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Food as an eye-catcher. An eye-tracking study on Children's attention to healthy and unhealthy food presentations as well as non-edible objects in audiovisual media

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Abstract

BACKGROUND: Food presentations within media content are often made responsible for todays' obesity epidemic. This assessment is based on the assumption that food presentations create cue reactivity, which in turn affects the amount of food intake.

OBJECTIVE: This study investigates children's implicit reactions (cue reactivity) toward healthy, unhealthy, and non-ediblel objects.

METHODS: We conducted an experimental eye-tracking study comparing children's cue reactivity assessed with visual attention toward healthy and unhealthy food presentations, as well as non-edible objects. We controlled for the role of children's hunger, body mass index (BMI), and age.

RESULTS: Results indicated no difference between healthy and unhealthy food presentations, yet food generally aroused more visual attention in children compared to non-edible objects. Explicit memory for the embedded foods or objects was mediated through visual attention. However, unhealthy food presentations also directly affected children's explicit memory.

CONCLUSIONS: Compared to non-edible objects, food presentations seem to be eye-catchers that immediately grab children's attention and they are also able to maintain this attention. Yet, for unhealthy food presentations, memory seems to be less dependent on visual attention. That is, compared to healthy products or non-edible objects, unhealthy food presentations do not require the same amount of visual attention in order to be remembered.

KEYWORDS

body mass index, children, Cue reactivity, eye tracking, food presentations

1 | INTRODUCTION

In the movie "Cloudy with a Chance of Meatballs", a scientist creates a machine that creates tasteful precipitation; in the TV-show and movies starring "SpongeBob Squarepants" the whole plot revolves around a burger franchise and its tasty recipe; and on Nickelodeon, a popular children's TV channel, approximately thirty percent of all aired commercials promote foods or beverages.[1] These examples show that

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food plays an important role in media content,[2] especially in movies, TV-series, and commercials targeted at children.[3-9]

However, what kind of food is presented in the media is often far off the ideal reality of a balanced, and healthy diet.[4] Content analyses on food presentations in commercials and entertaining media unequivocally suggest that unhealthy foods high in salt, fat or/and sugar are overrepresented compared to healthy foods.[3,5,8,10] Effect studies on unhealthy food placements, such as salty snacks, sweets and soft drinks, have furthermore continuously shown that children's attitudes and consumption behaviors are heavily influenced by these presentations.[11-19] Simultaneously, studies on healthy food placements, such as fruits or vegetables, showed that it is comparatively hard to steer children toward healthy food choices.[20,21] This can be explained by the fact that humans have an inherent preference for sweet products.[22] For instance, even infants (i.e., 1–3 days old) are able to discriminate between pure water and a sugar solution and show a preference for the latter.[23] Beside this preference for unhealthier options, studies also showed that all food presentations in media can serve as a cue for eating,[24-26] linking the abundance of food presentations in media to today's obesity epidemic, especially when it comes to children.[27]

Jansen[28] offers a theoretical background for these findings by pointing to humans' willingness to eat based on an increase in physiological and psychological reactions, that is, an increase in their cue reactivity. Cue reactivity is defined as a series of physiological responses such as an increase in heart rate, gastric activity, or salivation,[29,30] as well as psychological responses, such as increased thoughts about, or awareness to food.[28,29]

One way to assess cue reactivity is an increased visual attention toward food presentations.[28,29] Following this line of argumentation, the amount of cue reactivity activated by food presentations is connected to human's food intake.[31] While this rationale is frequently used to describe the link between TV-consumption and obesity,[27] studies investigating how cue reactivity is affected when it comes to food presentations *embedded* in media content are scarce.[17,32]

The few available studies have indicated that there is a link between children's visual attention and their preference for the embedded unhealthy food.[17] However, these results are only focused on unhealthy food presentations, hence providing no insights on whether these effects can also be translated to the presentations of healthy foods. So far, we are aware of only one study investigating the differences between visual attention to healthy and unhealthy food presentations within media content.[32] Although there is initial empirical evidence for differences between children's processing of unhealthy and healthy foods with different levels of integration,[32] we still lack insights into the general processing of food compared to neutral objects. Yet, a comparison of the processing of food-related stimuli with neutral objects is crucial for an objective evidence for cue reactivity toward food presentations. Additionally, studies linking cue reactivity measures with other dependent variables indicating food choice are urgently needed to gain a deeper understanding on how food presentations within media content affect viewers.[31]

We aim to further understand the processing of healthy compared to unhealthy food presentations by conducting an eye-tracking study. The goal of this study is to understand the cue reactivity toward food presentations in more detail by employing a baseline measure for visual attention (i.e., a condition showing non-edible objects). We thus conduct a 1x3 factorial design comparing children's visual attention for healthy food presentations, unhealthy food presentations, and non-edible objects.

As an additional extension of the literature, we consider two individual susceptibility factors that might affect children's visual attention to food presentations. We control for children's level of hunger[16,17,21,26,32] and for children's level of Body Mass Index (BMI).[33] Furthermore, we connect the observed visual attention measures for the embedded food presentations or non-edible objects with children's explicit memory of the observed content. We choose children's explicit memory as our dependent variable as it is assumed to be connected to visual attention, in that regard as paying attention to a visual cue should lead to more explicit awareness for this cue.[34,35] Furthermore, in the dietary literature, having products accessible in one's memory is assumed to be connected to implicit attitudes, which are of key importance in spontaneous choice situations.[36] Hence, having a certain food type more prevalent in one's memory increases the likelihood of choosing this product in a spontaneous shopping situation or an impulsive food choice situation at home. Therefore, assessing explicit memory as a dependent variable might provide us with a deeper understanding of the processing of food presentations within media content and its consequences. As literature points to age being an important predictor of the possibility to retrieve information from one's memory, we include children's age as an additional control variable in our design.[37]

We hypothesized that (i) children's visual attention assessed through a) *first fixation duration* and b) *dwell time* will be higher for food presentations compared to non-edible objects, (ii) children's visual attention will be higher for unhealthy compared to healthy food presentations, and that (iii) higher visual attention to (non-)food presentations will lead to greater explicit memory of the (non-)food presentations. For a visualization of our proposed effect model, see Figure 1.

2 | METHOD

We conducted a 1x3 experimental between-subject study with children. In our study, we combined eye-tracking measurements with survey data. The data for this study was collected in three primary schools in Austria in February and March 2018. The ethical committee of the University of Vienna as well as the headmasters of the participating schools approved the study. For each child, we furthermore obtained parents' written and children's oral consent.

2.1 | Participants

Initially, a total sample of 109 children between 6–10 years took part in the study. We had to exclude two children because of problems in the stimulus presentation (n = 2). Moreover, we had to exclude five children who showed poor deviation results following final calibration (>1°; n = 5). Thus, a complete dataset of N = 102 children (M_{age} = 7.96; SD = 1.27; 51.0% male) remained .[17] The size of the employed sample has to be considered with regard to the observable effect magnitude.

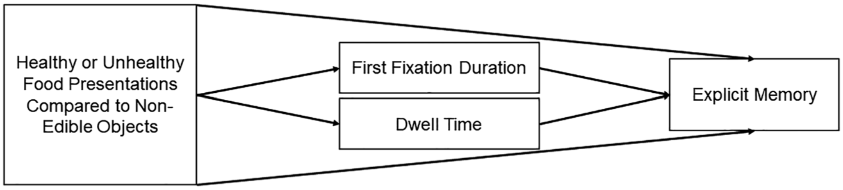

FIGURE 1 Proposed effects model

2.2 | Procedure

The children completed individual eye-tracking sessions. We used an eye-tracking system (SMI iView X™ RED) with high spatial resolution and a sampling rate of 120 Hz. Although viewing was binocular, only the right eye movements were monitored.[38] We randomly assigned each participant to either a healthy condition (n = 35), an unhealthy condition (n = 35), or the control condition showing non-edible objects (n = 32).

One principal investigator was conducting the eye-tracking sessions.The principal investigator seated each child individually in front of a computer, where he or she watched one version of a self-created stimulus. Before starting the study, the experimenter explained to the child that he or she should sit as still as possible and should try to move her or his head as little as possible. Then, children underwent a calibration procedure to assure the accuracy of the retrieved data. We conducted a 5-point calibration test at the beginning of the experiment and a 5-point validation test at the end of each session. When the calibration or the validation did not show appropriate values after repeating the measure three times, we excluded this participant. After the calibration test, the principal investigator showed the actual stimulus to the children. To assure that the eye-tracking procedure was feasible with children as participants, we conducted a qualitative pre-test (n = 8). This pre-test helped us to adjust children's positioning and aided us to develop the right instructions to ensure that children were able to follow the eye-tracking procedure.

After the stimulus presentation, each child was led to a separate interview room and was questioned individually by another investigator. Then, the investigator measured children's height and weight to assess their BMI. Afterwards the investigator brought the children back to their class. The children were instructed not to talk about the media-stimulus they just saw to avoid a potential influence on the children who took part in the study later on. All children were chaperoned throughout the whole procedure and were engaged in a simple ball game while waiting. This way we could make sure that all children followed these instructions.

2.3 | Stimuli

We designed three versions of the narrative stimulus for children (6:00 min) using the software PowToon. Later, we imported the stimuli to the eye-tracker system. Within the stimulus, either healthy foods such as a banana or raspberries (i.e., healthy condition), unhealthy foods such as an ice cream or a candy (i.e., unhealthy condition), or non-edible objects, such as a sunscreen or a beach ball (i.e., control condition), were integrated. We made sure that the objects were similar in color and shape to guarantee that the amount of visual attention assessed was only connected to the object-category (healthy foods, unhealthy foods, non-edible objects) and not to the objects' differences in color, size or product complexity.[21]

Our media-stimuli presented the story of two children, who went on a family vacation to the beach for the first time. During this story, the children were shown traveling on an airplane, relaxing on the beach, visiting an aqua park, or making a trip with a boat. In this story, we visually integrated either healthy foods (healthy condition), unhealthy foods (unhealthy condition), or non-edible objects (control condition). Other than that, the story remained exactly the same in all three conditions. All objects or food presentations were furthermore kept constant in their degree of integration. To let the inserted non-edible objects and food presentations stand out from the rest of the visual cues,[32] we decided to embed all foods and non-edible objects in interaction with the portrayed characters.

We saved the stimuli at a resolution of 972 × 1,137 pixels. Images had onscreen dimensions of approximately 40 cm in height and 34 cm in width and appeared before participants on a 17-inch monitor. In all conditions, the objects or foods were integrated six times for a total of 9,000 ms.

2.4 | Measures

2.4.1 | Visual attention

To adequately assess visual attention, observational methods, such as eye-tracking, are needed. Eye-tracking can record single fixations of the eye lasting 200–400 ms and eye movements in between those fixations, named saccades.[39] We decided to include two measures: *first fixation duration* and *dwell time*. First fixation duration can give insights into the initial attention children pay to a predefined Area of Interest (AOI). The duration of eye fixations is usually used as an indicator for the depth of processing.[39,40] Dwell time on the other hand sums up all fixations and is thus an assessment of the overall attention an AOI was able to arouse.[41]

To calculate first fixation duration and dwell time, the AOIs were defined. The healthy food presentations (healthy condition), the unhealthy food presentations (unhealthy condition), and the non-edible objects (control condition) within the audio-visual media-stimuli were defined as the AOIs. The mean coverage of the AOI over all conditions was 1.07% (SD = 0.38) of the screen. We calculated the mean of first fixation duration for all AOIs for each picture and we computed the first fixation means for each condition. Values ranged from 144.23 to 760.48 ms (M = 366.14; SD = 126.47). We also calculated the mean dwell time for all AOIs for each picture and we computed the dwell time means for each condition. Values ranged from 543.55 to 4,670.45 ms (*M* = 1,717.92; *SD* = 735.54) for the mean dwell time of the embedded food presentations and non-edible objects.

2.4.2 | Explicit memory

As our dependent variable, we measured children's explicit memory of the embedded food presentations respectively non-edible objects which were integrated within the audiovisual media-stimuli. To assess this dependent measure, we provided a picture with all the foods and objects, which were integrated in all three versions of the stimulus (for a similar procedure see[35]). We recorded how many of the six inserted foods respectively objects children were able to remember explicitly. Hence, only correct recognition dependent on the condition (healthy, unhealthy, or control) was recorded (*M* = 3.84; *SD* = 1.35).

2.4.3 | Controls

Because age was identified as an important predictor in studies examining storing and retrieval of explicit memory,[37] we included age as a control variable when testing our full model. Furthermore, we assessed children's hunger and BMI. To measure children's hunger, we employed a single-item measure with a 4-point scale (1 = *not hungry at all*, 4 = *very hungry*; *M* = 2.14; *SD* = 0.84). For children's BMI, we measured children's height and weight. Then we later computed the standard deviation score of BMI (zBMI) to adjust for children's age and sex (*M* = 0.30; *SD* = 1.02).[42] The results showed that 26.52% (*n* = 26) of all children in this study had a BMI score above the cut-offs of normal weight and are thus characterized as overweight (+1 *SD* = 21.42%), or obese (+2 *SD* = 5,1%).

2.4.4 | Descriptive data

As a relevant measure for the randomization check, we furthermore asked about the liking of the presented stimuli. This was assessed with a single item asking children to evaluate the stimuli ranging from 1 = "I didn't like the cartoon at all" to 4 = "I liked the cartoon very much". Liking of the stimuli was generally very high with 56.4% of the children liking the stimuli very much. To get a deeper understanding of our sample and the nutritional preference, we furthermore asked children about their eating preferences and food rules at home. Hence, we asked how much they like fruit (based on two statements, i.e. "I like to eat fruit", 1 = *Not true at all*; 4 = *Very true*, Cronbach's Alpha = .66; *M* = 3.18; *SD* = 0.79) which was rather popular in our sample. In addition, we also asked whether or not candies are allowed at their homes ("Do your parents allow you to have candy sometimes?", 1 = yes, 0 = no). Most children (89.1%) were allowed to have candy at home occasionally.

3 | RESULTS

3.1 | Randomization check

A randomization check for gender (χ^2 = 0.95, *df* = 2, *N* = 101, Φ = .10, *p* = .623), liking of the presented stimulus (χ^2 = 2.04, *df* = 4, *N* = 101, Φ = .14, *p* = .728), liking of fruit (*F* (2, 98) = 1.64; *p* = .200), and whether or not candy was allowed at home (χ^2 = 3.15, *df* = 2, *N* = 101, Φ = .18, *p* = .207) was successful.

3.2 | Examination of the proposed effects model

3.2.1 | Main effects on visual attention

We employed an ANOVA to investigate the main effects of the experimental conditions on children's visual attention by examining first fixation duration and dwell time. We observed a significant difference between the conditions for first fixation duration (*F* (2, 99) = 4.97; *p* = .009; η2 = .091) as well as for dwell time (*F* (2, 99) = 11.85; *p* < .001; η2 = .193).

A post hoc examination for first fixation duration indicated that the observed difference between unhealthy food presentations and non-edible objects reached significance (*p* = .011). Yet, first fixation duration for the healthy condition did not significantly differ compared to the control group (*p* = .096). We also did not observe a significant difference for first fixation duration between the unhealthy and the healthy condition (*p* = .786). See Table 1.

For dwell time, we found that both type of food presentations (healthy: *p* = .003; and unhealthy: *p* < .001) significantly aroused more attention compared to non-edible objects in the control group. Yet, again the healthy and the unhealthy condition did not differ in the observed dwell time (*p* = .583). See Table 2. These results lend support to the assumption (i) that proposed that food arouses more attention compared to non-edible objects. Yet, we did not observe a difference in visual attention for unhealthy compared to healthy food presentations (ii).

3.2.2 | Main effects on explicit memory

We furthermore examined the main differences between the explicit memory for the embedded food presentations and non-edible objects. Out of the six food or object presentations embedded in each

TABLE 1 ANOVA comparison of the three experimental conditions on Children's first fixation duration

				Scheffé post hoc-test	
Group	*n*	Mean	*SD*	Control condition	Healthy condition
Control condition	32	312.31	95.60		
Healthy condition	35	377.51	137.53	>.050	
Unhealthy condition	35	404.00	126.22	<.050	>.050

F (2, 99) = 4.97; *p* = .009; η2 = .091

TABLE 2 ANOVA comparison of the three experimental conditions on Children's dwell time

				Scheffé post hoc-test	
Group	*n*	Mean	*SD*	Control condition	Healthy condition
Control condition	32	1,259.29	423.57		
Healthy condition	35	1,824.34	803.00	<.010	
Unhealthy condition	35	2,030.82	698.82	<.001	>.050

F (2, 99) = 11.85; p < .001; η2 = .193

condition, the explicit memory for the embedded foods or non-edible objects differed significantly (F (2, 98) = 4.78; p = .010; η2 = .089). The post hoc test revealed that the explicit memory in the unhealthy condition compared to the control group was significant (p = .011). Whereas children were not able to explicitly remember more healthy food presentations in the healthy condition compared to non-edible objects in the control group (p = .201). The difference in explicit memory for food presentations between the unhealthy and the healthy condition did also not reach significance (p = .424). See Table 3.

3.2.3 | Full model

To examine the full-hypothesized model and to mirror the previous findings, we conducted a mediation analysis using Hayes' PROCESS macro for SPSS (model 9).[43] We inserted the control group as the reference group in our analysis. As our mediator variables, we included first fixation duration as well as dwell time simultaneously. As the dependent variable, we inserted the explicit memory of the inserted objects (i.e., either the embedded unhealthy or healthy foods, or the embedded non-edible objects). Children's hunger, the standard deviation score of BMI, and age were mean centered and inserted as our control variables. For results, see Table 4.

In line with the results reported earlier, we again found that children paid more visual attention to food presentations compared to non-edible objects (*first fixation duration*: healthy condition: β = 0.62; b = 78.58; LLCI = 18.94; ULCI = 138.21; p = .010; unhealthy condition: β = 0.67; b = 84.48; LLCI = 29.61; ULCI = 143.28; p = .006; *dwell time:* healthy condition: β = 0.91; b = 655.65; LLCI = 343.75; ULCI = 987.55; p < .001; unhealthy condition: β = 1.02; b = 752.75; LLCI = 435.36; ULCI = 1070.14; p < .001). Additionally, we found a main effect for

TABLE 3 ANOVA comparison of the three experimental conditions on Children's explicit memory

				Scheffé post hoc-test	
Group	*n*	Mean	*SD*	Control condition	Healthy condition
Control condition	32	3.34	1.26		
Healthy condition	35	3.91	1.34	>.050	
Unhealthy condition	35	4.32	1.27	<.050	>.050

F (2, 98) = 4.78; p = .010; η2 = .089

TABLE 4 Moderated mediated analysis explaining visual attention regarding first fixation duration and dwell time; as well as explicit memory

	First fixation duration		Dwell time		Explicit memory	
	b	*SE*	*b*	*SE*	*b*	*SE*
Healthy condition	**78.58***	**30.04**	**655.65*****	**162.14**	0.33	0.32
Unhealthy condition	**84.48****	**29.62**	**752.75*****	**159.87**	**0.67***	**0.33**
Hunger	−18.19	14.57	−24.51	78.66	**0.33***	**0.15**
Body mass index (BMI)	**−27.16***	**12.56**	**−180.75****	**−2.67**	0.16	0.13
Age	15.82	9.63	89.49	51.97	**0.27****	**0.10**
First fixation duration	-	-	-	-	−0.00	0.00
Dwell time	-	-	-	-	**0.00****	**0.00**
Explained variance	*.16*		*.27*		*.28*	

Note: N = 101; missing values: n = 1;

*p ≤ .05;

**p ≤ .01;

***p ≤ .001; *SE* = Standard Error; Using 1,000 Bootstrapping Samples; Control Group Inserted as a Reference Group.

BMI on our measures of visual attentional (*first fixation duration*: β = −0.21; b = −27.16; LLCI = −52.09; ULCI = −2.22; p = .033; *dwell time:* β = −0.25; b = −180.75; LLCI = −315.37; ULCI = −46.13; p = .009). Yet, when we examined in an additional analysis whether BMI was a moderator for visual attention, we did not find such an interaction effect. Hence, independent of whether food or non-edible objects were presented, children with lower levels of BMI showed more initial and overall visual attention for our presented objects.

When examining explicit memory for the observed food presentations or non-edible objects, we observed that while first fixation duration did not affect children's explicit memory (β = −0.16; b = −0.002; LLCI = −0.004; ULCI = 0.001; p = .121), dwell time was positively associated to the number of food presentations respectively objects children could explicitly remember (β = 0.33; b = 0.001; LLCI = 0.000; ULCI = 0.001; p = .004). Furthermore, compared to the control group, we observed a direct effect of the unhealthy condition on the explicit memory (β = 0.50; b = 0.67; LLCI = 0.02; ULCI = 1.32; p = .043). We however did not observe such an effect for the healthy condition compared to the control group (β = 0.24; b = 0.33; LLCI = −0.32; ULCI = 0.97; p = .316). As an additional result, we found that children's age (β = 0.20; b = 0.27; LLCI = 0.08; ULCI = 0.47; p = .006) and children's level of hunger (β = 0.25; b = 0.33; LLCI = 0.04; ULCI = 0.62; p = .026) were positively associated to explicit memory. Based on these results, we then examined whether the level of hunger was a significant moderator for explicit memory, hence whether hungrier children could remember more products depending on the experimental condition. However, we found no such effect. In addition, age did not moderate the observed effects.

Hence, as hypothesized (iii) we observed an indirect effect of visual attention via dwell time on children's explicit memory (healthy condition: b = 0.39; LLCI = 0.11; ULCI = 0.76; unhealthy condition: b = 0.45; LLCI = 0.14; ULCI = 0.80). However, we additionally observed a direct effect of the unhealthy condition on explicit memory, not mediated by visual attention (β = 0.50; b = 0.67; LLCI = 0.02; ULCI = 1.32). This points us toward the assumption that unhealthy foods are processed differently compared to non-edible objects and hence entrench themselves into children's memory not only via a mediation by visual attention.

4 | DISCUSSION

Our study provides some interesting insights into how food presentations within a narrative media content affect children. Our study is the first to provide definite proof that embedded food presentations in audiovisual media arouse more visual attention compared to non-edible objects. Hence, food presentations seem to be an eye-catcher that immediately grab children's attention (assessed with first fixation duration) and are also able to maintain this attention (assessed with dwell time).

Yet, in contrast to extant research, proposing unhealthy foods are more attractive to children compared to healthy products,[32] we did not find that unhealthy food presentations aroused more visual awareness compared to healthy foods. This might be based on methodological differences between our study and Spielvogel et al.'s study.[32] On the one hand, we employed a between subject design, hence children were only confronted with one food category depending on their condition. Spielvogel and colleagues,[32] on the other hand, tested their assumption with a within-subject design. Of course, we can only speculate on that, but it might be that only if given the choice, hence if being confronted with healthy as well as unhealthy food presentations within a media content, unhealthy foods arouse more attention. In other words, only if viewers are confronted with both food options, unhealthy products can truly unfold their attractive potential and hence result in an increase in attention compared to healthy foods. Of course, we need further research to corroborate this interpretation.

Regarding individual susceptibility factors of hunger, and BMI, we observed two main effects. Children with lower levels of BMI had an overall higher level of attention for the presented products (independent on whether they were edible or not) and hungrier children showed higher levels of explicit memory for all presented products. When we examined these variables as possible moderators, we did not find that these effects dependent on the experimental condition. However, this might be due to the relatively small sample size in our study because existing studies point to hungry[44] and overweight subjects[45] being more inclined to react to food. It therefore would be interesting to investigate BMI and hunger more extensively in a setting with a bigger sample. Regarding age, we observed an additional main effect, as older children were more likely to explicitly remember the objects they had seen in the stimuli independent of the condition. This is congruent with results of existing research.[37]

In line with our expectation, we also found that visual awareness was positively related to children's explicit memory of the observed food presentations respectively objects. However, we found this effect only for dwell time not for first fixation duration. This makes sense because first fixation duration can only assess the initial attention grapping potential of an AOI, whereas dwell time indicates the depth of processing of a defined AOI.[39] In other words, even if an object arouses children's initial attention this does not mean that they will direct their attention back to this object and consciously process as well as remember it.[46]

Regarding the effects on explicit memory, two key results have to be mentioned. First, unhealthy food presentations were significantly more likely to be explicitly remembered compared to non-edible objects. Thus, unhealthy food presentations within media content seem to entrench themselves more into children's memory compared to other objects. Second, explicit memory for the embedded food presentations and non-edible objects was mediated through dwell time. Yet, additionally to this indirect effect, we also observed a direct effect of the unhealthy condition on explicit memory of the embedded unhealthy food. This suggests that remembering healthy products or non-edible objects requires visual attention in the first place. That is, if children do not look at healthy products or non-edible objects long enough, they will not remember them. Yet for unhealthy food presentations, memory seems to be less dependent on visual attention. That is, compared to healthy products or non-edible objects, unhealthy food presentations do not require the same amount of visual attention in order to be remembered. Hence, merely confronting children with unhealthy food presentations within media content generates memory traces for the unhealthy products, making them retrievable in a subsequent situation. A possible theoretical explanation for this phenomenon could be priming theory.[26] As children are so used to being confronted with unhealthy foods,[10] this information might be easier for them to retrieve from memory. This of course has important implications for children's food choices that are connected to their accessible food categories.[36] As already described, food choices are oftentimes very spontaneous especially when it comes to snack choices. Having unhealthy foods more accessible due to their abundance of presentations within media content[5] might thus explain the association between unhealthy eating or overweight and excessive TV consumption.[27]

4.1 | Limitations

This study is not without limitations. First, even though in line with existing eye-tracking studies,[17] the number of observations in this study is limited. This is especially crucial concerning the moderating impact of the observed susceptibility factors BMI and hunger. Hence, replication studies are highly encouraged. Second, while we provided some interesting insights into the cue reactivity to food presentations within a narrative media content, we only observed one possible measure of the cue reactivity concept. Other indicators such as heart rate, gastric activity, or salivation[29,30] should be considered in future studies to get a more holistic view on how food presentations affect viewers.

Last, and in line with the already mentioned measurement critique, other dependent measures should be considered in future studies. While connecting visual attention to children's explicit memory of the embedded objects is a reasonable approach,[35] assessing other measures such as amount of food intake of different food categories[21,24-26] in connection to different media stimuli would be of importance.

5 | CONCLUSION

Our study enriches current research on food presentations within media content by providing evidence for how food presentations affect children's cue reactivity, more specifically their visual attention. We demonstrate that food presentations arouse more visual attention compared to non-edible objects. Although we did not observe a difference in attention between healthy and unhealthy foods, we found that unhealthy foods seem to be processed differently compared to healthy foods and non-edible objects. Unhealthy foods can be remembered independent of the amount of visual attention that children allocate toward them. This suggests, once unhealthy foods are processed, they automatically stick to children's memory. They also can be explicitly remembered by children to a higher extent compared to non-edible objects. We see these results as critical due to the abundance of food presentations in media content, especially considering the bias toward unhealthy foods.[5]

Considering the potential influence on children's diet, the cue reactivity theory[28] predicts that embedded food cues may act as conditioned stimuli that can lead to conditioned responses such as actual eating behavior. Although not investigated here, it can be assumed that food presentations in audiovisual media foster subsequent palatable food intake in children.[31] Yet, future research should study the link between visual attention, the explicit memory traces, and possible subsequent spontaneous food choices more thoroughly. In sum, our findings cause concerns about how food presentations are embedded in young viewer's media environment. We thus appeal for a reduction of unhealthy food cues in media content targeted at children.[47]

CONFLICT OF INTEREST

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Brigitte Naderer conceptualized the study, the data collection instruments, collected data, carried out the initial analysis, and drafted the initial manuscript. Alice Binder designed the research stimuli, collected data, and reviewed and revised the manuscript. Jörg Matthes supervised data collection instruments as well as the data collection, and reviewed and revised the manuscript. Ines Spielvogel and Michaela Forrai collected data, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors have no conflicts of interest relevant to this article to disclose.

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