How media appeals depicting social eating contexts increase the appetitive motivational processing of healthy foods

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ABSTRACT

Research suggests that depictions of social groups can improve the processing of pronutritional media promoting healthy foods. Drawing on a framework of motivational processing, which regulates the automatic emotional and attentional responses to stimuli with adaptive significance to the organism (Cacioppo, Gardner, & Berntson, 1999; Compton, 2003; Ito, Cacioppo, & Lang, 1998), two mixed-factorial experiments examined how adolescents process pronutritional media depicting various social versus alone eating contexts. Based on motivational theories of information processing and emotional contagion, we predicted that pronutritional media depicting social eating contexts capture attention, emotion, and memory formation, indicative of appetitive motivational processing. Study 1 (N = 58; aged 12–18; 54% female) examined how the depicted social eating contexts improve the processing of pronutritional media by increasing their attentional selection, attentional processing, the emotional affect, and arousal responses to them. The models’ faces—which automatically attract priority processing—are oriented towards the foods in the social eating contexts, the pronutritional images depicting social eating contexts were predicted to attract greater attention and mental resources, and to further direct them to the foods. Study 2 (N = 165; aged 12–18; 53% female) investigated how the depicted social eating contexts further improve the processing of the healthy foods in the pronutritional media, by directing the visual attentional focus to the foods and attracting memory formation for them. Visual attentional focus was assessed through eye-tracking and memory was operationalized via visual recognition. As hypothesized, healthy foods became noticeable, highly-arousing, and memorable stimuli with adaptive significance to the organism when promoted through depictions of shared meals in social groups. The findings illustrate how healthy foods can be promoted more effectively through depictions of social eating contexts, and how the appetitive motivational processing explicates their greater effectiveness.

1. Introduction

Commercials targeting youth effectively promote energy-dense foods, contributing to unhealthy diets and obesity (Harris, Bargh, & Brownell, 2009; Robinson et al., 2017). They do so by using social appeals (Buijzen & Valkenburg, 2002; Stitt & Kunkel, 2008), such as social eating contexts displaying shared meals. Given the effectiveness of unhealthy snack advertising that abounds in popular, liked, and memorable social appeals (Buijzen & Valkenburg, 2002; Stitt & Kunkel, 2008), depictions of social eating contexts have the potential to more effectively promote healthy foods as well—This is a welcome public health approach because interventions to increase fruit and vegetable consumption have been evidenced to significantly improve long-term diets, reduce overweight, and, subsequently, prevent obesity (Epstein et al., 2001). This study focuses on their effective processing through activating the appetitive motivational system (Cacioppo et al., 1999; Compton, 2003; Ito et al., 1998). This approach is especially welcome because, unlike high-calorie foods that automatically activate the appetitive motivational system, healthy foods attract less visual attention (Spielvogel, Matthes, Naderer, & Karsay, 2018) and fail to activate the appetitive motivational system overall (Killgore, Young, Bogorodzki, & Yurgelun, 2003; Toepel, Knebel, Hudry, le Coutre, & Murray, 2009; van der Laan, De Ridder, Viergever, & Smeets, 2011).

Motivational processing theories frame how social appeals can enhance processing through motivational mechanisms which regulate emotional and attentional responses. According to these theories, in
relatively safe, neutral environments, the appetite motivational system activates, guiding human processing and emotional responses to stimuli with adaptive significance to the organism (Cacioppo et al., 1999; Compton, 2003; Ito et al., 1998). From an evolutionary perspective, there are survival benefits in social contexts, such as shared activities in large groups or with friends, as opposed to solitary ones (Bernard, Mills, Swenson, & Walsh, 2005; Cacioppo & Patrick, 2008; Wilson, 1975, 1978). Human survival depends upon social groups and behaviors—its importance has been established through extensive empirical evidence (Cacioppo & Patrick, 2008), underlining the saliency of social cues. Due to their developmental stage, youngsters are highly susceptible to the social environment (Blakemore & Choudhury, 2006; Brechwald & Prinstein, 2011; Valkenburg & Piotrowski, 2017a, 2017b), making social appeals particularly fitting for pronutritional messages targeting youth.

Evidenced as salient motivationally-relevant stimuli, social cues are thus expected to trigger priority processing, capturing more visual attention, and influencing its focus to follow the eye gaze of the models to the foods, thus increasing memory formation (Birmingham, Bischof, & Kingstone, 2008; Driver IV et al., 1999; Friesen & Kingstone, 1998; Kuhn, Tatler, & Cole, 2009; Langton & Bruce, 1999). Furthermore, the positive emotions of the models are predicted to spread to viewers of social groups enjoying shared meals together through emotional contagion (Hatfield, Cacioppo, & Rapson, 1992). Although pronutritional interventions promoting healthy foods neglect the potential of social appeals, depictions of shared meals in social groups, rather than solitary eating alone, can enhance the promotion of healthy foods. These appeals are expected to elicit powerful evolutionary mechanisms to the processing of pronutritional messages—specifically by attracting attention, positive emotions, and memory formation for the pronutritional images and for the promoted core healthy foods, such as fresh fruits and vegetables (with energy values below 90 kcal/100 g). This study focuses on the motivational information processing of depicted eating contexts and investigates the predictions in two experiments: Study 1 examines the effects of the depicted eating contexts on attention, arousal, and affect—which are prerequisites of detail processing stages—when the elicited mental resources are guided toward the efficient processing of the nutritional food items. Study 2 investigates the effects of the depicted eating contexts on visual attentional focus and on memory formation for the nutritional food items themselves.

1.1. Processing food cues

The framework of motivational processing focuses on the mechanisms that guide the automatic processing of incoming stimuli. Motivational mechanisms have sculpted attentional systems to provide preferential access to those stimuli with adaptive significance to the organism (Cacioppo & Gardner, 1999; Cacioppo et al., 1999; Damasio, 1998). When the incoming stimuli are salient (i.e., social cues which have arousing positive hedonic valence), there is evolutionary advantage to approach and process them, activating the appetitive approach motivational system. It is thus expected that depictions of arousing, positive, hedonic social appeals, such as shared meals in large groups or with intimate friends as compared to solitary meals (Bernard et al., 2005; Cacioppo & Patrick, 2008; Wilson, 1975) trigger motivational processes, automatically capturing, and influencing appetitive motivational attention (Cacioppo & Bertnesson, 1999; Compton, 2003).

Orienting the audience toward immediate and automatic information intake, salient social stimuli versus nonsocial stimuli attract greater attentional selection and processing (Birmingham et al., 2008; Langton & Bruce, 1999). It is thus predicted that pronutritional images that depict social eating contexts will result in greater attentional selection (H1a) and greater attentional processing (H1b) as compared to those images that do not depict social eating contexts.

Motivational processing theories also frame how emotions are automatically triggered by motivationally-relevant appeals, such as social cues (Cacioppo et al., 1999; Compton, 2003; Ito et al., 1998). Arousing and positive depictions of social groups enjoying the foods are predicted to automatically elicit the appetitive approach motivational system, capturing positive affect and arousal while lowering negative affect (Cacioppo & Bernston, 1999; Compton, 2003). They thus create an approach-oriented emotional response towards the pronutritional messages. Moreover, as people share their emotions with others via facial expressions (Hatfield et al., 1992), positive depictions of social groups expressing enjoyment trigger positive emotions in audiences. Emotional contagion (Hatfield et al., 1992) theorizes how a model’s emotional states directly trigger similar states in audiences. It is posited to occur through the automatic and immediate processing of facial expressions, as faces are the main communicators of emotion (Kelner, Ekman, Gonza, & Beer, 2003). Studies in social emotional contagion have documented that emotions spread to others not only during in-person interactions but also in mediated environments (Ferrara & Yang, 2015; Small & Verrochi, 2009).

Promotional depictions of social groups expressing their enjoyment of the food through several emotional faces are thus expected to activate social emotional contagion. When the pronutritional images show social gatherings with collective emotions of low distress and high enjoyment—conceptualized as low levels of negative affect and high levels of positive affect and arousal (Samson & Potter, 2016)—these emotions will spread to the audiences more than the pronutritional images that do not display social gatherings. Based on the social emotional contagion and on motivational processing theories, it is predicted that pronutritional depictions of shared meals in social groups with several emotional faces expressing low levels of negative and high levels of positive affect and arousal will result in lower negative affect (H1c), greater positive affect (H1d), and greater arousal (H1e) as compared to those that do not depict social groups.

The research on social emotional contagion further evidenced that the “contagion” of emotions amplifies with exposure to more emotional stimuli, to more emotional faces (Ferrara & Yang, 2015; Hodas & Lerman, 2014). It could thus be argued that exposure to more versus fewer emotional faces might magnify the emotions elicited in viewers of promotional materials that display them. The study further explores the variance between two types of social eating contexts: with intimate friends (1 + 1), depicting two emotional faces; and in gregarious communities illustrating more than two emotional faces (3+). Social evolutionary perspectives (Bernard et al., 2005; Cacioppo & Patrick, 2008; Wilson 1975, 1978), however, do not differentiate based on the effects of social group size. Both social gatherings of large groups and of intimate friends are argued as motivationally relevant, automatically capturing and influencing appetitive motivational attention (Cacioppo & Bertnesson, 1999; Compton, 2003). Since there is a lack of prior evidence to build clear predictions, the first research question inquires how the two different social eating contexts influence attentional selection, attentional processing, negative affect, positive affect, and arousal (RQ1).

Shared meals with peers are often presented in unhealthy food commercials that target youth. This is not surprising because adolescents are receptive to peer influence and socialization processes (Brechwald & Prinstein, 2011; Brown, 2004; Valkenburg & Piotrowski, 2017a, 2017b), – susceptibility which is targeted through depictions of social eating contexts in snack advertising. Adolescence is a time of psychosocial development; with increasing the social space, the heightened awareness of social norms, social approval, and, subsequently, of social influence (Blakemore & Choudhury, 2006; Brown, 2004; Valkenburg & Piotrowski, 2017a, 2017b). During this time, adolescents experience higher social influence than other age groups (Berndt, 1979; Brechwald & Prinstein, 2011; Gardner & Steinberg, 2005; Steinberg & Silverberg, 1986). Furthermore, stages of early adolescence (until 15 years old) are differentiated from middle and late adolescents (above 15 years old) – as predicted through the developmental theory of adolescence (Breinbauer & Maddaleno, 2005; Christie
design was conducted. Depicted Eating Contexts was a within-subjects (Participant Age) x 2 (Participant Sex) x 16 (Message) mixed factorial question, an experiment with a 3 (Depicted Eating Contexts) x 2 (depicting a small group of two intimate friends having a shared meal) factor with three levels varying the display of social contexts: Alone (large group of 3 or more people) and in large groups (of 3 and above). The within-subjects treatment of the Depicted Eating Contexts was a within-subjects factor with three levels varying the display of social contexts: Alone (depicting contexts of solitary non-social eating), with Intimate Friends (depicting a small group of two intimate friends having a shared meal) and in Gregarious Community (depicting several young people sharing a meal within a large, friendly group). The factor tested differences between the absence versus presence of social eating contexts, as well as explored the variance between the two types of social eating contexts: with intimate friends (small group of 2 people) and in large groups (of 3 and above). The within-subjects treatment of the Depicted Eating Contexts has relatively high internal validity because subjects serve as their own control in comparisons across treatment levels, with more propitious opportunities for comparisons and causal inferences (Reeves & Geiger, 1994). The stimuli consisted of images depicting adolescents handling and preparing to consume common fruits and vegetables. The food types were natural, unbranded, diverse fruits and vegetables, which were also matched across conditions to control for food preference. Superimposed in the lower right corner of every image was an enlarged image of one of the depicted healthy foods, as is often done in print ads. This increased the visibility of the foods and authenticity of our stimuli as promotional materials. Also, for stimuli authenticity as promotional media, a (couple of) word(s) were included (e.g., “Good!”), superimposed on the peripheral lower corner of the images, as it is often done in typical promotional materials. The words were not related to the experimental manipulation and visual depictions. The stimuli were rated prior to the experiment (see Message Selection Pilot Studies for details). Participant Age was a between-subjects factor consisting of Younger adolescents (12–14 years old) and Older adolescents (15–18 years old), grouped using median split and according to the developmental stages of adolescence and susceptibility to social appeals (Breinbauer & Maddaleno, 2005; Christie & Viner, 2005; Valkenburg & Piotrowski, 2017, chapter 6). Adolescents are targeted in this study because they are likely to make more food choices of their own in comparison with children, whose food choices are more predominantly made by their parents. Participant Sex was also a between-subjects factor consisting of self-identified Boys and Girls.

Message was a within-subjects repetition factor incorporated as a control. There were 16 different images representing each category of eating contexts; thus, participants were exposed to 48 images in total. Multiple messages are suggested in experimental research to reduce confounding factors within a single message (Reeves & Geiger, 1994) and to validly generalize the findings of the Depicted Eating Contexts (Jackson, 1992). The experimental presentation displayed the images in random order to partial out the influence of message position on the dependent variables.

1.2.2. Message Selection Pilot Studies

Existing pro-nutritional media materials were identified and selected based on the young age of their protagonists. Because the available media were insufficient, stimuli images were created for the purposes of this experiment with several preconditions. First, the food items (displaying a large variety of fruits and vegetables) had to be central to the image topic. Second, the photos had to follow a similar style, with the main subject(s) in the spotlight and realistically portrayed in a cafeteria/lounge background that was blurred so that the focus was entirely on the subject(s). Third, the faces of the models were framed to cover similar image surfaces across conditions, controlling for the primacy of face processing (Young & Bruce, 2011). The faces of the models were naturally oriented toward the healthy foods they were handling and about to consume in realistic representations of eating situations. The biological sex of models was controlled by including relatively equal numbers of boys and girls, without interfering though with the natural group formation – this resulted in various female-predominant and male-predominant groups, with natural variation in the gender distribution of models. Context factors, such as luminosity and background color, were varied and matched across conditions (see Fig. 1, Sample stimuli for the Depicted Eating Contexts Condition).

Underage high school students were recruited to pose in images promoting healthy food by means of flyers distributed in schools and during open-university days. After receiving consent from the adolescents and their

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Fig. 1. Sample stimuli for the Depicted Eating Contexts Condition.

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1 No statistically significant differences were found between the predominantly-female versus the predominantly-male group images.
parents, approximately 300 images were created by a professional photographer. The created and the existing media pronutritional materials were viewed and rated by colleagues of the authors, all experts in the field of youth and media ($N = 7$). This initial pilot test uncovered that the existing media materials differed significantly in terms of image quality and model attractiveness from the locally created ones. In order to keep all conditions constant in terms of image quality and model attractiveness, all the existing media images were excluded.

A second pilot test ($N = 19$) with student volunteers between 18 and 19 years old was conducted with a pool of 96 of the created stimuli images. The participants were invited students to participate in a study about positive images. The purpose and carry-over effects between messages, information materials and socially-desirable responses, to prevent sensitization to the research intervention. The pilot testing also verified that the selected photos had minimum distracting elements, good photographic quality, clear focus, and clear display of the subject(s), whose faces and facial expressions were visible. Analyses of variance (ANOVA) were performed and revealed a significant main effect of Depicted Eating Contexts, $F (2, 17) = 8.54, p \leq 0.001$, and no significant effects on the other factors; the ANOVAs revealed similar ratings across the Depicted Eating Contexts conditions with $p$ values ranging from 0.58 to 0.96.

1.2.3.1. Emotion: affect and arousal. The emotional experiences conceptualized through the two dimensions of arousal and valence (Cacioppo & Berntson, 1999; Cacioppo et al., 1999; Cacioppo & Gardner, 1999; Ito et al., 1998) were operationalized through arousal, positive affect, and negative (valence) affect. Three questions asked participants to rate how aroused/positive/negative the pronutritional image made them feel—the three questions were randomly presented after viewing each image. The arousal, positive affect, and negative affect were self-reported using the Self-Assessment Mannequin (SAM; Bradley, Greenwald, Petry, Lang, 1992). SAM is a non-verbal pictorial scale comprised of five character figure drawings with varying facial expressions of arousal (ranging from calm to excited), negativity (ranging from neutral to negative), and positivity (ranging from neutral to positive). SAM is assessed by selecting an image or a spot between two images which translates into a 9-point scale validated by prior research and fitted to indicate emotional responses in underage participants.

1.2.3.2. Attentional selection. The experimental task offered participants the opportunity to select the images of their choice (displayed as small-to-medium icons) by clicking to enlarge them to full-screen for better viewing. Participants were instructed that only a limited number of images could be selected (without specifying exactly how many), so they should choose the images they wanted to see the most, a task that ensured the validity of the attentional selection measure. By clicking to enlarge to full-screen, subjects selected the images to attend to, without being able to go back or enlarge a formerly seen image. The website software recorded the order of the choices made, which was averaged to create the attentional selection: low values indicated high attentional selectivity.

The attentional selection was collected through a website with four webpages, each containing 12 image hyperlinks in a $4 \times 3$ grid. The grid image position within the webpage was randomized for every trial to partial out the influence of image position. Each webpage consisted of the three Depicted Eating Contexts conditions, four message repetitions within a webpage and four message repetitions across webpages. The 16 different images presented in each category of Depicted Eating Contexts were randomized so that any one of them could be displayed on any of the webpages, while ensuring that all three conditions were displayed on each webpage four times. On each webpage, all experimental conditions competed with each other and the task repeated until participants chose all 48 images.

1.2.3.3. Attentional processing. The website software also recorded how long participants looked at each pronutritional image when nothing else was displayed on the computer screen but the pronutritional image. The attentional processing was assessed through viewing time, in line with previous publications (Kahneman, 1973; McManis, Bradley, Berg, Cutbert, & Lang, 2001). It was reported as the actual mean time (in milliseconds) that participants took to view each image, which was tracked without their awareness.

1.2.4. Participants and procedure

The University Ethics Committee approved the research prior to participant recruitment. Power analysis for the main and interaction effects repeated measures ANOVAs with a large effect size ($f = 0.40$), a desired statistical power level of 0.80 and an $a$ level of 0.05, calculated through G-Power software v.3 (wwwpsycho.uni-duesseldorf.de/aap/projects/gpower), indicated a minimum sample size of 48. Fifty-eight secondary school students (28 Girls; $M_{age} = 15.48$, $SD_{age} = 1.58$, ranging from 12 to 18 years old) participated with parental and school consent. Fifty-two participants (90%) provided demographic information: 24 (46%) Boys and 28 (54%) Girls; 20 (39%) Younger adolescents and 32 (61%) Older adolescents. The participants were recruited from classes and offered opportunities to win prizes. To reduce potential socially-desirable responses, to prevent sensitization to the research purpose and carry-over effects between messages, information materials invited students to participate in a study about positive images. The cover story was believed, as revealed in the open-ended assessments about the study topic.

Upon arrival, participants provided informed assent and received an explanation of the procedure. To ensure the visibility of the images as small-to-medium icons, all participants were seated approximately 60 cm away from a laptop computer with a 15.4” diagonal screen that displayed the welcoming page and then guided them through the experiment. The data was collected directly through installed and verified software and it was stored on the internal memory of the experimental computer, preventing potential problems with networks and internet malfunctions. The software itself recorded the entire time it took for participants to complete the experiment and thus recorded any potential technical difficulties during the testing time. Two experimenters also silently observed the data collection at all times. No technical difficulties, no malfunctions, and no distractions were recorded by the software or by the observing experimenters. After viewing all images and making all their attentional selections, the volunteers provided demographics. They were also asked to write in their own words what they thought was the purpose of the study and what were their reasons for selecting the images and for their respective evaluations. Testing lasted approximately 35 min. At the end of the experiment, the participants were debriefed and thanked for their participation.

1.2.5. Data analysis

The data was exported from the software website and formatted for analysis with SPSS Statistics 21. Repeated measures ANOVAs 3 (Depicted Eating Contexts) x 2 (Participant Age) x 2 (Participant Sex) x 16 (Message) were performed on the dependent variables. To correct for the violation of sphericity in repeated measures designs, the Greenhouse-Geisser epsilon procedure was applied (Vasey & Thayer, 1987). All reported post-hoc tests used a Bonferroni correction.

1.3. Results study 1

All predictions of Hypothesis 1 were supported (see Table 1 for details). Young people are more likely to select, pay attention to, be more aroused, and have lower negative and higher positive affect to
pronutritional images Depicting Social Eating Contexts as compared to those not Depicting Social Eating Contexts. The results were not only statistically significant but also had large effect sizes.

The post-hoc tests revealed significant differences: The pronutritional images not Depicting Social Eating Contexts illustrating a person eating Alone resulted in lower attentional selection (a) than those Depicting Social Eating Contexts with Intimate Friends, t(51) = 7.57, p < .001, d = 1.05, and those Depicting Social Eating Contexts in Gregarious Communities, t(51) = 3.27, p < .01, d = 0.45. The pronutritional images depicting Gregarious Communities resulted in lower attentional selection than those depicting Intimate Friends, t(51) = 3.75, p < .001, d = 0.52. The pronutritional images not Depicting Social Eating Contexts illustrating a person eating Alone resulted in lower attentional processing (b) than those Depicting Social Eating Contexts with Intimate Friends, t(51) = −5.77, p < .001, d = 0.80, and those Depicting Social Eating Contexts in Gregarious Communities, t(51) = −5.47, p < .001, d = 0.76. The attentional processing to pronutritional images with Intimate Friends did not differ significantly from those with Gregarious Communities, t(51) < 1. The pronutritional images not Depicting Social Eating Contexts illustrating a person eating Alone resulted in greater negative affect (c) than those Depicting Social Eating Contexts with Intimate Friends, t(51) = 2.78, p < .01, d = 3.9. And those Depicting Social Eating Contexts in Gregarious Communities, t(51) = 3.78, p < .001, d = 0.52. The pronutritional images depicting Intimate Friends resulted in greater negative affect than those depicting Gregarious Communities, t(51) = 2.64, p = .01, d = 0.37. The pronutritional images not Depicting Social Eating Contexts illustrating a person eating Alone resulted in lower positive affect (d) than those Depicting Social Eating Contexts with Intimate Friends, t(51) = −4.22, p < .001, d = 0.59, and those Depicting Social Eating Contexts in Gregarious Communities, t(51) = −5.77, p < .001, d = 0.80. The pronutritional images depicting Intimate Friends resulted in lower positive affect than those depicting Gregarious Communities, t(51) = −3.62, p = .001, d = 0.50. The pronutritional images not Depicting Social Eating Contexts illustrating a person eating Alone resulted in lower arousal (e) than those Depicting Social Eating Contexts with Intimate Friends, t(51) = −3.13, p < .01, d = 0.44, and those Depicting Social Eating Contexts in Gregarious Communities, t(51) = −4.36, p < .001, d = 0.60. The pronutritional images depicting Intimate Friends resulted in lower arousal than those depicting Gregarious Communities, t(51) = −2.54, p = .01, d = 0.35.

In response to RQ2, results also revealed that the Depicted Eating Contexts, Participant Sex, and Age interacted significantly with medium effect size on attentional processing (see Table 1 for details). Older Girls had greater attentional processing of pronutritional images depicting Social Eating Contexts. As seen in Fig. 2 (The interaction of the Depicted Eating Contexts with Participant Sex and Age on attentional processing), Depicting Social Eating Contexts promotes healthy foods more effectively to Older Girls, who processed for a longer time the pronutritional images depicting Intimate Friends than those depicting a person Alone, t

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Table 1

<table>
<thead>
<tr>
<th>Main effects</th>
<th>M (SD)</th>
<th>F(2,47)</th>
<th>p</th>
<th>η²</th>
<th>M (SE)</th>
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</thead>
<tbody>
<tr>
<td>A person Alone</td>
<td>6.50 (.00)</td>
<td>25.91</td>
<td>&lt; .001</td>
<td>.35</td>
<td>7.21 (.12)</td>
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<td>Intimate Friends</td>
<td>3.88 (.33)</td>
<td>21.30</td>
<td>&lt; .001</td>
<td>.31</td>
<td>3.19 (.18)</td>
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<td>Gregarious Community</td>
<td>3.39 (.04)</td>
<td>11.88</td>
<td>&lt; .001</td>
<td>.20</td>
<td>3.68 (.16)</td>
</tr>
<tr>
<td>Attentional selection</td>
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<td>26.44</td>
<td>&lt; .001</td>
<td>.36</td>
<td>4.41 (.18)</td>
</tr>
<tr>
<td>Contingency in Intimate Friends</td>
<td>3.23 (.03)</td>
<td>12.54</td>
<td>&lt; .001</td>
<td>.21</td>
<td>2.93 (.19)</td>
</tr>
<tr>
<td>Negative affect</td>
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<td>&lt; .01</td>
<td>.36</td>
<td>4.75 (.16)</td>
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<td>&lt; .05</td>
<td>.31</td>
<td>4.04 (.23)</td>
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<td>&lt; .01</td>
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<td>3.96 (.44)</td>
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Interaction effects

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<th>Depicted Eating Contexts<em>Age</em>Sex on Attentional processing (in sec)</th>
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<th>η²</th>
<th>p</th>
<th>M (SE)</th>
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</thead>
<tbody>
<tr>
<td>A person Alone</td>
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<td>.09</td>
<td>&lt; .01</td>
<td>2.64 (.12)</td>
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<td>Intimate Friends</td>
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<td>.17</td>
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<td>3.32 (.18)</td>
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<tr>
<td>Gregarious Community</td>
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<td>.02</td>
<td>&lt; .01</td>
<td>3.78 (.20)</td>
</tr>
</tbody>
</table>

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Fig. 2. The interaction of the Depicted Eating Contexts with Participant Sex and Age on attentional processing.
(18) = 4.09, p = .001, d = 0.94. Older Girls also processed for a longer time the pronutritional images depicting Gregarious Communities than those depicting a person Alone, t(18) = 3.69, p < .01, d = 0.85. The attentional processing of Older Girls to pronutritional images depicting Intimate Friends did not differ significantly from those with Gregarious Communities, t(18) < 1. The pronutritional images using Gregarious Communities were also processed longer by Older Girls than by Younger Girls, t(27) = 2.01, p = .05, d = 0.81. The pronutritional images were not processed differently by Younger Boys compared to Younger Girls, nor by Older Boys compared to Older Girls. There were nonsignificant interaction effects of the Depicted Eating Contexts by Participant Sex and by Age on attentional selection, negative affect, positive affect, positive arousal, or arousal.

1.4. Discussion study 1

The results show that pronutritional images depicting Social Eating Contexts effectively captured attention and emotion, indicative of appetitive motivational system activation. Pronutritional images depicting Social Eating Contexts with several emotional faces that express high enjoyment and low distress activated the social emotional contagion of these emotions. The depiction of Social Eating Contexts also triggered appetitive motivational attention more than the Alone Eating Contexts. The exploratory post-hoc interaction tests seem to suggest that these were more effective for Older Girls, who were more likely to process for a longer time the pronutritional images depicting Social Eating Contexts compared to those not depicting Social Eating Contexts and compared to other demographic groups.

The theory of emotional contagion was strongly supported. Emotions spread in social contexts, even more so as the social groups grew. It is not only that visual messages depicting Social Eating Contexts influenced emotional responses more than those not depicting Social Eating Contexts, but the larger 3+ social groups elicited lower negative affect, greater positive affect, and arousal than those depicting smaller intimate (1 + 1) groups of friends. Moreover, the promotion of healthy foods through Social Eating Contexts attracted appetitive attentional processing irrespective of the social group size, whether the pronutritional images depicted smaller intimate (1 + 1) groups of friends or larger 3+ social groups.

The findings support the effectiveness of the depicted Social Eating Contexts in eliciting appetitive motivational attention and emotion to the pronutritional images, making them more likely to be selected for processing, processed, and liked. Nonetheless, the current results cannot indicate whether the attention is captured by the healthy food cues displayed in the pronutritional images. The attentional focus on the healthy foods is necessary for the pronutritional information to be processed and remembered.

In order to examine whether depicting Social Eating Contexts automatically influence the attention on the food items themselves, a second experiment was conducted. We argue that Social Eating Contexts direct the initial attentional selection and the positive affect to focus on the healthy food cues which, in turn, will capture memory formation. The research project further explores whether Social Eating Contexts are effective in directing the generated mental resources toward processing the healthy food cues displayed in the pronutritional images.

2. Study 2

2.1. Introduction study 2

Shared meals in social groups use salient motivationally-relevant social cues to capture attention and positive emotions, and they are centered around and highlight the food. Extensive research in social attention and visual orienting has documented the automatic tendency to attend to and follow another person’s eye gaze (Driver IV et al., 1999; Friesen & Kingstone, 1998; Kuhn et al., 2009; Langton & Bruce, 1999). Thus, because the shared meals depicted in the pronutritional messages are visually constructed around the healthy foods, the models’ eye-gaze guides the viewers toward their center of attention—toward the healthy foods (Driver IV et al., 1999; Friesen & Kingstone, 1998; Kuhn et al., 2009; Langton & Bruce, 1999). Depicting Social Eating Contexts is thus hypothesized to facilitate the allocation of mental resources to the healthy foods, which is particularly promising because it increases the processing of the promoted food items by directing attention to them. This is more effective than the ubiquitous promotional appeals, such as sex, fun, or humor, which automatically attract attention but do not direct this attention to the promoted items, instead distracting from them (Haaland & Venkatesan, 1968; Samson, 2018).

Face processing has been strongly evidenced as an area of ‘special processing’ (Yin, 1969). The immediate and automatic elicitation of visual attention and mental resources has been documented in numerous studies, evidencing the innate motivational mechanisms which regulate priority face processing (Farah, Wilson, Drain, & Tanaka, 1998; Johnson, Dzurawiec, Ellis, & Morton, 1991; Valentine, 1988). The motivational mechanisms underlying face processing guide the attention and mental resources particularly to the eye regions of the model faces (Xu & Tanaka, 2013). Moreover, the eye gaze of the models further guides the viewers’ visual attention to focus on the image area that the models are looking at (Driver IV et al., 1999; Friesen & Kingstone, 1998; Kuhn et al., 2009; Langton & Bruce, 1999). Because the models’ eyes are oriented toward the healthy foods in the pronutritional images, the viewers’ visual focus will follow that of the models to the foods which the models are looking at. The depicted social eating contexts are thus predicted to further guide more visual attention and mental resources to focus on the healthy foods. Pronutritional images depicting social eating contexts will result in greater visual attentional focus on the healthy foods being shared in the social eating contexts as compared to those not depicting social eating contexts (H2).

In order for the promotional messages to effectively influence purchase decisions, viewers should not only focus their visual attention on the messages but also should process them cognitively and remember them. Because of the delay between the exposure to persuasive media and the potential influence on purchases, persuasive strategies seek memorable appeals capable to shape purchase decisions. Memory for the promoted healthy foods is thus essential and it is investigated next.

Encoding is the first component of message information processing, which has been theorized by the Limited Capacity Model for Motivated Mediated Message Processing (LC4MP; Lang, 2009, pp. 193–204). The LC4MP describes information processing as a group of three subprocesses: encoding, storage, and retrieval.

Encoding is the subprocess of selecting the stimuli for information processing and initial memory formation—of orienting the audience toward the message for information intake (Lang, 2009, pp. 193–204). This early subprocess of encoding is arguably critical for processing media messages, which occurs predominantly at this level; most viewers do not actively consume the visually rich media images to store them into their working memory nor to intentionally integrate them into the networked organization of stored mental information (Lang, 2009, pp. 193–204). Audiences can thus effectively encode the images to which they have been exposed, but they might be less able to store and retrieve them.

In order to test the effectiveness of the depicted eating contexts, encoding levels were examined. Survival-relevant salient stimuli, such as social eating contexts, automatically activate the appetitive motivational system, guiding mental resources to processing and information intake, resulting in greater encoding (Samson, Namee, & Buijzen, 2021; Cacioppo & Gardner, 1999; Compton, 2003; Damasio, 1998; Ito et al., 1998; Lang, 2009, pp. 193–204). A recent study has shown that pronutritional images depicting shared meals with others as compared to nonsocial eating contexts attract more cognitive processing, increasing memory for the whole pronutritional images (Samson et al., 2021). It is further predicted that pronutritional images depicting social eating
contexts will also result in greater encoding of the foods displayed as compared to those not depicting social eating contexts (H3). Study 2 also explored differences between the two types of social eating contexts: intimate friends (1 + 1) and gregarious community (3+). We are interested in how the two depicted social eating contexts influence the visual attentional focus on food items and the encoding of the foods in the prounutritional images (RQ3).

The research project further explored whether the depicted social eating contexts interact with participant sex and age in their influence on the visual attentional focus to food items and on the encoding of the foods in the prounutritional images. Prior publications have deemed the effects of children’ age and sex as inconclusive as results have been mixed (Buijzen & Valkenburg, 2003; Valkenburg & Buijzen, 2005). Therefore, we inquire whether the depicted social eating contexts interact with participant sex and age to influence visual attentional focus on the food items (RQ4) as well as the encoding of the foods (RQ5).

2.2. Materials and methods study 2

A similar 3 (Depicted Eating Contexts) × 2 (Participant Age) × 2 (Participant Sex) × 8 (Message) mixed factorial design was conducted. The Participant Age factor consisted of Younger (12–14 years old) and Older adolescents (15–18 years old) grouped using median split and according to the developmental stages of adolescence and susceptibility to social appeals (Breinbauer & Maddaleno, 2005; Christie & Viner, 2005; Valkenburg & Piotrowski, 2017). The message factor had eight levels (eight images), displaying a total of 24 images. The stimuli messages and the data analysis were identical to those of Study 1.

2.2.1. Dependent variables

2.2.1.1. Visual attentional focus on food items. An eye-tracker assessed participants’ visual attentional focus on the stimuli, which were displayed at a resolution of 1024 × 786 pixels × 16 million colors on a True Color monitor. Eye fixations were recorded by a Tobii T60 table-mounted eye-tracker placed approximately 60 cm away from the participant’s head in a controlled environment laboratory with no natural or incandescent (gleeplamen) light—placement distance and conditions were recommended for optimal data collection by the Tobii Technology User Manual. Eye positions were sampled at 60 Hz. Viewing was binocular, although only the position of the right eye was used, as it is common in eye-tracking research (e.g., Henderson, Weeks, & Hollingworth, 1999). In line with methodological recommendations, the visual attentional focus on particular areas of interest were computed and analyzed as the viewer’s total fixation time divided by the area of the elements of interest, called fixation time per unit area (FTA; Bylinskii, Borkin, Kim, Pfister, & Oliva, 2015). The visual attentional focus on foods in images measured the FTA for the healthy foods being looked at by the model(s).

2.2.1.2. Encoding of foods in images. Encoding was operationalized via visual recognition (Baars & Gage, 2007; Lang, 2009, pp. 193–204). Participants were asked to identify snapshots of particular food items as shown (1) or not shown (0) in the experiment. The items were presented on screen for 100 ms and separated by a black screen. Participants then had 3 s to respond yes or no with assigned keyboard keys. Even if no answer was given in this timeframe, the next item was shown. This yes/no recognition test is in line with previous studies (Samson & Buijzen, 2020). The total of 48 items, 24 target snapshots of foods and 24 corresponding foils, were presented in random order. To create the corresponding foils, photos were used with similar but different food items.

2.2.2. Participants and procedure

Power analysis for the main and interaction effects ANOVAs with a medium effect size ($f = 0.25$), a desired statistical power level of 0.80 and an $\alpha$ level of 0.05, calculated through G-Power software v3.3 (wwwpsycho.uniduesseldorf.de/aap/projects/gpower), indicated a minimum sample size of 160. Adolescents visiting the Science Museum were recruited by means of announcements to participate in this research through the museum’s Science Live program. This resulted in 165 participants (87 Girls; $M_{age} = 13.76$, $SD_{age} = 1.77$, aged 12 to 18) The information materials invited minors to participate in a study on evaluating positive images by providing their opinions about them; this was realistic because 20 masking images—resembling the experimental stimuli but displaying positive activities not related to food (e.g., painting, traveling)—were added to the 24 experimental images. The youngsters simply clicked on the SAM character figure drawing of choice (SAM; Bradley et al., 1992) to express their opinion about the visual messages just seen. The cover story reduced potential socially-desirable responses, prevented sensitization to the research purpose and carry-over effects between messages. It was effective, given that no participants were aware of the research purpose or manipulation.

After parents provided informed consent, the participants were introduced to the Science Live controlled environment laboratory and equipment which was calibrated. The calibration consisted of participants fixating on five markers on the display screen area until the average error in gaze position was below 0.5°. After the Tobii system was successfully calibrated to each individual eye gaze, the experimental session began with a practice session that familiarized participants with the procedure and controlled for primacy effects. The 44 messages (24 experimental stimuli and 20 masking ones) were then presented in three orders that were organized to initiate stimuli presentation with a masking message, followed by an experimental one, and continuing the quasi-alternating sequence to end with an experimental message. There were no significant effects of the presentation orders on the dependent variables. The messages were randomly selected to form the presentation sequences and were programmed and controlled directly through Tobii Studio. The built-in Tobii Studio software ensures superior data quality because it uses a unified integrated system for stimulus presentation, data acquisition, and eye-tracker calibration. Each message was followed by a short questionnaire assessing SAM, which also served to prevent carry-over effects between conditions (Reeves & Geiger, 1994). The eye-tracker calibration and the experimental testing together with the memory test lasted approximately 25 min. This was followed by a debriefing, an educational explanation of the eye-tracker, and demonstration of the data collection—part of the Science Live program through which children learn about social scientific experiments by participating in them. This established an optimal testing for eight different messages, with a Message repetition factor of eight.

2.3. Results study 2

Hypothesis 2. was supported with medium-large effect size (see Table 2 for details). Participants were less likely to focus on the foods displayed in the prounutritional images that did not depict Social Eating Contexts than those depicting Social Eating Contexts with Intimate Friends, $t(164) = -6.56$, $p < .001$, $d = .52$ and those depicting Social Eating Contexts in Gregarious Communities, $t(164) = -5.13$, $p < .001$, $d = .40$. The visual attentional focus on foods displayed in images with Intimate Friends was not significantly different from that displayed in images of Gregarious Communities, $t(164) < 1$.

Hypothesis 3. was also supported with medium-large effect size (see Table 2 for details). The healthy foods displayed in the prounutritional images that did not depict Social Eating Contexts were less likely to be encoded than those depicting Social Eating Contexts with Intimate Friends, $t(164) = -5.66$, $p < .001$, $d = .44$, and those depicting Social Eating Contexts in Gregarious Communities, $t(164) = -3.78$, $p < .001$, $d = .30$. There was no significant difference between the encoding of
healthy foods displayed in prounutritional images depicting Intimate Friends versus those depicting Gregarious Communities, *t*(164) = 1.62, *p* = .11.

In response to Research Question 4, the Depicted Social Eating Contexts did not interact significantly with participant sex and age in influencing the visual attentional focus on the foods in the prounutritional visual messages. In response to Research Question 5, results revealed that the Depicted Social Eating Contexts and Participant Sex interacted significantly with a small effect size on the encoding of healthy foods (see Table 2 for details). The interaction effects were stronger for Girls who encoded significantly more of the healthy foods displayed in prounutritional images depicting Social Eating Contexts as compared to those not depicting Social Eating Contexts (see Fig. 3, The interaction of the Depicted Eating Contexts with Participant Sex on the encoding of the healthy foods in images). Girls encoded the healthy foods displayed in prounutritional images depicting a person Alone significantly less than those displayed in prounutritional images depicting Gregarious Communities, *t*(86) = 3.57, *p* < .001, *d* = 0.39, and significantly less than those displayed in prounutritional images depicting Intimate Friends, *t*(86) = 5.97, *p* < .001, *d* = 0.64. There was no significant difference between Girls’ encoding of healthy foods displayed in prounutritional visual messages depicting Intimate Friends versus those depicting Gregarious Communities, *t*(77) < 1, and no significant differences between Boys’ encoding of healthy foods displayed in prounutritional visual messages depicting a person Alone versus those depicting Gregarious Communities, *t*(77) = 1.67, *p* = .10. Boys’ encoding of healthy foods displayed in prounutritional visual messages depicting Intimate Friends differed from those depicting a person Alone, *t*(77) = 2.04, *p* = .05, *d* = 0.24.

3. Conclusions

This study provides promising recommendations on how to promote healthy foods to children and adolescents more effectively through depictions of social eating contexts. These are opportune findings for public health because promoting the intake of fruit and vegetables has been found to produce nutritional change, improving long-term dietary patterns, reducing, and preventing obesity (Epstein et al., 2001). The depictions of social eating contexts can be included in formal promotions, such as public health campaigns, PSAs, or media policy, as well as informal promotions by parents, educators, schools, or other social institutions. The main contributions of this research consist of empirical evidence about the potential of social eating contexts to capture appetitive motivational attention and emotion for the prounutritional images, as well as attentional focus and memory formation for the core healthy foods, an area of demonstrated low appetitive motivational processing (Killgore et al., 2003; Spielvogel et al., 2018; Toepel et al., 2009; van der Laan et al., 2011). The results demonstrate that social appeals such as social eating contexts can elicit attention, emotion, and mental resource

<table>
<thead>
<tr>
<th>Main effects</th>
<th>F(2,160)</th>
<th>$\eta^2$</th>
<th><em>P</em></th>
<th>A person Alone</th>
<th>Intimate Friends</th>
<th>Gregarious Community</th>
</tr>
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<tbody>
<tr>
<td>Visual attentional focus on foods in images</td>
<td>.12 (.03)</td>
<td>16.83</td>
<td>.10</td>
<td>.001</td>
<td>.106 (.003)</td>
<td>.129 (.004)</td>
</tr>
<tr>
<td>Encoding of foods in images</td>
<td>.32 (.29)</td>
<td>15.21</td>
<td>.09</td>
<td>.001</td>
<td>.26 (.02)</td>
<td>.36 (.02)</td>
</tr>
<tr>
<td>Depicted Eating Contexts * Sex on the encoding of foods in images</td>
<td>3.02</td>
<td>.02</td>
<td>.050</td>
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**Table 2.** Analysis of variance (ANOVA) Study 2.
allocation to the pronutritional messages (Study 1) and, specifically, to the core healthy foods promoted (Study 2). Young consumers processed and felt more positive about the pronutritional messages that depicted social eating contexts; they also paid attention and remembered the healthy foods promoted through depictions of social eating context—cognitive and affective processes which are essential for purchase decisions (Gunter, Oates, & Blades, 2004; Valkenburg & Buijzen, 2005).

The implications of the results rely not only on their statistical significance, but also on the magnitude of the effect sizes (Cohen, 1992; Keppel, 1991) and the predicted direction of the main effects of the depicted social eating contexts increasing motivational processing. Increasing children’s visual attention, positive emotions, and memory formation was achieved through pronutritional media images depicting salient motivationally-relevant social eating contexts that emphasize belonging to a group and peer acceptance.

Media social cues effectively activated the appetitive motivational processing (Cacioppo et al., 1999; Compton, 2003; Ito et al., 1998), influencing attentional selection, arousal, and affect. The capacity of the depicted social eating contexts to draw attention, positive affect, and initial processing to the pronutritional images was strongly supported. Moreover, as evidenced in Study 2, the depicted social eating contexts also further guided the attention and mental resources to focus on the healthy foods portrayed in the spotlight of mediated shared meals. Because the models’ faces and eyes—which automatically elicited priority processing—were oriented towards the healthy foods in the shared meal contexts, the depicted social eating contexts effectively directed the visual attention and the mental resources to the healthy foods. These findings support the strong impact of the depicted social eating contexts to activate motivated information processing for the core healthy foods. The social eating contexts are particularly effective because they visually highlight the promoted healthy foods (or other activities/objects) as central parts of the shared activities. A key objective of this study was to increase the effectiveness of messages promoting healthy foods, thus predicting that social eating contexts would increase encoding levels as well. Indeed, the social cues facilitated mental resource allocation and encoding of the core foods promoted.

The results seem to indicate a preference for visual messages that displayed gregarious communities. These social contexts elicited the least negative emotions, the most positive ones, and were the most arousing. They were also just as likely to be processed for a longer time as the images displaying intimate friends. Both social eating contexts (intimate friends and gregarious communities) were equally likely to direct visual attentional focus and mental resources to the foods and thus contribute to their encoding. The images displaying intimate friends were, however, more likely to be selected than all other images. If it is still debatable which of the two social eating contexts is the most successful, the results are unequivocal about the least effective one. The images that did not depict social contexts were least likely to be selected and processed, and they were the most negative, least arousing, and positive; they were also least successful in directing visual attentional focus and mental resources to the healthy foods and resulted in the lowest encoding. Although often used, the pronutritional images displaying a person alone were found to be less noticeable, less processed, and less liked, and the viewers of these PSAs would be less likely to focus and remember the foods promoted. PSA images would be more effectively processed if set in a social setting in which people are together involved in the target activity. In terms of promoting healthy foods, these would have been more effectively processed and remembered if presented within the context of shared meals.

Processing promotional messages enables young consumers to identify brands in stores or recall the brand name when making purchase decisions, as evidenced in several studies (Gunter et al., 2004; Valkenburg & Buijzen, 2005). Furthermore, children’s processing of the promotional messages is documented as an important precursor of purchase decisions (Gunter, Oates, & Blades, 2004; Valkenburg & Buijzen, 2005).

Because cognitive and affective responses are the underlying mechanisms and important precursors of behaviors such as food choice, purchase, and intake, it is important that young consumers process and feel positive about the healthy foods so that they remember and approach them when making decisions about food purchases and consumption. The greater appetitive motivational processing of healthy foods promoted through social eating contexts might lead to more requests to parents, purchases, and intake of healthy foods, and thus to a potential increase in the desired eating behaviors with key public health impacts.

This research could potentially extend the social modeling of eating (Cruwys, Bevelander, & Hermans, 2015; Higgs & Thomas, 2016). Important research on the social modeling of eating documented that cues emanated during food consumption set expectations about what is appropriate to eat, including shaping healthy food choices (Cruwys et al., 2015; Robinson & Higgs, 2013). Because depictions of shared meals in social groups have been found to elicit powerful appetitive motivational mechanisms to their processing, improving processing and memory, and potentially influencing decisions about healthy foods, the social modeling of eating effects might further increase when depicting social eating contexts as compared to models eating alone. This research also reveals how pronutritional mass media depicting social eating contexts could further increase the social modeling of eating effects, usually found with live confederates modeling eating (Cruwys et al., 2015). The mediated social modeling of eating can more widely spread in lower socioeconomic communities, where fewer healthy habits, including healthy eating habits are recorded (Health Poverty Action, 2018; World Health Organization, 2010, 2016). Pronutritional mass media depicting social eating contexts offers a potential increase in the social modeling of eating effects when using mediated healthy role models in communities with less healthy habits being recorded and modeled. It is also a viable public health solution as media has a wide reach and is often viewed in disadvantaged communities.

The second major contribution of this study is thus its theoretical implications. Social evolutionary perspectives (Bernard et al., 2005; Cacioppo & Patrick, 2008; Wilson, 1975, 1978) and motivational processing frameworks (Cacioppo et al., 1999; Compton, 2003; Ito et al., 1998) can hence extend the theory of social modeling (Cruwys et al., 2015; Higgs & Thomas, 2016). Pronutritional depictions of shared healthy meals in social groups elicit more appetitive motivational attention and positive emotions for the pronutritional images, and capture more attentional focus and memory formation for the healthy foods than the depictions of solitary eating. Depictions of social eating contexts increase the processing of pronutritional media, improve memory for them and potentially increase healthy food-consumption norms. Building on both theoretical frameworks, it is evidenced that pronutritional depictions of shared healthy meals, as opposed to depictions of solitary eating, enhanced the processing of the pronutritional messages and of the healthy foods promoted. The applicability of the motivational processing framework (Ito et al., 1998), the information processing theories (Lang, 2009, pp. 193–204), and social emotional contagion (Hatfield et al., 1992) have been documented in health communication research. By examining the underlying mechanisms of how young people process pronutritional visual messages, this study reveals how to attract visual attention, positive emotions, and memory formation for healthy foods. The theories have evidenced their potential to inspire pronutritional visual messages with everlasting effects: Their applications in the current research demonstrate powerful ways through which motivational processing and social evolutionary theories can be used to inspire pronutritional images depicting shared healthy meals. Last but not least, the current study also points to the fruitfulness of multidisciplinary studies employing sociological and psychological perspectives.

The exploratory interaction effects of the depicted eating contexts with participant age and sex should also be mentioned. No age differences were detected in the motivational information processing of the
pronutritional images. Adolescents of all ages seem to be susceptible to the social context (Valkenburg & Piotrowski, 2017a, 2017b). This is in line with prior results that young people, in general, are influenced by social factors (Berndt, 1979; Brechwald & Prinstein, 2011; Brown, 2004). This study provides preliminary supportive evidence for the effectiveness of the depicted social eating contexts on all teenagers. However, media social cues seem to be better motivators for older adolescent girls, who were more likely than all other demographic groups to process the pronutritional images depicting social eating contexts for a longer time. They also had better recognition of the healthy food items displayed in the images depicting social eating contexts. The social cues seem to influence girls more than boys—these results provide some preliminary support the traditional, alpha-bias sex differences, as predicted by classical publications (Coleman, 1961; Eagly, 1983; Eagly & Koenig, 2006). Interestingly, individual differences were only found for implicit data and memory tests, not through any of the self-reported measures. By avoiding self-reported questionnaire data, this study might have evaded the socially desirable bias and reached more objective, uninterpretable, and ‘true’ responses (De Houwer, Teige-Mocigemba, Spruyt, & Morsink, 2009). The current findings reveal that gender differences in information processing may start to develop during adolescence as this age group is more influenced by social cues. There is great potential to further explore the age and sex differences with regard to visual attention, memory processes, and emotional reactions to social images, which have not been examined by scholarly research to date. This paper thus opens up new directions for future research to investigate the interactions between the depicted social eating contexts and participant age and sex.

The theoretical and methodological merits of this study are accompanied by some limitations. There were reported differences between the samples of the two studies: Study 1 and 2 had distinct sample sizes and characteristics, although the age-range of the volunteering participants was kept constant. The sample differences might have influenced the findings, even though this research examined motivationally-relevant social stimuli which are universal. Future studies should focus on larger and more representative samples and thus provide more details related to individual difference. Limitations related to the laboratory nature of the study should also be acknowledged. The responses provided by the participants in the lab might not have accurately reflected their ‘real world’ reactions. The novel circumstance of a laboratory setting might have prompted the participants to experience higher levels of arousal and attention, with more cognitive resources focused on media processing (Lang, 2009, pp. 193–204). Moreover, the participants gave their opinions on a series of images about positive advertising, most of which were about healthy eating. The pronutritional images may have a different impact when incorporated within media programs. The study did not include any programming to frame the images, and they were shown in a rather artificial context. Field research conducted in a more natural media environment is thus called for in the future. In terms of stimuli, the depictions of social eating contexts with intimate friends (2 people) might also have been interpreted as a heterosexual couple although there were absolutely no displays of affection, nor physical intimacy with the models not touching each-other, nor leaning against each-other. In most images, the two were sitting separately at some distance from one-another and displaying no cues typically representing a couple. Future studies could also move beyond stimuli depicting naturally-formed groups and control or manipulate more strictly the model’s sex and age. The choice of a controlled lab experiment ensures a higher degree of internal validity but at the expense of the study’s ecological validity. This research primarily pursued psychological realism (Aronson, Wilson, & Brewer, 1998), ensuring that the relevant psychological mechanisms were activated and measured while also ensuring that the participants were not sensitized to the research goal. Finally, we should acknowledge that the current investigation focused on information processing stages. For more solid conclusions about the effectiveness of depictions of social eating contexts to increase healthy eating, further research should investigate attitude change and food consumption.

In summary, the research reported here makes several theoretically and societally relevant contributions, providing beneficial guidelines for health communication practice. This work is novel and important in four respects: (1) This paper introduces a new approach for health promotions, based on the motivated processing of social appeals; (2) This approach is aimed at increasing the appetitive motivational processing of healthy food cues, which are associated with lower activation of the appetitive motivational system; (3) The paper argues and provides evidence as to how social evolutionary perspectives can potentially extend the theory of social modeling; and (4) In response to calls from WHO (2005, 2016, 2018), these empirical findings document how mediated social cues can increase the effectiveness of pronutritional materials. Specifically, the paper provides promising recommendations regarding how fruits and vegetables can be made noticeable, highly arousing, likable, and memorable when promoted through media social cues in images depicting shared healthy meals.

Grounded in the motivational processing framework, encompassing emotional contagion and information processing theories, this investigation was the first to demonstrate how the desired health outcome can be achieved by focusing on mediated shared healthy meals. This research has several theoretical and methodological contributions, while also providing beneficial guidelines for health communication practice. Based on the current findings, we specifically recommend using social eating contexts to promote healthy foods more effectively to young people, especially visual depictions of large groups involved in shared social meals. The same social contexts can increase processing, attention, and memory for other nonmediated communications from parents, institutions, regulators, policymakers, or consumer welfare advocates. Even beyond advertising and marketing, these groups should use groups of teenagers to communicate to individuals. The promising results have been found with pronutritional messages using visual depictions of social shared meals. These images have the great flexibility to adapt to any available media format, as they can be included not only in newspaper print communications, magazines, and leaflets but also in television and digital media messages, which have recently gained great popularity among children. Furthermore, visual depictions of shared healthy meals can be easily incorporated in moving images, as part of short films, etc. Through which useful communications could be made to young people on platforms they frequently use, such as television and mobile devices. The results of this study form a basis for further research in this area and offer several interesting avenues for future studies.

Ethical statement

The authors of manuscript APPETITE_2019_209R3, entitled “How media appeals depicting social eating contexts increase the appetitive motivational processing of healthy foods” declare that the Ethics Committee of Radboud University approved the research prior to participant recruitment.

Credit author statement

Both authors approved the final version of this article. Both authors contributed to the conceptualization, design of the research project, and interpretation of results. Lelia Samson carried out the data collection and analysis, wrote the original draft, and revised versions of the manuscript. Lelia Samson also took care of data curation and project administration.

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