived by the participants. More formally, we hypothesized:

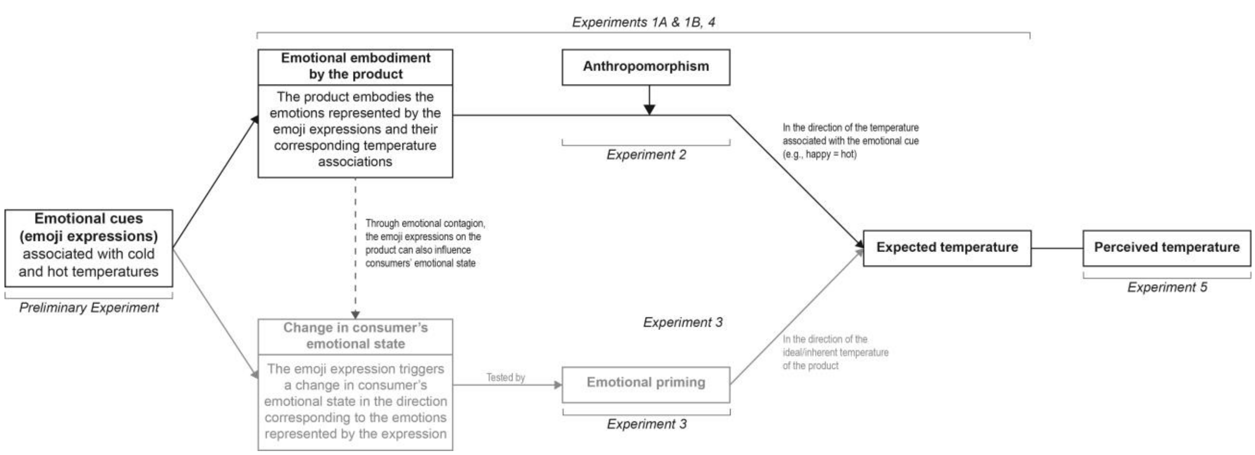
H_{1A}: A cold beverage with a positive valence, high arousal (vs. negative valence, low arousal) emoji expression will be expected to be at a higher (vs. lower) temperature.

H_{1B}: A hot beverage with a positive valence, high arousal (vs. negative valence, low arousal) emoji expression will be expected to be at a higher (vs. lower) temperature.

H_2: Higher (vs. lower) anthropomorphism will increase (vs. reduce) the effect of emoji expressions on the expected temperature of the beverage.

Figure 1

Conceptual Diagram of Mechanisms and Experiments Flow



Note. The proposed main mechanism (embodiment) is presented in black, and the alternative proposed mechanism is presented in gray.

Proposed Alternative Mechanism: Change in Individuals' Emotional State

It is important to consider that while individuals can imbue an anthropomorphized object with emotions, an object can also evoke emotions in an observer. A person can acquire emotions from other individuals around them, a phenomenon termed emotional contagion, whereby the emotional expressions of the latter cause the former to experience a congruent emotional state (Peters & Kashima, 2015). Given that through anthropomorphism, individuals imbue nonhuman entities with human traits, anthropomorphized objects are likely to trigger congruent emotions (Chang et al., 2018). Furthermore, as previous studies have shown, emojis can cause changes in people's emotional state through emotional contagion (Lohmann et al., 2017; Smith & Rose, 2020). In addition, anthropomorphized objects portraying smiles can trigger positive emotions (Landwehr et al., 2011). Consumers' emotional state is critical for marketing strategies, as it can impact consumer behavior. For instance, positive emotions enhance the valuation of objects, which results in positive product evaluations, and the opposite occurs with negative emotions (Clore & Huntsinger, 2007).

Considering the literature on emotional contagion and the influence of emotions on product judgements presented above, it is reasonable to suggest that the expected temperature of the beverage can alternatively be influenced by a change in individuals' emotional state (because of the emoji expressions or the product itself) and not by the product embodying the emotions per se. In this case, the direction of the change in expected temperature would be in line with the desired/ideal temperature of the beverage, and not temperature associated with the emoji expression, so the direction of the change in temperature in the hot beverage would differ from the cold one. For instance, since people prefer a hot chocolate beverage to be hot, a positive change in an individual's emotional state would result in a higher expected temperature of the beverage. On the other hand, in the case of a cold chocolate beverage, a positive change in emotions (induced by a positive emoji expression) would reduce the expected temperature of the beverage, as people want an iced/cold chocolate beverage to be as cold as possible. All in all, in the case of the hot beverage, the two mechanisms align in the predicted temperature direction, whereas they diverge in the case of the cold beverage.

Hence, we propose that a change in individuals' emotional state is an alternative path through which changes in expected product temperature may occur. We aimed to test these paths statistically (via moderation analyses) and experimentally (by using the emoji expressions as emotional primes instead of in the receptacle of the beverage). Emotional priming refers to the presentation of an emotion-laden stimuli that later activate congruent emotions in the perceiver (Milshtein et al., 2020). More formally, we hypothesized that:

H_{3A}: When primed with a positive valence, high arousal (vs. negative valence, low arousal) emoji expression alone, a cold beverage in a plain cup will be expected to be at a lower (vs. higher) temperature.

H_{3B}: When primed with a positive valence, high arousal (vs. negative valence, low arousal) emoji expression alone, a hot beverage in a plain cup will be expected to be at a higher (vs. lower) temperature.

Emotions and Tastes

Individuals' emotions can also impact the sensory evaluations of foodstuffs (Noel & Dando, 2015; Spence, 2022b). According to the sensation transference theory (Cheskin, 1957;

Motoki et al., 2020), the properties of stimuli in one sensory modality can transfer to stimuli in another modality and influence consumers' hedonic judgements and consequently impact the perceived sensory properties of products. For instance, previous research has shown that sweetness perception is enhanced by positively valenced emotional stimuli, whereas bitterness perception is increased by negatively valenced stimuli due to the positive valence of sweetness and the negative valence of bitterness, respectively (Reinoso-Carvalho et al., 2020). Therefore, we also expected the positive emoji expression to increase expected liking and sweetness and reduce bitterness and the opposite to occur with the negative expressions. Moreover, we expected that anthropomorphism would enhance these effects.

To obtain a more holistic view of the influence of the emotional cues on the broader product experience, we extended our investigation of their effects from expectations to perception. To make sense of the world, the brain creates predictive models that attempt to match incoming sensory signals with top-down expectations, and these expectations predict and shape individuals' experiences (de Lange et al., 2018). In this way, the expectations about products are key source of how they are perceived, in addition to incoming sensory input (Piqueras-Fiszman & Spence, 2015). Considering this, we expected that the effects of the emotional cues on the expectations about the product (i.e., temperature, liking, and tastes) would yield similar results in terms of its perception. Consequently, we expected that the hypotheses posed before about the expected product attributes would also hold true for perceived attributes.

Interim Summary: Two Proposed Mechanisms

We posed that the main mechanism through which emotional cues associated with specific temperatures (e.g., happy—warm; sad—cold) may influence product temperature expectations lies in the product embodying the emotions represented by specific emotional cues.

In this way, the product also embodies the associations individuals have between these emotions and other concepts and dimensions (i.e., temperature), and thus exhibits these properties, which ultimately changes individuals' product expected temperature. Nevertheless, we posed that an alternative mechanism of these effects may lie in changes in individuals emotional state, so that the emotional cues trigger a congruent emotional state in individuals, which then influences people's temperature expectations of the product.

We tested the hypotheses related to these mechanisms through six online experiments (Preliminary Experiment, Experiments 1A, 1B, 2 – 4) and one laboratory-based experiment (Experiment 5). Overall, in the online experiments, visual analogue scales (VASs), free-text questions, and the Self-Assessment Manikin (SAM; Bradley & Lang, 1994) were used to investigate participants' associations, product expectations, and affective states. Overall, the data analyses included ANOVAs, and bootstrapped mediation and moderation analysis. Detailed methods for each experiment are presented in their corresponding sections. In the Preliminary Experiment, we uncovered emoji expressions associated with cold and hot temperature concepts. In Experiment 1A, we incorporated the two emoji expressions most strongly associated with cold and hot temperatures in the receptacle of hot and cold chocolate beverages and evaluated their effect on the expected temperature, liking, sweetness, and bitterness of the beverages. Experiment 1B replicated the findings of the previous experiment under the hot beverage condition. In Experiment 2, we manipulated the anthropomorphism of the beverage. In Experiment 3, we aimed to dissociate the potential effect of a change in consumers' emotional state from the that of the emotions—temperature associations by using the emoji expressions as emotional primes instead of using them in the receptacle of the beverage. In Experiment 4 we investigated the generalizability of our findings on temperature expectations online and examined two new products with slightly modified emoji expressions. Finally, in Experiment 5, we extended our investigation from an online setting to a physical one and evaluated both expected and perceived temperature of the beverage (see Figure 1).

Preliminary Experiment: Emoji—Temperature Associations

The Preliminary Experiment was designed to uncover associations between emoji expressions (based on their valence and arousal connotations) and both cold and hot temperatures. We used emojis, as they are an effective way to convey affect and are less prone to biases from other factors from human images (e.g., gender, age, race). The two emoji expressions most strongly associated with cold and hot temperatures were selected to be used in the subsequent experiments.

Methods

Except for Experiment 5, all participants were recruited from Prolific (https://www.prolific.co/). All experiments were programmed and conducted in Qualtrics (https://www.qualtrics.com/). Except for the mediation and moderation analyses, all the analyses were conducted in R (R Core Team, 2022). All the experiments complied with the World Medical Association's Declaration of Helsinki and were approved by the respective ethics committee. Power calculations for all the experiments are detailed in the Web Appendix.

A total of 207 native English speakers from the UK (154 females, 53 males), aged 18 – 40 years (M_{age} = 28.66 years, SD_{age} = 5.61) took part in the Preliminary Experiment. Participants were compensated with GBP 0.25. The stimuli consisted of the facial expressions (i.e., eyebrows, eyes, and mouth) of four specific emojis extracted from the EmojiGrid (Toet et al., 2018). Emojis from the EmojiGrid were selected, as they were specifically created to communicate specific values of the valence and arousal dimensions of affect. They are not part of the official Unicode emoji and are not found in people's everyday life, which have been found to carry specific and diverse semantic associations and meanings (Bai et al., 2019; Jaeger et al., 2019) and hence could introduce confounding effects in our analysis. We selected the emojis in the four corners of the EmojiGrid: bottom left (lowest valence, lowest arousal; V1A1), top left (lowest valence, highest arousal; V1A5), bottom right (highest valence, lowest arousal; V5A1), and the top right (highest valence, highest arousal; V5A5). The stimuli are presented in the Web Appendix.

The experiment followed a one-way between-subjects design. Participants first indicated their affective state through the valence and arousal dimensions of the 9-point Self-Assessment Manikin (SAM; Bradley & Lang, 1994). Then, they were presented with general instructions and were asked to pay attention to the screen, as the expressions would only be visible for a few seconds. Subsequently, participants were exposed to an emoji expression for three seconds. Then, they completed the SAM again. Afterwards, participants were presented with the same emoji expression they saw earlier and indicated with what temperature they associated it on a 9-point visual analogue scale (VAS) from 1 (*cold*) to 9 (*hot*). Finally, participants indicated their age and gender.

To analyze the temperature associations of each of the emoji expressions, we conducted a one-way ANOVA with temperature as dependent variable and emoji expression as independent variable. To analyze the effect of the emoji expressions on the affective state of participants, we computed the change in valence (Δ_{Valence}) and arousal (Δ_{Arousal}) for each participant by subtracting the corresponding initial SAM scores from the final ones. Then, we conducted independent one-way ANOVAs on these variables with emoji expression as independent variable. Furthermore, we conducted one-sample one-sided *t*-tests to examine whether there was a change in valence and arousal generated by each of the emoji expressions.

Results

The ANOVA results revealed a significant effect of emoji expression on temperature association, $F(3, 203) = 63.56$, $p < .001$, $\eta_p^2 = .48$. Consistent with our expectations, the post hoc tests showed that the emoji expression with the highest temperature association was the highest valence, highest arousal one (V5A5; $M = 6.92$, $SD = 1.40$), whereas the emoji expression with the lowest temperature association was the lowest valence, lowest arousal one (V1A1; $M = 2.33$, $SD = 1.29$). Detailed results of all the analyses are presented in the Web Appendix.

The results also revealed a significant effect of emoji expression on the change in the valence, $F(3, 203) = 30.02$, $p < .001$, $\eta_p^2 = .31$, and arousal, $F(3, 203) = 4.06$, $p = .008$, $\eta_p^2 = .06$, states of participants. The post hoc tests showed significant differences in the expected direction in the valence and arousal affective states of participants after being exposed to the V1A1 compared to the V5A5 emoji expression, in which the former resulted in negative changes in both dimensions and the latter in positive changes. The one-sample one-sided *t*-tests revealed that the changes in valence, $t(50) = -4.15$, $p < .001$, and arousal, $t(50) = -1.82$, $p = .037$, of the V1A1 emoji expression were significantly less than 0. In addition, the changes in valence, $t(51) = 6.31$, $p < .001$, and arousal, $t(51) = 3.02$, $p = .002$, of the V5A5 emoji expression were significantly greater than 0.

The results of the Preliminary Experiment showed that the emoji expression most associated to low temperatures was the lowest valence, lowest arousal. In addition, the emoji expression most associated with high temperatures was the highest valence, highest arousal. Thus, we used these two emoji expressions for the subsequent experiments. Furthermore, these results demonstrated that these two emoji facial expressions can serve as emotional primes in their respective directions.

Experiment 1A

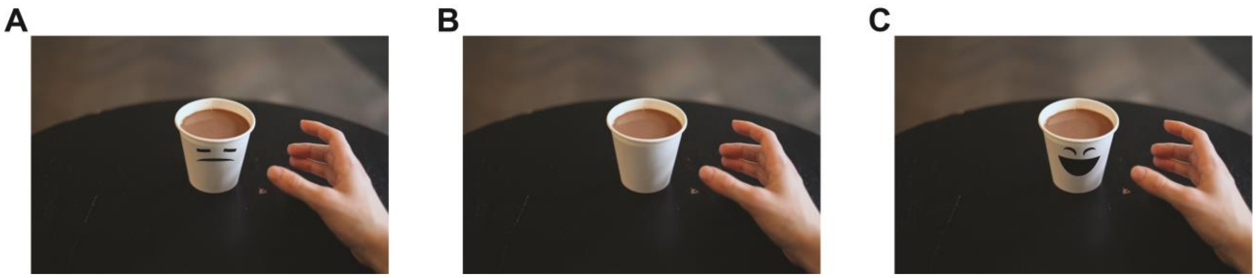
The goal of Experiment 1A was to investigate whether imbuing a product with emotional content using emoji expressions associated with low and high temperatures could influence expected product temperature in an online setting. To this end, we used chocolate milk as stimulus since it is a widely consumed beverage at both cold and hot temperatures.

Methods

The final sample of Experiment 1 comprised 591 participants (296 females, 291 males, 4 unreported), aged 18 – 40 years (M_{age} = 28.60 years, SD_{age} = 6.11). Participants received GBP 0.63 for their participation. The stimuli consisted of highly ecological photographs of a chocolate beverage in a paper cup—with or without an emoji expression on it. Based on the results of the Preliminary Experiment, we selected the lowest valence, lowest arousal (henceforth called *sad*) and the highest valence, highest arousal (henceforth called *happy*) emoji expressions, as they presented the coldest and hottest temperature associations, respectively. To enhance the mental simulation of drinking the chocolate beverage generated by the stimuli and consequently increase the reliability of responses on the expectations of the beverage and emotional reactions, we developed ecologically valid stimuli comprising real physical elements and included a first person-perspective view of the beverage and a hand reaching for the cup (see Figure 2). First-person-perspective images increase mental simulation of the actions portrayed (Elder & Krishna, 2012; Macrae et al., 2013), and they enhance representations of bodily sensations, emotional reactions, and psychological states (Libby & Eibach, 2011).

Figure 2

Stimuli Used in Experiment 1A



Note. The stimuli consisted of a chocolate beverage with either a sad emoji expression (A), no emoji expression (control; B), or a happy emoji expression (C).

The experiment followed a 2 (Beverage temperature: cold, hot) × 3 (Emoji expression: sad, control, happy) between-participants design. Each participant evaluated one chocolate beverage, either cold or hot, in either a cup with an emoji expression or in a plain cup. The manipulation of the beverage temperature was made solely by indicating the temperature of the beverage in the instructions and the questions of the study in order to ensure consistency across the stimuli and avoid that potentially different elements (e.g., vapor) could bias the results. In the cold condition the stimulus was referred to as an *iced chocolate beverage*, as this is a familiar name in the product category. In the hot condition the stimulus was referred to as a *hot chocolate beverage*.

Participants first indicated the valence and arousal of their current emotional state through the 9-point SAM (Bradley & Lang, 1994). Then, they evaluated their thermal sensation at the moment on a 9-point VAS from 1 (*cold*) to 9 (*hot*) adapted from (Chinazzo et al., 2020). Subsequently, participants were presented with the stimuli and were asked to imagine they were about to drink the *iced*/*hot* chocolate beverage shown. Later, participants were asked to evaluate the temperature they expected the *iced*/*hot* chocolate beverage to be at. Afterwards, they were asked to evaluate how much they expected to like the *iced*/*hot* chocolate beverage and how sweet and bitter they expected it to be. Subsequently, participants evaluated the extent to which the *iced*/*hot* chocolate beverage had human-like characteristics by indicating their level of agreement to five-items about the chocolate milk (i.e., *this iced/hot chocolate beverage*… "seems humanlike", "seems alive", "has its own emotions", "has its own intentions", and "has its own personality"), taken from (Chen et al., 2018). The stimulus was visible when these questions were presented. Then, participants evaluated the valence and arousal of their emotional state and thermal sensation again. They also indicated the temperature at which they prefer to drink chocolate beverages. Afterwards, those participants who were exposed to a chocolate beverage with an emoji expression were shown the same emoji expression alone and were asked to evaluate how much they liked it and to state the three words they most associated the expression with. Finally, participants indicated their age and gender. All the questions involving temperature were answered on a 9-point VAS from 1 (*cold*) to 9 (*hot*), all the other questions were answered on a 9-point VAS from 1 (*not at all*) to 9 (*very much*).

To analyze the main dependent variables (expected temperature, expected liking, expected sweetness, and expected bitterness), we ran a set of models consisting of separate ANOVAs on the main dependent variables with the main and interaction effects of beverage temperature and emoji expression. Furthermore, as robustness check, we ran a second set of models comprised of independent ANCOVAs on the main dependent variables adding participants' initial emotional state (SAM's values on positivity/negativity and intensity of emotion), their initial thermal sensation, age, and gender as covariates to the ANOVA models. The results of the robustness checks (ANCOVAs) are presented in the Web Appendix. The values of participants' emotional state were added as covariates due to the emotional nature of the study, as people's emotional state could alter the impact of the emoji expressions, as well as their evaluation of the chocolate beverage itself. We also controlled for participants' initial thermal sensation since people's regulatory behaviors to achieve physical-psychological homeostasis (Lee et al., 2014) could also influence the results. In addition, age could influence how the emotional cues (i.e., emoji expressions) were processed (Kutsuzawa et al., 2022). Older people (over 30 years) tend to interpret emojis literally or do not understand their function (Herring & Dainas, 2020). Furthermore, gender could influence the processing of the emotional cues. For instance, negativity bias in the processing of emoji expressions is more common in females than males (Jones et al., 2020). All the models for each dependent variable were tested via likelihood ratio tests (LRTs). Subsequently, Bonferroni-corrected pairwise comparisons for all the dependent variables were computed. Descriptive statistics and correlation matrices for all the key variables in all the experiments are presented in the Web Appendix.

We tested the reliability of the five items of the anthropomorphism scale using McDonald's omega (ω) given the issues with Cronbach's alpha (α) as discussed in recent literature (Deng & Chan, 2017; Hayes et al., 2020), and we computed an overall anthropomorphism index by averaging the scores of the five items. Moreover, we computed participants' change in emotional state in terms of valence (Δ_{Valence}) and arousal (Δ_{Arousal}) and tested for significant differences from zero through one-sided one-sample *t*-tests. Furthermore, we conducted separate bootstrapped moderation analyses for the cold and the hot beverage conditions each with 10,000 iterations using the PROCESS macro for SPSS (Hayes, 2022) on expected temperature with emoji expression as multicategorical predictor and the anthropomorphism index as moderator, where the emoji expressions were coded as 0 (control), 1 (sad), and 2 (happy).

To explore the semantic associations of the emoji expressions, we conducted a word frequency analysis coupled with a sentiment analysis using the Bing lexicon (Liu, 2012), which categorizes, 6,786 words in a binary fashion into positive or negative. Furthermore, we used the NRC VAD to extract the valence and arousal values of the words. The NRC VAD lexicon includes more than 20,000 words in English with fine-grained valence and arousal scores from 0 (lowest) to 1 (highest). Subsequently, we ran two separate linear mixed models (LMMs) on both valence and arousal values with beverage temperature and emoji expression as fixed factors, along with their interaction, and participants' ID as random factor. Subsequently, Bonferroni-corrected pairwise comparisons were computed.

Results

The ANOVA results revealed a significant main effect of beverage temperature on temperature expectations, $F(1, 585) = 1505.83$, $p < .001$, $\eta_p^2 = .72$. Under the cold beverage temperature condition, the chocolate beverages were expected to be colder than under the hot beverage temperature condition ($M_{cold} = 2.09$ vs. $M_{hot} = 7.14$; $p < .001$). Importantly, the results revealed a significant main effect of emoji expression on the expected temperature of the chocolate beverages, $F(1, 585) = 3.04$, $p = .049$, $\eta_p^2 = .01$ (Table 1). There was a tendency in the sad beverages to be expected to be at a lower temperature than the control ($M_{sad} = 4.39$ vs. $M_{control} = 4.74$; $p = .088$), There was no difference between the sad beverages and the happy ones ($M_{happy} = 4.72$; $p = .104$) or between the control and the happy beverages ($p > 0.999$).

Table 1

Estimated Marginal Means of Key Variables in Experiment 1A

	Cold			Hot		
	Sad	Blank	Happy	Sad	Blank	Happy
Expected temperature	1.97 [1.58, 2.36]	2.09 [1.72, 2.47]	2.25 [1.89, 2.60]	6.77 [6.38, 7.16]	7.45 [7.05, 7.86]	7.16 [6.77, 7.54]
Expected liking	4.23 [3.65, 4.80]	5.02 [4.47, 5.57]	5.18 [4.67, 5.70]	5.94 [5.38, 6.50]	6.16 [5.57, 6.75]	6.49 [5.93, 7.05]
Expected sweetness	6.86 [6.49, 7.23]	7.00 [6.65, 7.35]	6.8 [6.47, 7.13]	6.16 [5.80, 6.53]	6.48 [6.10, 6.86]	6.82 [6.46, 7.18]
Expected bitterness	2.77 [2.36, 3.19]	2.66 [2.26, 3.05]	2.41 [2.04, 2.79]	2.92 [2.51, 3.32]	2.58 [2.15, 3.00]	2.60 [2.02, 3.00]

Note. Expected temperature values are based on 9-point VAS from 1 (*cold*) to 9 (*hot*). Expected liking, expected sweetness, and expected bitterness values are based on a 9-point VAS from 1 (*Not at all*) to 9 (*Very much*). Confidence intervals are presented below each mean.

Regarding expected liking, the results revealed significant main effects of beverage temperature, $F(1, 585) = 51.18$, $p < .001$, $\eta_p^2 = .08$, and emoji expression, $F(2, 585) = 5.50$, $p = .004$, $\eta_p^2 = .02$. The hot chocolate beverages were expected to be liked more than the cold ones ($M_{hot} = 4.81$ vs. $M_{cold} = 6.20$; $p < .001$). Moreover, participants expected to like the happy chocolate beverages more than the sad ones ($M_{happy} = 5.84$ vs. $M_{sad} = 5.08$; $p = .003$).

In terms of taste expectations, the results showed a significant main effect of beverage temperature, $F(1, 585) = 10.55$, $p = .001$, $\eta_p^2 = .02$. Overall, the cold chocolate beverages were expected to be sweeter than the hot ones ($M_{cold} = 6.89$ vs. $M_{hot} = 6.49$; $p = .001$). In addition, the results revealed a significant effect of the interaction between beverage temperature and emoji expression, $F(2, 585) = 3.19$, $p = .042$, $\eta_p^2 = .01$, on expected sweetness. In the hot beverage condition, as expected, the happy beverage was expected to be sweeter compared to sad one ($M_{happy} = 6.82$ vs. $M_{sad} = 6.16$; $p = .006$). There were no other significant differences in terms of sweetness. Contrary to our expectations, there were no significant effects of beverage temperature or emoji expression on expected bitterness.

The anthropomorphism index presented high internal consistency (ω = .89, 95% CI = .87, .91), although the nominal levels across conditions were relatively low. The chocolate beverages under the hot temperature condition presented significantly higher levels of anthropomorphism than the ones in the cold condition (M_{hot} = 2.21 vs. M_{cold} = 1.82; p < .001). Moreover, both the sad (M_{sad} = 2.26; p < .001) and the happy (M_{happy} = 2.29; p < .001) chocolate beverages presented higher levels of anthropomorphism than the control ($M_{control}$ = 1.51). The *t*-tests revealed that, as reported by participants, none of the chocolate beverages triggered a significant change in their emotional state. The moderation analysis for the hot chocolate beverages revealed that the effect of emoji expression was not moderated by anthropomorphism. Detailed results of the moderation analyses are presented in the Web Appendix.

The word frequency analysis revealed that the top three words associated with the sad emoji expression were sad (n = 92), sadness (n = 82), and unhappy (n = 29). The top three words associated with the happy emoji expression were happy (n = 94), happiness (n = 56), and joy (n = 56). A frequency table with the top ten keywords per emoji expression is presented in the Web Appendix. As expected, the analysis on the affective loadings of the word associations revealed a significant main effect of emoji expression on valence, $F(1, 384.62) = 1619.39$, $p < .001$, η_p^2 = .81, so that the happy emoji expression presented a significantly higher valence than the sad one (M_{happy} = 0.84 vs. M_{sad} = 0.16; p < .001). Emoji expression also had a significant effect on arousal, $F(1, 379.70) = 450.59$, $p < .001$, η_p^2 = .54; the happy emoji expression presented a significantly higher arousal than the sad one (M_{happy} = 0.68 vs. M_{sad} = 0.45; p < .001).

Overall, the results in Experiment 1A provided initial support for our main argument that imbuing a product with emotional content by incorporating emoji expressions on it can influence the expected temperature of the product. Importantly, this effect was conditional on the inherent temperature of the product and the emoji expression used. Under the hot, but not the cold beverage condition, the sad emoji expression reduced the expected temperature of the beverage compared to the happy expression, providing support for H_{1B}. Furthermore, the use of emoji expressions also influenced liking and sweetness expectations, although these effects were also dependent on the temperature of the beverage. Under the cold temperature condition, the sad emoji expression reduced expected liking compared to the happy expression. Moreover, under the hot temperature condition, the sad expression reduced expected sweetness compared to the happy one.

Experiment 1B

The objective of Experiment 1B was to probe the results of Experiment 1A under the hot beverage temperature condition (where significant results were found) with a higher statistical power.

Methods

The final sample comprised 445 participants (228 females, 215 males, 2 unreported), aged 18 – 55 years (M_{age} = 29.91 years, SD_{age} = 6.17). Participants received GBP 0.63 for their participation. The stimuli were the same as in Experiment 1A, except that here participants were only exposed to the hot beverage condition. The experiment followed a one-way between-subjects design with emoji expression as 3-level factor (sad, control, happy). The procedure was the same as Experiment 1A.

As in the previous experiment, we analyzed the main dependent variables through two separate ANOVA models on the main dependent variables with emoji expression as main factor. Similarly, as robustness check, we ran separate ANCOVAs on the main dependent variables adding participants' initial emotional state (valance and arousal), their thermal sensation, age, and gender as covariates to the ANOVA models. Bonferroni-corrected pairwise comparisons for all the dependent variables were then computed. The remaining analyses were identical to Experiment 1A.

Results

The ANOVA results revealed a significant main effect of emoji expression, $F(2, 442) = 7.08$, $p = .001$, $\eta^2 = .03$, on the expected temperature of the chocolate beverages. The sad chocolate beverage ($M_{sad} = 6.50$) was expected to be significantly less hot than happy one ($M_{happy} = 7.08$; $p = .003$) and the control ($M_{control} = 7.09$; $p = .004$).

As per expected liking, the results showed a significant main effect of emoji expression, $F(2, 442) = 3.64$, $p = .027$, $\eta^2 = .02$. The sad chocolate beverage ($M_{sad} = 5.76$) was expected to be liked less than the happy one ($M_{happy} = 6.40$; $p = .023$) but not less than the control ($M_{control} = 6.13$; $p = .327$).

Regarding taste expectations, the results revealed a significant main effect of emoji expression, $F(2, 442) = 5.09$, $p = .007$, $\eta^2 = .02$, on expected sweetness. The sad chocolate beverage ($M_{sad} = 6.07$) was expected to be less sweet than the happy one ($M_{happy} = 6.62$; $p = .008$) and the control ($M_{control} = 6.51$; $p = .046$). Furthermore, the ANOVA results revealed a significant main effect of emoji expression, $F(2, 442) = 3.41$, $p = .034$, $\eta^2 = .02$, on expected bitterness. The sad chocolate beverage ($M_{sad} = 3.12$) was expected to be more bitter than the happy one ($M_{happy} = 2.61$; $p = .029$) but not the control ($M_{control} = 2.83$; $p = .421$).

The anthropomorphism index presented a high internal consistency (ω = .92, 95% CI = .91, .94). The sad (M_{sad} = 2.67; p < .001) and the happy (M_{happy} = 2.57; p < .001) chocolate beverages presented higher levels of anthropomorphism than the control ($M_{control}$ = 1.55). In terms of change in participants' emotional state, the *t*-tests revealed that the only significant effects were a positive change in valence ($\Delta_{\text{Valence}} > 0$) with the happy chocolate beverage, $t(144) = 2.54$, $p = .006$, and a negative change in arousal ($\Delta_{\text{Arousal}} > 0$) with the sad chocolate beverage, $t(143) = 2.70$, $p = .004$.

The bootstrapped moderation analysis revealed a significant moderation effect of anthropomorphism. The interaction between the sad chocolate beverage and anthropomorphism was significant, β = -0.28, SE = 0.11, 95% CI = [-0.496, -0.060], but the interaction with the happy emoji chocolate beverage was not significant, β = -0.22, SE = 0.12, 95% CI = [-0.458, 0.011]. Higher anthropomorphism enhanced the effect of the sad emoji. At higher levels of anthropomorphism, the expected temperature of the chocolate beverage with the sad emoji expression becomes increasingly lower, and the difference with respect to the other chocolate beverages becomes larger.

In sum, Experiment 1B replicated our earlier findings in Experiment 1A under the hot beverage condition with a higher statistical power and provided support for H_{1B}. The sad emoji expression reduced the expected temperature of the hot chocolate beverage compared to the happy emoji expression and the control. Importantly, the effect of emoji expression on temperature expectations was moderated by anthropomorphism, providing initial support for H_2. Furthermore, the sad emoji expression reduced expected liking compared to the happy emoji expression. The sad emoji expression also reduced the expected sweetness and increased the expected bitterness of the chocolate beverage compared to the happy emoji expression and the control.

Experiment 2

Experiment 2 was designed to probe the influence of anthropomorphism on the effect of emoji expressions on the expected temperature of chocolate milk. To this end, we manipulated the anthropomorphism levels of the same chocolate beverages used before.

Methods

The final sample comprised 603 participants (298 females, 294 males, 11 unreported), aged 18 – 40 years (M_{age} = 29.26 years, SD_{age} = 6.10). Participants received GBP 0.42 for their participation. The stimuli were the same as Experiment 1B, where only the hot beverage condition was used. The experiment followed a 3 (Emoji expression: sad, control, happy) × 2 (Anthropomorphism: low, high) between-subjects design. The procedure was similar to Experiment 1A, but the instructions and phrasing of the questions were modified to manipulate anthropomorphism. Based on previous literature, under the high anthropomorphism condition, we aimed to make participants think of the chocolate beverage as a person and focus on its emotions (Aggarwal & Mcgill, 2007; Chen et al., 2017). To this end, similar to earlier studies (Tam, 2015; Tam et al., 2013; Waytz et al., 2014), we assigned the chocolate beverage a gender and gave it a name: *Mr. Cocoa.* In addition, we instructed participants to focus on the emotions of chocolate beverage (Aggarwal & Mcgill, 2007; Chen et al., 2017), and we referred to it as a person by its name in the questions (Wang & Basso, 2019). On the other hand, under the low anthropomorphism condition, we aimed to make participants think of the chocolate beverage as an object and focus on its functional and physical characteristics (i.e., taste). The specific phrasing under both conditions is presented in the Web Appendix.

Similar to Experiment 1A, we analyzed the main dependent variables through two sets of models. The first set (M_1) comprised independent ANOVAs on the main dependent variables with the factors emoji expression and anthropomorphism, as well as their interaction. The second set (M_2) of models consistent of independent ANCOVAs on the main dependent variables adding participants' initial emotional state (valance and arousal), thermal sensation, age, and gender as covariates to the M_1 models. Bonferroni-corrected pairwise comparisons for all the dependent variables were then computed.

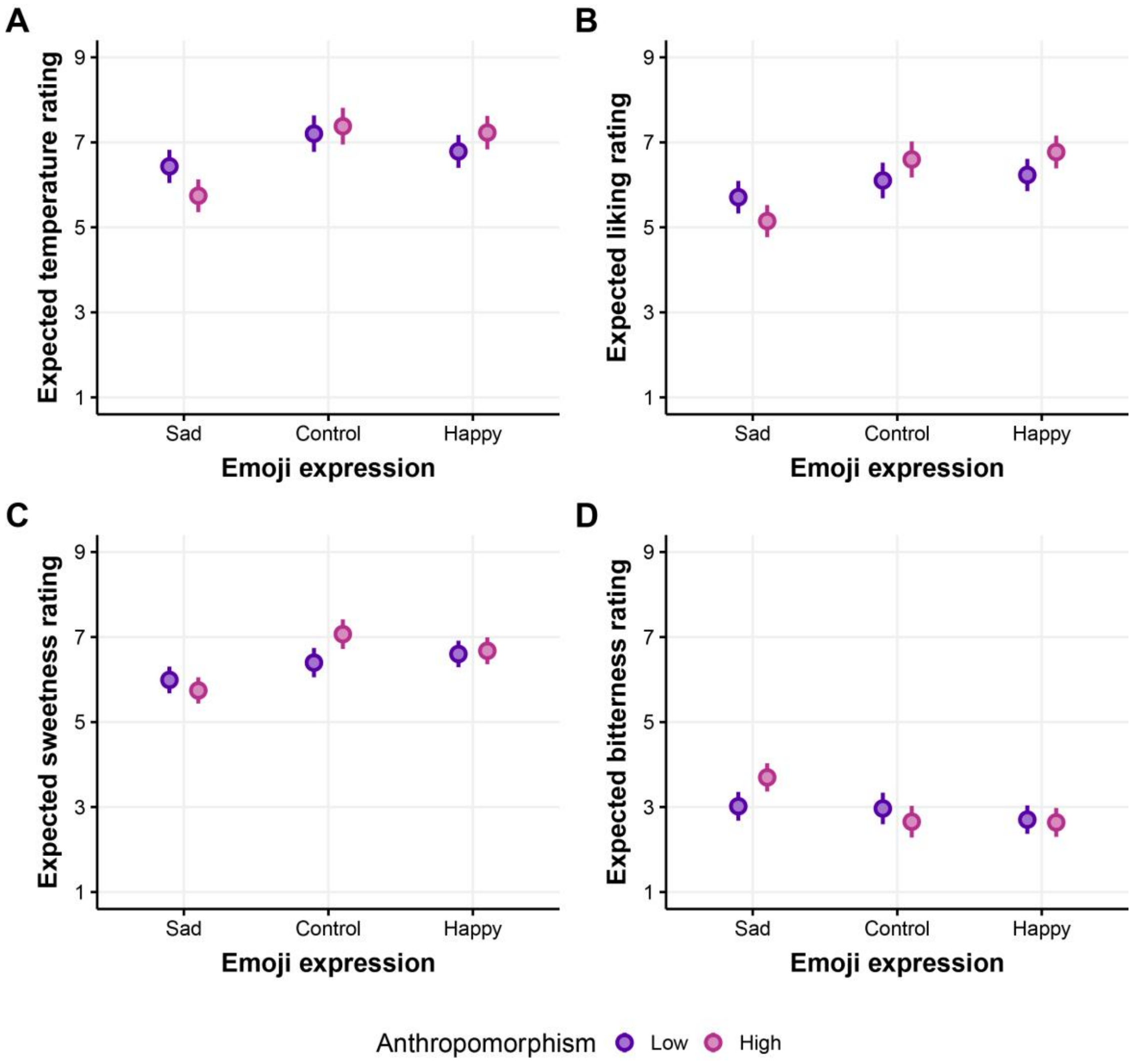
Results

Anthropomorphism presented a high level of internal consistency (ω = .89, 95% CI = .87, .90). The chocolate beverages in the high anthropomorphism condition presented significantly higher levels than those under the low condition (M_{high} = 2.91 vs. M_{low} = 2.52; p = .011). The ANOVA results reveled a significant main effect of emoji expression, $F(2, 597) = 28.69$, $p < .001$, $\eta_p^2 = .09$, and a significant interaction effect between emoji expression and anthropomorphism, $F(2, 597) = 6.64$, $p = .001$, $\eta_p^2 = .02$, on expected temperature (see Figure 3). Overall, participants expected the sad chocolate beverages (M_{sad} = 6.09) to be significantly less hot than the happy ones (M_{happy} = 7.01; $p < .001$) and the control ($M_{control}$ = 7.29; $p < .001$). Furthermore, the sad chocolate beverage in the high anthropomorphism condition (M_{sad} = 5.74; $p < .001$) was expected to be significantly less hot than the happy chocolate beverage (M_{happy} = 7.23; $p < .001$) and the control ($M_{control}$ = 7.38; $p < .001$) in the high anthropomorphism conditions, as well as the happy chocolate beverage (M_{happy} = 6.79; $p < .001$) and the control ($M_{control}$ = 7.20; $p < .001$) in the low anthropomorphism condition. In addition, participants expected the sad chocolate beverage under the high anthropomorphism condition to be significantly less hot than the sad chocolate beverage in the low anthropomorphism condition

(M_{sad} = 6.43; p < .001). There were no significant differences between the happy chocolate beverages and the control in either of the anthropomorphism conditions.

Figure 3

Estimated Marginal Means of Key Variables in Experiment 2



Note. The key variables are expected (A) temperature, (B) liking, (C) sweetness, and (D) bitterness. Expected temperature values are based on 9-point VAS from 1 (*cold*) to 9 (*hot*). Expected liking, expected sweetness, and expected bitterness values are based on a 9-point VAS from 1 (*Not at all*) to 9 (*Very much*). Error bars indicate 95% confidence intervals.

In terms of expected liking, the results revealed a significant main effect of emoji expression, $F(2, 597) = 17.73$, $p < .001$, $\eta_p^2 = .06$, and a significant interaction effect between emoji expression and anthropomorphism, $F(2, 597) = 5.03$, $p = .007$, $\eta_p^2 = .02$. Overall, the sad chocolate beverages ($M_{sad} = 5.43$) were expected to be liked significantly less than the happy ones ($M_{happy} = 6.50$; $p < .001$) and the control ($M_{control} = 6.35$; $p < .001$). There were no significant differences between the happy chocolate beverages and the control. Moreover, the sad chocolate beverage in the high anthropomorphism condition ($M_{sad} = 5.15$) was expected to be liked less than the happy chocolate beverage ($M_{happy} = 6.77$; $p < .001$) and the control ($M_{control} = 6.60$; $p < .001$) in the high anthropomorphism condition, as well as the happy chocolate beverage ($M_{happy} = 6.23$; $p = .001$) and the control ($M_{control} = 6.10$; $p = .014$) in the low anthropomorphism condition. In addition, participants expected to like the sad chocolate beverage under the low anthropomorphism condition ($M_{sad} = 5.71$) less than the happy chocolate beverage ($p = .002$) and the control ($p = .034$) under the high anthropomorphism condition.

As per expected sweetness, the ANOVA results showed a significant main effect of emoji expression, $F(2, 597) = 17.15$, $p < .001$, $\eta_p^2 = .05$, and the interaction effect between emoji expression and anthropomorphism, $F(2, 597) = 3.81$, $p = .023$, $\eta_p^2 = .01$. Participants expected the sad chocolate beverages ($M_{sad} = 5.87$) to be significantly less sweet than the ones ($M_{happy} = 6.64$; $p < .001$) and the control ($M_{control} = 6.73$; $p < .001$). Furthermore, the sad chocolate beverage in the high anthropomorphism condition ($M_{sad} = 5.74$) was expected to be significantly less sweet than the happy chocolate beverage ($M_{happy} = 6.68$; $p < .001$) and the control ($M_{control} = 7.07$; $p < .001$) in the high anthropomorphism condition, as well as the happy chocolate beverage in the low anthropomorphism condition ($M_{happy} = 6.60$; $p < .001$). In terms of expected bitterness, the results revealed a significant main effect of emoji expression, $F(2, 597) = 9.04$, $p < .001$, η_p^2

= .03, and a significant interaction between emoji expression and anthropomorphism, $F(2, 597) = 4.27$, $p = .014$, $\eta_p^2 = .01$. The sad chocolate beverages ($M_{sad} = 3.36$) were expected to be significantly more bitter than the happy ones ($M_{happy} = 2.67$; $p < .001$) and the control ($M_{control} = 2.81$; $p = .007$). In addition, the sad chocolate beverage in the high anthropomorphism condition ($M_{sad} = 3.70$) was expected to be more bitter than the happy chocolate beverage in the low ($M_{happy} = 2.70$; $p < .001$) and high ($M_{happy} = 2.64$; $p < .001$) anthropomorphism conditions, as well as the control in the high anthropomorphism condition ($M_{control} = 2.66$; $p < .001$).

The results of Experiment 2 showed that the influence of the emoji expressions on expected product temperature was enhanced by higher anthropomorphic perception, supporting H_2. The sad emoji expression reduced the expected temperature of the chocolate beverage compared to the happy one and the control condition. This reduction in expected temperature was greater under the high anthropomorphism condition than the low one. Moreover, the sad expression reduced expected liking compared to the happy expression and the control condition, although this effect was not enhanced by anthropomorphism. Furthermore, the sad emoji expression reduced expected sweetness and increased expected bitterness compared to the happy expression and the control. These effects were also enhanced in the high anthropomorphism condition.

Experiment 3

Experiment 3 aimed to investigate an alternative underlying mechanism for the influence of the emotional cues (i.e., emoji expressions) on the expected temperature of a hot chocolate beverage, more specifically, a change in individuals' emotional state. To do this, we used the same emoji expressions used previously as emotional primes (instead of using them in the receptacle of the beverage) before participants evaluated a chocolate beverage in a plain cup.

Methods

The final sample comprised 402 participants (205 females, 196 males, 1 unreported), aged 18 – 40 (M_{age} = 30.39, SD_{age} = 5.67). Participants received GBP 0.42 for their participation. The experiment followed a 2 (Beverage temperature: cold, hot) × 3 (Emoji expression: sad, happy) between-subjects design. The procedure was similar to Experiment 1A, but here participants were first presented with emotional primes consisting of either the happy or the sad emoji expression. The emoji expressions were presented in isolation, for three seconds. Then, participants were presented with the chocolate beverage in the plain cup, and they answered all the same questions as in Experiment 1A. As manipulation check, we conducted separate one-sample, one-sided *t*-tests on participants' change in valence (Δ_{Valence}) and arousal (Δ_{Arousal}) for each beverage temperature and emoji expression condition. The analyses on all the key variables were the same as in Experiment 1A.

Results

As manipulation check, the results revealed that the only significant change in participants' affective state was generated by the sad emoji expression and the cold chocolate beverage. The one-sample, one-sided *t*-tests revealed that participants reported a significant and negative change in valence after being exposed to the sad emoji expression prime and the cold chocolate beverage, $t(99) = -2.54$, $p = .006$, $d = 0.25$; $M = -0.19$, $SD = 0.75$. Detailed results of all the one-sample, one-sided *t*-tests are presented in the Web Appendix. Furthermore, the results revealed that participants' tendency to anthropomorphize the beverage after being exposed to the sad (M_{sad} = 1.40, SD_{sad} = 1.07) and the happy (M_{happy} = 1.58, SD_{happy} = 0.83) emoji primes in this experiment was similar in magnitude as the control conditions (no emoji) in the previous experiments, which is lower than the beverages with emoji expressions in their receptacles.

The ANOVA results revealed a significant main effect of beverage temperature, $F(1, 398) = 786.64$, $p < .001$, $\eta_p^2 = .66$, on expected temperature. The chocolate beverages under hot temperature condition were expected to be hotter than the ones under the cold beverage condition ($M_{hot} = 6.93$ vs. $M_{cold} = 2.15$; $p < .001$). Neither emoji expression nor the interaction between beverage temperature and emoji expression were significant.

In terms of expected liking, the results revealed significant main effects of beverage temperature, $F(1, 398) = 73.80$, $p < .001$, $\eta_p^2 = .16$, and emoji expression, $F(1, 398) = 8.61$, $p = .004$, $\eta_p^2 = .02$. The hot chocolate beverages were expected to be liked more than the cold ones ($M_{hot} = 5.55$ vs. $M_{cold} = 3.74$; $p < .001$). Moreover, participants expected to like the chocolate beverage more when exposed to the happy emoji expression prime than when exposed to the sad one ($M_{happy} = 4.95$ vs. $M_{sad} = 4.33$; $p = .004$). There were no significant effects of beverage temperature or emoji expression on expected sweetness or bitterness.

In sum, the results of Experiment 3 revealed that using emoji expressions as primes did not influence the temperature expectations of the chocolate beverages, failing to provide support for H_{3A} and H_{3B}. The emoji expression primes influenced expected liking, as the chocolate beverage was expected to be liked more under the happy emoji expression prime than the sad one. The emoji expression primes did not influence expected sweetness or bitterness.

Experiment 4

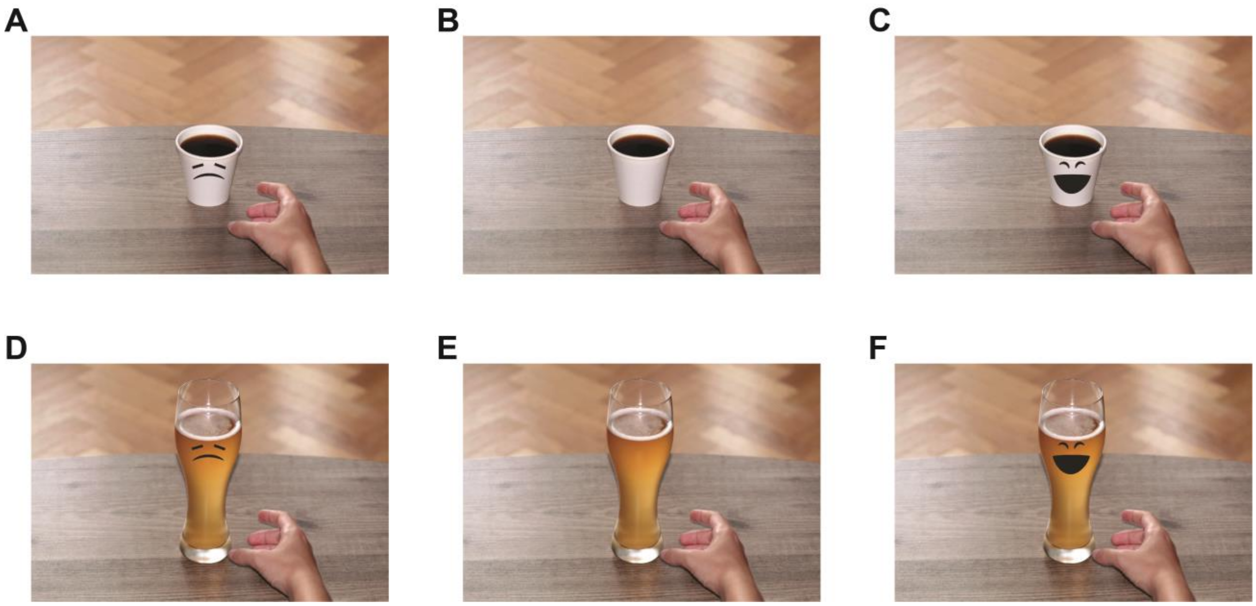
Experiment 4 was designed to test the generalizability of our previous findings on the effect of emoji expressions on product temperature expectations. To this end, we investigated the effects of the two emotional cues (i.e., happy and sad emoji expressions) on two additional products, namely beer and coffee. Here, we included a cold beverage (i.e., beer) with the objective of testing the robustness of our own results, both significant and null, using different products.

Methods

The final sample comprised 601 participants (303 females, 292 males, 6 unreported), aged 18 – 35 years (M_{age} = 28.33 years, SD_{age} = 4.08). Participants received GBP 0.45 for their participation. Similar to the previous experiments, the stimuli consisted of photographs of a beverage, with or without an emoji expression. The photographs comprised real products and included a first person-perspective view of the beverage and a hand reaching for them. To examine the generalizability of our findings, here we used a glass of beer and a cup of coffee, as they belong to different product categories than chocolate milk and the preferred sensory properties differed from those of chocolate milk. More specifically, beer is generally preferred cold and slightly bitter. Contrary to foreigners' beliefs, British ales are not served at room temperature but instead at around 11 °C (Oliver, 2013). On the other hand, coffee is consumed both cold and hot. Most consumers in the US drink coffee prepared through different hot brewing methods (e.g., V60, AeroPress, French Press), but coffee consumed cold (e.g., cold brew, iced coffee) has gained popularity in recent years (Fuller & Rao, 2017). In addition, the sensory properties of coffee are highly complex (Thomas et al., 2017). Regarding the emotional cues, we used the same sad and happy emoji expressions as in the previous experiments. However, to increase the generalizability of the study, we also slightly modified the two emoji expressions without changing their meaning, and hence they should conceptually replicate. More specifically, we marginally rounded the corners of both facial expressions' features by the same magnitude. Details on the development of the stimuli are presented in the Web Appendix). Figure 4 presents the stimuli used in Experiment 4.

Figure 4

Stimuli Used in Experiment 4



Note. The stimuli consisted of a cup of coffee (A – C) and glass of beer (D – E), with either the sad emoji expression (A, D), no emoji expression (control; B, E), or the happy emoji expression (C, F).

The experiment followed a 2 (Product: beer, coffee) × 3 (Emoji expression: sad, control, happy) between-participants design. Each participant evaluated either a glass of beer or a cup of coffee with or without an emoji expression. Furthermore, we used a high anthropomorphism setting similar to Experiment 2. We assigned names and genders to the products, asked participants to focus on their emotions, and referred to the products by their names in all the questions. We called the glass of beer *Mr. Hops* and the cup of coffee *Mr. Java*.

The procedure of Experiment 4 was similar to previous experiments with a few exceptions. In order to control for the possibility that arousal might drive the effects on temperature expectations given that arousal can intensify current feelings (Bradley & Lang, 1994), we directly asked participants to evaluate the valence and arousal induced by the products through two separate 9-point VASs at the end of the experiment, instead of asking for their emotional state at the beginning and at the end of the experiment through the SAM. The exact wording of all the questions is detailed in the Web Appendix). Furthermore, instead of asking participants about their temperature expectations of the products through a VAS, we asked them to give a point estimate of the temperature they expected the product to be at in degrees Fahrenheit (°F). To reduce noise in the data, we provided participants with temperature anchor points for each of the products, which was phrased as a normal serving temperature for either hot or cold beverages. We determined the temperature anchor point for each of the products by computing the median of their ideal serving temperature ranges. For the beer, we set the anchor temperature at 47 °F, as the ideal serving temperature of beer ranges from 38 to 55 °F (Betancur et al., 2020; Oliver, 2013), and for the coffee, we set it 145 °F since the optimal serving temperature of coffee ranges from 130 to 160 °F (Abraham & Diller, 2019). Finally, given that the thermal sensation did not exert any effect on any of the key variables, we removed the questions related to it. The remaining questions (expected liking, sweetness, bitterness, and the anthropomorphism scale) were identical to the previous experiments.

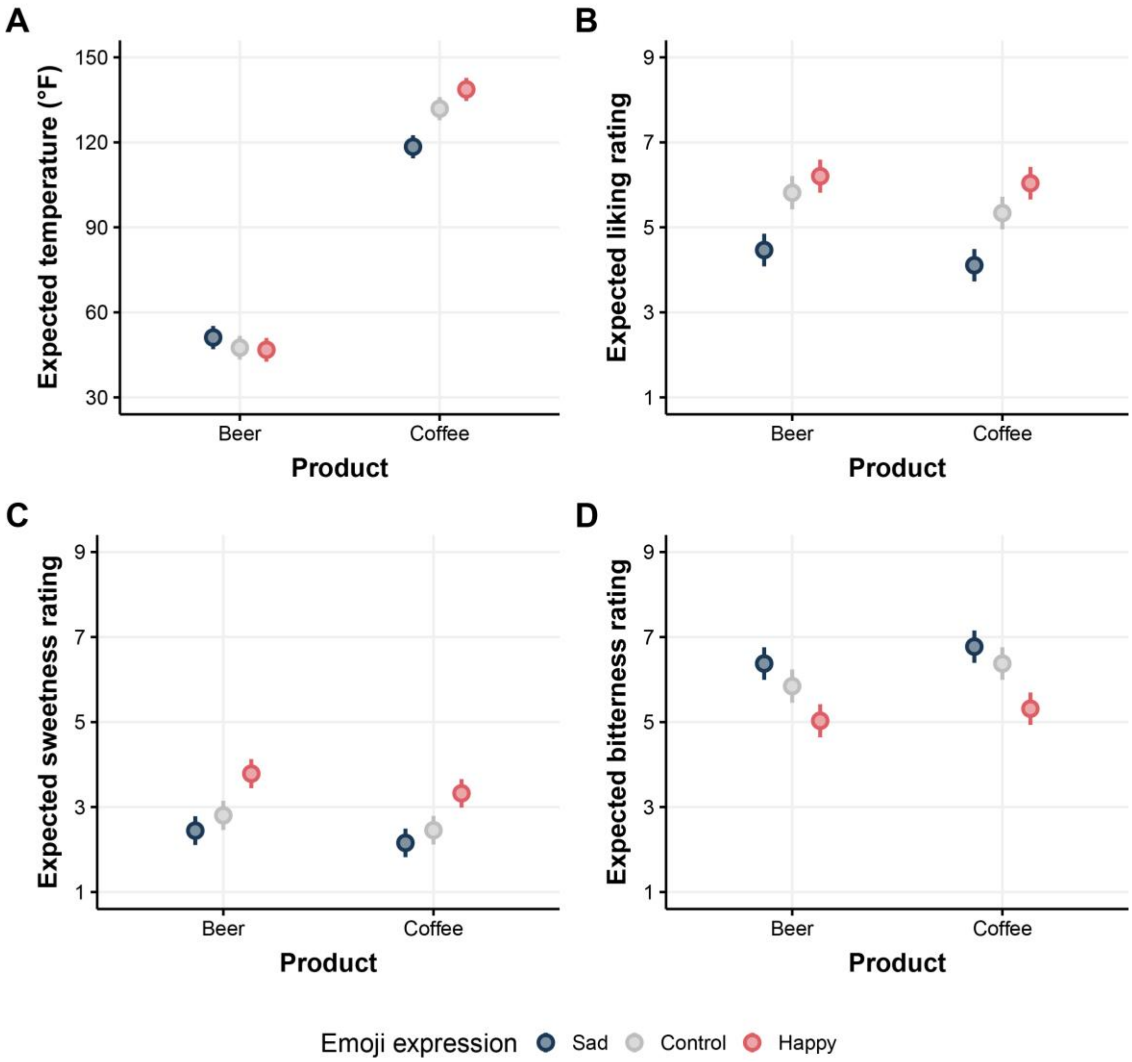
To analyze the effect of the emoji expressions on the key variables (expected temperature, expected liking, expected sweetness, and expected bitterness), we ran a set of separate ANOVAs on each of these variables with the main and interaction effects of product and emoji expression. Furthermore, as robustness check, we ran a second set of models comprised of separate ANCOVAs adding the valence and arousal triggered by the stimuli and participants' age and gender as covariates to the ANOVA models (the results of these analyses are presented in the Web Appendix). Furthermore, to examine the potential presence of liking-spillover effects in the influence of the emoji expressions on expected temperature, we ran two types of analyses with the products for which the emoji expressions significantly influenced expected temperature. First, we conducted a bootstrapped mediation analysis (Hayes, 2022) on expected temperature with emoji expression as multicategorical variable and liking as mediator. Next, we ran separate one-way ANOVAs on sweetness and bitterness with emoji expression as single factor to examine whether the effect on temperature moved in the same direction as the desired properties of the beverage when the hypothesized effect on temperature would suggest a change in the opposite direction.

Results

The ANOVA results revealed significant main effects of product, $F(1, 595) = 3362.24$, $p < .001$, $\eta_p^2 = .85$, and emoji expression, $F(2, 595) = 11.41$, $p < .001$, $\eta_p^2 = .04$, on the expected temperature of the products (see Figure 5). The beer was expected to be colder than the coffee ($M_{beer} = 48.5$ °F vs. $M_{coffee} = 129.7$ °F; $p < .001$). The products with the sad emoji expression were expected to be colder than the control ($M_{sad} = 84.8$ °F vs. $M_{control} = 89.7$ °F; $p = .013$) and colder than the ones with the happy emoji expression ($M_{happy} = 92.7$ °F; $p < .001$). The results also revealed a significant interaction effect of product and emoji expression, $F(2, 595) = 27.21$, $p < .001$, $\eta_p^2 = .08$, on expected temperature. The happy coffee was expected to be hotter than the control ($M_{happy} = 138.7$ °F vs. $M_{control} = 131.9$ °F; $p < .001$) and hotter than the sad coffee ($M_{happy} = 138.7$ °F vs. $M_{sad} = 118.4$ °F; $p = .015$). In addition, the sad coffee was expected to be less hot than the control ($p < .001$). There were no significant differences in the beers with the different emojis.

Figure 5

Estimated Marginal Means of Key Variables in Experiment 4



Note. The key variables are expected (A) temperature, (B) liking, (C) sweetness, and (D) bitterness. Expected temperature values are in degrees Fahrenheit (°F). Expected liking, sweetness, and bitterness values are based on 9-point VASs from 1 (*Not at all*) to 9 (*Very much*). Error bars indicate 95% confidence intervals.

In terms of expected liking, the results revealed significant main effects of product, $F(1, 595) = 4.06$, $p = .044$, $\eta_p^2 = .01$, and emoji expression, $F(2, 595) = 46.63$, $p < .001$, $\eta_p^2 = .14$. The beers were expected to be liked more than the coffees (M_{beer} = 5.49 vs. M_{coffee} = 5.16; p = .038). The products with the happy emoji expression were expected to be liked more than the control products (M_{happy} = 6.12 vs. $M_{control}$ = 5.58; p = .017) and more than the ones with the sad emoji expression (M_{sad} = 4.29; p < .001). In addition, the products with the sad emoji expression were expected to be liked less than the control ones (p < .001).

As per expected taste, the results revealed significant main effects of product, $F(1, 595)$ = 6.59, p = .010, η_p^2 = .01, and emoji expression, $F(2, 595)$ = 28.54, p < .001, η_p^2 = .08, on expected sweetness. The beers were expected to be sweeter than the coffees (M_{beer} = 3.01 vs. M_{coffee} = 2.65; p = .009). The products with the happy emoji expression were expected to be sweeter than the control products (M_{happy} = 3.55 vs. $M_{control}$ = 2.63; p < .001) and those with the sad emoji expression (M_{sad} = 2.30; p < .001). Furthermore, the results revealed significant main effects of product, $F(1, 595)$ = 6.19, p = .013, η_p^2 = .01, and emoji expression, $F(2, 595)$ = 26.86, p < .001, η_p^2 = .08, on expected bitterness. The coffees were expected to be more bitter than the beers (M_{coffee} = 6.15 vs. M_{beer} = 5.75; p = .012). The products with the happy emoji expression were expected to be less bitter than the control products (M_{happy} = 5.17 vs. $M_{control}$ = 6.11; p < .001) and those with the sad emoji expression (M_{sad} = 6.58; p < .001).

Anthropomorphism presented a high level of internal consistency (ω = .92, 95% CI = .91, .93). Across products, participants tended to anthropomorphize those with the sad emoji expressions than the control (M_{sad} = 3.31 vs. $M_{control}$ = 1.83; p < .001) and the ones with the happy emoji expressions more than the control (M_{happy}= 3.35; p < .001). Considering solely the glass of beer, participants tended to anthropomorphize the happy more than the sad one (M_{happy} = 3.68 vs. M_{sad} = 3.02; p = .041) and the happy more than the control ($M_{control}$ = 1.96; p < .001), as well as the sad one more than the control (p < .001). As for the cup of coffee, participants tended to anthropomorphize more the sad one than the control (M_{sad} = 3.61 vs. $M_{control}$ = 1.92; p < .001), as well as the happy one more than the control (M_{happy} = 3.04; p < .001). The results of the moderation analysis revealed that neither the interaction effect of the sad emoji expression and anthropomorphism, β = 0.96, SE = 2.04, 95% CI = [-3.054, 4.976], nor the interaction effect of the happy expression and anthropomorphism were significant, β = 3.26, SE = 2.02, 95% CI = [-.709, 7.229]; although the effect of anthropomorphism for the control condition was significant, β = -4.52, SE = 1.713, 95% CI = [-7.890, -1.146].

Given that the emoji expressions only significantly influenced the expected temperature of coffee, we conducted the analysis to examine the presence of liking-spillover effects only with coffee. The mediation analysis of the effect of the emoji expressions on the expected temperature of coffee with liking as a mediator revealed that the relative indirect effects of the sad, β = -3.85, SE = 1.243, 95% CI = [-6.585, -1.720], and the happy, β = 2.20, SE = 0.100, 95% CI = [.527, 4.424], emoji expression were significant. As per the relative effects, that of the happy emoji expression was not significant, β = 4.60, SE = 3.180, 95% CI = [-1.657, 10.861]. However, the relative direct effect of the sad emoji expression was significant, β = -9.59, SE = 3.253, 95% CI = [-15.988, -3.185]. Furthermore, the one-way ANOVA for coffee on expected sweetness and bitterness with emoji expression as single factor revealed a significant effect of emoji expression on the expected sweetness of coffee, $F(2, 302) = 11.97$, $p < .001$, $\eta_G^2 = .07$. The coffee with the happy emoji expression was expected to be sweeter than the control (M_{happy} = 3.32 vs. $M_{control}$ = 2.46; p = .002) and the sad coffee (M_{sad} = 2.16; p < .001). However, there was no difference between the sad coffee and the control (p = .690). The one-way ANOVA on bitterness revealed a significant effect of emoji expression, $F(2, 302) = 15.71$, $p < .001$, $\eta_G^2 = .09$. The coffee with the happy emoji expression was expected to be less bitter than the control (M_{happy} = 5.31 vs. $M_{control}$

= 6.38; $p < .001$) and the sad coffee ($M_{sad} = 6.77$; $p < .001$). However, there was no difference between the sad coffee and the control ($p = .424$). Altogether, the results of the mediation analysis based on liking of the sad emoji expression on expected temperature, as well as the presence of an effect of the sad emoji expression on liking but lack of effect on desirable properties of the product (i.e., sweetness, bitterness) suggest that while a hedonic mechanism may have partly driven the effect of the sad emoji expression on temperature, it did not fully account for it.

In summary, the results Experiment 4, which used two new products, revealed that the emoji expressions significantly influenced the expected temperature of the coffee but not the beer. Supporting H_{1B}, the sad emoji expression decreased the expected temperature of the coffee, whereas the happy emoji expression increased its expected temperature. Contrary to the other experiments, anthropomorphism did not moderate the effect of the emoji expressions. Importantly, our analyses to examine the presence of liking-spillover effects suggest that the effects of the happy emoji expression on the expected temperature of the coffee are be driven by liking. However, the effects of the sad emoji expression exhibited only some degree of spillover effects, but its effect was not entirely driven by liking. In terms of the sensory properties of the products, in line with our expectations and our previous results, the sad emoji expression reduced the expected sweetness and increased the expected bitterness of the two beverages, whereas the happy emoji expression triggered the opposite effects, providing further support that the effects of the happy expression are fully driven by liking but not the effects of the sad expression.

Experiment 5

In order to have a more comprehensive perspective on the extent of the effects of the emotional cues on temperature, liking, and tastes, we extended our analysis from expectations to perception. Specifically, in Experiment 5, we investigated whether the effect of the emoji expressions on the temperature expectations of a chocolate beverage in a digital setting would also be present in the physical realm in terms of temperature expectations, as well as temperature perception as felt in the hand and in the mouth.

Methods

A total of 70 people (47 females, 22 males, 1 unreported), aged 19 – 40 years (M_{age} = 28.13 years, SD_{age} = 5.16) participated in the experiment. Participants received a package of chocolate-covered nuts valued at DKK 54 for their participation. The experiment followed a single-factor within-subject (Emoji expression: control, sad) design. Participants evaluated two identical hot chocolate beverages presented one at a time. One beverage was presented in a plain cup, and the other one was presented in a cup with the sad emoji expression. The beverages were served at 60 °C based on previous literature on the ideal temperature for hot beverages considering consumers' preference and avoidance of burn hazard (Brown & Diller, 2008).

The experimental sessions comprised one participant at a time, and participants responded to a questionnaire on an iPad (details on the procedure are presented in the Web Appendix). Similar to the previous experiments, participants evaluated their emotional state and thermal sensation before starting and after finishing the experiment. Participants evaluated three dimensions of the beverages' temperature, on 9-point VASs anchored at 1 (*cold*), 5 (*midpoint*), and 9 (*hot*) scales: (1) expected temperature without touching the cup or tasting the beverage, (2) temperature perception of the cup in their hands, and (3) temperature perception of the beverage in their mouth. To calibrate participants' temperature perception, they were given a reference for the midpoint of the temperature scale. The reference consisted of distilled water at 40 °C served in a plain paper cup (same cup used for the chocolate beverages). Participants also indicated how much they liked the beverage, as well as how sweet and bitter it was on 9-point VASs from 1 (*not at all*) to 9 (*very much*). Then, participants rinsed their mouth with distilled water at 20 °C. Later, they were presented with the second beverage and repeated the same procedure. All the dependent variables were analyzed via independent Linear Mixed Models (LMMs) with emoji expression as fixed factor and participant ID as random factor.

Results

There were no significant effects of emoji expression on temperature expectation, $F(1, 69) = 0.92$, $p = .341$, $\eta_G^2 = .004$; $M_{sad} = 5.23$, $SD_{sad} = 1.80$; $M_{control} = 5.46$, $SD_{control} = 1.86$, temperature perception in the hand, $F(1, 69) = 0.18$, $p = .676$, $\eta_G^2 < .001$; $M_{sad} = 6.51$, $SD_{sad} = 1.00$; $M_{control} = 6.46$, $SD_{control} = 1.11$, or temperature perception in the mouth, $F(1, 69) = 0.01$, $p = .920$, $\eta_G^2 < .001$; $M_{sad} = 7.26$, $SD_{sad} = 0.91$; $M_{control} = 7.24$, $SD_{control} = 1.06$. There was also no significant effect of emoji expression on liking, $F(1, 69) = 0.20$, $p = .658$, $\eta_G^2 = .001$; $M_{sad} = 6.90$, $SD_{sad} = 1.56$; $M_{control} = 6.81$, $SD_{control} = 1.45$, sweetness, $F(1, 69) = 0.11$, $p = .740$, $\eta_G^2 < .001$; $M_{sad} = 5.80$, $SD_{sad} = 1.61$; $M_{control} = 5.87$, $SD_{control} = 1.66$, or bitterness, $F(1, 69) = 0.004$, $p = .948$, $\eta_G^2 < .001$; $M_{sad} = 2.96$, $SD_{sad} = 2.02$; $M_{control} = 2.94$, $SD_{control} = 1.92$.

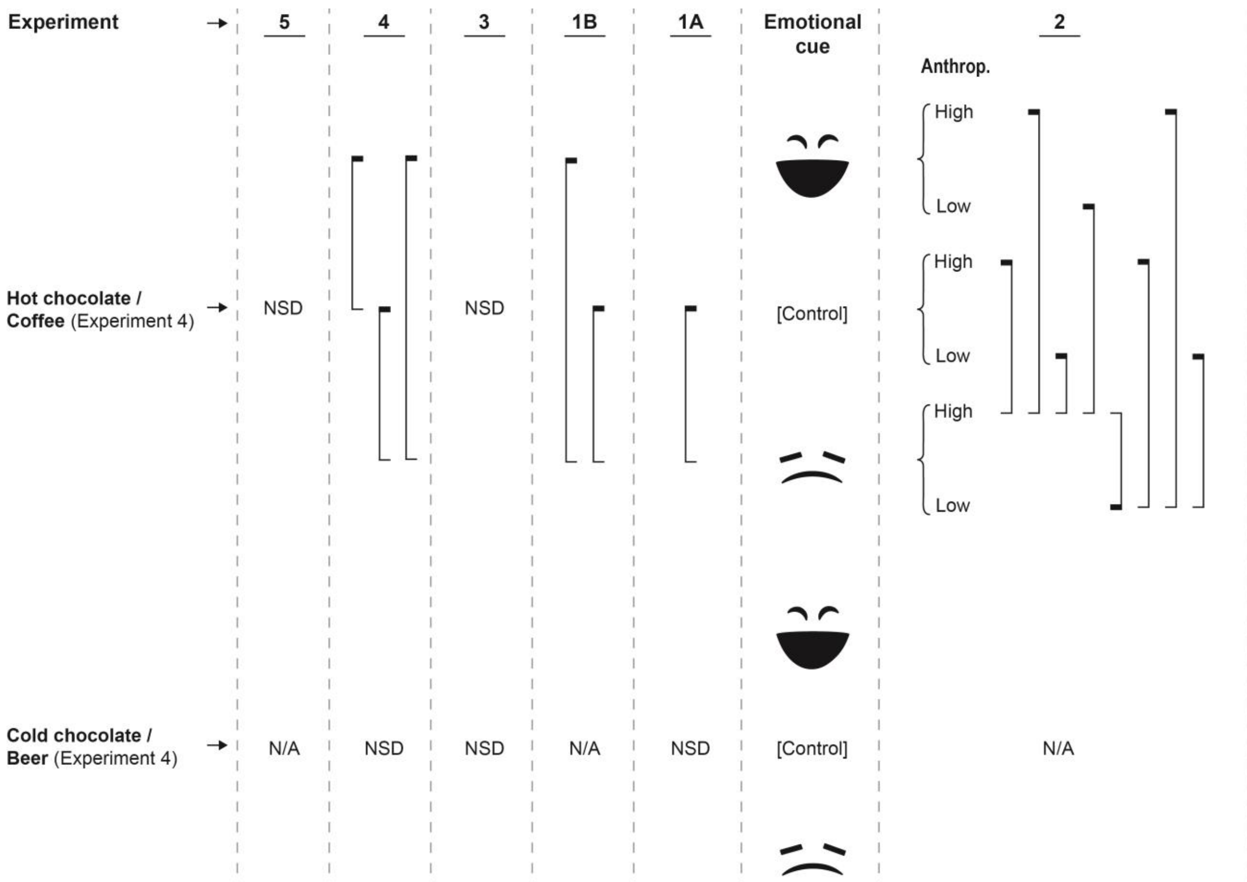
In sum, contrary to our expectations, the results of Experiment 5 revealed that the emoji expressions did not influence the expected or perceived temperature (in the hand or in the mouth) of the hot chocolate beverage in a physical setting. Furthermore, the emoji expressions did not impact participants' liking of the beverage or their perception of sweetness or bitterness.

General Discussion

Through seven experiments, we document that the use of emotional cues, operationalized via the use of emoji expressions associated with cold and hot temperatures, can influence product temperature expectations in online settings. In the Preliminary Experiment, we found associations between a negative valence, low arousal emoji expression and low temperatures, and between a positive valence, high arousal emoji expression and high temperatures. Experiment 1A provided initial evidence that incorporating the emoji expression associated with low temperatures (i.e., sad) in the receptacle of a hot chocolate beverage decreased its expected temperature in an online setting compared to a beverage with the emoji expression associated with high temperatures (i.e., happy). Experiment 1B replicated the finding of Experiment 1A under the hot beverage condition and revealed that the effects of the emoji expression on temperature expectations are moderated by individuals' tendency to anthropomorphize the product, so that higher anthropomorphism further reduces the expected temperature of the beverage with the sad expression. In Experiment 2, we experimentally manipulated the anthropomorphism of the chocolate beverage and found that higher anthropomorphism enhances the effect of the sad emoji expression on temperature expectations. Experiment 3 showed that using the emoji expressions as primes, instead of incorporating them in the receptacle of the chocolate beverages, did not influence temperature expectations. In Experiment 4, we examined the generalizability of our findings by investigating the effect of the sad and happy emoji expressions on the expected temperature of two additional products (i.e., coffee and beer). We found that the sad emoji expression reduced the expected temperature of the coffee and that the happy one increased its expected temperature. However, there were no significant effects in the expected temperature of the beer. Finally, extending our investigation from expectations in an online setting to expectations and perception in a physical setting, in Experiment 5 we did not find any significant effect of the sad emoji expression (compared to the control) on the expected or perceived temperature of the hot chocolate beverages. Figure 6 presents a graphical summary of the results.

Figure 6

Graphical Summary of Key Results on Temperature



Note. The figure presents a summary of the differences in expected/perceived temperature of the stimuli under the different conditions in all the experiments. Each vertical block relates to one of the experiments conducted. The upper panel relates to the hot chocolate or coffee (in Experiment 4), whereas the lower panel relates to the cold chocolate or beer (in Experiment 4). Square brackets indicate statistically significant differences between the different conditions, and the thicker ends indicate the condition with the higher estimated marginal mean. *Anthrop*. refers to the anthropomorphism conditions in Experiment 2. N/A denotes a condition not tested. NSD denotes no significant differences in any of the pairwise comparisons.

Taken together, our results support our hypothesized main mechanism for the influence of emotional cues (i.e., emoji expressions) on product temperature expectations in an online setting (but not in a physical one), namely, the embodiment of the emotions evoked by the emoji expressions and subsequently their corresponding temperature associations. The influence of the emotional cues, as our alternative proposed mechanism, was found only when they were used in the chocolate beverage's receptacle but not when they were used as emotional primes. Furthermore, in the case of the chocolate beverages, the impact of the emoji expressions was enhanced by higher levels of anthropomorphism, suggesting that the more individuals thought of the product as having human-like characteristics, the more they believed the product embodied the emotions (and the temperatures associated with them).

Regarding the hypothesized alternative mechanism, the results of Experiment 3 revealed that, participants' self-reported evaluation of their emotional state only changed with the sad emoji expression under the cold beverage condition, which generated a significant decrease in individuals' valence. However, this does not necessarily mean that participants did not experience a change in their emotional state with the other emoji expressions, as participants might not have been aware of actual changes. Some affective states are unconscious and are not accessible to introspection (Winkielman et al., 2005). For instance, briefly presented affective stimuli can circumvent perceptual awareness but still influence consumers' behavior and trigger neurophysiological and behavioral actions (Tamietto & de Gelder, 2010). Similarly, changes in affective state triggered by affective stimuli (i.e., faces) are difficult to identify in emotion detection tasks, but they still trigger behavioral and physiological changes (Bornemann et al., 2012). Furthermore, happy emojis have been found to induce conscious and unconscious positive affect in consumers (Smith & Rose, 2020).

It is worth highlighting that the influence of the emotional cues on expected temperature was only found in the hot chocolate and the coffee, which could have been caused by a general difference in people's sensitivity to hot temperatures compared to cold ones or by differences in the hedonic levels of chocolate beverages at the two temperatures. In the former case, it is possible that since people are more sensitive to changes in temperature at higher ranges than at lower ones (Bunk et al., 2018), due to repeated exposure, they may be are prone to expect wider changes in temperature for hot foodstuffs than for cold ones. Related to the hedonic levels of the chocolate beverages, while chocolate milk is overall a hedonic product (Shen et al., 2016), hot chocolate tends to be more hedonic than iced/cold one, as the former evokes feelings of warmth and coziness (Phillips, 2000). Extrinsic factors exert a higher influence on the evaluation of hedonic products than utilitarian ones (Zhou et al., 2021). Moreover, emojis used in product advertisements have been shown to trigger changes in consumers' emotions only in hedonic products and not in utilitarian ones (Das et al., 2019). Thus, consumers may have been more susceptible to the effects of the sad emoji expression with the hot chocolate beverage than the cold one. It is also possible that since hot chocolate tends to be more hedonic than cold chocolate, individuals imbued it with emotions more easily, which seems to be supported by the overall higher levels of anthropomorphism under the hot beverage condition than the cold one.

With the hot chocolate, significant effects on temperature expectations were only found with the sad emoji expression but not with the happy one. This may have been caused by an asymmetry between positive and negative information. Everything else equal, people tend to assign higher weights to negative information than positive one. Research has shown that negative information has stronger effects across a wide array of psychological phenomena than positive information of equal magnitude, an effect termed negativity bias (Baumeister et al., 2001; Norris, 2021). In our study, it is possible that the negative valence of the sad emoji expression had higher weight and consequently higher impact on participants' evaluations than the happy one. Alternatively, the temperature associations of the sad expression might have been stronger than the happy one. Furthermore, it is possible that these results are driven by the incongruence between the sad emoji expression and the chocolate beverage, which is inherently positively valenced (Shen et al., 2016).

It is important to consider alternative explanations for the effects found here. It is possible that the effects of the emoji expressions on expected temperature could have been the product of liking-spillover effects, as the emojis may have reduced or enhanced the liking of the product and therefore transferred to the preferred features of the product. The results of the mediation analysis in Experiment 4 revealed that the effects of the happy emoji expression on the expected temperature of coffee were completely driven by liking. However, while the effects of the sad emoji expression were partly influenced by liking, they did not fully account for their effect. Furthermore, the analysis on the sensory evaluation of the coffee revealed consistent results with the mediation analysis. The happy emoji expression increased sensory properties preferred in coffee compared to the control condition. More specifically, it increased sweetness and reduced bitterness. However, the sad emoji expression did not result in significant differences in sweetness or bitterness with respect to the control. These results indicate a transference of liking to the preferred characteristics of coffee in the case of the happy emoji expression. However, this was not the case for the sad emoji expression, suggesting the absence of spillover effects. In sum, the effect of the sad emoji expression is not driven by a transference of liking. These results also highlight the asymmetry between positive and negative emotions. The magnitude of the difference between the sad coffee and the control coffee was larger than that between the happy coffee and the control. It is possible that a higher emotional weight of the negative emoji (vs. the happy one) results in higher levels of embodiment, as evidenced by participants' higher tendency to anthropomorphize the sad coffee than the happy one.

Another potential alternative explanation of the findings here relates to signaling. Individuals may have construed that the sad emoji expression was signaling that something was wrong with the product. However, the results on the sensory properties of the chocolate beverage and the coffee provide support against this alternative explanation. Neither the sad chocolate beverage nor the sad coffee was expected to be less sweet or more bitter than their respective control conditions. This suggests that participants may not have thought that neither the hot chocolate nor the coffee were subpar products.

As the results of Experiment 5 showed, the sad emoji expression did not significantly impact the expected or perceived temperature of the chocolate beverages in a physical setting. It is worth noting that even though Experiment 5 had fewer participants than the other experiments, it was a within-participants design and was above the required sample size. Nevertheless, the effect size of the emotional cues on expected temperature in Experiment 5 ($\eta_G^2 = .004$) was more than seven times lower than in Experiment 1B ($\eta^2 = \eta_G^2 = .03$), where only the hot condition was evaluated. These null effects may have been caused by the product intrinsic and extrinsic cues individuals relied on to infer temperature in a physical setting. Compared to online scenarios, in a physical one, people rely on a greater range of sensory cues to assess the temperature of stimuli without touching it, although these cues may not necessarily provide accurate information about the temperature of the stimuli (i.e., there may not be an actual physical relationship between specific cues individuals may consider and the temperature of the stimuli). For instance, in Experiment 5, people may have relied on the beverage's aroma strength to infer its temperature, which is informative, as the odor of foodstuffs is more potent at higher temperatures due to increasing compounds' volatility (Vaclavik & Christian, 2014). The reliance on more cues to infer temperature may have been exacerbated under the experimental task in the laboratory, as participants were explicitly asked about their expectations, which may have caused them to actively look for a larger number of cues that lead to different directions.

Overall, the results indicated that participants tended to like the beverages with the sad emoji expressions less than those with the happy expressions and the controls. Even though these results might seem unremarkable, they are more complex than apparent at first sight. People tend to seek negative emotional stimuli, as they enjoy and value them (Levinson, 2014), as evidenced by how sadness in art (Taruffi & Koelsch, 2014) and music (Attie-Picker et al., in press) make people feel. In business contexts, research has shown that negative emotional cues can trigger positive emotions and behaviors, as they can generate feelings of empathy and help develop connections (Van Kleef & Côté, 2022). Importantly, negatively valenced emojis in marketing communications have been shown to trigger higher levels of consumer satisfaction and repurchase intention compared to positively valenced emojis (Ma & Wang, 2021). In our study, although it was not the case, based on the literature introduced above, the sad emoji expression could have increased liking of the beverages due to perceptions of cuteness and feelings of empathy (Kringelbach et al., 2016). This latter effect could be more prevalent in younger individuals since they interpret emojis differently (Herring & Dainas, 2020; Kutsuzawa et al., 2022). Hence, our results add to the literature on negative emotions.

In terms of taste expectations in online settings, the sad emoji expression on the cup increased expected bitterness, whereas the happy emoji expression increased expected sweetness. These results are consistent with previous literature on associations between taste words and emotion words showing that sweetness is associated with happiness, whereas bitterness is associated with sadness (Zhou & Tse, 2020). That said, we did not find any effect of emoji expression on taste expectations and perceptions in a physical setting. Our results are somehow inconsistent with previous studies showing that positively valenced stimuli can influence sweetness perception. For instance, (Wang & Spence, 2018) found that people perceived fruit juice to be sweeter when looking at a picture of a laughing child than when looking at a picture of a crying child. Nevertheless, it is worth noting some critical differences. The emotional stimuli in the latter study consisted of pictures of real children that participants looked at during the entire duration of the tasting experience, whereas our stimuli consisted of emoji expression in the receptacle of the beverage. Furthermore, while the latter authors used laughing vs. crying expressions, we used sad vs. no expression. It is possible that the effects of emotional cues are relative and depend on what they are compared to. Thus, the inconsistency in the results may have been caused by differences in the types and presentation of stimuli.

Implications for Industry

While the use of emotional cues has been shown to be an important tool for marketers (Andrade, 2015; Bagozzi et al., 1999), and emojis have become a widely used tool in marketing communications, our findings show that emotional cues, such as emoji expressions, can be used as a novel method to influence foodstuffs' expected temperature. It is worth noting that the use of emotional cues such as facial expressions is a growing research topic and an increasingly widely used tool by marketers, as evidenced by the rapidly growing interest in cuteness, *Kawaii*, and *Kindchenschema* (Dydynski, 2020). For example, cute food can generate positive affective (e.g., pleasure, wellbeing, therapeutic feelings) and behavioral (e.g., indulgence, exploration, and tolerance) to foods (Tang et al., 2023). In addition, the use of cuteness in packaging design can increase the tastiness perception of food products, although it can also reduce healthiness perception (Schnurr, 2019). Nevertheless, explicit facial features may not be necessary to leverage these findings, as more subtle or abstract smile-like horizontal curves may generate lead to similar effects (Salgado-Montejo et al., 2015). Furthermore, as emojis are instances of the broader concept of valence, other congruent affective cues may yield similar results. Our findings have several implications for marketers centered around sensory expectations, online food ordering, immersive technologies, and sustainability.

First, marketers can use positively valenced emoji expressions to increase consumers' acceptance, sensory perception, and emotional responses to food products through higher expected temperatures (Singh & Seo, 2020). For example, companies in the food sector can use happy emoji expressions in their advertisements for hot chocolate in the wintertime to make customers expect the product to be at higher temperature and trigger higher feelings of comfort and coziness. In addition, companies may use happy emotional cues in hot foodstuffs to serve them at more appropriate temperatures. Individuals tend to consume beverages at temperatures that are too high, which hinders the taste and flavor perception of foodstuffs (McBurney et al., 1973; Talavera et al., 2007). Using emotional cues, companies in the foodservice industry may serve foods at lower temperatures that enhance the flavor perception of the products, while customers would expect them to be at higher temperatures, which they usually prefer. On a related note, increasing the expected temperature of hot drinks can allow companies to reduce their serving temperature and help reduce the number and severity of burn injuries due to hot beverages. Just in the US, an estimated 486,000 cases of burn injuries occur per year, and 85 – 90% of these injuries are related to hot liquids (American Burn Association, 2018). Hot beverages tend to be served at temperatures well above safe range (Abraham & Diller, 2019).

Furthermore, our findings have important implications for the food sector given the fast-growing market of food delivery apps (Kaur et al., 2021). Online food delivery is expected to reach a market value of USD 484 billion by 2032, a 12% compounded annual growth rate from 2023, as companies invest in different technologies to enhance the customer experience (GlobeNewswire, 2023). This is an important space for food businesses due to the large number of competitors, diversity of apps, and consumers' ability to quickly search for different options, which makes this a highly competitive space. Thus, marketers of restaurants and food companies may use emotional cues in touchpoints around food delivery apps to communicate temperature properties in their products and stand out in a rapidly crowding market.

Our findings have relevant applications surrounding immersive technologies given the increasing interest and investment in these technologies to enhance the customer experience (Flavián et al., 2019). Indeed, augmented reality (AR) can increase consumers' mental simulation abilities of consuming foodstuffs and increase the desirability and purchase intent. (Fritz et al., 2023; Petit et al., 2022). Related to our study, marketers can embed dynamic emotional cues through AR applications in smart phones and mixed reality goggles, to make products seem alive design and enhance their expected temperature-related sensory properties and create engaging customer experiences.

Furthermore, an important application of our findings relates to the environmental impact of hot drinks both at the household and foodservice industry levels. Household cooking accounts for approximately 7% of CO_2 emissions, and research suggests that improving household cooking habits may have a significant positive impact to combat the climate crisis (Clark et al., 2020; Jia et al., 2022). For instance, people waste large amounts of water and energy in overfilling and overfilling kettles to make hot beverages (Murray et al., 2016). Indeed, research has shown that reducing the temperature at which hot beverages are prepared in households can lead to significant energetic and financial savings (Durand et al., 2022). At the foodservice level, companies and establishments can reduce their carbon footprint by reducing the temperature at which beverages are served. For example, coffee is a highly appreciated and ubiquitous drink in most countries around the world that has great economic importance. Coffee consumption reached 9.9 million tons in 2020 (ICO, 2021). However, coffee consumption comes at a high environmental cost, and the highest share of this cost from the consumption stage, (Hicks & Halvorsen, 2019; Killian et al., 2013), where energy utilization to prepare the coffee (including the energy required to heat water or milk), has a large impact on its environmental impact (Brommer et al., 2011; de Figueiredo Tavares & Mourad, 2020). Therefore, reducing the temperature at which coffee is brewed and served could yield reductions in the carbon footprint of coffee, without negatively impacting its flavor (Batali et al., 2020).

As for the negatively valenced emoji expression, it may be more difficult for marketers to use in marketing communication. However, the sad emoji expression may be used in culinary settings to play with diners' expectations with the goal of providing them with unexpected elements in their dining experience. For example, chefs may use sad emoji expressions to convey the coldness of dishes, while in fact they deliver a hot, and perhaps molten, dish. Delivering incongruent culinary experiences that go against diners' expectations has been shown to create delight and positive evaluations of the food and the overall experience (Spence & Piqueras-Fiszman, 2014).

Limitations and Future Directions

We acknowledge several limitations of our study. First, it is not possible to generalize that the effects found here extend to other food types or products beyond those used here. These effects may vary depending on the product and food category and their hedonic level. In addition, other limitations relate to the emotional stimuli used. We cannot conclude with absolute certainty that it is the emotion conveyed by the emoji expression that is driving the effect and not the expression itself or some of their specific elements (e.g., curvature). Nevertheless, the fact that facial expressions are so effective at conveying emotional information and that temperature-emotion associations are robust provides confidence in the results. Moreover, even though we used the emoji expressions most strongly associated with low and hot temperatures on the results of the Preliminary Experiment and previous research, the two expressions selected varied in terms of arousal. Hence, while we can say that the sad emoji expression influenced temperature expectations compared to the happy one and the control, we cannot explicitly say that this effect is due to valence. Nevertheless, our objective was to test the emotional cues most strongly associated with higher and lower temperature concepts.

Furthermore, while we measured participants' emotional state before and after the presentation of the stimuli, we did not measure the direct emotional responses to the emoji expressions on expected temperature. Given that these emotional cues may trigger congruent emotional states and empathetic responses, future studies could investigate the effect of emotional cues on expected temperature through direct emotional responses to these cues.

It is worth noting that the nominal level in which participants tended to anthropomorphize the products was relatively low, although the differences when anthropomorphism was manipulated were significant. For instance, in Experiment 2, the mean level of anthropomorphism under the high condition was 2.91 and under the low condition 2.52. An additional limitation comes from the receptacle of the cold beverage stimuli, as paper cups are not the most common receptacle for cold beverages. Nevertheless, paper cups are increasingly being used for cold beverages to reduce single-use plastic waste. That being said, participants did rate the cold beverage as cold. Furthermore, Experiment 5 was conducted in a laboratory. Thus, we cannot rule out the possibility that the emotional cues may impact product temperature perception under more ecologically valid scenarios.

A potential limitation of the present study relates to the temperature conditions used (i.e., hot and cold), as the addition of a room-temperature product, acting as neutral condition, would arguably serve as a reference point in the experimental design. However, given that we focused on foodstuffs, we aimed for a more ecologically valid design and therefore chose food products for which temperature is an important dimension (i.e., commonly consumed at either hot or cold temperatures). In this regard, future studies could investigate the effects of emotional cues on the expected temperature of non-food products, as their temperature may play a completely different role in their evaluation compared to foodstuffs. For example, for non-food products, extreme high temperatures may indicate that they are overworking or malfunctioning.

There are also limitations stemming from the demographics of the participants in the experiments. Participants in the online experiments were based in the UK, but those in the laboratory-based experiment were based in Denmark, although participants in both experiments had the same age range and similar age distribution. Furthermore, these are countries with colder climates relative to other ones, such as those closer to the equator. It is possible that the effects found here differ for people based in warmer climates, as ambient temperature and seasonality can affect food preferences and choices (Spence, 2021). Another aspect to consider is that the effect of the emoji expressions might differ for people from cultures that are less emotionally expressive, as the emoji expressions could be interpreted in different ways.

An important limitation comes from the study design of Experiment 5. Given the limitations and uncertainty of the COVID-19 pandemics, we employed a within-participants design. While the required sample size is smaller with such design, it may trigger demand artifacts (Sawyer, 1975), as it can make participants guess the research question. Nevertheless, demand artifacts may be present in all methods of data collection. In addition, three conditions are necessary for demand artifacts to occur, namely encoding the demand cue, discerning the hypothesis, and acting on the hypothesis (Shimp et al., 1991). That being, future studies should adopt experimental designs that reduce such potential issues.

The present work opens multiple avenues for future research. While we used emoji facial expressions to operationalize emotional content and imbue a product with emotions, further research can explore other ways to convey emotions, such as text and audio. Considering the importance of temperature on the perception and acceptance of foodstuffs and the differences between hedonic and utilitarian products, future research should investigate the impact of emotional cues on temperature expectations in other food categories and nonfood products, besides less hedonic products. Furthermore, future studies can extend our findings and investigate whether higher anthropomorphism can enhance the effect of the emotional cues on temperature expectations and perception in physical settings. Finally, researchers can extend our findings using biometric measures, such as individuals' body temperature, or behavioral ones, like individuals' time to reach for the beverage.

Conclusion

The present work contributes to the growing literature on the rich relationships between emotions and temperature in multiple domains, especially consumer products and foodstuffs. While previous studies have documented that exposure to specific physical or visually-induced temperatures can impact product evaluations (Park & Hadi, 2020; Zwebner et al., 2014), the present work extends this line of research by investigating an understudied direction of this relationship. More specifically, we show that imbuing a product with specific emotional content can influence expectations of a concrete sensory dimension of products, namely temperature. We show that individuals' associations between emotions and temperature (Barbosa Escobar et al., 2021) can be operationalized in a straightforward fashion through emoji expressions and anthropomorphism and leveraged to influence product expected temperature. Importantly, we show that not all emotions are created equal, such that negative emotions may exert a greater impact on product expectations. Furthermore, our work contributes to the expanding literature on affective touch, as temperature is an important factor in the pleasure derived from touch (Spence, 2022a). We show another way in which touch and emotions are connected, and our work opens possibilities for a new line of research investigating the effects of temperature-associated emotional cues on product perception and the pleasure derived from these products.

Conflict of Interest

The authors declare that they have no conflict of interest.

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