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Do food cinemagraphs evoke stronger appetitive responses than stills?

ABSTRACT

Viewing images of food triggers the desire to eat and this effect increases when images represent food in a more vivid way. Cinemagraphs are a new medium that is intermediate between photographs and videos: most of the frame is static, while some details are animated in a seamless loop, resulting in a vivid viewing experience. On social media cinemagraphs are increasingly used for food-related communication. Given their vivid appearance we hypothesized that food cinemagraphs may evoke stronger appetitive responses than their static counterparts (stills). This would make them a promising medium for food advertisements on the Internet or on digital menu boards. In this study we measured the 'wanting' (appetitive) and 'liking' (affective) responses to both cinemagraph and stills representing a wide range of different food products. Our results show that food cinemagraphs slightly increase 'wanting' scores while not affecting 'liking' scores, compared to similar stills. Although we found no overall main effect of image dynamics on 'liking', we

KEYWORDS

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affect
appetite
liking
wanting

did observe a significant effect for some individual food items. The effects of image dynamics on 'wanting' and 'liking' appear to be product specific: while dynamic images were scored higher on 'wanting' or 'liking' for some products, static images were scored higher on these factors for other products. Observer responses to a free association task indicate that image dynamics can affect the appeal of a food product in two ways: by emphasizing its hedonic qualities (lusciousness, freshness) and by enhancing the observers' awareness of their own core affect ('liking') for the product. We conclude that the effective use of cinemagraphs in food advertisements therefore requires a careful consideration of the characteristics (hedonic aspects) of the food product that are to be highlighted through image motion and the inherent preferences (core liking) of the target group.

Introduction

Viewing images of food triggers the desire for the real thing: just looking at pictures of food causes salivation (Spence 2011) and an uptick in ghrelin, a hormone that causes hunger (Schüssler et al. 2012). These effects increase when images represent food in a more vivid way (Moore and Konrath 2015; Spence 2011). A new medium that is well suited to produce vivid visualizations of food are cinemagraphs. Cinemagraphs are intermediate between photographs and videos: most of the frame is static, while some regions are animated in a seamless loop (e.g. see www.cinemagraphs.com). Given their capability to display vivid imagery, cinemagraphs may be an effective medium for food marketing.

By freezing most of the moving image details while animating only a few, cinemagraphs can effectively draw attention to a subject or area of interest. The moving details are expected to result in a vivid viewing experience, enhancing the perceived realism of the product. In case of food images, falling droplets or steam may for instance enhance the perceived attractiveness of an otherwise static food item (e.g. a melting ice-cream, sizzling hot shrimps or a steaming sausage; for examples see flixel.com/cinemagraphs/food and kitchenghosts.carbonmade.com). Their capability to attract a consumer's attention and enhance the perceived attractiveness of displayed food items could make cinemagraphs an interesting medium for food marketing.

Originally the production of cinemagraphs was a time-consuming manual process, using general applications like Adobe Photoshop®, Premiere® and After Effects®. Nowadays, a wide range of mobile apps and computer programmes is available to automatically create cinemagraphs. Users can select which areas to animate (Tompkin et al. 2011), combine small looped clips called cliplets (Joshi et al. 2012) or scribble over image regions to automatically (de-)animate them (Bai et al. 2012; Liao et al. 2015). Now that they are easy to make and distribute, the use of cinemagraphs is likely to increase significantly over the coming years.

Because of their capability to provide vivid representations of food, the ease with which cinemagraphs can now be produced on smartphones, the current trend to share food images over the Internet ('digital grazing':

Spence et al. 2015), and the growing number of sites dedicated to enticing food images on platforms like Instagram, Flickr and Snapchat (Mejova et al. 2016), we expect that cinemagraphs will play an increasingly important role in the digital communication about food on social media (Abbar et al. 2015). Also, we expect that they will increasingly be used to advertise food items on display boards in public spaces like bus shelters and stations, in supermarkets and in food courts and will appear on digital menus in restaurants to provide more appealing descriptions of the dishes served (Beldona et al. 2014; Peters and Mennecke 2011).

Several previous studies investigated the effects of image dynamics on observer appraisal of scenes and products (see Table 1 for an overview of the literature). Studies using affective images and clips extracted from films and television programmes, found that image motion mainly affected arousal while having no significant impact on image valence (liking; Detenber and Reeves 1996; Detenber et al. 1998; Simons et al. 1999, 2000). Static frames extracted from dynamic videos also had an arousing effect (probably resulting from the fact that they contain cues that imply frozen movement: Cian et al. 2014, 2015), but the effect size was significantly smaller than for dynamic videos. Thus (implied) motion appears to augment the arousing quality of a displayed product without affecting its valence (Simons et al. 1999). Although some studies used food products as stimuli, it is currently still not known how image dynamics influences the affective evaluation of food pictures. Food products displayed with implied motion were rated as fresher than static products (Gvili et al. 2015, 2017). Also, compared to stills, rotating product displays positively affect purchase intention (Park et al. 2008; Verhagen et al. 2016) and the observer's mood and attitude towards the product (Park et al. 2008). However, none of these studies explicitly investigated the effects of image dynamics on the affective appraisal of food. A recent and related study on augmented reality (AR) found that arousal and valence ratings for food stimuli presented in AR (a rich and dynamic medium) were similar to those for real food and higher than those for photographic stimuli (Pallavicini et al. 2016). A concise overview of the aforementioned findings in the literature on the effects of image motion on the observer evaluation of scenes and products (as summarized in Table 1) is presented in Figure 1.

Retailers depend on the power of (exciting) product displays to attract customers, initiate a direct interaction with the product, and evoke (wanting) responses to the merchandize and the shopping experience that ultimately result in a sale. Some previous studies suggest that their capability to draw attention and to create a vivid viewing experience makes cinemagraphs an interesting display medium for marketing purposes. When showing electric appliances, cinemagraphs induce longer gazing times and stronger purchase intention compared to stills (Park et al. 2016). Cinemagraphs positively affect the perceived freshness, perceived taste, perceived value price and intention to buy agricultural food products (Park et al. 2013). When displayed on screens of shopping malls, cinemagraphs increased purchase intention compared to stills (Park et al. 2014). When used to show food in e-magazines, cinemagraphs evoke more varied positive emotional responses compared to stills (Park et al. 2015). This suggests that cinemagraphs may be an effective medium for food marketing.

Vividness (Steuer 1992), also referred to as media richness (Daft and Lengel 1986), refers to the sensory breadth (the number of sensory dimensions) and sensory depth (the information quality and resolution) of stimuli.

Source	Stimuli	Measures	Results
Detenber and Reeves (1996)	Video clips and still frames	Self-reported valence and arousal (SAM)	Real (clips) and implied (frames) motion both generated arousal.
			Implied motion generated more arousal than real motion.
			Motion had no effect on stimulus valence.
Detenber et al. (1998)	Video clips and still frames	SAM	Real (clips) and implied (frames) motion enhanced both subjective and physiological arousal.
		Physiological measures (heart rate, skin conductance)	Motion had no effect on stimulus valence.
Gvili et al. (2015)	Photographs of juices with and without implied motion	Perceived appeal Perceived freshness	Juices displayed in motion were rated as more appealing and fresher than static juices.
Gvili et al. (2017)	Photographs with and without implied motion of orange juice, water, pretzels, corn-flakes, yogurt	Perceived freshness Perceive tastiness	Products displayed in motion were rated as fresher and tastier than static products.
Pallavicini et al. (2016)	Plated food, handled in reality, on pictures and in augmented reality (AR)	Self-reported valence Physiological measures (skin conductance, EMG)	Subjective valence and physiological arousal were similar for real food and food in AR, and higher than for food on pictures.
Park et al. (2016)	Cinemagraphs of electric appliances	Visual attention	Compared to stills, cinemagraphs induced longer gazing times.
		Purchase intention	Compared to stills, cinemagraphs enhanced purchase intention.
Park et al. (2013)	Cinemagraphs and photographs of agricultural food products on websites	Perceived freshness Perceived taste Perceived value Intention to buy	Compared to stills, cinemagraphs enhanced perceived freshness, taste, value, and intention to buy.
Park et al. (2014)	Cinemagraphs and photographs of food products presented on screens in shopping malls	Fixation time Purchase intention	Compared to stills, cinemagraphs induced shorter fixation times and increased purchase intention.

(Continued)

Source	Stimuli	Measures	Results
Park et al. (2015)	Cinemagraphs and photographs of food products in E-magazines	Emotion questionnaires	Compared to stills, cinemagraphs evoked significantly more positive emotions.
Park et al. (2008)	Rotating and still images of garments	Mood questionnaire Attitude towards product Perceived information Purchase intention	Compared to stills, rotating product displays positively affected the observer's mood, attitude towards the product and purchase intention.
Roggeveen et al. (2015)	Video clips and photographs of hotel rooms	Preference for hedonic options Willingness to pay	Compared to stills, dynamic displays enhanced preference for hedonic options and willingness to pay.
Verhagen et al. (2016)	Rotating and still images of sunglasses	Purchase intention	Compared to stills, rotating displays enhanced purchase intention.
Simons et al. (1999, 2000)	Video clips and still frames	SAM	Motion enhanced both subjective and physiological arousal.
		Physiological measures (heart rate, skin conductance, EMG)	Motion had little or no effect on stimulus valence.

Table 1: Overview of the literature on effects of image dynamics on product and scene appraisal.

Vivid stimuli allow observers to fill in more missing sensory information and thereby diminish the user's perception of mediation (i.e. the indirect perception of a product through technical means or devices). This enables users to activate a fuller, more concrete or vivid mental model regarding the actual product, which in turn positively affects their product appraisal (Choi and Taylor 2014) and enhances the imagined product experience (Roggeveen et al. 2015). It has for instance been found that the vividness of in-shop advertisements positively affects purchase intention, product attitude and shopping enjoyment (Park et al. 2013; for a review see Van Kerrebroeck et al. 2017). Vivid (full colour) images of pizza elicited higher levels of food craving, a stronger salivation response and stronger eating intentions than similar pallid (black and white) images (Moore and Konrath 2015). This was especially the case for people that were high in positive affectivity, who are more likely to fantasize about the pleasures of anticipated product experiences (Larsen et al. 1996). These findings suggest that cinemagraphs displaying vivid imagery of food may be a more effective medium for marketing purposes than photographs if they do indeed evoke stronger appetitive responses than stills.

Previous studies found that people's appetitive (wanting) responses to food images are affected by their body mass index (BMI; Burger et al. 2011) while their affective (liking) responses are modulated by their global state of happiness (Otake and Kato 2016). BMI is positively related to the desire to eat (wanting) but not to liking ratings (Burger et al. 2011). People with higher
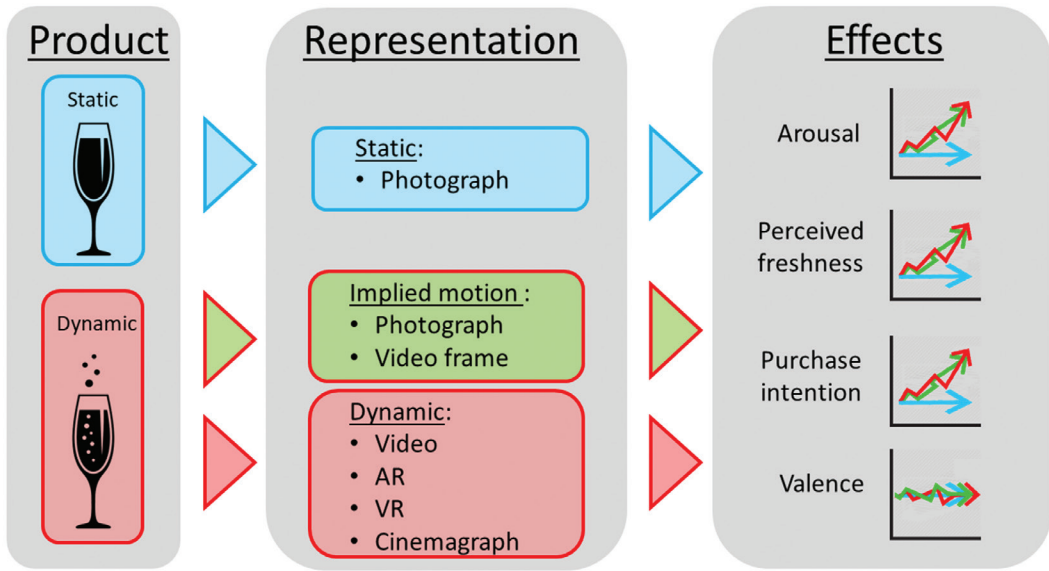
Figure 1: *Schematic representation of the findings in the literature (as summarized in Table 1) on the effects of image representation (static, implied motion or dynamic) for static and dynamic products and scenes on (subjective and physiological) observer arousal, perceived product freshness and valence and purchase intention. Blue, green and red symbols represent, respectively, static stimuli, stimuli showing implied motion and dynamic stimuli. Upward arrows symbolize an increase in the corresponding evaluation measure, while horizontal arrows indicate no effect of (implied) image motion.*

global happiness levels experience stronger positive emotional responses (feeling happy or glad) when looking at images of food (as if they were actually eating the food) than those with lower happiness levels (Otake and Kato 2016). However, global happiness does not affect the appetitive responses to food stimuli (Otake and Kato 2016). This implies that the level of subjective happiness affects liking but not wanting (Berridge 2009). To control for these effects, we also measured the participants' global happiness levels and their BMI in this study.

As reviewed above, several previous studies have shown that food cinemagraphs have the ability to attract a consumer's attention and enhance the perceived attractiveness of displayed items. Food cinemagraphs would be an even more interesting medium for food marketing if they also elicit stronger wanting responses (since this could ultimately lead to increased purchase behaviour). However, previous studies did not investigate the effects of image dynamics on wanting responses. In this study we therefore measured the wanting and liking responses to both cinemagraphs and their associated stills. 'Wanting' typically refers to the (transient) reflexive drive to consume, which can be triggered by food-related (visual auditory or olfactory) sensory cues, while 'liking' refers to the (stable, learned) intrinsic perceived palatability of a food. Neuroimaging studies on hedonic eating behaviour have shown that liking and wanting responses are mediated by distinct neural mechanisms (Berridge and Kringelbach 2015; Castro and Berridge 2014). As a result liking and wanting responses to food can be dissociated in humans (Finlayson et al. 2007). Since food cinemagraphs appear to provide a more vivid visual product representation than similar stills (Park et al. 2013), we hypothesize

(H1) that they will effectively evoke stronger wanting responses compared to their static counterparts. Because food cinemagraphs essentially convey the same information as their static counterparts we also hypothesize (H2) that image dynamics does not affect food liking (e.g. both image modalities yield the same perceived palatability of a food). In this study we tested these hypotheses by comparing both conative responses (wanting – the incentive salience or motivation to consume) and affective responses (liking – the positive hedonic evaluation) to cinemagraphs of a wide range of different food products and their static counterparts. The results of this study may provide insight into the strategic potential of cinemagraphs for food marketing on new media such as digital displays and menu boards, online shopping malls, social networks and mobile apps.

Materials and methods

Participants

Participants were 81 Dutch citizens (33 males and 48 females, mean age = 38 years, SD=16 years, age range = 16–72 years) recruited by email among TNO employees, interns and their family and among students from Utrecht University. The invitation excluded vegetarians (since the stimuli included several non-vegetarian food items). The online experiment first presented an informed consent. By pressing a button labelled 'continue' the participants acknowledged that they had read and understood the informed consent and accepted the conditions. The experimental protocol was reviewed and approved by the TNO Ethics Committee (Ethical Application Ref: TNO-IRB-2015-10-3) and was in accordance with the Helsinki Declaration of 1975, as revised in 2013 (World Medical Association 2013). Participation was voluntary and did not involve any kind of compensation.

Stimuli

The stimuli used in this study were 24 cinemagraphs and 24 corresponding stills (single frames taken from the cinemagraphs), representing 24 different food and drink products (for some examples see Figure 2. The full set of stimuli is provided in the additional material with this article that is available from the figshare repository at https://doi.org/10.6084/m9.figshare.5522137). One cinemagraph (showing a Unox smoked sausage) was produced by Unilever (Unilever R&D Vlaardingen, the Netherlands). The remaining 23 food cinemagraphs were produced by Daria Khoroshavina (Moscow, Russia; see Turner 2015) and obtained (with permission) from her website (kitchenghosts.carbonmade.com; see also www.behance.net/barelungs). The stimuli represented nineteen different food items (French fries with dripping ketchup, steaming corn on the cob, boiling crème brûlée, boiling noodle soup, Danish with dripping chocolate, melting ice-cream cones, sizzling mushrooms, pancakes with dripping maple syrup, steaming seafood with vegetables, a sizzling pizza and a pizza being cut in slices, sizzling calamari, steaming shrimps, sizzling shrimps, a steaming sausage, a sorbet with cherries and flowing sauce, a sorbet with coffee and pouring sauce, steaming hot vegetables, sushi being sprinkled with sesame seeds) and five different drinks (bubbling beer, steaming hot coffee, iced coffee with pouring sauce, bubbling iced tea, bubbling prosecco).

The 48 stimuli were divided in two sets of 24 stimuli each. Each set contained twelve stills (the static condition) and twelve cinemagraphs (the dynamic condition). Stimuli represented as stills in one set were represented

Figure 2: Examples of the stimuli used in this study (obtained from kitchenghosts.carbonmade.com with written permission of the author Daria Khoroshavina; see Turner [2015]): (a) steaming hot coffee, (b) bubbling ice tea, (c) sparkling prosecco, (d) pancakes with dripping syrup, (e) steaming shrimps, (f) honey pouring over waffles.

as cinemagraphs in the other set. Participants were randomly assigned to one of the two stimulus sets. Hence, each participant viewed all 24 food and drink items (twelve in still format and twelve in cinemagraph format), but participants assigned to different sets viewed complementary dynamic conditions. This was done to prevent a direct comparison of the static and dynamic versions of the same food or drink item (since people may be inclined to rate the second occurrence of a food item the same as the first occurrence to be consistent), while still enabling a global assessment of the effects of dynamics within participants. Although the experimental context does not determine how image dynamics influences affective responses (i.e. similar effects are observed in between- and within subject designs: Detenber and Reeves 1996; Detenber et al. 1998; Simons et al. 2000), we chose for a within-subjects

design since previous studies have shown that effect sizes are typically significantly larger in these designs (Simons et al. 2000).

Measures

Participants gave their age, gender, weight and height. Their BMI was calculated as weight (in kilograms) over height (in centimetres) squared.

Global (main) subjective happiness was measured using a Dutch version of the four-item Subjective Happiness Scale (SHS: Lyubomirsky and Lepper 1999). The four items are scored on seven-point Likert scales. The first item asks participants to describe their state of happiness ('in general, I consider myself: not a very happy person … a very happy person'). The second item asks participants to characterize themselves relative to their peers ('compared with most of my peers, I consider myself: less happy … more happy'). The third item asks participants to rate to what extent a general description of happy people applies to them ('some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you? Not at all … a great deal'). Finally, the fourth item similarly asks participants to rate to what extent a general description of happy people fits them ('some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you? Not at all […] a great deal').

A single composite score for global subjective happiness was computed by averaging the responses to the four items (after reverse-coding the fourth response). Thus, scores on the SHS range from 1.0 to 7.0, with higher scores reflecting greater happiness. The SHS is easy to administer, has high internal consistency and an excellent reliability (Lyubomirsky and Lepper 1999).

The participants' hunger level (degree of satiation) was measured through a single item ('how hungry are you right now?') that was rated on a labelled ('not at all, neutral, very much') VAS (visual analogue) scale, providing a range of scores from 1 to 10.

For each stimulus the participants first reported their free associations in response to an open question ('please enter what first comes to your mind when looking at this image?'). Sentiment Analysis (also known as affect analysis or emotion analysis; see Pang and Lee 2008) was used to systematically identify, categorize and quantify spontaneous 'wanting' and 'liking' statements provided by the participants in response to the free association question. Statements like 'I want this very much', 'this looks delicious', 'this gives me an appetite, 'this makes my mouth water', 'this makes me hungry', 'gimme!' were categorized as positive 'wanting' (appetitive) responses, while statements such as 'I don't want this', 'this looks awful/strange, 'throw this away!', 'no thanks', 'not for me' were categorized as negative 'wanting' responses. Similarly, statements such as 'I like this very much', 'this makes me happy', 'this makes me glad', 'this reminds me of good times/dinners with my friends', 'this gives me a holiday feeling' were categorized as positive 'liking' (affective) responses, while statements like 'I don't like this', 'this makes me feel sick', 'yikes!', 'disgusting!' were categorized as negative 'liking' responses. Hence, each of the two categories had three gradations: negative, neutral and positive. All responses were individually rated by three judges. The agreement between the judges was high: Krippendorff's $\alpha=0.987$. In case of disagreement the majority vote was adopted as the final score.

The appetitive or 'wanting' response was measured through four items ('I want this very much', 'this looks delicious', 'this gives me an appetite', 'this makes my mouth water'; see Otake and Kato 2016) that were rated on labelled (fully disagree, disagree, neutral, agree, fully agree) VAS scales, providing a range of scores ranging from –2 (via 0 or neutral) to 2. A single composite 'wanting' score was obtained by averaging the responses to the four individual items. These measures have previously been shown to reliably measure the appetitive response to food pictures (Otake and Kato 2016).

The affective or 'liking' response was measured through two items ('this makes me happy', 'this makes me glad') that were rated on labelled (fully disagree, disagree, neutral, agree, fully agree) VAS scales, providing a range of scores from 1 to 5 (see Otake and Kato 2016). A single composite 'liking' score was obtained by averaging the responses to the two individual items. These measures have previously been shown to reliably measure the affective response to food pictures (Otake and Kato 2016).

Procedure

Candidate participants were invited by e-mail. After accepting their invitation, they received instructions and a link for the online questionnaire and were informed of their option to terminate the experiment at any time.

We asked the participants to assess the images in the afternoon or evening, since several stimuli used in this study show food or drinks that are typically not consumed before noon. We also instructed them to use electronic viewing devices with larger display sizes (no smartphones or tablets with a small screen area), to maximize their browser window, and to carefully inspect each image before answering the questions. This was done because larger image sizes enhance the visibility of subtle movements in the cinemagraphs, while a careful inspection of each image increases the probability that the moving details in the cinemagraphs will be noticed. No time limit was imposed for the task. On average the experiment lasted about one hour.

The questionnaire started with the demographic questions, followed by the four SHS items and a question about their hunger level. Then the 24 stimuli were shown in random order. For each stimulus, participants first reported what initially came to their mind when looking at the image (free association), then responded to the two items measuring their affective ('liking') response and to the four items measuring its perceived appetitiveness ('wanting'), and finally indicated how frequently they consumed the displayed product. All stimuli were presented on a black background. The response scales and questions were presented one at a time below each stimulus. Thus, each stimulus was continuously displayed while the participant responded to all questions.

Analysis

To estimate if the potential covariates (BMI, SHS, hunger level) were a source of systematic variance, correlation analyses between possible covariates and the dependent variables were run first. A two-way analysis of variance (ANOVA) was conducted to explore the impact of the between-subjects independent variable image-dynamics (dynamic, static) and food item (24) on the affective ('liking') and appetitive ('wanting') ratings. All statistical analyses were performed with IBM SPSS 24.0 for Windows (www.ibm.com). For all analyses, a probability level of $p<0.05$ was considered to be statistically significant.

Results

Most participants had a normal or healthy weight (mean BMI=23.8, SD=4.6). In addition, participants were typically very happy (mean SHS score = 5.6 on a scale from 1 to 7, SD=1.1). The SHS had a good internal consistency with a Cronbach alpha coefficient of 0.86. This indicates that the items making up the SHS scale all measure the same underlying construct. On a scale from 1 to 10 the mean hunger level was 5.62 (SD=1.94). Thus, the participants were moderately hungry, but not satiated nor extremely hungry. There was no significant correlation between BMI, Happiness or Hunger Level and the dependent variables 'liking' and 'wanting'. Hence, these were not included as covariates in the further analysis.

The results of the affect analysis of the response to the free association question are shown in Figures 3 and 4. These figures show the percentage of participants that spontaneously gave either negative or positive 'wanting' (Figure 3) and 'liking' (Figure 4) statements in response to the free association task, for each of the dynamic and static stimuli.

Figure 3 shows that spontaneous 'wanting' responses occur quite frequently (on average in about 38% of all responses), while positive 'wanting' responses are given significantly more frequent (on average in about 29% of all responses) than negative responses (on average in about 9% of all responses: a difference of 20%, χ^2=4.74, p=0.03). There appears to be no systematic relation between image dynamics and the percentage of (positive or negative) 'wanting' responses. Image dynamics significantly increases the percentage of
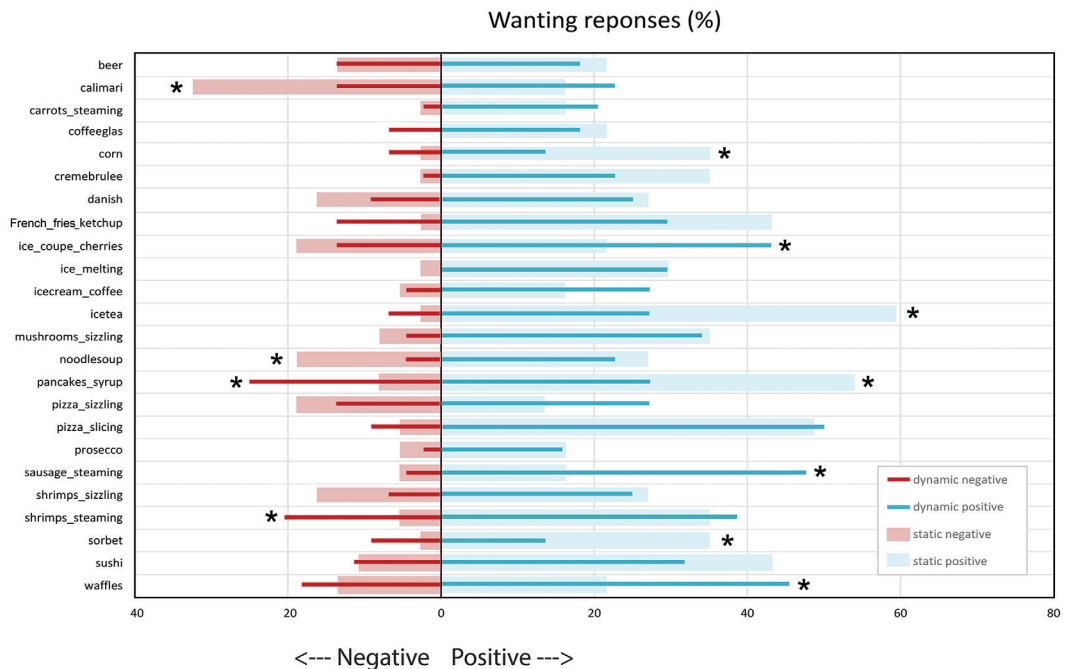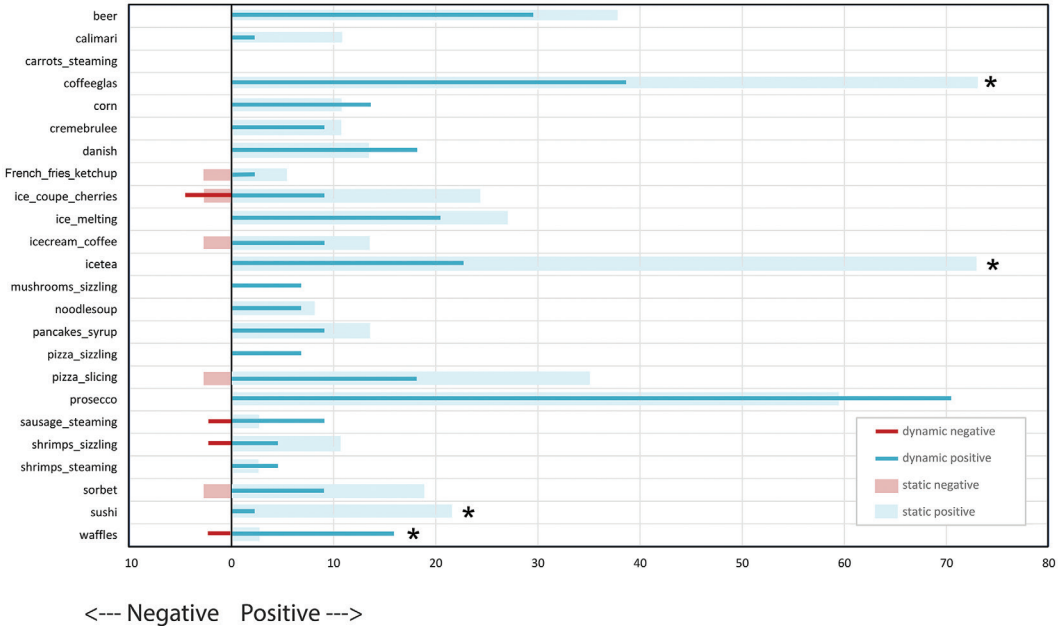

Figure 3: The percentage of participants that spontaneously gave either negative (left, red) or positive (right, blue) wanting statements in response to the free association task, for each of the dynamic (solid colour) and static (transparent colour) stimuli. Significant differences between the dynamic and static conditions are indicated with *.

Figure 4: *The percentage of participants that spontaneously gave either negative (left, red) or positive (right, blue) liking statements in response to the free association task, for each of the dynamic (solid colour) and static (transparent colour) stimuli. Significant differences between the dynamic and static conditions are indicated with *.*

positive 'wanting' responses for only three products (ice coupe with cherries, steaming hot sausage, waffles) and the percentage of negative 'wanting' responses for only two products (pancakes with syrup, steaming hot shrimps). Also, image dynamics significantly decreases the percentage of positive 'wanting' responses for four products (corn, iced tea, pancakes with syrup, sorbet) and the percentage of negative 'wanting' responses for two products (calamari, noodle soup). However, some trends can be observed. For some products (e.g. French fries with dripping ketchup, pancakes with dripping syrup, sorbet), image dynamics appears to have an overall negative effect: dynamic images yield both less positive and more negative 'wanting' responses. This negative sentiment is reflected in the answers the participants provided for these products in response to the free association task (e.g. dripping ketchup was generally found unappealing, while dripping syrup appeared to give an impression of too much sweetness). However, as noted before, this effect is only significant for pancakes (dynamic images yield 27% (χ^2=5.96, p=0.01) less positive 'wanting' responses and 17% (χ^2=3.96, p=0.04) more negative 'wanting' responses). For other products (e.g. ice coup with cherries, sizzling pizza) image dynamics appears to have an overall positive effect: dynamic images yield more positive and less negative 'wanting' responses. This positive sentiment is also reflected in the answers provided by the participants for these products in response to the free association task (e.g. the ice coup was associated with luxury, dining in restaurants and summertime, while the pizza was seen as rewarding, warm and fresh). For some products (e.g. steaming shrimps and waffles with honey)

image dynamics appears to enhance both the frequency of positive and negative wanting responses. Summarizing, although the data indicate some trends for the effects of image dynamics on spontaneous 'wanting' responses, most results were not significant.

Figure 4 shows that spontaneous 'liking' statements occur less frequently (on average in about 17% of all responses) than spontaneous 'wanting' statements (see Figure 3: on average in about 38% of all responses, a difference of 21%, χ^2=4.37, p=0.04), while disliking statements are quite rare (on average in about 0.5% of all responses). There appears to be no systematic relation between image dynamics and the percentage of 'liking' responses. While image dynamics increases the percentage of spontaneous positive 'liking' responses for eight of the 24 products, it decreases the percentage of spontaneous positive 'liking' responses for fifteen of the 24 products. However, the increase in the percentage of spontaneous positive 'liking' responses is only significant for one product (waffles), while the corresponding decrease is only significant for three products (hot coffee, iced tea, sushi).

Figures 5 and 6 show, respectively, the mean 'wanting' and 'liking' rating scores over all participants, for each of the dynamic and static stimuli.

The subjective 'wanting' and 'liking' constructs had a good internal consistency, with Cronbach alpha coefficients of, respectively, 0.95 for 'wanting' and .91 for 'liking'. This indicates that the items that make up each scale measure the same underlying construct.

ANOVA with factors Image_dynamics (two levels: static and dynamic) and Product (24 levels) showed a significant main effect of image dynamics on the subjective 'wanting' and 'liking' ratings for the 24 different products used in this study ($F_{1,68}$=4.66, p=0.03). Further analysis showed that 'wanting' was scored significantly higher ($F_{1,68}$=5.48, p=0.02, d=.27) for dynamic images (M=3.34, SD=.54) than for static images (M=3.19, SD=.59). However, the effect size was rather small, while image dynamics had no significant main effect on 'liking'. Thus, the present results only weakly support our first hypothesis (H1) that dynamic images evoke stronger appetitive ('wanting') responses than comparable stills. The data appear to confirm our second hypothesis (H2) that image dynamics does not affect 'liking' responses.

A further explorative analysis showed that the effects of image dynamics on subjective 'liking' and 'wanting' may be product specific. Although image dynamics had no significant overall main effect on 'liking', image dynamics significantly enhanced 'liking' for iced coffee ($F_{1,68}$=4.60, p=0.04, d=.51), sizzling pizza ($F_{1,68}$=6.05, p=0.02, d=.62) and waffles ($F_{1,68}$=4.25, p=0.02, d=.58), while it significantly reduced 'liking' for pancakes ($F_{1,68}$=5.21, p=0.03, d=.69). Also, while image dynamics significantly enhanced 'wanting' for waffles ($F_{1,68}$=5.25, p=0.03, d=.57), it significantly reduced 'wanting' for pancakes ($F_{1,69}$=8.69, p<0.01, d=.73). Except for the finding that image dynamics enhanced 'liking' for iced coffee, all these results agree with the analysis of the sentiments of the free associations (see previous section). Although this exploratory analysis showed that there were overall more significant effects than expected based on chance, we consider this outcome merely as an interesting lead for future research. An extensive and systematic follow-up study involving a wide range of products is needed to establish the exact nature of the food qualities that contribute to the effectiveness of image dynamics on the appetitive response.
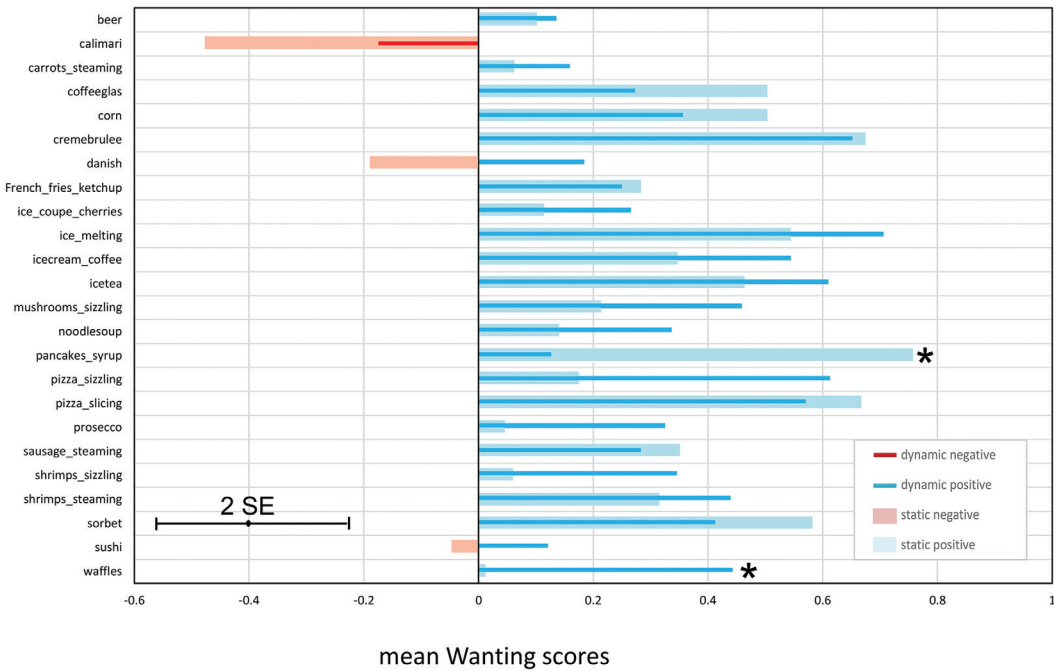
Figure 5: The mean 'wanting' rating scores (on a five-point scale ranging from –2 to 2) over all participants, for each of the dynamic and static stimuli. Significant differences between the dynamic and static conditions are indicated with *. The error bar represents twice the standard error of the mean.
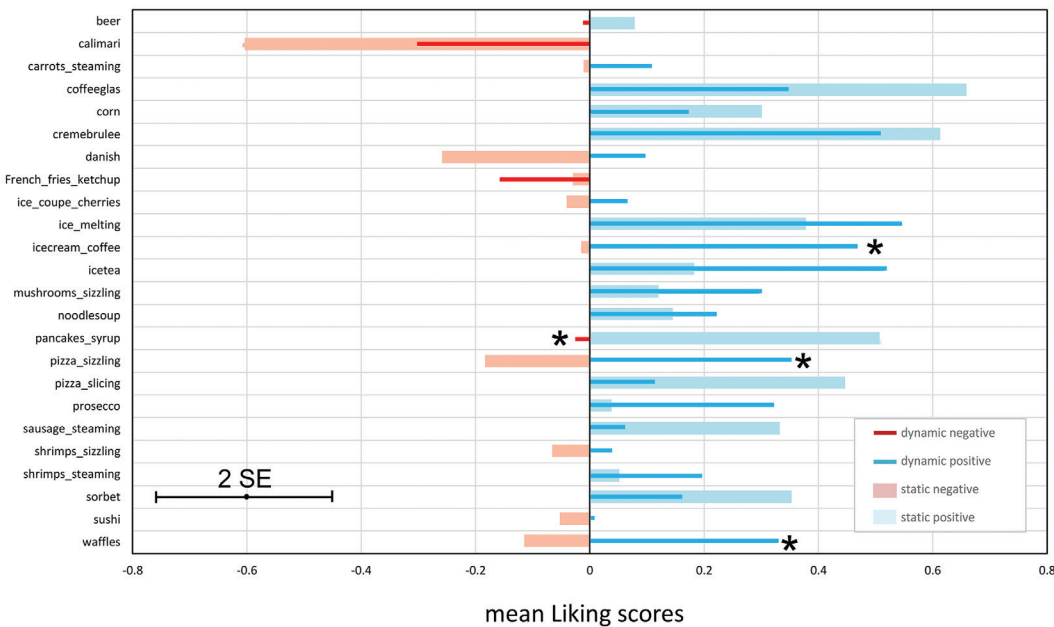

Figure 6: The mean 'liking' rating scores (on a five-point scale ranging from –2 to 2) over all participants, for each of the dynamic and static stimuli. Significant differences between the dynamic and static conditions are indicated with *. The error bar represents twice the standard error of the mean.

Discussion

Although food cinemagraphs are typically considered to provide a vivid product representation (e.g. Park et al. 2013), we found that in general they only slightly increase subjective 'wanting' (appetitive) responses compared to similar stills. Thus, our present results only weakly support our first hypothesis (H1: cinemagraphs evoke stronger wanting responses compared to their static counterparts). In addition, we found no significant main effect of image dynamics on subjective 'liking' (affective) responses, thereby confirming our second hypothesis (H2). These results agree with previous observations that image motion enhances the arousing quality of images without affecting their valence (Detenber et al. 1998; Simons et al. 1999, 2000).

Although we found no main effect of image dynamics on 'liking', we did observe a significant effect for some individual food items. In general, the effects of image dynamics on both 'liking' and 'wanting' appear to be product specific. For instance, cinemagraphs showing ketchup dripping on French fries or syrup pouring on pancakes yielded less positive and more negative wanting responses. The responses to the free association task indicate that the image motion in these scenes made the abundance of ketchup or syrup highly salient, and these items were considered highly unappealing (in the Netherlands French fries are typically not consumed with ketchup, and many participants found that the syrup made the pancakes much too sweet). In contrast, cinemagraphs showing an ice coup with cherries and a sizzling pizza evoked more positive and less negative wanting responses. The responses to the free association task indicate that the image dynamics in these scenes emphasized the appealing aspects of the food (the lusciousness of the ice coup and the freshness of the pizza), thereby making them more attractive to the participants. For some products (e.g. steaming shrimps and waffles with honey) image dynamics enhanced the frequency of both positive and negative 'wanting' responses. The responses to the free association task indicate that the image motion in these scenes enhanced the subjective awareness of one's core affect (liking) for these products (as suggested by associated negative liking statements like: 'I hate shrimps' or 'I don't like sweet stuff'), which may in turn have affected their 'wanting' responses. Summarizing, these findings suggest that observers predominantly focus on the most vivid (animated) details in cinemagraphs and weigh these more heavily when making their judgements based on a perceived product experience (Shiv and Huber 2000). Hence, when cinemagraphs are to be successfully used in food advertisements, the characteristics (hedonic aspects) of the food product that are highlighted through the image dynamics should be carefully tuned to the characteristics of the target group (their inherent liking of certain food qualities).

The absence of an overall effect of image motion on appetitive responses may reflect some uncontrolled sources of variance. We a priori considered BMI, SHS and hunger level as the main sources of variance. However, we did not control for the other possible confounding effects like repeated image exposure, affectivity level, dieting status and image background variability.

Repeated exposure to images of food is known to decrease peoples' appetite (Larson et al. 2014). In this experiment the participants subsequently rated 24 images on six items (two items measuring 'liking' and four items measuring wanting) each. In addition, they reported their free associations for each stimulus. As a result of this repeated and intense confrontation with food pictures their

appetite may have decreased over the course of the experiment, which may have affected their judgements. Since the images were presented in random order to the participants, this results in an additional source of statistical noise and therewith in an attenuation of the statistical power. In a future experiment we plan to present less images per participant and ask fewer questions per image.

Positive affectivity (a human characteristic that describes to what extent people experience positive affect and as a consequence how they respond to their environment: Naragon and Watson 2009) and dieting status can both moderate the relationship between stimulus vividness and consumption-related responses. People with high positive affectivity experience elevated pleasure anticipation, while restrained dieters experience elevated salivation levels (Moore and Konrath 2015). Hence, we expect that both groups will show enhanced 'wanting' responses. In a follow-up study we will therefore also measure the participants' affectivity and dieting status.

Some of the stimuli included other items besides the product of interest, which may have influenced the observer ratings. In a future experiment we plan to use stimuli that only show the product of interest.

Apart from the above-mentioned sources of variance, our measures may not have been sensitive enough. Observers are notoriously unreliable at assessing and reporting their own (food-related) feelings (Köster and Mojet 2015). Verbal self-reporting questionnaires are still the most common technique to measure food-related affective responses, due to their ease of application, cost effectiveness and discriminative power (Churchill and Behan 2010; Dorado et al. 2016). However, self-reported measures are inherently subjective and incomplete because they only capture conscious, declared opinions (Venkatraman et al. 2015). Also, asking consumers to report their feelings can interfere with their food experience itself (Wilson et al. 1993). It has also been noted that individuals are simply not aware of the existence of unconscious affective reactions even when explicitly asked to report them (Winkielman et al. 2011). Therefore, in a follow-up study, we also plan to register behavioural (e.g. facial expression) and physiological (e.g. autonomic nervous system) measures.

Conclusions

It appears that image dynamics can affect the appeal of a food product in two ways: by emphasizing its hedonic qualities (lusciousness, freshness) and by enhancing the observers' awareness of their own core affect (liking) for the product. This suggests that cinemagraphs can, in principle, be an effective medium for food advertisements when they emphasize the aspects of the food that are most attractive to the consumer, such as product freshness (e.g. emphasized by showing water drops flowing from lettuce leaves, or juice pouring from oranges that are being squeezed) or temperature (steam and other effects of cooking). Further research is needed to establish the specific characteristics (hedonic aspects) of food products that are to be highlighted through image motion to ensure that they agree with the inherent preferences (core liking) of the target group.

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