**The effects of manipulated exposure to different types of television-style  
food advertising and young children’s food intake**

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Abstract

Childhood presents as a particularly potent time for food preferences to develop and eating habits to establish via exposure to food cues and eating norms in the environment, including media and advertising (Lioret et al., 2020). A healthy balanced diet is essential for physical and psychological well-being (Firth, Gangwisch, Borisini, Wootton & Mayer, 2020; Shan et al., 2020), but is rarely promoted in digital food advertising (Naderer, 2021). Research investigating the effects of different types of food advertising on children’s food intake to assess media-based preventions and interventions for improving children’s diets is lacking (Folkvord, 2020).

This thesis includes four studies investigating the effects of specifically-designed, television-style food advertisements on children’s food intake. The advertisements included (1) a healthy food advertisement, (2) an advertisement promoting foods high in sugar, salt and fat (HSSF), (3) an advertisement discouraging the intake of HSSF foods and (4) a non-food toy control advertisement. Studies 1 - 3 were longitudinal studies ranging from a total study duration of nine weeks in Study 1 to seventeen weeks in Studies 2 and 3. Studies 1, 2 and 4 included two conditions, whereby children were exposed to either healthy food advertising exposure or toy control advertising. Study 3 included four conditions, whereby children were either exposed to healthy food advertising, anti-HSSF food advertising, HSSF food advertising or control advertising. Following advertising exposure, children selected and ate foods and drinks from a buffet. In Studies 1 - 3, children selected from a 16-item buffet offering equal numbers of healthy and HSSF food and drink options. Study 4 was a pre-test/post-test design conducted over two weeks. In Study 4, children selected from a 7-item buffet offering exclusively healthy foods, which were fruit, vegetables and whole grain bread. Studies 1 - 3 found no changes in children’s food intake in response to advertising exposure. Study 4 found increases in children’s healthy food intake following healthy food advertising exposure. Children who viewed control advertising in Study 4 decreased their healthy food intake. Findings from Studies 1 - 4 suggest that increasing children’s healthy food intake relies on a combined approach of exclusively healthy food options and healthy food advertising. Parents, caretakers and childcare settings may wish to explore the benefit of providing children with exclusively healthy food options whilst being aware that encouragement, in this case, through media-based healthy food promotion, is required for children to eat the available healthy foods.

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Declaration

I, the author, confirm that the Thesis is my own work. I am aware of the University’s Guidance on the Use of Unfair Means. This work has not previously been presented for an award at this or any other university.

# Introduction

## Childhood obesity, unhealthy eating practices and food advertising

Childhood obesity constitutes a major public health concern on global and national levels (WHO (World Health Organisation), 2020a), including the UK (Karnik & Kanekar, 2012; Reilly, 2007; Stamatakis, Wardle & Cole, 2010) and Germany (Mensink, Schienkiewitz, Haftenberger, Lampert, Ziese & Scheidt-Nave, 2013). Globally, 38 million children under the age of 5 were diagnosed with overweight or obesity in 2019 (WHO, 2020a). According to NHS Digital, around one-quarter (23.5%) of British children aged 4 to 5 years displayed a Body Mass Index (BMI) above a healthy weight (PHE (Public Health England), 2020), and this number was 35.7% for children aged 10 to 11 years (PHE, 2020). The German Robert Koch Institute in Germany reported that 10.8% of 3- to 6-year-old girls and 7.3% of boys were affected by overweight or obesity (Schienkiewitz, Brettschneider, Damerow & Rosario, 2018).

Obesity is caused by an energy imbalance (Omer, 2020). The aetiology of the energy imbalance that is required for weight gain or loss, however, depends on complex interactions of genetic, behavioural, environmental factors including social and cultural conditions (Omer, 2020). Obesity rates tend to be highest in the most deprived communities (DGE (Deutsche Gesellschaft für Ernährung), 2020; PHE, 2020; WHO, 2020a), but obesity occurs across all socio-economic groups and education levels, highlighting a role for shared influences in the environment and universal neurophysiological pathways (Cohen, 2008). Marketing of unhealthy, ultra-processed foods and drinks with high sugar, salt and fat (HSSF) content has been highlighted as risk factors for the development and maintenance of unhealthy eating habits, poor dietary health and the global childhood obesity pandemic (Folkvord, 2020). Digital food marketing is the focus of this thesis.

Unhealthy eating practices are characterized by consumption of foods and drinks with HSSF content and few micro- and macro-nutrients such as vitamins, minerals and fibre (NHS (National Health Services), 2020). Negative physical health outcomes include elevated risk of developing obesity, high cholesterol, high blood pressure, pre-diabetes, bone and joint issues and breathing difficulties (PHE, 2020). One of the paradoxes of obesity is that affected individuals present as simultaneously overfed and undernourished, with children displaying deficiencies in micro- and macro-nutrients needed for optimal growth and functioning at the same time as excess energy supplies that support weight gain (Astrup & Bügel, 2019). Unhealthy eating patterns are widespread. Unhealthy snack foods make up close to one-third of nursery children’s daily food intake while only 18% of children in the UK meet 5-a-day recommendations for daily portions of fruit and vegetables (NHS Digital, 2020). Most children’s sugar intake via sweetened drinks, breakfast cereal, biscuits, chocolate and other processed sweet and savoury snacks exceeds recommended guidelines while children’s intake of vegetables and fruit does not meet them (Karnik & Kanekar, 2012, Mackenbach et al., 2008; Spence, Campbell, Lioret & McNaughton, 2018; WHO, 2017).

Digital media and food advertising reflect exactly those problematic eating behaviours and have been shown to negatively influence children’s diets and weight status via attitudes, preferences, purchase requests, intake decisions and consumption habits (Boyland et al., 2016; Russell, Croker & Viner, 2019; Sadeghirad, Duhaney, Motaghipisheh, Campbell & Johnston, 2016; Smith, Kelly, Yeatman & Boyland, 2019). Foods and drinks with high HSSF content constitute the most heavily advertised product category to children across all digital channels, including television programmes, online websites and games (Boyland & Whalen, 2015; Calvert, 2008; Folkvord et al., 2016; Kraak, Gootman & McGinnis, 2006; Lavriša & Pravst, 2019; Sixsmith & Furnham, 2010). Across countries, high sugar cereals, fast food restaurants and candy constitute the most frequently advertised products, creating a detrimental imbalance in advertising content between HSSF products and healthy foods (Nestle, 2013). Omnipresent food cues are an issue, because food cue exposure triggers appetite and overeating even in the absence of energy-deficiency (Gilbert-Diamond et al., 2017). HSSF cues are particularly problematic, because they can trigger overeating of products associated with increased risk of obesity (Brownell & Horgen, 2004). In 2002, a content analysis comparing over 200 hours of children’s programming and 42 hours of adults’ television in the UK found more food advertising during children’s programming (62.5%) than on prime-time television (18.4%) (Chestnutt & Ashraf, 2002). Given the changes in advertising regulations over the past 15 years, the advertising landscape has changed.

In the UK, advertising is regulated by the Advertising Standards Authority Ltd. (ASA) and the Committee of Advertising Practice Ltd. (CAP). According to ASA and CAP, advertising must use health and nutrition claims correctly. Advertising must not condone or encourage practices that are detrimental to children’s health (BCAP Code 5.3), must not condone or encourage poor nutritional habits or an unhealthy lifestyle in children (BCAP Code 15.11), encourage children to eat more than they otherwise would (BCAP Code 15.14.3) or be likely to mislead; for example, by exaggerating the features of a product or service in a way that could lead to children having unrealistic expectations of that product or service (BCAP Code 5.7). Advertising must not exploit children’s credulity or ‘pester power’, children’s tendency to nag parents to purchase products (ASA, 2022). In the UK, different age ranges are applied to advertising regulations aiming to protect children (ASA, 2022). HSSF food advertisements must not be placed in children’s media, which refers to media where under-16-year-olds are the main target audience, or other media where under-16-year-olds make up more than 25% of the audience (ASA, 2022). HFSS advertisements directed at under-12-year-olds through their content are not permitted to include promotions or celebrities and licensed characters popular with children (ASA, 2022).

A 2019 advertising analysis demonstrated that in the UK, almost half (47.6%) of all food advertisements shown over the month on ITV1, Channel 4, Channel 5 and Sky1 were for products high in fat, salt and sugar, rising to nearly 60% between 6pm and 9pm (Cancer research UK, 2022). Ofcom research suggests that children’s viewing peaks in the hours after school, with the largest number of child viewers concentrated around family viewing time, between 6pm and 9pm (Ofcom, 2022). In response to these findings, new regulations will come into force at the end of 2022 to apply a watershed for HSSF food advertisements from all businesses with 250 or more employees to television and UK on-demand programmes (Gov UK, 2022b). The watershed will apply from 9pm to 5.30am, meaning HFSS food advertisements can only be shown during these times Gov UK, 2022b). Online restrictions will be limited to paid-for advertising, meaning that brands can continue to advertise within ‘owned media’ spaces online such as a brand’s own blog, website, app or social media page Gov UK, 2022b). There are also no limits to the posts that brands can share on their own social media accounts and regulations do not address podcasts, which are an emerging advertising platform used by children (Foodtank, 2022).

In Germany, food advertising on radio, television and social media is regulated by the EU Audiovisual Media Services Directive (AVMSD), the state media treaty and the rules of conduct for food advertising of the German Advertising Council, a control body of the Central Association of the German Advertising Industry (Zentralverband der deutschen Werbewirtschaft, ZAW) (Zeit, 2022). As of June 2021, companies are no longer be allowed to advertise the positive nutritional properties of HSSF foods (Zeit, 2022). Claims such as ‘with the addition of valuable vitamins and minerals’ for fruit gums or ‘high wholegrain content for physical performance’ for chocolate bars are banned (Zeit, 2022). Like advertising regulations in the UK, direct requests to buy or consume a product and requests to persuade parents to buy a product are not allowed in advertising to children in Germany (Zeit, 2022). In addition, the ZAW raised the age limit in the State Treaty on Youth Media Protection (JMStV) for advertising regulations concerning children from 12 to 14 years, regardless of the medium used or the advertising environment (Zeit, 2022). This applies not only to television advertising, but also to Internet advertising, which is rapidly gaining in importance (Zeit, 2022). Due to the wide scope of application, the new regulations go significantly beyond the European requirements (Zeit, 2022). They restrict advertising not only in the context of its broadcasting context (children’s programmes and video sharing platform), but also because of the target group (under 14-year-olds), meaning that young users of social media platforms such as YouTube and TikTok are better protected (Zeit, 2022).

In contrast to unhealthy eating, healthy eating practices describe the consumption of a diverse and varied diet, eating at least three portions of vegetables and two portions of fruit a day, including legumes and nuts, and choosing wholegrain products (DGE, 2020; PHE, 2020; WHO, 2020b). According to national dietary guidelines, daily sugar intake for 4- to 6-year-olds should be less than 19g of free sugars, and less than 24g for 7- to 10-year-olds (NHS, 2020). Salt should be used sparingly (DGE, 2020). Plant-based oils are preferable over animal fats, and ‘hidden fats’ in processed foods should be avoided (DGE, 2020). Cooking techniques that maintain high amounts of vitamins, minerals and taste, mindful eating and maintaining a healthy weight through a combination of healthy eating and physical exercise are recommended (DGE, 2020). Following healthy eating guidelines set out by the WHO (2020), PHE (2018) and the German nutrition association, ‘Deutsche Gesellschaft für Ernährung’ (DGE, 2020), have been linked to healthy weight status, improvement of a range of health indicators including inflammation levels, blood lipids, blood pressure, insulin sensitivity, mental health (Lock, Pomerleau, Causer, Altmann & McKee, 2005), reduced risk of coronary heart disease, hypertension (Joshipura et al., 2001), multiple forms of cancer (Aune et al., 2017) and improvements in psychological function (Rooney, McKinley & Woodside, 2013). Healthy eating is hardly promoted, and only mentioned to highlight one product feature over another, such as the health benefits of a snack providing recommended daily fibre intake while information about sugar and fat contents is left out (Hastings, McDermott, Angus, Stead & Thomson, 2007).

Television has long been the most prominent communication tool for advertising to children (Kraak et al., 2006). Despite some evidence that the dominance of television has begun to decrease as regulations tighten and new media channels gain popularity among consumers and marketers alike (IZI, 2020), children prefer television over any other leisure pursuit (IZI, 2020). Television remains the main channel used by food marketers to reach children (Folkvord, 2020; Ofcom, 2016). Television viewing increases the risk of developing obesity not just due to the amount of time displaced from more active pursuits, but independently through exposure to food advertising promoting unhealthy eating habits and HSSF products (Mazur et al., 2018). Veerman, Van Beeck, Barendregt & Mackenbach (2009) used a mathematical simulation model to suggest that up to a third of children affected by obesity in the USA might not have become obese in the absence of televised advertising for HSSF products. Other researchers have found that by distracting children from physiological signals of satiety, mealtime television viewing alone results in overeating and excess caloric consumption (Bellissimo, Pencharz, Thomas & Anderson, 2007; Patel, Bellissimo, Thomas, Hamilton & Anderson, 2011).

## Exposure and familiarity effects on eating behaviour during childhood

Children’s exposure levels to HSSF food advertising are concerning because childhood stands out as a particularly impressionable period of life for health behaviours and eating habits to develop and establish (Cooke, 2007). Through pre- and post-natal experiences during the early years of life, biological predispositions unfold and interact with environmental factors to programme adaptive mechanisms that persist in adulthood (Cooke, 2007). The first 1000 days of life, from conception to the second birthday, constitute a particularly sensitive period during which interactions between the child and its environment are likely to have a strong impact on short- and long-term health outcomes (Dattilo & Saavedra, 2020). Experiences with food and eating establish habits that can support optimal nutrition, healthy growth, cognitive development, protect innate intuitive eating skills in accordance with physiological hunger and satiety signals (Tylka, 2006), and reduce the risk of developing overweight or obesity later in life (PHE, 2020; WHO, 2020a). Critical periods for shaping eating behaviour include the transition from suckling to eating at approximately six months of age (Agostoni et al., 2008), the first year of life, the period of adiposity rebound which reflects a typical pattern of low BMI followed by increased BMI between the ages of three and seven, and puberty (Rolland-Cachera & Cole, 2019) as a window of opportunity and challenge(Schwartz & Puhl, 2003).

As food preferences, eating habits and food norms are strongly influenced by repeated exposure, familiarity and role modelling (Mura Paroche, Caton, Vereijken, Weenen & Houston-Price, 2017) presenting children with healthy food cues at home and in media can help to build strong foundations for a healthy, nutritious diet for years to come (Birch & Fisher, 1998; Cooke, 2007). Since children are born with food neophobia, a tendency to reject unknown foods (Pliner & Salvy, 2006), food marketers and caregivers must find ways of overcoming children’s reluctance to try, taste and like new foods. Children can overcome food fussiness and neophobia through repeated exposure (Birch & Marlin, 1982). Familiarity bias, a cognitive and probably evolutionary process by which individuals learn to like foods which they have been repeatedly exposed to, enhances children’s willingness to taste and eat foods (Ahlstrom, Dinh, Haselton & Tomiyama, 2017). Repeated exposure increases familiarity, and humans prefer foods that they are familiar with (Naderer et al., 2018; Sullivan & Birch, 1990). Familiarity bias can be produced through sight, smell, touch and taste exposure (Coulthard & Ahmed, 2017). A preference for familiar foods can be observed following exposure in utero (Cooke & Fildes, 2011), infancy (Maier, Chabanet, Schaal, Leathwood & Issanchou, 2008), childhood (Wardle et al., 2003) and adulthood (Pliner, 1982). Learned safety theory suggests that when humans taste a food several times without becoming ill, humans know that this food is safe to eat and over time, they develop a liking for this safe food option that can contribute to our overall dietary health (Ahlstrom et al., 2017). Mere exposure theory suggests that humans do not have to taste a new food to learn to like it. Encountering novel foods repeatedly may be sufficient to overcome reluctance to try and eat it (Rioux, 2020).

Exposure effects may be used to improve children’s diets as mere exposure has been shown to enhance children’s familiarity with vegetables and fruit to increase children’s liking and intake of healthy foods (Coulthard & Ahmed, 2017; Dulay, Masento, Harvey, Messer & Houston-Price, 2020; Houston-Price, Owen, Kennedy & Hill, 2019; Owen, Kennedy, Hill & Houston-Price, 2018). In a picture book study, Heath, Houston-Price & Kennedy (2014) demonstrated that mere exposure effects and familiarity bias can be used to increase children’s healthy eating. Heath et al. (2014) asked families to look at a book about a vegetable that their two-year-olds liked, disliked or had never tried. In the laboratory, willingness to taste tests showed that children were easier persuaded to try foods that they had been exposed to via the picture books (Heath et al., 2014). Children touched and ate more of the food that they had been exposed to (Heath et al., 2014). Effects were strongest for foods that children had been unfamiliar with prior to the study (Heath et al., 2014). When testing mere exposure effects on children’s food intake at home, Owen et al. (2018) and Houston-Price et al. (2019) found that children who had looked at books about vegetables for two weeks before being able to taste them were easier to persuade to try them when they became available for eating. Children who had looked at the books prior to being able to taste them ate more of the vegetable when it was offered, liked the vegetable more when they tasted it according to parents, and parents enjoyed the vegetable tasting sessions more (Houston-Price et al., 2019; Owen et al., 2018). Children showed lower levels of food neophobia and food fussiness compared to children in the control condition (Houston-Price et al., 2019; Owen et al., 2018). Follow-up measures demonstrated that changes in vegetable and fruit consumption were maintained for at least three months (Houston-Price et al., 2019; Owen et al., 2018). Picture book interventions, which draw on the principles of visual familiarity and social reinforcement, have been shown to be effective in increasing children’s acceptance of vegetables using digital versions too (Dulay et al., 2020). Opportunities for interactive learning and personalisation make e‐book-based eating interventions especially effective (Dulay et al., 2020).

The effect that mere exposure to food cues may have on children’s willingness to taste and eat foods and to incorporate them into their regular diet is important, because HSSF food advertising exposes children to high volumes of visual food cues every day. From a young age, children access and use digital media devices and interact with digital devices and actively react to images on a screen within their first year of life when they begin to imitate and state what they see and hear (Strasburger et al., 2010). Television advertisements are devised with the purpose of promoting familiarity with the product and associating product consumption with positive outcomes through repeated exposure to the advertised message (Dovey et al., 2011). Strassburger and Wilson (2002) found a clear dose-response relationship in repeated exposure to food and non-food advertising. Heavy television viewers who were exposed to higher volumes of advertising wanted more toys and ate more food that had been advertised to them than children who watched less television (Strassburger and Wilson, 2002). Marketers know of the powerful influence of early year experiences on lifelong behavioural patterns. The cradle to grave approach describes marketers’ attempts to establish strong attachments between growing customers and particular brands and products as early as possible (Mittal, Griskevicius & Hawks, 2020). Before learning how to speak, children as young as two years of age can recognise brands and will point to products that they have previously seen in advertisements (Kraak & Story, 2015; Nestle, 2013). Targeting children at a young age allows marketers to secure lifelong customers (Mittal et al., 2020).

## Children’s understanding of and coping with advertising

In addition to childhood being a specifically impressionable period of life (Cooke, 2007), food advertising to children is concerning due to children’s lack of a developed understanding of advertising, which makes them more trusting of and vulnerable to advertising. Children’s understanding of advertising typically matures as children grow older, develop more sophisticated executive functioning skills and gain consumer experience (Gunter et al., 2004). An understanding of advertising entails the skills to identify advertising correctly by discriminating advertising from programme content, to attribute persuasive intent to advertising efforts and to evaluate the use and value of a product or service (Gunter et al., 2004). Findings regarding the development of children’s understanding of advertising are mixed and vary depending on the research methods that have been applied to the investigation (Gunter et al., 2004). The extent to which a better understanding of advertising can protect children from the negative impact of HSSF food cues is questionable (Cohen, 2008; Folkvord, 2020; Rozendaal, Lapierre, Buijzen & Van Reijmersdal, 2011). Appropriate and sustained eating behavioural change may depend on children’s motivation to resist palatable HSSF foods and appealing HSSF food marketing (see chapter 1, section 1.4). Successful activation of media literacy and advertising skills at the time of advertising exposure is unlikely due to automatic and unconscious reactions to food cues (see chapter 1, sections 1.4 and 1.6) and sophisticated marketing techniques that bypass rational processing (see chapter 1, section 1.4). This section will describe children’s understanding of advertising, how cognitive development may affect children’s understanding of advertising and highlight factors that may account for the gap between competence (i.e., sufficient understanding of advertising, media literacy skills and developed cognitive abilities) and performance (i.e., eating behaviour in line with health recommendations).

Distinguishing advertising from programme content is one milestone in children’s developing understanding of advertising (Gunter et al., 2004). Children make some distinctions about advertising and programmes by the time they start school (Gunter et al., 2004). Research methods for investigating very young children’s abilities to distinguish advertisements from programmes content have included observing children’s screen attention when switching from programming to advertising, children’s verbal expressions of differences and children’s ability to recognise and recall advertising elements (Gunter et al., 2004). Researchers have focused on verbal and non-verbal attention patterns to determine how well children distinguish between commercial and programme content. Discriminating between advertising and programme content can be based on superficial perceptual features such as length, speed and sound, rather than understanding (Gunter et al., 2004) and may therefore not be sufficient for guarding against the potentially negative effects of advertising (Mosen & Baldwin, 2005). Cohen (2008) argued that the ability to cope with advertising effectively may not depend on rational processing and correct interpretation of marketing materials. Rather, automatic processes beyond conscious awareness may guide children’s food advertising responses (Cohen, 2008) so that the ability to recognise advertising to understand and respond effectively may not protect children from the negative effects of food advertising (Cohen, 2008).

Another milestone in children’s understanding of advertising is the ability to distinguish fantasy and reality because beliefs as to whether television characters and roles adopted by actors in advertising are real and therefore credible sources of information may affect children’s ability to understand, interpret or cope with promotional content (Boyland et al., 2013; De Droog, 2013; Gantz, Schwartz & Angelini, 2007). Children younger than 6 years of age do not reliably distinguish between digital fantasy and reality (Van Evra, 2004; Young, 1990). Believing that what is seen on television literally represents real life is referred to as the ‘magic window’ and may render children more trustful of false marketing promises, including food marketing material that children mistake for genuine nutritional advice (Potter, 1986, 1988).

The use of cartoon characters, celebrities and other social endorsements may increase children’s beliefs about the credibility of advertising and impact children’s eating behaviour (Boyland et al., 2013; De Droog, 2013; Gantz, Schwartz & Angelini, 2007). The presence of a popular character can alter children’s food preference (Roberto, Baik, Harris & Brownell, 2010), food choice (Roberto et al., 2010), purchase requests (De Droog, 2013), willingness to taste (Kotler, Schifferman & Hanson, 2012), food intake (Keller et al., 2012; Kotler et al., 2012) and hedonic experiences (DeCosta, Møller, Frøst & Olsen, 2017) such as taste perception (Lapierre, Vaala & Linebarger, 2011). Children may interpret an actor dressed as a doctor or nutritionist as a credible source of health advice (Binder, Naderer & Matthes, 2020). In Binder et al. (2020), children viewing an expert endorser in narrative media programme changed their eating behaviour in line with the endorser’s recommendations. In the context of food advertising, the belief that images and characters depicted in advertising are representative of real life may lead to a ‘health halo’, which describes skewed ideas about how healthy and nutritious a product may be when it is presented by sporty actors or attractive models in HSSF food advertising (Bragg, Roberto, Harris, Brownell & Elbel, 2018). The ‘magic window’ (Potter, 1986, 1988) may then lead children to believe that it is possible to stay healthy on an unhealthy diet (Bragg et al., 2018).

By six years of age, children tend to have a sense of what is realistic and what is not (Gardner & Krasny Brown, 1984). Acknowledging the difference between mental representations and real objects, between fantasy and reality, appearance and reality and television images and real things are conceptual tools that pre-schoolers tend to have available to them for understanding advertising (Moses & Baldwin, 2005). A more sophisticated understanding of advertising entails an understanding of advertising purpose, intent and techniques (Gunter et al., 2004). Moses and Baldwin (2005) distinguished between (1) the overarching selling intent, (2) overt or covert persuasion intent, (3) informative intent concerned with informing consumers about availability, accessibility and features of their product, (4) promotional intent, that may entail highlighting the benefits of a product while deemphasizing disadvantages and (5) deceptive and manipulative intent, which may or may not be explicit and often creates a biased and possibly misleading image of the product (Moses & Baldwin, 2005). While children may understand that advertisers try to sell products, understanding that this is being done by changing consumer beliefs and conceptions appears to represent a cognitive challenge to be solved only in later stages of development (Moses & Baldwin, 2005). There may be a difference between understanding that advertising entails persuasive intent and being aware of the forms that persuasive efforts can take, and the mechanisms which underpin it, such as creating bias. The multiple purposes of advertising are complex, multifaceted and require a diverse set of cognitive skills and experience of advertising. The variation in advertising intent and purpose has led to mixed findings regarding the ages at which children comprehend the intent of advertising (Oates, Blades & Gunter, 2002).

Understanding the general implications of marketing such as consumerism and capitalism, having personal opinions about products and brands and being able to rationally analyse product characteristics are further markers of media literacy (Gunter et al., 2004). Children develop these skills after about 8 years of age, but children as old as 11 years may not retrieve these skills at the appropriate times and may not activate their defences unless explicitly cued to do so, leaving them vulnerable to increasingly sophisticated marketing techniques (Folkvord, 2020). A lack of a full understanding of how advertising works and what motivations underpin promotional activity can mean that children remain ill-informed about the purposes of advertising until their late adolescence (Gunter, Oates & Blades, 2004).

## The gap between competence and performance: Emotional appeals, hedonic goals and automatic processing

A better understanding of advertising and high media literacy levels may not necessarily protect against the harmful effects of HSSF food marketing on eating behaviour and subsequent health (Cohen, 2008). In a television advertising study, Fox (1980) found that older children were just as affected by food advertising as young children, even though they were better able to explain the purpose and intent of advertising. Compared to 4-year-olds, the 9-years-olds in Fox (1980) were better able to explain what a healthy, balanced diet was, were more cognitively sophisticated, more able to distinguish programmes from advertisements, more aware of the intentions of the advertisements and more distrustful of them, but these increased levels of media literacy did not mediate the effect of advertising exposure on food intake.

There are numerous explanations for the gaps between advertising competence and healthy eating performance. First, being able to identify advertising, distinguish advertising from surrounding programme content and build a detailed understanding of the multiple purposes of advertising requires numerous cognitive skills to be activated at the time of exposure to translate this understanding of advertising into a decision and subsequent behaviour. As children grow older, they develop a better awareness of how advertising works, but that knowledge does not necessarily lessen the impact of advertising on attitudes or behaviours (Harris et al., 2009). Second, children’s immature executive functioning skills may mean that even if children are able to identify, process and interpret marketing messages correctly, they may lack the impulse control and decision-making skills to resist asking for, purchasing or consuming a product against better judgement (Moses & Baldwin, 2005). Third, The Food Marketing Defence Model (Harris et al., 2009) asserts that motivation is an essential component in resisting marketing messages, and children may lack the motivation to want to resist food advertising (see chapter 1, section 1.4). Children tend to eat for pleasure and encouraging children to eat for health reasons has been found to be ineffective or counterproductive (see chapter 1, section 1.4).

Even if children are aware of being targeted by sophisticated marketing and stealth advertising techniques (Folkvord, 2020), children’s impulsive focus on taste, hedonic preference for HSSF products (Bruce et al., 2016), and predisposition to be less driven by long-term goals such as health (Harris et al., 2018) may render children less motivated to resist food advertising. Research investigating the effectiveness of health goals as a motivation to consume has shown that messages about health, wellbeing and functionality may be ineffective (Hausman, 2012) or even counterproductive (Golloway et al., 2005; Raghunathan, Naylor & Hoyer, 2006) when trying to increase children’s vegetable, fruit, whole grain and water intake. Golloway et al. (2005) found that motivating children to eat foods ‘because they are good for you’ decreased children’s intake of the target foods. Telling children a story about a child that liked carrots for taste was more effective at increasing children’s carrot intake than telling children a story about a child that ate carrots for functionality, i.e., because she believed they would give her great eye sight (Maimaran & Fishbach, 2014). Raghunathan et al. (2006) found the less healthy food items were portrayed to be, the better their inferred taste was and the more they were enjoyed during actual consumption. When a hedonic goal was more (versus less) salient, children preferred foods that were portrayed as less healthy in choice tasks (Raghunathan et al., 2006).

Hedonic goals such as good taste (Bruce et al., 2016) may always be more salient in children (Folkvord, 2020). Children are less driven by long-term goals such as health (Harris et al., 2018), potentially because children’s understanding of health is less clear than that of adults (Daigle, Herbert & Humphries, 2007). Rather than for health reasons, children eat for pleasure (Marty, Chambaron, Nicklaus & Monnery-Patris, 2018). Marty et al. (2018) identified three dimensions of pleasure from eating learned during childhood, including (1) the sensory dimension, referring to the pleasure derived from sensory sensations during food consumption (taste, texture, temperature), (2) the interpersonal dimension, related to the pleasure gained from the social context of food consumption (communal meals, sharing food) and (3) the psychosocial dimension, which is the pleasure grounded in cognitive representations of food (special occasions, rewards, treats).

Marketers design marketing messages and content to prime viewers on hedonic product properties (Folkvord, 2020) by focusing viewers’ attention on the sensory aspects of the product such as great taste and smell or interesting and exciting texture (Boyland et al., 2016; Cairns et al., 2013; Folkvord et al., 2020; Hastings et al., 2007; Kelly, Smith, King, Flood & Bauman, 2007; Kim, Chen & Cheon, 2019; Lynn & Zolkepli, 2019). Making the hedonic aspects of a food more salient enhances viewers’ attitudes towards the product and their desire to purchase and consume it (Folkvord, 2020). Highlighting sensory product qualities (Kim et al., 2019; Lynn & Zolkepli, 2019) may be more effective than communicating health and wellbeing benefits (Golloway et al., 2005; Hausman, 2012; Raghunathan et al., 2006) and should be emphasised in healthy food promotion to children.

In addition to highlighting sensory product features to elicit hedonic eating responses, food marketers employ emotional advertising techniques. Rather than communicating information about product features, the primary goal of emotional advertising is to raise awareness of a product by creating positive associations with the brand (Jenkin, Madhvani, Signal & Bowers, 2014). Emotional advertising makes up the largest part of food advertising (Cohen, 2008). When confronted with attractive images for palatable foods and drinks, rational information processing and application of media literacy may be suspended when it is most needed to guard children against the adverse effects of HSSF food advertising (Cohen, 2008; Folkvord, 2020; Harris et al., 2009; Rozendaal et al., 2011).

An examination of 880 different advertising campaigns and found campaigns with emotional messages to be more successful (higher sales, increased brand preference) than campaigns with rational messages and concluded that ‘the most effective advertisements of all are those with little or no rational content’ (Binet & Field, 2009) (p.131). With increasing age or experience, viewers may become aware of the non-existential logic base of an advertisement, reject the message and express criticism towards marketing, but still be vulnerable to the accumulative effect of frequent exposure to pleasing associations and thus find it hard to resist the emotional appeal of the advertisement (Folkvord, 2020).

When viewers respond emotionally to advertising, rational analysis may be suspended because of strong but poorly defined universal human needs (Hansen & Christensen, 2003). Marketers primarily use four emotional needs to sell food products to children, including the need for nurture and protection, the need for stimulation, the need for role models and the need for peer group acceptance (Dibb et al., 2001). Other emotional appeals used in televised advertisements are feelings of being a grownup, power, peer popularity, humour, sports or action-adventure (Kunkel & Gantz, 1992). In 75% of advertisements, food is associated with fun (Folta, Goldberg, Economos, Bell & Meltzer, 2006), pleasant taste (54%), being cool (43%) and happiness (43%) were other common themes in food advertising to children (Folta et al., 2006). Similarly, in a literature review of emotional and rational appeals in food advertising directed at children, Lynn and Zolkepli (2019) listed 21 emotional appeals relating to ‘fun/happiness’, ‘play’, ‘fantasy/adventure’, ‘energy’, ‘hunger/thirst satisfaction’, ‘in control/personal freedom’, ‘social enhancement/peer acceptance’, ‘novelty/trendy’, ‘parental pleasing’ and rational appeals relating to ‘taste/flavour’, ‘healthy/nutritious’, ‘fruit appeal/association’, ‘novelty/new claims’, ‘food product shown or displayed’, ‘super-charged’, ‘comparative claims’, ‘food as a toy’. In contrast, rational appeals may include information about the characteristics of a food product including taste or flavour, such as ‘chocolatey’, ‘fruity’, ‘sweet’, or texture, like ‘crunchy’ or ‘crispy’ (Lynn & Zolkepli, 2019).

Some of these appeals raise concerns with respect to marketing communication codes and rulings for children under the age of sixteen as set out by The Advertising Standards Authority Ltd (ASA) and The Committee of Advertising Practice Ltd (CAP) (ASA, 2021). According to CAP codes and regulations, marketing communications addressed to, targeted directly at or featuring children must contain nothing that is likely to result in their physical, mental or moral harm. Although the code states that children must not be made to feel inferior or unpopular for not buying the advertised product, Lynn and Zolkepli (2019) found ‘social enhancement/peer acceptance’ to have been used in food advertising directed at children who viewed television via online streaming.

The effectiveness of emotional appeals may be explained as a function of emotional advertising immobilising the application of advertising knowledge to rationally analyse product features by activating low involvement processing (shallow cognitive processing) and implicit learning (automated, instinctive processing) (Hansen & Christensen, 2003). Tendencies for low involvement processing may be explained as a function of limited cognitive capacity (Cohen, 2008). Human ability to consciously respond to food cues is limited (Cohen, 2008). Human cognitive processing capacity including visual systems and unconscious systems is estimated at 11 million bits per second, whilst the brain parts that regulate conscious awareness are relatively small and process 40 to 60 bits per second (Dijksterhuis, Smith, Van Baaren & Wigboldus, 2005). The part in the human processing system that enables us to make carefully considered choices is relatively small and works slowly. The other part allows us to make unconscious, automatic and impulsive decisions quickly and is estimated to govern 95% of our behaviours (Cohen, 2008). The speed at which this unconscious part processes information stems from using limited information and heuristics to make decisions and becomes particularly active when individuals are stressed, overwhelmed or exhausted (Cohen, 2008). When individuals are overloaded, impulsive decisions are more likely, and marketers exploit this neurophysiological predisposition by continuously exposing consumers an overwhelming variety of products promoted through omnipresent, fast paced, colourful and information-dense advertising (Nestle, 2013). Since our default preference is sugary and fatty food, limited capacities to make decisions and exert self-regulation predispose us to choose HSSF products in our modern food environment (Shiv & Fedorikhin, 1999).

## Healthy food cues in product placement and narrative media

Stealth advertising used in product placement and narrative media draws on similar mechanisms as emotional appeals by which advertising messages bypass rational evaluation due to viewers’ being entertained by characters, stories or interactive elements. Product placement and narrative media are relevant mediums for health communications, because unlike healthy food cues in television, healthy food cues in product placement and narrative media have been found to increase children’s healthy food intake (Gonçalves et al., 2018; Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Upton et al., 2013).

Although narrative media differs from television advertising with the level of food cue embedding, findings from narrative media studies can help to gain a better understanding of children’s healthy eating in response to healthy food cues in digital media, since the evidence base on children’s healthy food intake in response to television-style healthy food cues is very small (see chapter 1, section 1.8). Narrative media, product placement and EE are similar to television advertising in terms of the advertising techniques that are used, including engaging stories and narratives, attractive peer, parent and celebrity endorsers, appealing product presentations such as food advertising highlighting sensory aspects of foods to make hedonic enjoyment more salient, and attention-grabbing visual and auditory editing techniques to influence children’s food intake, purchase requests and surrounding eating norms (Boyland et al., 2016; Cairns et al., 2013; Guo et al., 2019; Folkvord et al., 2016; Kraak & Story, 2015; Russel et al., 2019; Shen & Han, 2014; Smith et al., 2019). Narrative media research also overcame some of the methodological issues and research gaps in television-style food advertising and children’s food intake (see chapter 1, section 1.8). In contrast to television-style food advertising research, narrative media studies assessed children’s eating behaviour in response to healthy food cues when only healthy food options were available (Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Upton et al., 2013). Narrative media studies that did provide healthy as well as HSSF options at the eating opportunity did so in equal numbers (Binder et al., 2019; Gonçalves et al., 2018; Naderer et al., 2018). While available television-style food advertising studies relied on the use of recorded advertisements, narrative media studies specifically-designed media materials for the purpose of their research, which helped to ensure that media conditions only differed in the intended direction, namely on the type of food cue that was embedded (Binder et al., 2019; Horne et al., 2004, 2009, 2011; Gonçalves et al., 2018; Lowe et al., 2004; Naderer et al., 2018).

Narrative media draws on product placement, which describes the intentional display of products into movies and programmes to elicit positive associations with the embedded product (Balasubramanian, 1994). Product placement allows marketers to create a scene in which the product features naturally and may feel more authentic to the viewer than direct product promotion (Guo, Ye, Hudders, Lv, Li & Duffy, 2019). Since product placement does not employ loud or overt arguments typically used in television advertising to convince the viewer of a product, viewers are less likely to engage in counterarguments that may lead to rejection of the promotional message (Guo et al., 2019). Embedded food cues can enhance viewer enjoyment because the presence of food cues does not interrupt the storyline (Villegas-Nevas et al., 2020). Unlike televised advertising breaks, embedded food cues cannot be skipped (Villegas-Nevas et al., 2020). Due to their natural and authentic appearance, children are less likely to recognise embedded food cues as advertising, less likely to evaluate them critically (Matthes & Naderer, 2015), and more likely to perceive the campaign as trustworthy and credible (Guo et al., 2019). In addition to children’s inability of recognize stealth food cues, children’s focus on the entertainment aspect of the programme may trigger low-involvement, superficial processing and automatic memory storage that facilitates greater acceptance of the media messages that bypass critical evaluation.

Narratives in healthy communications delivered by audio and video produce significant effects on attitudes, intentions and behaviours (Shen et al., 2015). In a series of studies using a narrative media programme with healthy food cues and healthy eating role models (‘Food Dudes’), Horne et al. (2004, 2009, 2011), Lowe et al. (2004) and Upton et al. (2013) demonstrated that exposure to ‘Food Dudes’ brought about substantial increases in children’s consumption of fruit and vegetables compared to children who were provided with vegetables and fruits only. Horne et al. (2004, 2009) and Lowe et al. (2004) reported spill-over effects to home eating and particularly large increases among children who initially ate very little fruit and vegetables (Horne et al., 2004). During the intervention period, children who participated in the programme consumed significantly more fruit than at baseline and three times as many vegetables (Horne et al., 2004). Children in the control condition showed a significant decline in fruit and vegetable consumption (Horne et al., 2009). Food options in Horne et al. (2004, 2009, 2011) and Lowe et al. (2004) were limited to healthy options (vegetables and fruits) and did not include HSSF options. The exclusive investigation of healthy food cues and healthy food options in Horne et al. (2004, 2009, 2011) and Lowe et al. (2004) filled a significant gap in the research literature. Since the ‘Food Dudes’ intervention included narrative media viewings as well as rewards for tasting and eating vegetables and fruits, it remains unknown which elements of the intervention caused improvements in children’s eating. Since children in the control condition reduced their vegetable and fruit intake over time (Horne et al., 2009), the mere availability of healthy foods without promotion and encouragement to consume appears insufficient for increasing children’s fruit and vegetable intake.

Gonçalves et al. (2018) tested whether exposure to two sequential, 10-minute episodes of a cartoon show with healthy eating messages (‘Nutri Ventures’) positively affected children’s food choices and food preferences. Gonçalves et al. (2018) found that viewing ‘Nutri Ventures’ led to children eating more healthy foods (grapes and baby carrots) than children in the comparison group, who had watched a neutral cartoon. Exposure to ‘Nutri Ventures’ did not influence the intake of the HSSF options chips and chocolates (Gonçalves et al., 2018). Findings from Gonçalves et al. (2018) suggest that healthy food cues in narrative media can increase children’s healthy food intake, but not decrease children’s HSSF intake. For optimal health outcomes, further research may be required to assert ways of reducing children’s HSSF intake at the same time as increasing healthy food intake.

Naderer et al. (2018) designed three versions of a cartoon with fruit cues, candy cues or no food cues. Despite healthy food cue exposure, children were more likely to pick candy (fruit gum) over fruit (mandarin). This effect was more pronounced for children with high BMI. In the fruit cue condition, approximately 70% of children choose candy, 25% choose fruit and the remaining children did not want to eat. In the candy cue condition, approximately 70% of children choose candy and 30% chose fruit. In the control condition, children choose fruit as frequently as candy. Outcomes in Naderer et al. (2018) indicated that despite exposure to narrative media showing verbal and visual healthy food cues and character-food interaction, children could not be influenced to choose a healthier snack when unhealthy alternatives were available. The mere presence of a food cue, whether for healthy or HSSF food, led to the majority of children selecting candy (Naderer et al., 2018). Outcomes in Naderer et al. (2018) may be explained in terms of children’s inherent preference for HSSF foods, which can be activated by food cues, regardless of their specific content. Food cues exposure may trigger appetite and prime children for food cravings (Harris et al., 2009) for similarly palatable or even more palatable foods (Mandel & Brannon, 2017), since those foods activate reward pathways in the brain in ways that non-sugary foods do not (Luo et al., 2015). HSSF snacks offer faster gratification of food cue induced cravings than healthy foods (Benelam, 2009).

Additionally, children’s choice of candy over fruit in Naderer et al. (2018) was likely connected to the discreet choice situation that required children to choose one snack over another. When Gonçalves et al. (2018) allowed children to eat as much as they wished from a selection of healthy and HSSF snacks, healthy food cues in ‘Nutri Ventures’ increased children’s intake of healthy snacks although it did not decrease children’s intake of HSSF snacks. Since children in Naderer et al. (2018) were only allowed to choose either candy or fruit, children prioritized candy. Binder et al. (2019) applied the same choice situation in a narrative media study to test the effects of majority peer cues (the majority of children eating raspberries) and minority peer cues (one child eating raspberries) on children’s consumption of healthy or HSSF snacks. Binder et al. (2019) found that despite fruit cue exposure, children did not readily switch from HSSF snacks to fruit when having to choose one option over another. In addition, Binder et al. (2019) found that majority peer cues did not lead to children selecting fruit over candy. Minority cues decreased the likelihood of children picking fruit over candy. Neophobia emerged as an individual susceptibility factor that impacted the link between narrative media exposure with peer cues and children’s discrete choice of fruit versus candy (Binder et al., 2019). Children with high levels of neophobia were less likely to choose the healthy fruit snack when the minority of cartoon characters ate raspberries (Binder et al., 2019). Findings from Naderer et al. (2018) and Binder et al. (2019) suggest that instructing children to choose between healthy and HSSF snacks increases the likelihood of HSSF intake regardless of healthy food cue exposure. Findings from Gonçalves et al. (2018) complement findings from Naderer et al. (2018) in suggesting that unlimited access to both healthy and HSSF snacks after healthy food cue exposure can increase children’s healthy food intake.

Social Cognitive Theory (Bandura & McClelland, 1977) and the Extended Elaboration Likelihood Model (E-ELM, Slater & Rouner, 2002) have been used to explain the effects and mechanisms by which narrative media, product placement and entertainment education (EE) influence thoughts, feelings and behaviours (Shen & Han, 2014). Social Cognitive Theory (Bandura & McClelland, 1977) underscores the importance of modelling and observation to increase self-efficacy and initiate behaviour. According to E-ELM (Slater & Rouner, 2002), narrative media, product placement and EE capture viewers’ attention through interesting stories, which elicit identification with characters to reduce counter-arguing. Narrative transportation, immersion, positive product and brand evaluations, and character involvement including identification, adoration, similarity and liking, are key drivers to reduce resistance and counter arguing (Escalas, 2007; Phillips & McQuarrie, 2010; Moyer-Guse, 2008). When viewers felt that advertisements intruded on the story, advertising effectiveness was reduced as a function of breaking viewers’ transportation experience (Wang & Calder, 2009).

In contrast to product placement, which has predominantly been used to promote HSSF products, narrative media and EE mainly aim to encourage positive health behavioural change. EE is designed to convey specific health messages or target social norms by evoking emotional responses and creating a lasting impression that can change viewers’ knowledge, beliefs, attitudes, behavioural intentions and behaviour (Shen & Han, 2014; Singhal, Cody & Everett, 2003). Singhal et al. (2003) identified several challenges and benefits of EE, which are relevant to understand how digital media needs to be designed to improve children’s eating behaviour. First, EE that contain too much education and not enough entertainment were perceived as lecturing, pedantic and preachy by viewers, especially if the lecturing characters were authority figures in the relevant area, such as doctors promoting breastfeeding (Singhal et al., 2003). Low-threshold characters involved in a dialogue between a village health promoter and a mother were better received and highlight a need for subtle incorporation of educational content in entertainment media (Singhal et al., 2003). Second, too much entertainment and too little education can divert attention away from the health message (Singhal et al., 2003). Third, characters, plots and dialogues must be well-developed and credible to attract viewers and impact their behaviour (Singhal et al., 2003). The lack of urgency in many health behaviours including healthy eating is a challenge for health prevention and intervention because long-term health consequences undermine immediate action (Singhal et al., 2003). Skilful scripting and storytelling can make health risks appear more immediate, serious and personally relevant (Singhal et al., 2003). EE can discuss controversial or difficult topics by carefully choosing a messenger, such as a likeable peer model, that may be better received by the target group than public health advocates (Singhal et al., 2003).

In a similar vein, Shen et al. (2015) outlined a number of factors that increased the effectiveness of narratives in health communications. Gain messages, such increasing vegetable and fruit intake, were more effective than loss messages, such as cutting down on sugar (O’Keefe & Jensen, 2009). Message length correlated with effect size, suggesting that the longer the narratives were, the more effective they were (Shen et al., 2015). Video and audio channels as opposed to print were particularly effective to influence viewers and useful to induce narrative transportation and emotional reactions, which helped viewers to warm to the health messages (Shen et al., 2015). Tailored and culturally sensitive advertising narratives were more effective than standardised advertising narratives with less relevance to the individual viewer (Shen et al., 2015).

Narrative media and advertising need to be pitched at the appropriate cognitive level to influence viewers via framing and tailoring (Shen & Han, 2014). The effectiveness of narrative media to influence viewers may be compromised by viewers’ cognitive abilities and capacities (Chang, 2009) as well as situational factors such as distraction or fatigue. Kim, Ratneshwar and Thorson (2017) found four process variables, emotive response, hedonic value of the advertisement, credibility of the advertisement and perceived goal facilitation, to collectively mediate the positive effects of narrative advertising (compared to non-narrative advertising) on attitudes towards the advertisement and the brand.

## Automatic physiological and psychological responses to food cue exposure

Sophisticated marketing strategies such as emotional or stealth advertising interact with unconscious neurophysiological mechanisms to elicit unconscious advertising responses (Cohen, 2008). As described in the previous sections, there are several factors that explain children’s susceptibility to food advertising, including (1) children’s immature understanding of advertising (see chapter 1, section 1.3), (2) children’s immature executive functioning skills (see chapter 1, section 1.3), (3) the use of emotional advertising techniques that bypass rational information processing (see chapter 1, section 1.4) and (4) children’s reduced motivation the resist attractive advertising for palatable foods due to health goals being less salient than hedonic goals in children (see chapter 1, section 1.4). In addition, children’s ability to resist omnipresent HSSF food marketing is compromised by physiological and psychological mechanisms outside of our conscious awareness, which guide a large part of our eating behaviour (Cohen, 2008). Research on neurophysiological responses to food and food cues in advertising suggests that most information processing and behavioural responses are automatic, unconscious and emotional so that the extent to which media literacy translates into appropriate and sustained behavioural change is questionable (Cohen, 2008; Folkvord, 2020; Harris et al., 2009; Rozendaal et al., 2011).

‘Food choices are not occurring at the level of rational decision-making, but are governed by the impulsive, emotional, and non-rational part of the brain simply because of the ways the foods are marketed.’ (Cohen, 2008, p. 1771).

Cohen (2008) put forward 10 neurophysiological pathways that underscore that rather than eliciting rational processing of incoming information, exposure to food cues in HSSF food advertising elicit automatic, reflexive eating responses (Cohen, 2008; Folkvord et al., 2016; Papies, 2016; Sheeran, Gollwitzer & Bargh, 2013). These mechanisms include (1) physiological reflexive responses to food cues, (2) innate preferences for sugar and fat, (3) hardwired survival strategies such as increased food intake as a reaction to abundant food environments and new foods, (4) inability to judge consumption amounts by volume or calories that encourages eating in the absence of an energy deficit, (5) natural tendency to preserve energy that may account for the popularity of energy-dense and easily accessible HSSF snacks, (6) mirror neurons that facilitate imitation of others’ eating often without awareness, (7) automatic stereotyping, (8) conditioned responses that produce food carving when confronted with food cues, (9) automatic priming responses and (10) limited cognitive capacity and self-regulation ability (Cohen, 2008). This section will look at some of the neurophysiological mechanisms that encourage excessive food intake in the context of HSSF food marketing and -availability in more details to provide a better understanding of the impact of contemporary food and advertising environments on children’s eating to support research, prevention and intervention efforts to improve children’s eating and dietary health.

Priming describes as a process by which the introduction of one stimulus influences how people respond to a subsequent stimulus (Molden, 2014). Exposure to one stimulus predisposes the recipient of that stimulus to respond in a specific way by making existing memories and associations more salient. Imagery, music or lighting can prime consumers to purchase and consume a specific product, such as French wine after exposure to French music or German wine after exposure to German music, during shopping (North, 2012). Priming often occurs without consumers’ awareness (Bargh & Morsella, 2008), and adults in North (2012) were unaware that the supermarket music had influenced their choice of wine. In priming studies, relevant mental representations are activated in a subtle, unobtrusive manner in one phase of an experiment, and, then, the unconscious, unintended effects of this activation are assessed in a subsequent phase (Harris, [Bargh & Brownell,](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2743554/#R3) 2009). One real-life source of priming influences is media, including television programmes and advertisements which exert subtle but potentially far-reaching effects on eating behaviours (Harris et al., 2009).

Another automatic and unconscious process by which exposure to one stimulus (i.e., food advertising) predisposes the recipient of that stimulus to react in a certain way (i.e., food cravings), is classical conditioning (van den Akker, Schyns & Jansen, 2018). Foods and drinks with high amounts of sugar, salt and fat (stimulus) are known to activate the dopaminergic mesolimbic pathways (rewards), which are involved in classical conditioning (van den Akker et al., 2018). When identifying rewarding stimuli and motivating behaviours, a learning process is activated whereby a reward-related stimulus can lead to anticipation and motivation for that reward, thus, encouraging repeated exposure to that stimulus (Pavlov, 1928). Over time, conditioned food cue responses produce food cravings (Cohen, 2008). When classical conditioning principles (Pavlov, 1928) are applied to marketing to build brand loyalty, brands and products are imprinted with meaning and status to generate desire to buy and consume (Brunstrom, 2007; Folkvord, 2020). Over time, consumers learn to use the brand as a heuristic to guide their purchase and consumption decisions without being aware of this mental shortcut (Cohen, 2008). Folkvord (2020) called this the ‘reinforcing value’ of a product, referring to the liking and wanting of foods whose consumption is experienced as psychologically rewarding due to the positive attitudes that marketers attached to them. Upon repeated exposure to attractive marketing stimuli paired with food brands, these positive associations build positive brand images, preferences and consumption through ‘affective conditioning’ that may even occur in the absence of positive stimuli due to the ‘mere exposure effect’ (Monahan, Murphy & Zajonc, 2000). Classically conditioned brand attitudes such as those established by pairing attractive images with a food brand are reinforced with every exposure and persist to influence consumption patterns across the life span (Haughtvedt, Herr & Kardes, 2018; Nestle, 2013).

Folkvord (2020) points to a combination of physiological and psychological reward systems that undermine children’s ability to resist food cues, particularly HSSF cues. Cue Reactivity Theory (Carter & Tiffany, 1999) suggests that cognitions, emotions and external cues trigger desire for eating through physiological and psychological responses to food cues (Carter & Tiffany, 1999). These responses are summarized as food cue reactivity (Carter & Tiffany, 1999). Learning processes, feelings linked to eating occasions and sensory stimuli (like the sight or smell of food) trigger non-homeostatic food intake (Carter & Tiffany, 1999), which is hedonic food intake in the absence of physiological hunger (Berthoud, 2006). Applied to food advertising and food intake, Incentive Sensitization Theory (Robinson & Berridge, 2001) and Attentional Bias Theory (Field & Cox, 2008) suggest that intake and rewarding experience create a reciprocal relationship between cued reactivity and food intake, which increases reactivity to food cues (Rangel, 2013). Neuroimaging studies provide support for Cue Reactivity Theory (Carter & Tiffany, 1999) based on evidence that the nucleus accumbens, a part of the brain’s dopaminergic reward pathway linking motivational food cues and food intake (Zahm, 2000), responds to food advertising through increased activation (Rapuano, Zieselman, Kelley, Sargent, Heatherton & Gilbert-Diamond, 2017).

Physiological responses may include changes in heart rate, gastric activity and salivation (Nederkoorn, Smulders & Jansen, 2000) and increased activation of the dopaminergic reward system (Nijs, Franken & Muris, 2010). Physiological food cue reactivity describes the way in which our brains physiologically react to food cues in an automatic, reflexive manner. Exposure to food cues produces desire to eat due to dopamine release in the brain’s dorsal striatum (Volkow et al., 2003), which encourages us to seek and eat the available food. This physiological reflexive response to food cues cannot be averted (Volkow, 2003). Dopamine is secreted by individuals with normal weight and overweight in response to triggers in the environment (Volkow, 2003), although children with higher BMI tend to be sensitive to food cues and react with greater levels of overeating (Jansen et al., 2003). Activating of the brain’s reward pathways is particularly pronounced for foods and drinks with high sugar, fat and calorie content (Erlanson‐Albertsson, 2005; Folkvord, 2020), which makes their consumption neurophysiologically rewarding (Erlanson‐Albertsson, 2005; Folkvord, 2020). Confronted with HSSF foods, innate food preferences for sweet (Keskitalo et al., 2007) and fatty foods (Kast, 2018) lead to impulsive consumption, often despite existing food knowledge or intentions to abstain (Cohen, 2008). Self-control has been shown to diminish over time so that prolonged exposure to food cues in advertising rich environments can override behavioural intentions (Baumeister, Muraven & Tice, 2000). As discussed in Section 1.4, there is little evidence for children to have behavioural intentions for ‘healthier eating’ when hedonic eating is an option.

Psychological responses may include increased attention to food-related cues (Folkvord et al., 2016; Nijs et al., 2010), food cravings and obsessing over food intake (Kakoschke, Kemps & Tiggemann, 2014). As described in Cohen (2008), physiological reward responses may be especially pronounced for HSSF products due to the pleasurable ways in which the brain and body react to HSSF content (see chapter 1, section 1.6). Psychological reward responses are also more pronounced for HSSF compared to healthy products due to the use of appealing and well-funded advertising campaigns promoting almost exclusively HSSF products. HSSF foods and drinks are commonly associated with birthdays, rewards, special celebrations and displays of affection (Lupton, 1994; Namie, 2011; Nguyen, 2008; Nguyen-Rodriguez, Unger & Spruijt-Metz, 2009; Niland, McCreanor, Lyons & Griffin, 2017), which raises their psychologically status further above healthy foods for most children (Folkvord, 2020). In contrast, healthy food is rarely promoted and lacks funding for equally convincing marketing (Kaser-Boyd, 1978).

## Healthy food promotion

The Promotion of Healthy Food Model (Folkvord, 2020) suggests that to compete with hedonic influences and existing reinforcing value of physiologically and psychologically rewarding HSSF food, effective healthy food promotion must be able to increase the reinforcing value of healthy foods. Five assumptions form the foundations of the Promotion of Healthy Food Model (Folkvord, 2020): (1) Directing attention towards fruit and vegetables through food promotion increases their reinforcing value, which is viewers’ liking and wanting of the advertised product; (2) Increased attention, liking and wanting for the healthy food product elicits a reciprocal relationship with eating behaviour; (3) leading to a normalization, automatization and ultimately, habit formation, of healthy food intake; (4) Healthy eating habits in turn lead to improved physiological and psychological health, making healthy food consumption a rewarding experience and (5) Individual and societal factors (impulsivity, BMI, gender, SES, food fussiness, parental feeding style) determine individual susceptibility to food marketing exposure (Folkvord, 2020). Based on the five assumptions outlined in the Promotion of Healthy Food Model (Folkvord, 2020), building a positive attitude towards healthy foods, reinforcing children’s willingness to repeatedly try and taste healthy foods, increasing children’s intention to make purchase requests for healthy foods or to buy and consume them and supporting preferences for healthy foods over other foods are key steps to increase the reinforcing value of healthy foods and ultimately, children’s intake and integration of healthy foods into their regular diet (Folkvord, 2020).

Priming children more often with cues of fruit and vegetables through repeated advertising exposure and increased availability could then increase children’s healthy food consumption by eliciting an automatic response, which requires no deliberate, conscious and cognitively demanding decision-making (Berridge & Kringelbach, 2015). The aim of healthy food promotion may therefore be to increase the rewarding effect of healthy foods, to strengthen the connection between exposure to healthy food cues and subsequent intake of healthy foods and to elicit an automatic eating response or automatic preference for healthy foods (Chandon & Wansink, 2012). When food intake is automatic, habits are formed (Orbell & Verplanken, 2010). Habit formation is a crucial part in health promotion because healthy eating habits rather than isolated cases of healthy food choices support overall health (Alissa & Ferns, 2017; Papies, 2016; WHO, 2017) – without the need for deliberate, conscious and cognitively demanding decision-making (Berridge & Kringelbach, 2015). Eating a healthy diet out of habit is more likely to succeed and lead to long-term positive health outcomes than applying cognitive resources, restraint and higher order goals every time at a decision is required (Berridge & Kringelbach, 2015). Repeated exposure to healthy foods including digital food cues can support a healthy diet throughout the lifespan via familiarity, acceptance, liking, preference and routine consumption, particularly during the early years of life and critical periods of development (Mura-Paroche et al., 2017).

Folta et al. (2006) recommended that health educators may want to adopt some of the HSSF food advertising techniques used in the commercial sector to promote more healthful food. Halford et al. (2011) pointed out that the effectiveness of marketing strategies to promote HSSF products may not readily apply to the promotion of healthy foods. Halford et al. (2011) is supported by Cohen (2008) and Folkvord (2020) who underscore the importance of hedonic enjoyment in food choice, which is physiologically and psychologically greater in HSSF versus healthy food consumption. In addition to differences in physiological and psychological gratification levels derived from HSSF versus healthy food intake, the relative absence of healthy eating despite healthy food cue exposure in television-style advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), narrative media (Binder et al., 2019; Naderer et al., 2018) and digital games (Folkvord et al., 2012) may be explained through the advertising techniques that are typically applied to promote healthy versus HSSF products.

To date, health communication has favoured rational argumentation to improve health behaviours – with limited success (Brusse et al., 2016; Hinyard & Kreuter, 2007). In contrast, HSSF food marketing has relied almost exclusively on emotional advertising and appealing narratives and has been shown to be highly effective in influencing children’s eating (Boyland et al., 2016; Cairns et al., 2013; Folkvord et al., 2016; Russel et al., 2019; Smith et al., 2019). Healthy food promotion tends to highlight long-term gains through a logical argument involving health benefits and disease prevention, which requires responding to a rational argument via cognitive processing of the information that is being provided (Dastidar & Bhadra, 2017). HSSF food promotion tends to focus on short-term gains such as the immediate gratification of cravings for inherently rewarding, highly palatable foods high in sugar, salt and fat (Boyland, Harrold, Kirkham & Halford, 2012). These advertising strategies emphasize taste, enjoyment and fun, and are processed on an easily accessible, emotional, rather than rational level (Jenkin et al., 2014). According to Hinyard and Kreuter (2007), a combined approach incorporating valuable health information and messages packaged in an easily comprehensible and accessible approach using narratives is likely to enhance the effectiveness of health communication.

Since healthy foods do not have the same intrinsic appeal as HSSF products (Cohen, 2008; Folkvord, 2020), HSSF advertising approaches may not readily apply to healthy food promotion. If healthy food promotion needed to persuade consumers through health arguments, and greater effort was required to attend to and comprehend such arguments, viewers would then be less likely to engage with cognitively demanding healthy advertisements than with low involvement advertisement for HSSF products. Engaging with healthy advertising would require the viewer to become aware of the health risks of eating a long-term nutritionally deficient diet, to internalize the importance of healthy eating and to, ultimately, change their eating behaviour. In contrast to cognitively demanding advertising for healthy food, HSSF advertising simply aims to establish or strengthen brand loyalty, which does not require engaging with higher order concepts such as the long-term health implications of an unhealthy diet (Boyland et al., 2012). Since HSSF products are inherently pleasurable to eat, they appeal to viewers automatically (Cohen, 2008; Folkvord, 2020). In contrast, instilling a healthy diet through advertisement would need to challenge these predetermined food choices. It may therefore be remiss to conclude that healthy food advertisements are weaker than HSSF advertisements, as it would not be possible to uncouple the healthy message from the necessary higher cognitive involvement with the advertisements. Healthy food advertisements that do not require acceptance of the necessity for a healthy diet may show a different relationship with subsequent food intake, as this has been demonstrated in healthy food cues embedded in narrative media (see section 1.5). Investigations of healthy and HSSF food promotion may benefit from separate analysis, since healthy versus HSSF food cues are likely to correspond with different cognitive responses and possible target inherently different behaviours (Cohen, 2008).

Based on an analysis of successful European advertising campaigns for healthy foods, Aschermann-Witzel et al. (2012) proposed ‘data and knowledge’, ‘emotions’, ‘endorsement’, ‘community’, ‘media’ and ‘why and how’ as the key success factors (KSFs) in healthy food marketing to children. This section will explore the key success factors outlined in Aschermann-Witzel et al. (2012). The KSF ‘data and knowledge’ refers to the use of scientific nutritional evidence, insight into market and consumer behaviour, intuitive knowledge or awareness of emerging consumption trends and the application of knowledge about health-, developmental-, marketing- and social psychology to inform the design and distribution of healthy food advertising campaigns (Aschermann-Witzel et al., 2012).

The KSF ‘emotions’ refers to the use of emotional appeals to target universal human needs for happiness, health or belonging that marketers associate with the purchase of the promoted product (Aschermann-Witzel et al., 2012). Humour, simplicity, naturalness and reconnection to nature are popular themes in food advertising for healthy products (Aschermann-Witzel et al., 2012). Emotional advertising appeals to promote healthy foods to children may relate to themes of fun, fantasy, excitement and friendship and positive mood alteration from having or consuming the promoted. Highlighting sensory product qualities such as great taste and smell, exciting texture or soft touch and interesting texture (Hastings, McDermott, Angus, Stead & Thomson, 2006; Kelly, Flood and Bauman, 2007; Kim, Chen & Cheon, 2019; Lynn & Zolkepli, 2019) over health and wellbeing messages can support healthy food marketing by communicating the hedonic enjoyment of healthy foods. Encouraging children to eat for pleasure is more effective than cognitively demanding health appeals, which have been shown to be ineffective (Hausman, 2012) or counterproductive (Raghunathan, Naylor & Hoyer, 2006). Marty, Chambaron, Nicklaus and Monnery-Patris (2018) identified three dimensions of pleasure from eating learned during childhood, including the sensory dimension, referring to the pleasure derived from sensory sensations during food consumption (taste, texture, temperature), the interpersonal dimension, related to the pleasure gained from the social context of food consumption (community meals, sharing food) and the psychosocial dimension, which is the pleasure grounded in cognitive representations of food (special occasions, rewards, treats). Healthy food advertising may benefit from designing campaigns that include all three dimensions of pleasure from eating, since hedonic rewards tend to be more salient in children when making food related decisions than health benefits.

The KSF ‘endorsement’ of peers, parents (Tellis, 2003) and celebrities (Boyland et al., 2012) can create trust and credibility in the advertising messages (Aschermann-Witzel et al., 2012). The use of social endorsers is a powerful marketing technique to create positive associations with brands and products, build brand loyalty and encourage compliance of the marketing message (Smits, Vandebosch, Neyens & Boyland, 2015). Parents, teachers, relatives, siblings, peers and celebrities in real life (DeCosta, Møller, Frøst & Olsen, 2017; Scaglioni, De Cosmi, Ciappolino, Parazzini, Brambilla & Agostoni, 2018) and in digital media (Binder, Naderer & Matthes 2019; Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Upton et al., 2013) can serve as role models for young children. Strong socialization processes help children to learn about many aspects of food and eating, including how, what, when, how much, with whom, how and why to eat (Albuquerque et al., 2018; Vartanian et al., 2015). Observations of others’ eating serve as guides for children to develop their own eating behaviours (Cruwys, Bevelander & Hermans, 2015; Kim, Chen & Cheon, 2019). Social endorsers in food advertising can increase fruit consumption (Baldassarre & Campo, 2015; De Droog, Valkenburg & Buijzen, 2010; De Droog et al., 2014) and vegetable intake (Hanks et al., 2016). The effectiveness of social endorsers may in part be attributed to young people’s emotional and cognitive needs for belonging and identity that may be addressed using branded characters (Baldassarre & Campo, 2015; De Droog, Valkenburg & Buijzen, 2010; De Droog et al., 2014) and branded media (Hanks et al., 2016), which increase the psychologically rewarding attributes of healthy foods (Bruce et al., 2013).

According to Bandura’s Social Learning Theory (Bandura & McClelland, 1977), children learn through observation and imitation of role models in their immediate environment. Acquisition of food preferences and eating behaviour is then a function of observational learning (Dovey & Dovey, 2010). Imitation of an observed behaviour relies on attention, retention, motoric reproduction and motivation (Bandura, 1971). Motivation to attend to, remember and reproduce a behaviour may depend on extrinsic, vicarious or intrinsic reinforcement, such as praise from parents, observing another child receive rewards or self-generated desire to imitate a behaviour (Bandura & Barab, 1971). Modelling impacts food acceptance, food preferences and food intake (Blissett, 2018) even in the absence of hunger (Cruwys et al., 2015) as mirror neurons promote imitation of observed behaviour, including mimicry of food choices, food preferences and food portions without awareness (Chartrand & Lakin, 2013; Hermans et al., 2012; Nam & Shune, 2020). Imitation of eating behaviour is particularly pronounced when we perceive eating models to be similar to us (Curwy et al., 2015). Individual differences such as neophobia (Binder et al., 2019) also affect whether eating behaviour of others is imitated (Blissett, 2018).

Birch (1980) experimentally investigated social influence of peers on ‘pre-schoolers’ food preferences and found that child’s observation of other children selecting and consuming foods that the observing child did not like, increased the observing child’s preference for and consumption of the initially disliked food. According to Aschermann-Witzel et al. (2012) peer-endorsement operates on a horizontal level among individuals and groups sharing the same status to create credibility and trust amongst viewers. Peer-modelling was a key element in Horne et al. (2004, 2009, 2011), Lowe et al. (2004) and Upton, Upton and Taylor (2013) who designed and implemented the narrative media intervention ‘Food Dudes’ to increase children’s tasting and eating of vegetables and fruits in nurseries and schools. Peer-modelling, rewards-based narrative media exposure increased children’s vegetable and fruit intake while mere availability of vegetables and fruits led to a decline in intake over time (Horne et al., 2009; Upton et al., 2013).

In a narrative media study, Binder et al. (2019) found that peer effects depended on children’s general willingness to try new foods, the food type and the number of peers who carried out the target eating behaviour (minority and majority cues). Binder et al. (2019) created digital cartoon characters that were similar to the children viewing the narrative media material. The digital peer models were approximately the same age as their participants and Binder et al. (2019) made sure that the characters varied in sex and race to make them equally appealing for children of different sexes and races. Across the three different cartoon versions, Binder et al. (2019) manipulated the number of children who were shown eating raspberries to test the effects of majority and minority peer food cues on children’s consumption of healthy or unhealthy snacks. After viewing the cartoons with minority and majority food cues, the children were asked to choose one out of four snacks masked as a thank you for participation. Healthy snack options were raspberries and apple slices, unhealthy snack options were fruit gummies and fruit chews. Majority peer cues did not lead to children selecting fruit over candy. Minority cues decreased the likelihood of children picking fruit over candy. Binder et al. (2019) cautioned against the use of peer cues as a strategy to normalize and encourage healthy eating as majority peer food cues were counterproductive and minority peer cues could lead to the healthy target foods being rejected.

Links between parental eating behaviours and child intake habits are firmly established across a wide range of consumption patterns and food types (Birch, Savage & Ventura, 2007; Brown & Ogden, 2004; Scaglioni et al., 2018; Scaglioni et al., 2008). Children imitate parents healthy eating habits (Domnariu, Ilies & Furtunescu, 2013; Tysoe & Wilson, 2010) such as vegetable and fruit intake (Pearson, Biddle & Gorely, 2009), and copy parents’ unhealthy eating patterns like junk food consumption (Kiefner-Burmeister, Hoffmann, Meers, Koball & Musher-Eizenmann, 2014). Christian, Evans, Hancock, Nykjaer and Cade (2012) found that children who ‘always’ ate family meals together, had higher intake of fruit and vegetables than children who ‘never’ ate a family meal together. Parents’ daily vegetable and fruit intake was linked to children’s vegetable and fruit intake (Christian et al., 2012). Pliner and Salvy (2006) linked parents’ food neophobia to children’s neophobia. In young children, mothers’ eating appears to play a particularly important role in role modelling, with young children being more likely to imitate mother’s eating rather than other carers’ eating (Harper & Sanders, 1975).

The KSF ‘community’ refers to advertising appeals generating a sense of ‘common ground’, shared social or cultural values, shared responsibility, general human values or spiritual and religious experiences that allow viewers to relate to the characters and narrative in the advertisement and to one another by linking the product to local origin or relevance (Aschermann-Witzel et al., 2012). Advertising targeting children may include common values of friendship, family, health and wellbeing by showing a community of happy children and parents unified by their enjoyment of healthy food and shared play time. The KSF ‘community’ relies on shared social norms, which serve as powerful guides for eating behaviour (Kim, Chen & Cheon, 2019). Social and cultural norms transmitted through mass media exert influence on the food and feeding environment in which children are raised (Campbell & Crawford, 2001; Qualls‐Creekmore et al., 2020). Social and cultural norms transmitted through mass media exert influence on the food and feeding environment in which children are raised (Campbell & Crawford, 2001; Qualls‐Creekmore et al., 2020). Eating norms are perceived standards of socially and culturally appropriate consumption behaviours, a code of conduct to guide decisions ranging from food choice to food preparation, meal presentation, portion sizes, intake amounts and consumption rituals (Higgs, 2015). Next to parental and peer influences, media represents one major source of education, information and social and cultural norms relating to food and eating (Nestle, 2013). Norms regarding the social and physical characteristics of mealtime structure influence children’s eating patterns, for example, whether families prepare meals from scratch and eat together, or whether television-viewing is deemed acceptable during meals (Patrick, Nicklas & Hughes, 2004).

Higgs (2015) proposed that eating norms are followed because compliance is associated with positive social judgements. Following eating norms may increase food safety, facilitate food sharing and enhance affiliation with a social group (Deutsch & Gerard, 1995), but dietary health outcomes depend on prevailing food norms (Curwys et al., 2015). Since most food advertising promotes overeating and increased intake of HSSF products, prevailing food norms in media and advertising may be detrimental to health (Nestle, 2013).

Norm following is more probable when there is doubt about what constitutes appropriate behaviour, and when there is greater shared identity with the norm referent group (Higgs, 2015). Children are confronted with large volumes of conflicting information about healthy eating, individual dietary needs and what constitutes a balanced diet (Nestle, 2013). By creating social norms that portray junk food and fast-food consumption as safe, enjoyable and socially desirable, marketers create eating norms that are detrimental to health and most seductive to vulnerable populations with little or no food knowledge who are then specifically targeted through tailored advertising (Higgs, 2015). Marketers make use of automatic imitation and stereotyping by producing tailor-made advertising campaigns to reflect characteristics of the target group in an in-depth and sophisticated manner (Eisend & Kanevska, 2020; Strycharz, van Noort, Smit & Helberger, 2019). Complying with unhealthy eating norms in media when in doubt about the appropriate behaviour (Higgs, 2015) reflects neurophysiological mechanisms discussed by Cohen (2008), who proposed that consumers subconsciously and impulsively choose foods and drinks with HSSF content when they feel stressed or overwhelmed without conscious awareness. The same neural systems that mediate the rewarding effects of food intake are likely to reinforce compliance with prevailing eating norms (Higgs, 2015).

The KSF ‘media’ refers to the most effective selection or combination of media for communicating the promotional message (Aschermann-Witzel et al., 2012). Television as a means of communication has the enhanced potential over non-digital advertising to appeal to emotions through combining sound, story, commentary and vivid imagery (Aschermann-Witzel et al., 2012; Hastings et al., 2007). Video-based advertising can be used across a variety of devices and communication channels on television and online (on streaming sites, in pop-up advertisements, embedded in television-on-demand). In addition to television, mobile phones, tablets and computers are increasingly popular media devices where children are exposed to new, stealth advertising techniques used in advergames, branded homepages, online clubs and pop-up advertising (Hastings, McDermott, Angus, Stead & Thomson, 2006).

The KSF ‘why and how’ viewers should be interested in the product, change their consumption behaviour in favour of the advertised product or comply with a recommended health behaviour requires marketing to effectively communicate the promotional message, elicit motivation to act on the message and provide viewers with the ability to act (Aschermann-Witzel et al., 2012). In the context of healthy food promotion to children, health messages must be communicated clear and simple enough for children to understand it (Aschermann-Witzel et al., 2012). ‘Why’ refers to the motivational factor of changing behaviour (Aschermann-Witzel et al., 2012). Presenting long-term benefits such as mental clarity, improved physical health, more satisfactory appearance and general wellbeing and short-term benefits, including taste, excitement and novelty was found to be one tool used in successful health marketing campaigns (Aschermann-Witzel et al., 2012), but may apply less readily to children who typically prioritise eating for pleasure (Bruce et al., 2016). ‘How’ refers to the actions that viewers must take to respond to the advertisement as intended by the marketer and may be a step-by-step explanation, a call to action or instructions to follow (Aschermann-Witzel et al., 2012). When promoting healthy food to children, healthy snacks that require little or no preparation can decrease barriers to children being able to respond to healthy eating messages.

## Literature review on the effects of manipulated exposure to television-style food advertising and children’s food intake

As part of this thesis, a literature search of the international evidence base on the effects of food and beverage marketing on children’s food intake was carried out to identify and evaluate all relevant evidence and identify gaps in the research literature. Although existing reviews on digital food advertising and children’s eating behaviour are available (Boyland et al., 2016; Boyland & Whalen, 2015; Russel, Croker & Viner, 2019; Sadeghirad, Duhaney, Motaghipisheh, Campbell & Johnston, 2016; Smith, Kelly, Yeatman & Boyland, 2019; Young, 2003), there are no reviews focusing on television-style food advertising and children’s actual food intake that include healthy and HSSF food advertising and food and drink options. The literature search strategy focused on articles published in English in peer‐reviewed journals. Inclusion criteria were the use of child participants (aged 12 years and under), the controlled manipulation of television-style food advertising only and the measurement of actual food intake as opposed to preferences, purchase request, nutrition knowledge, intentions and other markers of eating behaviours in the context of food marketing. The literature search strategy included articles published up until the end of 2020. Several interdisciplinary electronic databases were searched for relevant publications (SCOPUS, PsycINFO, PubMed/MEDLINE, Cochrane Library Web, CINAHL, Web of Science, ProQuest, Emerald Insight, JSTOR and Google Scholar). Key literature search terms included: food advertising, children, children’s eating, eating behaviour, food intake, food advertising effects, food advertising exposure, television food advertising and digital food cues.

The aim of the broad literature search was to gain an understanding of how much empirical evidence there was to support links between children’s food intake and exposure to television-style advertising and how methodological variation including research design, research setting, food advertising stimuli, food intake opportunity, food intake measurement may have influenced the reported findings to then highlight gaps in the available research literature on manipulated exposure to television-style food advertising and children’s food intake. As shown in Table 1.1 below, 14 studies that examined exclusively the effects of manipulated exposure to televised food advertising on children’s food intake met the inclusion criteria outlined above (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979; Lorenzoni et al., 2017). The aim of this thesis was to investigate the effects of television-style food advertising on children’s food intake in the nursery setting, which typically includes children aged three to five in the UK (Gov UK, 2022a) and children aged three to seven in Germany (Kita, 2022). Since only four available studies (Dovey et al., 2011; Halford et al., 2007; Kaser-Boyd, 1978; Lemnitzer et al., 1979) reflect that age range, the literature search was extended to include studies with samples of children up to and including 12 years of age (Anschutz et al., 2009, 2010; Boyland et al., 2013; Fox,1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2004, 2008; Harris et al., 2009; Lorenzoni et al., 2017) (see Table 1.1).

| **Author, Country** | **Participants** | **Design** | **Viewing phase** | **Eating phase** | **Relevant results** | **Limitations** |
| --- | --- | --- | --- | --- | --- | --- |
| Anschutz et al., 2009  Netherlands | *N* = 120  Age range = 8-12  Mean age = 9.8  Semi-naturalistic setting in 3 primary schools | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 2 conditions | Individual viewing  Condition 1: 3 (HSSF) food adverts + 2 non-food adverts  Condition 2: 5 non-food adverts  Programme: 20-min-movie ‘The March of the Penguins’  Insertion: after 5 min + 12 min | Individual eating  20 min; during viewing  Ad lib intake of HSSF snack: M&Ms (chocolate-coated peanuts); Pre-/post-weighting of bowl; g converted into kcal; None of the advertised products were available at the eating phase | Food advertising increased intake of M&Ms in boys; Food advertising decreased intake of M&Ms in girls  M&M intake was positively correlated with hunger and liking of test food; No correlation to age, BMI | Long-term effects were not assessed; Use of recorded advertisements; Potential sex-bias in advertisements towards boys; Children’s excitement to participate in study may have affected food intake; Children may not have exhibited natural eating behaviour |
| Anschutz et al., 2010  Netherlands | *N* = 121  Age range = 8-11  Mean age = 10.4  Semi-naturalistic setting in 2 primary schools | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 3 conditions | Individual viewing  Condition 1: 4 (HSSF) food adverts + 1 non-food advert (5 min total)  Condition 2: 5 non-food adverts (5 min total)  Condition 3: 4 ‘light’ calorie food adverts + 1 non-food advert (5 min total)  Programme: 20-min-movie ‘March of the Penguins’  Insertion: after 5 min + 12 min  All advertising targeted adult audiences | Individual eating  20 min; during viewing  Ad lib intake of HSSF snack: M&Ms (chocolate-coated peanuts); Pre-/post-weighting of bowl; g converted into kcal; None of the advertised products were available at the eating phase | Adult food advertising had no significant main effect on M&M intake; Age, hunger, liking of test food had significant main effect on M&M intake but not BMI or maternal weight concern | Long-term effects were not assessed; Use of recorded advertisements; Children may not have exhibited natural eating behaviour |
| Boyland et al., 2013  United Kingdom | *N* = 181  Age range = 8-11  Mean age = 10.0  Classrooms in 8 primary schools | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 4 conditions | Group viewing (*n* = 5-10)  Condition 1: 45 sec branded crisp (HSSF) advertising  Condition 2: 45 sec non-branded (HSSF) crisp advertising  Condition 3: 45 sec celebrity endorser in non-food context  Condition 4: 45 sec non-food advertising  Programme: 20-min-cartoon ‘The Simpsons’  Insertion: once | Group eating (*n* = 5-10)  No time constraint reported; post viewing  Ad lib intake of HSSF snack: crisps labelled branded and unbranded; Pre-/post-weighting of bowls; g | Endorsed food adverts and endorser in non-food context increased the intake of branded food only; Endorser effect contributed to overconsumption as intake of unbranded crisps was not reduced to compensate for intake of branded crisps | Long-term effects were not assessed; Use of recorded advertisements; Individual susceptibility factors such as children’s previous food preferences, eating styles and SES were not measured but may have had an influence on outcomes; Taste ratings were not assessed; it is unclear whether children realised that both crisps were the same food |
| Dovey et al., 2011  United Kingdom | *N* = 120  Age range = 5-7  Mean age = 6.0  Classrooms of 4 classes from 2 schools | Repeated measures  Experimental  Within-Subjects (2 sessions; 1 month washout)  All children completed all 3 conditions | Small group viewings (*n* = 4-5)  Condition 1: 5 HSSF food advertising (2 min total)  Condition 2: 3 healthy food advertising (2 min total)  Condition 3: 4 non-food advertising (2 min total)  Programme: 14-minute-show ‘The Secret Show’  Insertion: 1 advertising break halfway through the programme | Small group eating (*n* = 4-5)  15 min; post viewing  Ad lib intake of individual servings of six snack foods on a plate, served on their own individual tray  4 HSSF snacks: chocolate, jelly sweets, potato crisps, Snack-a-Jacks  2 healthy snacks: green grapes, carrot sticks; Pre-/post-weighting of food options on plates/trays; kcal; None of the foods available during the eating phase had been advertised during the viewing | Food advertising increased intake of food  Total kcal intake was higher following HSSF food advertising compared to healthy food and non-food advertising; Irrespective of content (HSSF or healthy snacks), food advertising increased food intake by 47 kcal (11%) in high food neophobic children; Following healthy advertising, children with low neophobia levels consumed less HSSF snacks (chocolate) but did not increase healthy food intake (fruit, vegetables); BMI did not affect food intake | Use of recorded advertisements; None of the snacks available during the eating phase had been advertised during viewing phase; food intake following advertising did not reflect snacks advertised against those that were not; Findings were limited by the number of snacks offered and the scale of the study; Since the study was school based, it is unknown how children would respond to food advertising within their home environment, findings cannot infer the potential impact on children’s habitual diet |
| Fox, 1980  United Stated of America | *N* = 96  Preoperational group; N = 48  Age range = 4  Mean age = 4.65  Concrete operational group; *n =* 48  Age range = 9  Mean age = 9.78  Mobile research laboratory parked next to primary school | Cross-sectional (pre-/post-test)  Experimental  Between-Subjects  Random assignment to 1 out of 3 conditions | Individual viewing  Condition 1: 30 sec HSSF food advertising (5 min total)  Condition 2: 30 sec healthy food advertising (5 min total)  Condition 3: 30 sec non-food advertising (5 min total)  Programme: 7.5-minute-show ‘The Jetsons’  Insertion: 5 min advertising break inserted twice; each advertisement was repeated at least twice | Individual eating  8 min; post viewing  Ad lib intake of 12 snacks presented in individual clear plastic glasses randomly arranged on tray  6 HSSF snacks: Hershey bars, Fritos, Chips Ahoy cookies, Fruit Loops, Pepsi, cherry Kool-Aid  6 healthy snacks: cheese, carrots, grapes, apples, milk, orange juice; Pre-/post-weighting of serving glasses; g/ml converted into kcal | HSSF advertising increased HSSF snack intake in boys; HSSF advertising did not affect snack intake in girls  Healthy food advertising had no effect on snack intake; Age, cognitive development, understanding of advertising and media literacy did not affect outcomes | Long-term effects were not assessed; Use of recorded advertisements; Potential sex-bias in control advertisements towards boys; Eating opportunity may have been too artificial given the research laboratory and presentation of foods for children to display typical eating behaviour; Generalizability to other eating environments unknown |
| Gilbert-Diamond et al., 2017  United Stated of America | *N* = 200  Age range = 9-10  Mean age = 9.9  Laboratory | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 2 conditions | Viewing: not reported  Condition 1: 7.7 min HSSF food advertisements + 3.1 min non-food advertisements (20 advertisements total)  Condition 2: 7.7 min non-food advertisements + 3.1 min non-food advertisements (20 advertisements total)  Programme: 34-min- show ‘Figure it Out!’  Insertion: not reported | Eating: not reported  34 min; during viewing  Ad lib intake of 4 HSSF snacks: gummy candy, cookies, chocolate, cheese puffs; Pre- and post-weighting; g converted into kcal; Gummy candy was advertised during the viewing phase | All children overate; HSSF food advertising increased caloric intake of the recently advertised snack in children who had already eaten a meal to satiety; association was modified by the *FTO* rs9939609 obesity-risk allele; Children who viewed HSSF advertising ate more of the advertised foods than the control group, but not more of the non-advertised food and not more in total | Long-term effects were not assessed, children may have compensated for increased short-term intake in long-term intake; High inter-individual variability in total consumption, study may have been underpowered; Generalizability of laboratory-based findings to the home environment is unknown; Use of recorded advertisements |
| Gorn & Goldberg, 1980  Canada | *N* = 151  Age range = 8-10  Mean age = not stated  Boys only  Cub Scout Groups | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 6 conditions | Large group viewings (*n* = 18-40)  5 experimental conditions: with varying numbers of 30 sec ice cream (HSSF) advertisements from the same ice cream company inserted at various points during programme  1 Comparison condition: Programme no ads  Programme: 30-min- show ‘The Flintstones’  Insertion: varying | Large group eating (*n* = 18-40)  15 min; during viewing of neutral programme  Ad lib intake of pre-portioned, excessive amount HSSF food: Chocolate or vanilla ice cream; Pre-/post-weighting of bowls; ounces | HSSF food advertising for Danish Hill ice cream was not effective in increasing ice cream intake; Viewing increased numbers of the same advertisement decreased ice cream intake | Long-term effects were not assessed; Use of recorded advertisements; Large group viewings and eating opportunities may have distracted children (attention to media materials and hunger and satiety signals); Control group was double the size of experimental groups and may not be comparable to experimental conditions as control group viewed programme without any advertising rather than non-food advertising |
| Halford et al., 2008  United Kingdom | *N* = 59  Age range = 9-11  Mean age = 10.2  Classrooms in schools | Repeated measures  Experimental  Within-Subjects (2 sessions, 2-week washout)  All children do 2 out of 2 conditions | Large group viewings  Condition 1: Collection of HSSF food advertising  Condition 2: Collection of non-food advertising  Programme: Cartoon  Insertion: At the beginning of the programme  None of the snacks available during the eating phase were advertised during viewing phase | Smaller groups eating (*n =* 4-5)  No time limit; post viewing  Ad lib intake of an assortment of packaged snacks prepared on a plate  3 HSSF snacks: Haribo jelly sweets (low-fat sweet), chocolate (high-fat sweet) and crisps (high-fat savoury)  2 healthy snacks: Snack-a-Jacks (low-fat savoury), green grapes (fruit); Pre-/Post-weighting; 50g portions converted into kcal | HSSF food advertising increased intake of all foods; HSSF advertising increased total food intake in children with normal weight by 89%, in children with overweight by 100% and in children with obesity by 150%; Change in procedure enhanced effects: 5 min of HSSF advertising + 10 min of cartoon without tasks between viewing + eating may have enhanced salience of food cues | Use of recorded advertisements; Large group viewings may have distracted children (reduced attention to media materials); Fewer healthy than HSSF options at the eating opportunity; Comparison of packaged HSSF snacks versus unpackaged healthy snacks may have impacted children’s intake |
| Halford et al., 2007)  United Kingdom | *N* = 93  Age range = 5-7  Mean age = 6.3  Classrooms in schools | Repeated measures  Experimental  Within-Subjects (2 sessions, 2-week washout)  All children do 2 out of 2 conditions | Large group viewings  Experimental condition: Collection of 10 HSSF food adverts  Comparison condition: Collection of 10 non-food adverts  Programme: 10-min-cartoon  Insertion: At the beginning of the programme | Smaller groups eating (*n* = 4-5)  No time limit; post viewing  Ad lib intake of an assortment of packaged snacks on a plate  3 HSSF snacks: Haribo jelly sweets (low-fat sweet), chocolate (high-fat sweet) and crisps (high-fat savoury)  2 healthy snacks: Snack-a-Jacks (low-fat savoury), green grapes (fruit); Pre-/post-weighting; 50g portions converted into kcal | HSSF advertising increased snack intake (total kcal); HSSF advertising increased intake of all snacks except fruit; Intake increases produced by HSSF advertising varied across food types with HSSF snacks being more popular than healthy snacks; No main effect for BMI | Use of recorded advertisements; Large group viewings may have distracted children (reduced attention to media materials); Children may have grown bored of viewing the same cartoon twice, boredom has been linked to increased food intake (Moynihan, Igou & van Tilburg, 2020); Lack of assessment of individual susceptibility factors such as children’s habitual TV viewing behaviour; Amount and type of television programmes watched, regular amount and types of advertising exposure; Inequal number of HSSF versus healthy snacks |
| Halford et al., 2004  United Kingdom | *N* = 42  Age range = 9-11  Mean age = 10.4  Classrooms in 1 primary school | Repeated measures  Experimental  Within-Subjects (2 sessions, 2-week washout)  All children do 2 out of 2 conditions | Large group viewings  Experimental condition: Collection of 10 HSSF food adverts  Comparison condition: Collection of 10 non-food adverts  Programme: 10-min-cartoon  Insertion: At the beginning of the programme | Smaller groups eating (*n* = 4-5)  No time limit; post viewing  Ad lib intake of an assortment of packaged snacks on a plate  3 HSSF snacks: Haribo jelly sweets (low-fat sweet), chocolate (high-fat sweet) and butter puffs (high-fat savoury)  1 healthy snack: Ryvita whole grain crackers (low-fat savoury); Pre-/post-weighting; 50g portions converted into kcal | HSSF advertising increased intake of all snacks except low-fat savoury, particularly in overweight and obese children; Children ate more healthy snacks (low-fat savoury) following non-food advertising; Positive correlation between weight status, food advert recognition and food intake | Use of recorded advertisements; Large group viewings may have distracted children (reduced attention to media materials); Fewer healthy than HSSF options at the eating opportunity |
| Harris et al., 2009  United States of America | *N* = 118  Age range = 7-11  Mean age = 8.8  Classrooms at school and camp | Cross-sectional  Experimental  Between-Subjects  Random Assignment to 1 out of 2 conditions | Individual viewing  Condition 1: 4\* 30 sec HSSF food adverts  Condition 2: 4\* 30 sec non-food adverts  Programme: 14-minute-show ‘Disney’s Recess’  Insertion: Twice | Individual eating  14 min; during viewing  Ad lib intake of one HSSF snack (Goldfish crackers) not advertised during viewing  Pre-/post-weighting of bowl; g | HSSF advertising increased HSSF snack intake (+45%); Intake was correlated to parents’ assessment of child’s liking of snack food, no correlation with amount of time since last meal, age, parents’ assessment of child’s appetite, snacking while watching TV in the past week, parents’ or child’s reports of child’s weekly TV viewing | Use of recorded advertisements; Long-term effects were not assessed; Single item study, children’s dis/like of test food may have influenced outcomes |
| Kaser-Boyd (1978)  United States of America | *N* = 47  Age range = 4-5  Mean age = not stated  Experimental rooms in mobile laboratory and psychology department building | Cross-sectional  Experimental  Between-Subjects  Random assignment to 1 out of 3 conditions | Individual viewing  Condition 1: 30 sec HSSF advertising (3 min total)  Condition 2: 30 sec healthy food advertising (3 min total)  Condition 3: 30 sec non-food advertising (3 min total)  Programme: 7-min-show ‘The Pink Panther’  Insertion: 3 ad breaks; each advert shown twice  Some of the available snacks had been advertised during viewing phase | Individual eating  8 min; post viewing  Ad lib intake of 12 snacks presented in transparent food containers on tray with individual compartments for foods, drinks and labels  6 HSSF snacks: Hershey bars, Frito’s Corn Chips, Chips-Ahoy Chocolate Chip Cookies, Honeycombs cereal, Coke, cherry Kool-Aid  6 healthy snacks: cheese, carrots, grapes, apples, milk, orange juice; Pre/post-weighting of test foods and drinks; g/ml converted into kcal | Between-group differences: None; Within-group differences: HSSF advert exposure increased HSSF snack intake; Healthy food advertising did not increase healthy snack intake; SES did not influence outcomes | Use of recorded advertisements; Long-term effects were not assessed; Despite matching advertisements across conditions (length, appeal, production quality as indicated by visual interest, auditory interest, product appeal, technical quality), Kaser-Boyd (1978) pointed out the lower quality and appeal of healthy food vs. HSSF advertising |
| Lemnitzer et al., 1979  United Stated of America | *N* = 47  Age range = 4-5  Setting: not reported | Cross-sectional  Experimental  Random assignment to 1 out of 3 conditions | Viewing: unknown  Condition 1: 30 sec HSSF advertisements (3 min total)  Condition 2: 30 sec healthy food advertisements (3 min total)  Condition 3: 30 sec non-food advertisements (3 min total)  Programme: 9-min-programme  Insertion: Twice | Individual eating  8 min; post viewing  Ad lib intake of a selection of 12 foods/drinks in transparent, equal-sized cups on a tray  6 healthy snacks: cheese, grapes, carrots, apples, orange juice, milk  6 HSSF snacks: Hershey Chocolate, Chips Ahoy, Fritos, Honeycombs, Kool-Aid, Pepsi  Pre/post-weighting of test foods and drinks; g/ml converted into kcal | HSSF advertising increased total calories food, total calories beverages, total calories food and beverages  Health food advertising increased total calories beverages; Recognition: In HSSF condition, approx. 30% of children correctly identified at least one item vs. approx. 7% in the healthy food condition and 25% in the non-food advert condition | Use of recorded advertisements; Long-term effects were not assessed |
| Lorenzoni et al., 2017  Georgia | *N* = 60  Age range = 3-11  Mean age = 6.0  School | Cross-sectional  Between-Subjects  Random assignment to 1 out of 3 conditions | Individual viewing  Condition 1: TV and TV advertising (no, low, medium, high)  Condition 2: No viewing  Programme: 22-min-cartoon ‘Disney’s Pluto’  Insertion: Low at 0min; at 0min, medium at 6.15min; high at 0min, 6.15min, 10.35min | Individual eating  20 min, during viewing  Ad lib intake of chocolate snack  Counting of consumed chocolate snacks; converted into kcal | No difference in intake between conditions; median snack intake of 2 chocolates/child | High bias (Russel et al., 2018) |

Table 1.1 Methodological summary of studies on manipulated exposure to television-style food advertising exposure and children’s food intake included in the literature review

The standard paradigm to assess the effect of advertising on children’s eating is to expose children to food advertising and to measure their food intake. As described in Table 1.1, there is variation in how this was carried out across the available evidence base concerning the effects of manipulated exposure to television-style food advertising and children’s food intake. As discussed in the following Sections 1.8.1 - 1.8.5, the available studies were heterogeneous in location, sample, recruitment, setting, design, procedures (including acquaintance activities, instructions, information provision, disclosure), viewing phase, eating phase and food intake measurement (see table 1.1). Research locations included the Netherlands (Anschutz et al., 2009, 2010), the UK (Boyland et al., 2013; Dovey et al., 2011; Halford et al., 2008, 2007, 2004), the US (Fox, 1980; Gilbert-Diamond et al., 2017; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979), Canada (Gorn & Goldberg, 1980) and Georgia (Lorenzoni et al., 2017).

### Design

Research on manipulated exposure to food advertising and children’s food intake has included cross-sectional (Anschutz et al., 2009, 2010; Boyland et al., 2013; Fox., 1980; Gilbert-Diamond et al., 2017; Harris et al., 2009; Lemnitzer et al., 1979; Lorenzoni et al., 2017) and repeated measures (Dovey et al., 2011; Halford et al., 2008, 2007, 2004), but no longitudinal studies. Since food intake is influenced by previous energy consumption after as much as four days (Benton & Young, 2017), Benton and Young (2017) criticized short-term studies aiming to investigate the mechanisms that influence food intake. Peterson et al. (1984) suggested that although longitudinal studies would offer valuable insight into the effects of prolonged exposure to food advertising on children’s food intake, exposing children to real life advertising volumes is hardly achievable within the boundaries of a research trial.

Practical considerations relating to time, workload, access to participants and funding may explain why most research on manipulated exposure to television-style food cues and children’s food intake has been cross-sectional. Cross-sectional studies cannot account for children’s compensation of food intake after the experiments and allow for no conclusions about the long-term effects of advertising exposure (Anschutz et al., 2009, 2010). It is yet to be clarified whether children’s responsiveness to food advertising declines with increased advertising repetition and intensity (Gorn & Goldberg, 1980) or increases (Anschutz et al., 2009; Boyland et al., 2013, Dovey et al., 2011, Fox, 1980, Gilbert-Diamond et al., 2017, Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lemnitzer et al., 1979), and if such trends are the same for all types of food advertising and food categories. The advantages of using a repeated measures design to assess the effects of television-style food advertising exposure on children’s eating (Halford et al., 2008, 2007, 2004) is that when study groups consist of the same participants, there can be no difference between the groups in variables such as habitual television viewing, nutritional knowledge, media literacy or parental feeding techniques that may act as confounding variables (Coolican, 2017). Children may still obtain task practice or knowledge regarding study purposes, which may impact performance and outcomes, and order effects require counterbalancing of conditions (Coolican, 2017).

### Research settings

Research settings have included classrooms in schools (Boyland et al., 2013; Dovey et al., 2011; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017), classrooms that were made to look like a living room (‘semi-naturalistic setting’, Anschutz et al., 2009, 2010), mobile research laboratories (Fox, 1980; Kaser-Boyd, 1978), research laboratories (Gilbert-Diamond et al., 2017; Kaser-Boyd, 1978) and summer camps (Gorn & Goldberg, 1980; Harris et al., 2009). Since the research settings were not representative of children’s usual eating environments at home or at school, it is probably that children did not display their typical eating behaviour in response to food advertising (Anschutz et al., 2009; Anderson et al., 2014). Children were tested individually (Anschutz et al., 2009; 2010; Fox, 1980; Harris et al., 2009) or in groups (Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004) with researchers aiming to reduce peer effects through various methods (Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004).

Distinguishing between eating in company and eating alone allows for a more precise evaluation of the effects of manipulated exposure to food advertising on children’s food intake. Social facilitation suggests that people eat more in groups compared to when they are alone, especially when the social experience of eating in groups enhances enjoyment (Bublitz, Peracchio & Block, 2010). In a study with adult participants, Hetherington, Anderson, Norton and Newton (2006) tested energy intake when eating alone, when eating with others (friends or strangers) and when eating in front of the television. Participants ate more in the presence of familiar others and when watching television compared to eating alone, which may have been explained in terms of distraction from satiety signals. Since eating with strangers also drew attention away from the food, but did not result in increased energy intake, Hetherington et al. (2006) suggested that social facilitation effects can only in part be explained through distraction from self-monitoring. Enhanced enjoyment, impression management and modelling may influence eating behaviour in the presence of others (Tice, Butler, Muraven & Stillwell, 1995).

Experiments were carried out at the same time of day to control for energy, hunger and attention levels (Dovey et al., 2011; Gorn & Goldberg, 1980; Harris et al., 2009). Morning sessions allow researchers to better control previous eating by ordering participants not to eat before testing (Norman et al., 2018) and to work in accordance with existing school schedules and routines, and this is where the majority of television-style food advertising research has been conducted (Boyland et al., 2013; Dovey et al., 2011; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017). Afternoon sessions may affect eating outcomes via cognitive exhaustion. Children’s self-regulation capacity peak at the beginning of the day and lessens as the cognitive resources needed to exert inhibition and executive control become depleted over the course of the day (Millar, 2017). The time since the last meal, time of day, day of the week and the season of the year affect food intake and food choice (De Castro, 1991). De Castro (1991) found that as the day progressed, the time until participants chose to consume their next meal shortened, meaning that participants felt less satiety later in the day, even if the amount of food was the same. Food preferences change throughout the day, possibly due to certain foods being rated as more appropriate than others as a function of cultural learning (Kramer, Rock & Engell, 1992). Peryam and Gutman (1958) showed that breakfast items such as cold cereals and orange juice were preferred in the morning, compared to pizza and green salad, which was preferred in the afternoon and evening.

### Advertising stimuli

All of the 14 available studies in this narrative literature review included random assignment to conditions of varying types, volumes and frequencies of food and non-food advertisements typically embedded in an entertainment programme to create a realistic viewing experience (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al.,1979; Lorenzoni et al., 2017). Most available studies investigated exclusively HSSF advertising exposure (Anschutz et al., 2009; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017) and assessed only HSSF snack intake (Anschutz et al., 2009, 2010; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Harris et al., 2009; Lorenzoni et al., 2017). HSSF advertising increased HSSF intake in 11 out of 14 studies (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

Four studies included healthy food advertisements in addition to HSSF advertisements and provided little to no evidence for healthy food cues to increase healthy food intake in children (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). Changes in healthy eating behaviour in response to healthy food advert exposure were limited to children with low neophobia scores decreasing their chocolate intake, but children did not increase their healthy food intake (Dovey et al., 2011). To date, there are no published studies investigating exclusively the effects of television-style advertising for healthy foods and drinks on children’s healthy food and drink intake. Research focusing on improving children’s food intake rather than exploring the negative impact of HSSF food advertising is lacking. The available evidence base on television-style healthy food cues and children’s healthy food intake is compromised by the very limited number of studies to draw on in the first place (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) and by methodological issues such as the use of recorded advertising materials.

Using recorded advertisements as experimental stimuli poses methodological issues regarding previous exposure levels and differences in advertising techniques across conditions (Binder, Naderer & Mattes, 2020; Smits et al., 2015). First, children are exposed to more HSSF food advertising than healthy food advertisements, hence, the levels of exposure to, familiarity with and liking of brands and products are likely to vary across conditions prior to experimental manipulation. Second, advertising techniques vary between healthy food and HSSF product promotion (Calvert, 2008; Vilaro et al., 2017), because they are intended to appeal to different audiences (Jenskins et al., 2014). HSSF foods are presented in more persuasive ways than healthy foods (Binder, Naderer & Mattes, 2020; Smits et al., 2015). These HSSF food advertising techniques have been shown to be appealing to children and effective at influencing their food choices (Russel et al., 2019; Smith et al., 2019). HSSF advertising frequently uses celebrity tie-ins, popular cartoon character endorsements and emotional advertising techniques using themes of fun, fantasy, adventure and friendship (Brownell & Horgen, 2004; Calvert, 2008; Nestle, 2013; WHO, 2006), which are more appealing to children than typical healthy food advertisements that target adults with rational, cognitively demanding arguments (Calvert, 2008; Vilaro et al., 2017).

Rational, cognitively demanding healthy food advertising (Young, Puggelli & Bertolotti, 2014) may therefore be less able to attract and maintain children’s attention and interest, effectively increase children’s liking and wanting of the product (Aschermann-Witzel et al., 2012; Folkvord, 2020). A content analysis of healthy and unhealthy food in television advertisements showed that healthy food products are marketed almost exclusively to adults, using adult-oriented advertising techniques, whereas unhealthy food advertisings rely on communicative formats and appeals more suited for children and adolescents (Young et al., 2014). To date, no published study on television-style advertising and children’s food intake has included specifically-designed advertisements to test the effects of healthy versus unhealthy food advertisements on children’s eating.

One way of overcoming methodological problems in food advertising studies relating to previous exposure to recorded advertising clips and the lack of comparability of the advertising stimuli across conditions is the use of food cues that are specifically designed for the purpose of the research (Dovey et al., 2011). Dovey et al. (2011) pointed out that designing advertising stimuli for research purposes that can parallel the production standard of professional real-world equivalents might be challenging due to financial costs and the expertise that is required in such endeavours. However, specifically-designed digital food cues have been implemented in other digital media to assess the effects of food cues on children’s food intake, including narrative media cartoons and children’s programmes (Binder et al., 2019, 2020; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013), advergames (Folkvord et al., 2012, 2016, 2017; Pempek & Calvert, 2009) and social media (Coates, Hardman, Halford, Christiansen & Boyland, 2019).

Total advertising exposures in previous television-style food studies included 45 seconds (Boyland et al., 2013), 2 minutes (Dovey et al., 2011; Harris et al., 2009), 3 minutes (Kaser-Boyd, 1978; Lemnitzer et al., 1979), 5 minutes (Anschutz et al., 2009, 2010; Fox, 1980) and 10 minutes (Gilbert-Diamond et al., 2017). Halford et al. (2008, 2007, 2004) and Lorenzoni et al. (2017) gave the number of advertisements rather than total exposure duration. Dovey et al. (2011) included five different advertisements in the unhealthy advertising condition, but only three different advertisements in the healthy advertising condition. Unequal numbers of healthy food advertisements, HSSF food advertisements and toy advertisements across conditions may pose methodological issues, because advertising repetition influences eating outcomes (Gorn & Goldberg, 1980). When Gorn and Goldberg (1980) tested the effects of various exposure levels to ice cream advertising, they found that there was a tendency for children who viewed increased numbers of the same advertisement to eat fewer ounces of ice cream. By exposing children to increased numbers of the same healthy advertisements and more variety in unhealthy advertisements, Dovey et al. (2011) may have contributed to an aversion against the healthy food options and may have biased their study.

Regardless of the duration or number of advertisements, almost all of the studies included in this review found that children’s HSSF intake increased in response to HSSF advertising (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979). The exceptions were studies which exposed children to large numbers of repetitive ice cream advertisements (Gorn & Goldberg, 1980), advertisements targeting adult audiences (Anschutz et al., 2010) and one cross-sectional study that varied the number of advertisements (1, 2 or 3 HSSF advertisements) and included relatively low advertising exposure overall (Lorenzoni et al., 2017). Although healthy food intake was promoted for the same duration as HSSF advertisements, advertising exposure effects were limited to HSSF advertisements and HSSF intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). The effects of repeated food cue exposure on children’s diets are well established for healthy food intake (Coulthard & Ahmed, 2017; Dulay et al., 2020; Houston-Price et al., 2019; Owen et al., 2018) as well as HSSF intake (Strassburger & Wilson, 2002), but none of the studies included in this review reported increases in healthy food intake. As discussed in the following sections, the lack of healthy food advertising effects may relate to the methodology applied in the available studies on television-style healthy food advertising – and in inherent preferences for HSSF foods when they are available (see chapter 1, section 1.6).

### Eating opportunity

Children’s food intake took place during (Anschutz et al., 2009, 2010; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Harris et al., 2009; Lorenzoni et al., 2017) or after the viewing (Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978). Increases in HSSF intake in response to HSSF advertisements were evident in studies where children ate during the viewing (Anschutz et al., 2009; Gilbert-Diamond et al., 2017) or ate after the viewing (Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978). In all of the studies that reported a lack of advertising effects, children ate during the viewing (Anschutz et al., 2010; Gorn & Goldberg, 1980; Lorenzoni et al., 2017), which contradicts Gilbert-Diamond et al. (2017), who attributed some of children’s eating in the absence of hunger in their study to the distraction from internal satiety signals when eating and viewing simultaneously.

Children’s food intake in response to television-style food advertising has usually been assessed by providing children with multiple test foods and drinks (‘multi-item study’) (Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008, 2007, 2004; Kaser-Boyd, 1978; Lemnitzer et al., 1979), including HSSF as well as healthy options (Dovey et al., 2011; Fox, 1980; Halford et al., 2008, 2007, 2004; Kaser-Boyd, 1978; Lemnitzer et al., 1979). Fox (1980), Kaser-Boyd (1978) and Lemnitzer et al. (1979) provided as many healthy as HSSF options (six options each, twelve options in total), but Dovey et al. (2011) and Halford et al. (2008, 2007, 2004) provided more HSSF than healthy options, which may have biased children’s food selection towards HSSF intake.

In Dovey et al. (2011) offering children more HSSF than healthy food options may have primed children to select unhealthy snacks via food variety effects (Brondel, Romer, Van Wymelbeke, Pineau, Jiang, Hanus & Rigaud, 2009) and majority food cues (Pechey & Marteau, 2018). Brondel et al. (2009) found food variety to increase food intake in humans. Since there was a larger variety of HSSF options, food variety effects may have contributed to children picking HSSF options over healthy options in Dovey et al. (2011). In terms of majority food cues, Pechey and Marteau (2018) investigated the impact of number of healthy versus unhealthy available snacks on food choice and found that when the majority of snack options were healthy (6 healthy snacks versus 2 unhealthy snacks), the number of participants choosing a healthy snack was twice as high compared to equal amounts of snacks (2 healthy snacks versus 2 unhealthy snacks). The choice of an unhealthy snack was four times higher when the majority of snack options were unhealthy (2 healthy snacks versus 6 unhealthy snacks). Pechey and Marteau (2018) concluded that availability of unhealthy food choices had a larger effect on food choice than healthy food cues.

In addition to variety effects (Brondel et al., 2009) and majority food cue effects (Pechey & Marteau, 2018), presenting more HSSF than healthy food options make the selection of HSSF statistically more likely. However, Fox (1980), Kaser-Boyd (1978) and Lemnitzer (1979) did offer equal numbers of healthy versus HSSF options, and children still preferred HSSF snacks regardless of HSSF or healthy food advertising exposure. Halford et al. (2008, 2007, 2004) offered healthy as well as HSSF options but exposed children to HSSF food advertisements only. Halford et al. (2008, 2007) found increases in all foods apart from the healthy options. In Halford et al. (2004), children were able to make healthier choices in the absence of HSSF advertising, as demonstrated by increases in low-fat savoury snack intake in the non-food toy advert condition.

Single item studies offering one test food only focused exclusively on HSSF intake (Anschutz et al., 2009, 2010; Harris et al., 2009; Gorn & Goldberg, 1980; Lorenzoni et al., 2017). Two single item studies reported increases in test food intake (Anschutz et al., 2009; Harris et al., 2009), one single item study reported decreases in target food intake (Gorn & Goldberg, 1980) and one single item study reported no changes in children’s eating behaviour in response to HSSF food advertising exposure (Lorenzoni et al., 2017). The difference in advertising effects between these single item studies may be explained by several factors including (1) parents’ reports of children’s liking of the test food, which emerged as a better predictor of children’s food intake than advertising exposure in Harris et al. (2009), (2) the use of adult advertisements that may not have appealed to children in Anschutz et al. (2010) and (3) excessive and repetitive advertising exposure and test food portions in Gorn and Goldberg (1980). The focus of single item studies on HSSF products limits the investigations of food advertising effects to unhealthy food promotion and explorations of pathways to promote healthy food intake to better support children’s dietary and overall health are lacking (Binder et al., 2019).

The fact that every one of the multi-item studies (Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008, 2007, 2004; Kaser-Boyd, 1978; Lemnitzer et al., 1979), but only two-thirds of single-item studies (Anschutz et al., 2009; Harris et al., 2009), found links between television-style food advertising exposure and children’s food intake may indicate that multi-item studies are more sensitive to detecting the effects of food advertising on children’ eating. Another advantage of a multi-item study is that a selection of different foods and drinks may be more representative of children’s abundant food environments. Single-item studies may be better suited to assess eating during media use, as snacking while watching television often takes place with one bag of snack items or take away food in the home environment (Anderson et al., 2014). However, children’s particular like or dislike of the one test food that is available in a single-item study may affect results (Harris et al., 2009) in a way that may not happen in studies with multiple items to choose from.

Conclusions that can be drawn from single-item studies may be limited to the particular test food, but multi-item studies, particularly those offering advertised and non-advertised foods, allow for broader conclusions about advertising effects, such as advertising effects that generalise from product-to-product category referred to as ‘beyond-brand effects’ (Gilbert-Diamond et al., 2017). Multi-items studies that include HSSF as well as healthy options allow for broader conclusions about children’ eating in abundant food environments (Dovey et al., 2011; Fox, 1980; Halford et al., 2008, 2007, 2004; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

To date, none of the studies on television-style food advertising exposure and children’s food intake have assessed children’s eating responses at a buffet, although buffet-style food environments offering a variety of different foods are a more realistic representation of children’s eating situations at home, in the nursery and at school lunches (DGE, 2021) than the single-item eating opportunities that make up most published studies on television-style food advertising and children’s food intake (see table 1.1). Using presentation methods that are different from children’s usual eating occasions may hinder children from displaying their typical eating behaviour in response to food advertising, undermining the generalisability of the findings (Anschutz et al., 2009, 2010). External cues such as container size and shape, food variety and portion size affect food intake (Cohen, 2008; Stroebele & De Castro, 2004). Test food and drink presentation across the studies considered in this review varied, including presentation in bowls (Anschutz et al., 2009, 2010; Boyland et al., 2013; Gorn & Goldberg, 1980; Harris et al., 2009), individual transparent tubs and cups on serving trays (Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), pre-prepared plates with a selection of snacks (Dovey et al., 2011; Halford et al., 2004, 2007, 2008).

In eating opportunities that took place during children’s viewing of advertisements and programmes, children were allowed to eat as much as they wished for 14 minutes (Harris et al., 2009), 15 minutes during the viewing of a neutral programme (Gorn & Goldberg, 1980), 20 minutes (Anschutz et al., 2009, 2010), 22 minutes (Lorenzoni et al., 2017) and 34 minutes (Gilbert-Diamond et al., 2017). Eating opportunities after the viewing were ad libitum intake within a set time frame including 8 minutes (Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), 15 minutes (Dovey et al., 2011) and unlimited time to eat as much as children desired (Boyland, et al., 2013; Halford et al., 2008, 2007, 2004). Protocols in Lorenzoni et al. (2017) included a maximum of 12 chocolates per child, but children were not aware of this limit and had an average intake of 2 chocolates (Lorenzoni et al., 2017). Apart from Lorenzoni et al. (2017), studies did not report whether children were aware of time or how the duration of the eating opportunity might have affected outcomes.

Most studies explained that regardless of the portion sizes that were provided, children were able to receive more food if they ran out (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Gorn & Goldberg, 1980; Halford et al., 2008; 2007; 2004; Harris et al., 2009). In Halford et al. (2008), children were required to ask for refills themselves, while with children in Halford et al. (2007, 2004), experimenters offered refills as soon as the children had run out. Variations in refill procedures may affect outcomes due to verbal and non-verbal feeding cues (Black & Creed-Kanashiro, 2012). The format of instructions can affect participants’ understanding and experimental behaviour (Bigoni & Dragone, 2012). Variations in who communicates what kind of instructions to participants in what kind of way may therefore affect children’s food intake, for example via mood (Patel & Schlundt, 2001), understanding of instructions (Alekseev, Charness & Gneezy, 2017), and children’s own interpretation of ‘correct responses’ (Vassilopoulos, Blackwell, Moberly & Karahaliou, 2012).

### Food intake measurement

Food intake was almost exclusively measured through pre-/post-weighting of prepared bowls, plates and trays with individual compartments for each test food and drink (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979). When food intake is assessed by pre-/post-weighting of test foods, leftovers are accounted for automatically. In addition to pre-/post-weighting, direct observation (Gorn & Goldberg, 1980), observation through a one-way mirror (Fox, 1989) and video recording (Anschutz et al., 2009) have been used to control for spillage, hoarding, sharing and swapping of foods. Anschutz et al. (2009) reported that food intake was hard to establish with the video system, and that pre- and post-weighting of test foods was more accurate. While most television-style food advertising studies used pre-/post-measuring of test foods to establish children’s food intake (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979), research on other food cues in media has used discrete observation to measure children’s food intake following media exposure (Gonçalves et al., 2018) and visual estimation following television-style food advertisements and advergame play (Norman et al., 2018). Gonçalves et al. (2018) defined the discrete observation method as the researchers counting and registering the number of consumed food items as discreetly as possible to leave children unaware of the observation. Gonçalves et al. (2018) maintained neutral body language during the task and conducted the experiment without making comments about the food. No feedback regarding the type or quantity of food chosen or consumed by the children was given (Gonçalves et al., 2018). Observation and visual estimation in Norman et al. (2018) included recording whether children had eaten their entire plate of food, half of their plate or a quarter of their plate.

All studies on television-style food advertising exposure and children’s eating have measured and reported children’s food intake in weight (g) or energy (kcal). Since HSSF snacks and healthy snacks such as vegetables and fruit differ greatly in caloric content, reporting children’s changes in food intake in kcal only may bias outcomes. Due to the relatively low caloric value of vegetables and fruit, increases in healthy food consumption are harder to pick up on than changes in HSSF snack consumption. Halford et al. (2007) reported children’s food intake following HSSF advertising and toy advertising in gram and kcal. Reported in gram, the foods that children consumed the most were grapes, followed by jellies, chocolate and crisps (Halford et al., 2007). Reported by kcal, grapes were the item that children consumed the least (Halford et al., 2007). The difference between findings reported in gram and those reported in kcal demonstrates the limitations of kcal as a unit of measurement to communicate meaningful findings about children’s food intake (Halford et al., 2007). If the intake of HSSF products versus fruit and vegetables was measured in portions, changes in the intake of healthy foods would weigh as heavily in a statistical analysis as unhealthy foods. To illustrate, a child would need to eat three whole cucumbers at 50 calories each (Sharma, Sharma & Sandhu, 2020) to consume the same number of calories that one Cadbury Cream Egg contains (150 calories; Cadbury, 2020). Since many people are not able to judge consumption amounts by calories (Cohen, 2008), calories may be a meaningless unit to communicate health information in healthy prevention and intervention efforts. Measuring food intake in portions in addition to energy (kcal) can provide a clearer and more meaningful account of research outcomes (Benton & Young, 2017), as the effect of any given food on health depends not only on caloric value, but also on micro- and macro-nutrient-content (Carels, Harper & Konrad, 2006; Kast, 2018).

The variety of research methodologies applied in research on the effects of television-style food advertising and children’s food intake is a disadvantage, because the variety makes it difficult to compare individual studies. Nonetheless, methodological variety is an advantage in an evidence base that repeatedly demonstrates that HSSF advertisements increase HSSF intake in children, but healthy food advertisements repeatedly fail to increase healthy food intake in children, because the variety indicates the robustness of the findings. However, the literature on manipulated exposure to television-style food advertising and children’s food intake is limited to 14 studies and has research gaps that this thesis aimed to fill.

## Thesis aims

The overall aim of this thesis was to test the effects of food advertising on children’s food intake. This aim included conducting a series of studies that addressed the research gaps in the existing research literature on manipulated exposure to television-style food adverting and children’s food intake outlined in Table 1.2. Specific objectives included testing the effects of different types of television-style food advertising on young children’s healthy and HSSF food and drink intake at a buffet in a nursery setting.

| Research gaps | How they will be addressed |
| --- | --- |
| Most studies have measured the effect of television-style food advertising on food preferences, purchase requests or behavioural intentions (Smith et al., 2019), but assessments of children’s actual food intake in response to television-style food advertising exposure are limited to a relatively small evidence base (of 14 studies between 1979 and 2020). | Studies 1, 2, 3 and 4 assessed children’s actual food intake. |
| Previous research locations for investigating children’s eating behavioural responses to television-style food advertising have included the Netherlands, the UK, the US, Canada and Georgia, but not Germany. With television being children’s favourite leisure time activity in Germany (IZI, 2020), children are exposed to food advertising that has been linked to childhood obesity rates in Germany (RKI, 2020). | The studies in this thesis were conducted in Germany (Studies 2, 3 and 4) and piloted in the UK (Study 1). |
| Research settings of studies assessing children’s healthy food intake in response to television-style healthy food advertisements have been limited to schools and laboratories, which may not reflect children’s naturalistic eating behaviour. | Studies 1, 2, 3 and 4 were conducted in children’s nursery environment and replicated an eating opportunity (buffet) similar to children’s usual breakfast, accompanied by nursery staff familiar to the children. |
| There are no longitudinal studies on manipulated exposure to television-style food advertising and children’s food intake that monitored children’s food intake over time. | Studies 1, 2 and 3 in this thesis were longitudinal studies spanning nine weeks in Study 1 (1 week baseline + 8 weeks intervention) and seventeen weeks in Studies 2 and 3 (1 week baseline + 8 weeks intervention + follow-up 8 weeks later). Study 4 was a pre-/post-test design. |
| All studies that have measured food intake have used only advertisements that were recorded from television. | The studies in this thesis used specially designed advertising clips as stimuli that were matched across conditions (Studies 1, 2, 3 and 4). |
| Studies that assessed the effects of food advertisements on children’s food intake have almost exclusively investigated children’s intake of HSSF snacks. | The studies in this thesis investigated the effects of healthy food advertising (Studies 1, 2 and 4), of food advertising promoting HSSF products (Study 3) and of food advertising promoting HSSF products (Study 3). |
| There are no studies that exclusively investigated the effects of television-style healthy food advertising exposure on children’s healthy food intake. | Study 4 investigated exclusively the effects of television-style healthy food advertising exposure on children’s healthy food intake. |
| Although multi-item studies constitute the majority of television-style food advertising studies, only three studies provided equal numbers of healthy and unhealthy food and drink options at the eating opportunity. | The studies in this thesis investigated food advertising effects on children’s intake of an equal selection of healthy and unhealthy foods and drinks (Studies 1, 2 and 3) and the intake of a selection of exclusively healthy food options (Study 4). |
| In the existing studies, food intake has been measured in weight (g) and reported in energy (kcal) only, despite issues detecting eating behavioural changes in healthy food intake with very low caloric value compared to HSSF products with very high caloric content. | The studies in this thesis measured and reported food intake in portions as well as energy (kcal) (Studies 1, 2, 3 and 4). |

Table 1.2 Research gaps in the literature, and how this thesis will address those gaps

As outlined in the following chapter (see chapter 2, study 1), the primary aim of Study 1 as a pilot and feasibility study was to test and refine the research procedures and materials including the advertisements that were specifically produced for this thesis. The secondary aim of Study 1 was to explore the effects of specifically-designed, television-style healthy food advertising versus non-food toy advertising on children’s ad libitum intake of a selection of equal numbers of healthy and unhealthy snacks at a buffet in one nursery in the UK over a period of nine weeks. It was hypothesised that exposure to healthy food advertising would increase children’s healthy food intake in Study 1.

Drawing on the learning outcomes from Study 1, Study 2 employed a longitudinal design to investigate the effects of healthy food advertising and children’s intake of healthy and HSSF snacks in one nursery in Germany over a period of seventeen weeks (see chapter 3, study 2). Study 3 increased the number of advertising conditions from two in Study 2 to four in Study 3 and employed a longitudinal design to compare the effects of television-style food advertising for healthy foods, against HSSF products, for HSSF products and control advertising on children’s intake of healthy and HSSF snacks in one German nursery over a period of seventeen weeks (see chapter 4, study 3). Study 4 employed a pre-intervention/post-intervention to investigate the effects of healthy food versus control advertising on children’s intake of exclusively healthy foods in five German nurseries (see chapter 5, study 4).

| Study | Sample | Design | Conditions | Advertising exposure | Eating opportunity | Intake measurement |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | *N* = 11  Age range: 2 - 4  Age mean: 3.00  Location: Penistone, UK | Longitudinal 9-week study including 1 week baseline and 8 weeks intervention; experiments took place between 9.30 and 11.30 | Individual randomisation to one out of two conditions (healthy food advertising and control advertising) | Three one-minute advertisements per screening; 8 screenings with advertisements per intervention; total advertising exposure = 24 advertisements or 24 min | 16-item-buffet with 8 healthy and 8 HSSF food and drink options | Observation and recording via monitoring sheets and photography |
| 2 | N = 26  Age range: 2 - 6  Age mean: 3.71  Location: Frankfurt, Germany | Longitudinal 17-week study including 1 week baseline, 8 weeks intervention and follow-up 8 weeks post-intervention; experiments took place between 9.30 and 11.30 | Individual randomisation to one out of two conditions (healthy food advertising; control advertising) | Three one-minute advertisements per screening; 8 screenings with advertisements per intervention; total advertising exposure = 24 advertisements or 24 min | 16-item-buffet with 8 healthy and 8 HSSF food and drink options | Observation and recording via monitoring sheets and photography |
| 3 | N = 34  Age range: 3 - 6  Age mean: 4.64  Location: Frankfurt, Germany | Longitudinal 17-week study including 1 week baseline, 8 weeks intervention and follow-up 8 weeks post-intervention; experiments took place between 9.30 and 11.30 | Individual randomisation to one out of four conditions (healthy food advertising; HSSF food advertising; anti-HSSF food advertising; control advertising) | Three one-minute advertisements per screening; 8 screenings with advertisements per intervention; total advertising exposure = 24 advertisements or 24 min | 16-item-buffet with 8 healthy and 8 HSSF food and drink options | Observation and recording via monitoring sheets and photography |
| 4 | N = 172  Age range: 3 - 7  Age mean: 4.72  Location: Frankfurt and Offenbach, Germany | Pre-test/post-test study including 1 week baseline and 1 week intervention; experiments took place between 9.30 and 11.30 | Cluster randomisation to one out of two conditions (healthy food advertising and control advertising) | Three one-minute advertisements per screening; one screening with advertisements per intervention; total advertising exposure = 3 advertisements or 3 min | 7-item buffet with 7 healthy food options | Observation and recording via monitoring sheets |

Table 1.3 Methodological summary of Studies 1 - 4 including sample, design, conditions, advertising exposure, eating opportunity and intake measurement

# Study 1

## Introduction

Digital media and food advertising influence children’s food preferences, food choices and food intake (Boyland et al., 2016; Cairns et al., 2013; Russell et al., 2019; Smith et al., 2019). Exposure to large volumes of highly appealing food advertising and sophisticated marketing techniques that promote almost exclusively HSSF products are contributors to unhealthy eating practices and rising levels of obesity in children (Brownell & Horgen, 2004; Nestle, 2013; Pourmoradian et al., 2020). HSSF advertising targeted at young children may be concerning, because the early years of development are an impressionable period of life (see chapter 1, section 1.2). Food preferences that are established early on in life may influence lifelong eating habits and impact short- and long-term health (Craigie et al., 2011). Children are vulnerable to marketing, because children lack the cognitive defences and consumer experience to cope with advertising effectively (see chapter 1, section 1.3).

Most of the increase in caloric intake during the last decades has been attributed to calories derived from snacking (Cutler, Glaeser & Shapiro, 2003). ‘Snacks’ are food items that take little or no preparation, require few motor skills for independent consumption, can be consumed raw or straight out of the package and tend to be consumed in addition to meals (Schinkert, Gillebaart, Benjamins, Poelman & de Ridder, 2020). Children influence family food shopping (Turner, Kelly & McKenna, 2006) including snack choices (Damen, Luning, Fogliano & Steenbekkers, 2019) so that even at a young age, children are able to influence their snack choice and intake (Brown & Rowan, 2016; Damen et al., 2019). Increases in HSSF snack consumption among nursery-aged children are a concern to children’s dietary health (Boots, Tiggemann & Corsini, 2018). HSSF snack foods make up close to one-third of nursery children’s daily food intake, and only 18% of children in the UK meet 5-a-day recommendations for daily portions of fruit and vegetables (NHS Digital, 2020).

The UK’s National Health Service lists fresh vegetables, fruit, vegetable and fruit skewers, including pieces of whole grain bread and water, as ‘healthy’ snack ideas (NHS, 2021). Sweets, chocolates, crisps and other processed foods and drinks containing large amounts of sugar, salt and fat are highlighted as snacks that should be avoided or reduced (NHS, 2021). Such energy-dense but nutrient-poor HSSF products contain high amounts of sugar, salt and fat and will be referred to as ‘unhealthy’ foods and drinks. ‘Healthy foods’ such as vegetables, fruit and whole grain products contain high amounts of vitamins, minerals and fibre and low amounts of sugar, salt and fat (DGE, 2020; NHS, 2020; PHE, 2020; WHO, 2020b) and are therefore referred to as ‘healthy’. Due to significant differences in macro- and micro-nutrient composition as well as caloric value of healthy versus HSSF foods and drinks (Romieu et al., 2017), small changes such as snack choices can have an impact on short- and long-term dietary and overall health (Hall et al., 2011). Helping children swap energy-dense and nutrient-poor HSSF snacks for vegetable, fruit or whole grain snacks that are low in sugar, salt, fat and calories but rich in vitamins, minerals and fibre is a way of improving children’s dietary health (Geller & Dzewaltowski, 2009; NHS, 2021).

Despite being limited to 14 published studies (see chapter 1, section 1.8), the effects of HSSF food advertising on children’s food intake have been repeatedly demonstrated in longitudinal and cross-sectional research (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2004, 2007, 2008; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979; Lorenzoni et al., 2017). Although the health and wellbeing benefits of eating a nutritious and balanced diet are well established, healthy food consumption is rarely promoted and rarely researched in digital media (Folkvord & Hermans, 2020). The available studies found little (Dovey et al., 2011) or no evidence that television-style healthy food advertising increased children’s healthy food intake (Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

Differences in how the human physiology and psychology react to the very composition of healthy versus HSSF foods (see chapter 1, section 1.6) may account for the lack of healthy food advertising effects in previous studies, i.e. children eating HSSF foods despite healthy food cue exposure in television-style advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), narrative media (Binder et al., 2019, 2020; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton, Upton & Taylor, 2013), social media (Coates et al., 2019) and interactive advergames (Folkvord et al., 2012, 2013; Pempek & Calvert, 2009). Beets et al. (2014) found that when given a choice of healthy and HSSF snack foods, children select HSSF snacks. The preference for HSSF snacks over healthy snacks may relate to evolutionary preferences for foods with high caloric content, which are usually sweet or fatty (Birch, 1992, 1999; Keskitalo et al., 2007). Benelam (2009) suggested that when confronted with food cues, whether healthy or HSSF, children’s appetite increases. To achieve immediate gratification of the appetite triggered by a palatable food cue, children chose the option with higher rather than lower sugar levels, leading to an increase in HSSF snack intake despite healthy food cues (Benelam, 2009).

Another explanation for the lack of healthy food advertising effects may be methodological limitations of the available studies including the use of recorded advertisements (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), unequal numbers of healthy versus HSSF food advertisements during the viewing phase (Dovey et al., 2011), unequal numbers of healthy versus HSSF food options at the eating opportunity (Dovey et al., 2011) and calories as the sole unit of monitoring and comparing children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8.3, 1.8.4 and 1.8.5). Research investigating the effects of healthy food advertising on children’s healthy food intake is both lacking and needed (Boyland & Whalen, 2015; Boyland et al., 2016; Cairns et al., 2013; Folkvord, 2020; WHO, 2006; Young, 2003).

Study 1 will fill some of the gaps in the existing evidence base on food advertising and children’s eating outlined in Chapter 1, Section 1.8 and Table 1.2. Previous studies have measured the effect of television-style food advertising on food preferences, purchase requests or behavioural intentions (Smith et al., 2019), but studies that measured actual food intake focused on the effects of HSSF advertisements, which were always recorded from television (see chapter 1, section 1.8). Studies that included healthy food advertising to assess children’s healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer, 1979) were confined to a small selection of research settings and locations, namely mobile research laboratories in the US (Kaser-Boyd, 1978; Lemnitzer et al., 1979), in Canada (Fox, 1980) and in school classrooms in the UK (Dovey et al., 2011), and these settings may not reflect children’s naturalistic eating behaviour accurately (Anschutz et al., 2009, 2010). In previous studies, food intake has been reported in kcal only (see chapter 1, section 1.8.5). Longitudinal studies that assess children’s food intake in response to television-style food advertising exposure over time have not been published. Given the relatively small number of published studies investigating the effects of television-style food advertising on children’s food intake, specifically of healthy food advertising and healthy food intake, Study 1 will fill this research gap by contributing a longitudinal pilot study exploring the effects of specifically-designed healthy food advertising on children’s healthy and HSSF food and drink intake in a nursery setting.

Study 1 was designed and conducted as a pilot study in line with definitions outlined by The National Institute for Health Research (NIHR, 2021) to gain experience in conducting experimental research in a nursery setting with young children and to refine methodology and procedures. According to NIHR (2021), feasibility and pilot studies prepare the ground for larger, more definite research by increasing the chances of subsequent studies producing valuable evidence or by helping to reduce the risk of using resources on large studies that fail to answer the intended research questions (NIHR, 2021). Pilot studies should demonstrate the promise of proposed research and interventions and identify the uncertainties that need to be addressed before carrying out the main study (NIHR, 2021).

Pilot studies investigate whether, and how, research can be carried out by conducting a future study or, part of a future study, on a smaller scale to test that study processes such as recruitment, randomisation, materials, procedure, treatment and follow-up assessments run smoothly (NIHR, 2021). Uncertainties in relation to the conduct of larger studies may be reduced by ascertaining the acceptability of an intervention, willingness to take part, compliance to research protocols, choice of primary outcomes, choice of adequate comparator, follow-up rates, time needed to collect and analyse data, practicality of delivering the interventions in the proposed settings, variation in use or delivery of the intervention in each setting or by refining particular components of an intervention (NIHR, 2021).

Study 1 piloted part of the research materials, namely two out of four advertising videos that were specifically designed for this thesis. Study 1 spanned nine weeks including baseline and intervention phase. The aim of Study 1 as a pilot study was to focus on the feasibility of conducting research concerning digital media exposure and eating behaviour in nurseries. Outcomes from Study 1 were used to inform the design of Studies 2, 3 and 4 in this thesis (see chapters 4, 5 and 6).

In addition to testing methods, materials and procedures for investigating advertising effects on children’s eating in nursery settings, Study 1 explored the effects of repeated exposure to digital food advertising on young children’s food intake in a nursery setting. Study 1 aimed to address some of the gaps in the research base (see chapter 1, section 1.9) by contributing a randomized, controlled, longitudinal pilot study of children’s actual food intake of a variety of healthy and HSSF food and drink options in energy (kcal) and portions (items) in response to specifically-designed, television-style advertising clips for healthy foods (experimental condition) and for toys (control condition). A better understanding of the impact of television-style digital food advertising on young people’s lives is essential for reducing the harmful impact of media on children’s development and for developing media-based prevention and intervention opportunities to improve children’s dietary health (Folkvord, 2020).

Study 1 was a longitudinal pilot study exposing groups of children to either healthy food advertising or control advertising embedded in a children’s programme and assessing children’s food intake in items and calories at a 16-item buffet with healthy and HSSF food and drink options using observation, monitoring sheets and photography over a period of nine weeks. It was hypothesised that children in Study 1 who viewed the healthy food advertisements (experimental condition) would eat more healthy food than children who viewed the control advertisements.

## Method

### Participants and design

Nurseries were recruited by contacting nurseries in Sheffield, United Kingdom, via email. Potential participants including parents and children, were recruited via nursery staff of the one participating nursery. No payment was made.

Out of the 30 children that were registered with the participating nursery in Sheffield at the time of the study, 11 children (36.67%) aged 2 to 4 years (3 boys and 8 girls) took part in the study. The mean age of the children was 3 years (SD = 0.77 years). 6 children (5 girls and 1 boy) were randomly allocated to the experimental condition who viewed an advertising clip promoting healthy eating once a week for eight weeks. 5 children (3 girls and 2 boys) were randomly allocated to the control condition who viewed an advertising clip promoting toys once a week for eight weeks. Random allocation was conducted via tossing a coin (Gelman & Nolan, 2002). The experiment was conducted over a period of nine weeks, including one week baseline, and eight weeks of intervention.

Ethical approval was given for Study 1 from the ethics committee at the University of Sheffield Psychology Department (Reference number: 011950). Requirements for participation were written consent forms that included a section on children’s food allergies, food intolerances and other specific dietary requirements. Written consent was obtained from all parents through the childcare institution. Parents were provided with information sheets explaining the aims, objective and procedure of the research study and a link to view the advertising clips online. Permission to use photographs, stills and videos in the written thesis and online was obtained from parents. Only children of parents with completed consent forms including a section on food allergies, food intolerances and other specific dietary requirements were allowed to participate. Choking hazards were minimized through constant supervision, child-appropriate portion sizes and bite-size foods. Clear, still water was available at all times. A nursery first aider who was familiar with emergency measures to prevent choking was on hand at the time of the study. Oral consent was obtained from the children on the day of the experiment by asking if they would like to watch a children’s programme and by telling them that they could eat as much as they want but did not have to eat anything at all. There was no pressure to eat and no restrictions on food intake.

Study 1 was conducted between June and August 2017. Study 1 took place in children’s usual nursery environment accompanied by the nursery staff. A quantitative research design with two conditions was employed to investigate the effects of digital food advertising on children’s food intake. The independent variable was the type of advertising clip embedded in a children’s programme that the children were exposed to, which was either healthy food advertising or toy advertising, specifically designed for the purpose of Study 1. Outcome variables of the experiment were food intake in calories and items at a buffet measured through observation using a monitoring sheet and photography. Since Study 1 was primarily designed as a pilot study, outcome variables also included response rates, recruitment rates, dropout rates, the willingness of nurseries, parents and children to collaborate with the experimenter, suitability of procedures for nursery children in a nursery setting, children’s ability to follow instructions, children’s responses to the research setting, children’s responses to the media materials (group viewing phase), children’s responses to the buffet (individual food and drink selection phase), children’s responses to the eating opportunity (group eating phase) and the suitability of children’s food intake measurements (observation and photography).

### Materials

Materials included in Study 1 were two specifically-designed, television-style advertising clips (https://tinyurl.com/kids-media-and-eating) promoting either healthy foods (DGE, 2020; NHS, 2020; PHE, 2020; WHO, 2020b) or toys embedded in a children’s programme, a sixteen-item buffet including eight healthy options (seven foods, one drink) and eight HSSF options (seven foods, one drink) and monitoring sheets and a smart phone for photography to monitor children’s food intake. The layout of the research setting is discussed in Section 2.3.

### Advertising stimuli

The advertising stimuli utilised in Study 1 were two digital, television-style advertising clips. Advertising screening took place once a week, with three advertising exposures per screening during the intervention phase, adding up to 24 advertising exposures in total. The development of the advertising clips was informed by research evidence relating to children’s understanding of advertising (see chapter 1), theories about children’s coping with advertising (see chapter 1), research highlighting effective marketing and advertising techniques to promote foods and drinks to children, particularly healthy foods and drinks (see chapter 1) and spontaneous input by families who participated in the production of the advertising clips.

Two digital, television-style advertising clips were developed. One clip was developed for the experimental, healthy food advertising condition and showed children and parents tasting, eating, preparing and playfully interacting with fresh vegetables, fruit, whole grain bread and water. The other clip was developed for the control condition and included the same children and parents playfully interacting with a variety of toys including stuffed animals, picture books and balloons. The advertising clips were identical in setting, actors, narrative, music, logo, special effects and length. The advertising clips differed only on the products that were promoted and on the voice-overs, which were adapted to suit either food or toy promotion. The advertising clips were 1-minute each and embedded at the beginning, middle and end of a 7-minute children’s programme.

Actors were parents and children with a variety of ages and backgrounds to utilise the positive effect of social endorsers including peers (Binder et al., 2020) and adults (Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013) on behavioural imitation that are commonly used in food advertising (Boyland, Harrold, Kirkham & Halford, 2011; Hebden et al., 2011). According to social cognitive theory (Bandura & McClelland) children observe and imitate the behaviour of desirable models in their surroundings, including those in media (Cruwys et al., 2015). Advertising aims to create positive associations between social endorsers and endorsed products to establish a preference for the advertised product (Kraak & Story, 2015), leading to greater intake of the endorsed product versus non-endorsed equivalent (Boyland et al., 2013). Children and adults of both genders were seen and heard in the advertising clips and voice-overs to avoid gender bias reported in advertising (Childs & Maher, 2003).

Both advertising clips followed the same narrative. Depending on the specific advertising clip, a large table is shown filling with either healthy foods and drinks or toys. Each item ‘magically’ appears on the table with a popping sound to appeal to children’s liking for fun and fantasy that has been used as an effective theme in advertising to children (Albers-Miller & Stafford, 1999; Buijzen & Valkenburg, 2002; Connor, 2006; Folta et al., 2006; Hastings et al., 2007). Children and parents are shown interacting with the foods or toys based on research highlighting the effectiveness of peer and parent models (Houldcroft, Haycraft & Farrow, 2014; Savage, Fisher & Birch, 2007; Scaglioni et al., 2008) interacting with and consuming foods rather than mere presentation (Spielvogel, Matthes, Naderer & Karsay, 2018).

In the healthy food advertising clip, ten plates appeared. Each plate was filled with a different food in its original, whole form. The items were whole grain bread, oranges, carrots, apples, plums, cucumbers, plum tomatoes, mixed peppers, pears and kiwi fruit, all of which were considered healthy options (DGE, 2020; NHS, 2020; PHE, 2020; WHO, 2020b). Scenes of children and parents eating were intersected with scenes of children and parents playing with and preparing foods. Food preparation included scenes of oranges, apples and cucumbers being chopped to serving size and a glass of water being poured. Food play activities included children and parents preparing vegetables and fruit skewers and using vegetables and fruit for fantasy play (Dazeley & Houston-Price, 2015). Scenes of food preparation and play activities were included based on research suggesting that play activities can enhance tasting of fruits and vegetables in preschool children (Coulthard & Sealy, 2017). In line with research highlighting the effectiveness of sensory food advertising, foods and drinks are shown in close-ups to appeal to multiple senses using visual, tactile, olfactory cues (Roose & Mulier, 2020).

In the healthy food advertising clip, voice-overs using children’s voices commented: ‘I eat fruit and vegetables every day’, ‘Oh, look at all those colours!’, ‘So tasty!’, ‘Oh, look, cucumber!’, ‘Tasty!’, ‘Water is the number one thirst-quencher!’, and ‘I love apples’ using boys’ and girls’ voices to accompany the scenes to harness peer effects (Binder et al., 2019; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013), avoid gender bias (Childs & Maher, 2003) and highlight the appealing sensory properties of the foods (Kelly et al., 2007; Lynn & Zolkepli, 2019; Roose & Mulier, 2020).

No health claims were made, since health appeals have been shown ineffective (Kim et al., 2019) or even counterproductive (Raghunathan et al., 2006) for increasing children’s healthy food intake. This may be particularly true for young viewers including children, who tend to process via peripheral rather than central routes of information processing (Livingstone & Helsper, 2006). Dual-process models such as the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986) and the Heuristic-Systematic Model (HSM; Chaiken, 1987) postulate that information processing occurs either through the central, systematic route that require conscious engagement with incoming information or through the peripheral, heuristic route, which is based on automatic, unconscious and less demanding processing. One of the reasons as to why health promotion efforts continue to yield unsatisfactory results in terms of sustained behavioural change (WHO, 2020b) is that public health promotion campaigns focus on transmitting rational but cognitively demanding health messages via the central route, while food advertising employs less demanding but emotionally engaging messages via the peripheral route (Harris et al., 2009).

Facilitating viewer attention and engagement via media materials that elicit automatic, unconscious and less demanding processing via the peripheral route has been utilised in entertainment education, which has been shown to positively influence health behavioural change if the health messages are subtly embedded into the programme content (Wang & Singhal, 2021) tailored to exposing children to appealing images of healthy food through engaging narratives and attractive role models have been effective at increasing children’s healthy food intake (Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013). In a narrative media study, Binder et al. (2020) found that children showed little awareness of the health arguments that were presented in the cartoons. Rather, children’s food intake was influenced by the type of social endorser. Therefore, the advertising clips developed for Study 1 refrained from communicating rational, instructive arguments for healthy eating and instead focused on providing appealing role models, creating a positive atmosphere and communicating visual and auditory messages about the sensory enjoyment of the advertised foods.

The instrumental music track ‘Little Idea’ was used as background music to set a positive mood, engage viewers and underscore the positive experience of preparing and eating healthy foods and drinks with friends and family (Bensound, www.bensound.com), based on Allan (2008) who showed that 94% of advertisements used some type of music to advertise their products. The music in Study 1 was sourced via an open resource platform (www.bensound.com). The music contained no lyrics and was tagged in the categories ‘kids’, ‘bouncy’, ‘happy’, ‘light’, ‘fun’, ‘joy’ and ‘positive’ (www.bensound.com).

The advertisement finished with a time-lapse, an editing technique that has been used in advertising to increase attention (Lynn & Zolkepli, 2019), showing children and parents (Cruwys et al., 2015) moving around the table, tasting and enjoying and interacting with the different foods and drinks (Aschermann-Witzel et al., 2012; Lynn & Zolkepli, 2019; Soielvogel et al., 2018). A logo animation was designed and placed at the beginning and end of the advertising clip to mark the beginning and end of the advertisement and to help children distinguish between advertisement and programme by cueing (Zarouali, De Pauw, De Jans & Vanwesenbeeck, 2017).

A picture containing text, different, several

Description automatically generated

Figure 2.1 Healthy food advertising clip stills (experimental condition)

A picture containing text, different, various, same

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Figure 2.2 Toy advertising clip stills (control condition)

In the toy advertisement clip, the same actors were shown in the same setting acting out the same narrative. The toy advertising clip used the same music, editing and advertising techniques as the healthy food advertisement. Instead of foods and drinks, toys ‘magically’ appear on the table. Children and parents interact with the toys and each other. Voice-overs using children’s voices were adapted to apply to toys rather than foods and included comments such ‘Cool!’, ‘Awesome!’, ‘Wow’, ‘Whohee’, ‘Yeah’ and ‘This is so much fun!’ Like the healthy food advertising clip, the toy clip starts with a logo and finishes with a time-lapse and a logo.

### Development of the advertising stimuli

A volunteer film crew was recruited via advertisements in local social media groups for filmmaking and by contacting the University of Sheffield’s media studies departments. Children and parents were recruited via personal contacts, posters near nurseries and schools and social media advertisements to star as volunteer actors in the advertising clips. Parents and children were invited to take part in a ‘Fun with Food Day’, as part of a media project to develop and produce a series of advertising clips that would be used in research exploring media influences and children’s eating behaviour.

As part of the ‘Fun with Food Day’, children and parents played nutrition-related games, carried out healthy food activities and engaged in discussions about media, advertising, food environments and eating behaviour. ‘Fun with Food Day’ was an opportunity for children, parents, researcher and film crew to get to know each other, become familiar with the filming equipment and location and to record some scenes that were included in the advertising clips. Children and parents were able to share their ideas about the design of the advertising clips.

Following ‘Fun with Food Day’, a filming day was held to record the remaining scenes for the advertising clips. The advertising clips included items that magically popped up on a table (Rose, Merchant & Bakir, 2012) and children sitting at the table to engage with those items (Dazeley & Houston-Price, 2015) and one another (Kim et al., 2019), spliced with scenes from ‘Fun with Food Day’ to include parents (Coto et al., 2019), play and food preparation activities (Dazeley & Houston-Price, 2015). During filming, children were able to engage with the items on the table and with each other spontaneously to create an authentic advertising clip, leading to child-driven scenes such as a playful sword fight using a cucumber and using carrot sticks for vampire teeth. Improvisation is a well-known tool to stimulate children to engage with a ‘fresher, more truthful acting style’ and produce a more authentic performance (Stalinksy & Frances-White, 2017, p. 5).

The advertising clips were specifically produced for the purpose of this research to overcome research challenges apparent in previous studies relating to participants’ previous exposure and comparability across conditions (see chapter 1, section 1.8.3). Based on children’s understanding of advertising and marketing and advertising insights discussed in Chapter 1, the advertising clips were pitched at a cognitively appropriate and appealing level for the target audience of very young children with respect to features including length (one minute), story (children and parents enjoy eating healthy foods or playing with toys) and commentary (e.g., ‘Yummy!’) (Miller & Simmering, 2018). The advertising clips were produced in cooperation with the University of Sheffield’s Creative Information and Computing Services (CiCS), a Berlin-based music and video production studio (Felix Klostermann, https://de.linkedin.com/in/felix-klostermann-b3537034), a digital media production student from Sheffield Hallam University, a Portuguese filmmaker, a UK-based media studies graduate and a Sheffield-based film and animation studio (Hugh Mann Adamson, www.ltblproductions.com). The cooperation of these groups achieved production values approximating to current television and online advertising.

### Children’s programme

The one-minute advertising clips were embedded at the beginning, middle and end of seven-minute episodes of ‘Shaun the Sheep’, a children’s programme and stored on a USB Stick. The total viewing time per screening was ten minutes. ‘Shaun the Sheep’ (Aardman Animations) is a British stop-motion animated television series that features the adventures of a sheep and his flock living on a farm with their farmer, a sheep dog and other farm animals. It has been broadcast in 180 countries (https://en.wikipedia.org/wiki/Shaun\_the\_Sheep, retrieved 29.12.2019). ‘Shaun the Sheep’ was selected because of its popularity and familiarity to children and the fact that it does not use language, thus, it can be enjoyed by children of all ages, language skills and origin. There were nine different ‘Shaun the Sheep’ episodes, so that children would watch a different episode each week with the same advertising clip at the beginning, middle and end, apart from the baseline episode, which included no advertising. Based on Anschutz et al. (2009, 2010) who edited ‘March of the Penguins’ to exclude any references to food or eating, any references to food or eating were removed from the ‘Shaun the Sheep’ episodes used in Study 1 while keeping the story line intact.

Each of the ‘Shaun the Sheep’ episodes was presented to groups of children once a week, for eight weeks, adding up to three exposures per screening and 24 advertising exposures in total. Fadilah (2020) underscored repetition as a prominent feature in commercial food advertising, which informed the placement and repetition of the advertising clips in Study 1. With a total advertising length of three minutes per screening, the advertising clips produced for Study 1 compared to the advertising stimuli used in previous research (Gorn & Goldberg, 1980; Harris et al., 2009), although some studies have included longer exposure periods (Gilbert-Diamond et al., 2017; Fox, 1980; Halford et al., 2004, 2007, 2008). In contrast to Anschutz et al. (2009, 2010), the advertising stimuli used in Study 1 did not include neutral advertising in between condition-dependent advertisements to focus the attention of the relatively young children in this sample on the advertising messages that were the focus of this investigation. The advertising clips can be viewed online on the researcher’s YouTube channel ‘Turning Earth Fun with Food’ or via the link: https://tinyurl.com/kids-media-and-eating.

### Food and drink buffet

The buffet included 16 options in total, including 14 food options and two drink options. ‘Healthy’ options were apples, oranges, cherry tomatoes, carrots, cucumbers, mixed peppers, whole grain bread and still water. ‘Unhealthy’ HSSF options were chocolate pieces, gummy bear sweets, milk chocolate digestive biscuits, cheesy crackers, hoop crisps, potato crisps, white bread and orange lemonade. All the ‘healthy’ options had been advertised in the healthy food advertising clip, alongside two additional fruits that were not available at the buffet (kiwi fruit and pears).

Several factors influenced the amount and choice of foods and drinks that were available at the buffet: (1) Sufficient options needed to be provided to avoid children’s potential like or dislike of any particular food or drink option to influence research outcomes (Harris et al., 2009); (2) The range of the buffet needed to be small enough to avoid choice overload (Chernev, Böckenholt & Goodman, 2015); (3) Equal numbers of healthy versus HSSF food and drink options needed to be provided to avoid a biased eating opportunity (Dovey et al., 2011); (4) Foods and drinks needed to be appealing to overcome previous researchers’ issues of children not selecting healthy food options at all (Halford et al., 2004, 2007, 2008), and this was done by offering foods and drinks with a range of colours and textures and presenting them in appetising ways (Olsen, Ritz, Kramer & Møller, 2012); (5) Foods and drinks needed to be familiar to the children, to avoid neophobia as a confounding variable (Heath, Houston-Price & Kennedy, 2011), and this was done by confirming with nursery staff that all buffet options were familiar to the children; (6) To increase the practical implications of outcomes from the present study to improve children’s diets, foods and drinks were chosen that children typically have access to (Scaglioni et al., 2018) and can consume relatively independently (Warren, Parry, Lynch & Murphy, 2008). Access, availability and ability for independent consumption were confirmed by speaking to nursery staff about children’s consumption patterns and requests in the nursery; (7) Options were similar in number to previous multi-item studies, which provided a total of 12 options with six healthy options (four foods, two drinks) and six HSSF options (four foods, two drinks) in studies that included an investigation of television-style healthy food advertising and children’s food intake and (8) Healthy food and drink options were in line with healthy eating guidelines, which recommend three portions of vegetables and two portions of fruit every day, whole grain foods and water for hydration (DGE, 2020; PHE, 2020; WHO, 2020b). The buffet options were modelled on these recommendations for healthy eating, and HSSF options were matched on size, shape, colour (Binder et al., 2020) and number.

Food options were presented on identical plastic plates. Plates were borrowed from the nursery so that children would be familiar with the table setting. The buffet items were cut into bite-size portions and presented in ways that have been shown to be appealing to children (Olsen et al., 2012), including carrot sticks and cucumber wheels. Olsen et al. (2012) found that children preferred having their vegetables cut rather than whole and that the shape was influential. In Olsen et al. (2012), shapes such as stars were liked the most, but slices and sticks were equally popular, so the serving style used at the buffet in Study 1 was vegetables and fruit cut into slices and sticks. Drinks were presented in transparent plastic cups. ‘Healthy’ and HSSF options alternated. Healthy and HSSF options were presented unwrapped to avoid packaging and brand effects (Boyland & Halford, 2013). The buffet was refilled after each participant to avoid presentation effects. Plates were rotated in between participants so that the first plate on the table was the last for the next participant to counteract positioning effects.

A table with food on it

Description automatically generated with medium confidence

Figure 2.3 16-item food and drink buffet

As pictured in Figure 2.3, the buffet was made up out of three tables that were angled in such a way as to create a U-shape, positioning the child in between the tables at an equal distance to all food and drink options to avoid positioning effects. The tables were at children’s waist height to enable children to see the buffet options easily and help themselves to food and drink items freely.

### Food intake measurement

Food intake (number of pieces of each food taken minus leftovers) was recorded using monitoring sheets and photography. Drink intake was measured via visual estimation of leftovers in the cup (none consumed, ¾ consumed, ½ consumed, ¼ consumed, all consumed). One monitoring sheet was used per child. The statistics software SPSS was used to convert items into calories based on nutritional information provided by the manufacturer. In addition to unobtrusive observation and note taking, selection at the buffet and the leftovers were recorded using photography. Photographs of the plate and cup of each child were taken unobtrusively after the children had completed their selection and were on their way to the eating area (see figures 2.4 and 2.5).

A plate of food

Description automatically generated with medium confidence

Figure 2.4 Example 1 of food and drink intake measurement using photography

A picture containing indoor, plastic

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Figure 2.5 Example 2 of food and drink intake measurement using photography

### Research setting

The research setting included a room separated into three different areas using room dividers (see figure 2.6). The first area that children visited was a viewing area for children to group-view the advertising clips embedded in the children’s programme. This area included a flat screen for viewing and mats on the floor in front of it for children to sit on. The second area was the selection area, where children waited on benches to individually make their food and drink selection at the buffet. The buffet and queue of waiting children were positioned at such an angle and distance to one another that children were able to observe the procedure but not the actual food and drink selection of other children. Children left the selection area for the eating area, where children sat down and consumed foods and drinks together. The experiments were conducted in the nursery’s activity rooms, which were large, bright rooms with which the children were familiar. Children were accompanied by nursery staff at all times.

A picture containing diagram

Description automatically generated

Figure 2.6 Research setting Study 1

### Procedure

The experiment was conducted in 4 stages:

1. Exposing children in their nursery to either healthy food or control clips embedded in a children’s programme (‘viewing phase’). Within their allocated group, children viewed together.
2. Giving children the opportunity to choose a variety of foods and beverages available at an open buffet immediately after the screening. There was no pressure to choose and eat and no restrictions on food intake (‘selection phase’). Children made their food and drink selection individually.
3. Giving groups of children the opportunity to consume the items that they chose at the buffet in a separate area in the same room (‘eating phase’). Within their allocated group, children ate together.
4. Recording children’s food choices at the buffet during the selection phase and children’s consumption after accounting for leftovers which were recorded after the eating phase. The measurement units were the number of bite-size portions (‘items’) which were then converted into weight in grams and energy in calories (‘measurement phase’).

As illustrated in Fig. 2.6, the experiments took place in an activity room of the nursery, which was large enough to accommodate a viewing area, where groups of children viewed the children’s programme and advertisement clips in their respective conditions, and a food and drink selection area with a 16-item buffet for children to individually select items they then consume in the group eating area. Besides the children, the children’s nursery teacher, the researcher and a research assistant were present in the activity room. The research assistant was familiar with childcare and trained in the procedures of the study.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Week  1 | Week  2 | Week  3 | Week  4 | Week  5 | Week  6 | Week  7 | Week  8 | Week  9 |
| Time-point | Baseline (T0) | Start-point (T1) |  |  | Mid-point (T2) |  |  |  | End-point (T3) |
| Children’s programme | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Advertising exposure | ✕ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Eating opportunity (buffet) | ✓ | ✓ | ✕ | ✕ | ✓ | ✕ | ✕ | ✕ | ✓ |

Table 2.1 Study 1 research schedule with programme screenings, advertising exposure and eating opportunities throughout one-week baseline period and eight-week intervention period

As shown in Table 2.1, measurement points to assess children’s food and drink intake at the buffet were baseline (after the first screening of a children’s programme without any advertising), start-point (after the first screening of a children’s programme with either the healthy food or the toy advertising embedded), mid-point (at intervention week four) and end-point (at the last screening at intervention week eight). On screening days, each condition started with the group screening of the children’s programme with the appropriate advertising clips inserted. On measurement days, food intake was measured individually straight after the screening at the subsequent buffet. Which condition went first on each day was decided randomly by the flip of a coin.

In line with procedures of previous television-style, food advertising studies that investigated children’s food intake (Fox, 1980; Harris et al., 2009), children in Study 1 were introduced to the researcher prior to the experiment as part of an acquaintance activity and informed about the event. On screening days, consent was obtained from children directly each week by asking whether they would like to view a cartoon. On measurement days, consent was obtained from children by asking whether they would like to view a cartoon and pick snacks to eat afterwards. A similar procedure was previously used by Matthes and Naderer (2015) who assessed children’s consumption behaviour in response to food product placements in movies. Food consumption was recorded unobtrusively by the research assistant counting the standardised portions of the target food item. Previous studies on children’s food intake in response to food cues in television-style advertising (Gorn & Goldberg, 1980) and digital narrative media (Gonçalves et al., 2018) used observation. Once all children finished eating, children were led back into their usual rooms. Any leftovers were accounted for to assess children’s actual food and drink consumption.

### Instructions

Grouped in their allocated condition, children were accompanied into the nursery’s activity room by their usual nursery teacher. The children were invited to sit down in the viewing area (see figure 2.6). The instructions at the first meeting (baseline measure) were as follows:

Researcher: ‘Hello! My name is Laura. Do you know why I am visiting you in your nursery today?’

Children: [voiced suggestions and guesses about who the researcher was and why she was visiting]

Researcher: ‘I am visiting you in your nursery, because I want to watch a cartoon with you. Do you know Shaun the Sheep?’

Children: [knew the cartoon and responded accordingly]

Researcher: ‘Shaun the Sheep is a cartoon about a sheep that lives on a farm with his sheep friends, a sheep dog, a farmer and other farm animals. Does that sound good?’

Children: [wanted to view the cartoon and responded accordingly]

Researcher: ‘First you need a cinema ticket. I will give you a sticker and you put that on your jumper. That is your cinema ticket.’ [researcher provided children with stickers with participant numbers]

Researcher: ‘Do you see the buffet over there? [researcher pointed towards buffet] After watching Shaun the Sheep together, you can pick food and drink to eat from the buffet. You can take whatever you want and you do not have to take anything at all. Ok?’

Children: [wanted to eat snacks and responded accordingly]

[Before the screening started, children were arranged in such a way that all children were comfortable and had a good view of the screen. After the screening, the children received instructions for the selection phase of the experiment.]

Researcher: ‘Did you enjoy Shaun the Sheep?’

Children: [enjoyed the screening and responded accordingly]

Researcher: ‘Okay, in a moment you can go to the buffet one by one and pick whatever you want to eat and drink. I want you to make a queue by your teacher. When your teacher calls out your name, it is your turn to get a plate and go to the buffet and take whatever you want to eat. You can take however much you want so you don’t need to share or swap foods or drinks. You do not have to take anything at all. Once you’ve got everything you want, you can sit down and eat. [researcher pointed to the eating area]. You do not have to finish your plate if you do not want to, just leave any leftovers on your plate.’

The nursery teacher stood a few metres away from the buffet with a stack of plates that were given to the children once it was their turn at the buffet. The plates were labelled with participants’ numbers by the nursery teacher writing on the back of the plate (corresponding to the participant number on the sticker of each child’s jumper) using a marker pen, before the plates were handed out to each child. Once all children formed a queue, the first child was given a plate with his or her participant number written on the bottom and allowed to go to the buffet and pick whatever he or she wanted.

The children made their selection one at a time. A research assistant was at hand to ensure there was never more than one child at the buffet at a time and to reassure and assist the child if needed. The researcher noted each child’s food and drink selection at the buffet using a monitoring sheet. Once the child had completed his or her selection, he or she sat down in the eating area where the children ate together. When the children had finished eating, they were thanked for their participation and accompanied back into their nursery rooms by their teacher. Any leftovers were noted by the researcher using the participant number on the bottom of the plate and the corresponding monitoring sheet.

For the following sessions, instructions were adapted to omit the introduction to the researcher with whom the children were now familiar, but children were reminded of the procedure following the instructions of the first session. As screenings took place every week for nine weeks, but food and drink intake were only measured at baseline, start-point, mid-point, end-point and follow-up, instructions were adapted to inform children each week if the appointment was a screening only or screening and snack session. After each session the children were thanked for their participation.

In line with Dovey et al. (2011), the study took place at the same time of day, between 9.30am and 11.30am, and day of the week for all sessions to control for hunger levels. Each week, the children allocated to control condition and the children allocated to experimental condition were led into the screening room by the childcare staff for group-viewings in their allocated condition. The child’s sticker number corresponded to their name on the attendance sheet and was used as reference for monitoring consumption.

Children were asked to form a queue for the buffet on a first-come, first-serve basis to maintain the sense of a natural process least likely to inhibit participant behaviour by creating an artificial research environment (Coolican, 2018) or by adding unnecessary cognitive demand through instructions, which may affect eating behaviour (Byrd-Bredbenner, Quick, Koenings, Martin-Biggers & Kattelmann, 2016). This was to help children grasp the procedure more quickly by observing their peers (Bandura & Barab, 1971). On the way to the buffet table, each child was given a large plastic plate (provided by the nursery) marked with the child’s participant number on the bottom. Children were told to either leave their plates where they are or to return them to the researcher. Any leftover food recording was carried out once all the children had left the room.

In line with Halford et al. (2004) there was no time constraint at the buffet. Children tended to be quick, and it was not necessary to move children along to avoid other children waiting for a very long time for their turn. All children were reminded once that they were allowed to take whatever they wanted and however much they wanted, but that they did not have to take anything at all. No reference to any particular food or drink item was made. This prompt was used to ensure that all children felt free to take whatever they wanted and however much they wanted. When the researcher or nursery staff noticed that a child was struggling with the motor task involved in carrying a plate and a cup, they received help from the researcher and the familiar nursery staff. Specifically, the researcher, the nursery staff or the research assistant would carry the plate while the child would put his or her selection on the plate. The researcher observed children’s food choice at the buffet in a non-intrusive manner and recorded responses using a monitoring sheet and photography of the children’s plates and plastic cups. The photograph was taken unnoticed by the child from above to capture the plate and cup, but not the child’s face, after the child had completed his or her selection.

## Analysis and results

Study 1, as a pilot, aimed to address issues like response rates, recruitment rates, dropout rates, willingness of nurseries, parents and children’s collaboration with the experimenter, suitability of procedures for nursery children in a nursery setting, children’s ability to follow instructions, children’s responses to the research setting, children’s responses to the media materials (group viewing phase), children’s responses to the buffet (individual food and drink selection phase), children’s responses to the eating opportunity (group eating phase) and suitability of children’s food intake measurements (observation, photography). The results of Study 1 as a pilot study testing procedures and materials are reported in the form of a narrative summary in Section 2.5.

Any statistical analysis derived from Study 1 can only be described as preliminary given the very small sample size in Study 1 (*N* = 11). The statistical analysis of Study 1 included descriptives, histograms and boxplots to assess the distribution of the data, Mann-Whitney tests to assess whether the randomly allocated conditions (control and experimental) were equal at the beginning of the experiment, Friedman’s tests to test for differences in all outcome variables over time in the control and experimental condition separately and Mann-Whitney tests to test for significant differences in all outcome variables between control and experimental condition for each time-point separately.

Outcome variables included children’s intake in items and calories. ‘Total items’ referred to the sum of all available items that children consumed during the experiment. ‘Healthy items’ was the sum of all healthy items that were consumed, which were apples, oranges, cherry tomatoes, carrots, cucumbers, mixed peppers, brown bread and water. ‘HSSF items’ was the sum of all HSSF items that were consumed, which included chocolate pieces, gummy bear sweets, milk chocolate digestive biscuits, cheesy crackers, hoop crisps, potato crisps, white bread and orange lemonade. ‘Balance healthy – HSSF items’ referred to the balance of healthy items compared to HSSF items that were consumed. ‘Total calories’, ‘Healthy calories’, ‘HSSF items’, ‘Difference healthy – HSSF calories’ referred to these variables converted into calories based on information provided by the food manufacturers.

|  | Condition | | | |
| --- | --- | --- | --- | --- |
|  | Control | | Experimental | |
|  | *M* | *SD* | *M* | *SD* |
| Total kcal T0 | 154.66 | 114.28 | 95.36 | 18.64 |
| Healthy kcal T0 | 18.29 | 19.00 | 3.42 | 3.44 |
| HSSF kcal T0 | 136.37 | 98.31 | 91.94 | 19.66 |
| Balance kcal T0 | -118.08 | 83.61 | -88.52 | 21.21 |
| Total items T0 | 4.50 | 1.73 | 3.80 | 1.30 |
| Healthy items T0 | 1.50 | 1.00 | 0.80 | .84 |
| HSSF items T0 | 3.00 | .82 | 3.00 | 1.00 |
| Balance items T0 | -1.50 | .57 | -2.20 | 1.30 |
| Total kcal T1 | 195.52 | 110.73 | 143.66 | 83.65 |
| Healthy kcal T1 | 12.02 | 13.84 | 7.74 | 5.80 |
| HSSF kcal T1 | 183.50 | 106.80 | 135.92 | 86.89 |
| Balance kcal T1 | -171.48 | 104.56 | -128.18 | 90.38 |
| Total items T1 | 6.50 | 1.73 | 6.50 | 1.22 |
| Healthy items T1 | 1.25 | .50 | 2.00 | 1.26 |
| HSSF items T1 | 5.25 | 1.50 | 4.50 | 1.38 |
| Balance items T1 | -4.00 | 1.41 | -2.50 | 2.35 |
| Total kcal T2 | 293.68 | 90.13 | 95.92 | 53.74 |
| Healthy kcal T2 | 5.40 | 7.47 | 8.67 | 6.77 |
| HSSF kcal T2 | 288.28 | 96.00 | 87.25 | 49.97 |
| Balance kcal T2 | -282.87 | 102.07 | -78.58 | 46.88 |
| Total items T2 | 5.80 | 1.10 | 6.60 | 2.79 |
| Healthy items T2 | 0.80 | .84 | 2.00 | 1.41 |
| HSSF items T2 | 5.00 | 1.22 | 4.60 | 1.95 |
| Balance items T2 | -4.20 | 1.79 | -2.60 | 1.95 |
| Total kcal T3 | 358.60 | - | 124.95 | 51.07 |
| Healthy kcal T3 | 0.00 | - | 7.00 | 8.86 |
| HSSF kcal T3 | 358.60 | - | 117.96 | 55.44 |
| Balance kcal T3 | -358.60 | - | -110.96 | 60.80 |
| Total items T3 | 5.00 | - | 5.75 | 1.50 |
| Healthy items T3 | 1.00 | - | 1.50 | 1.73 |
| HSSF items T3 | 4.00 | - | 4.25 | .50 |
| Balance items T3 | -3.00 | - | -2.75 | 2.06 |

Table 2.2 Means (*M*) and standard deviations (*SD*) for control and experimental condition on all outcome variables at all time-points (T0-T3)

Histograms and boxplots were used to assess the distribution of the outcome variable data (total calories from all items, calories from healthy items, calories from HSSF items, difference between calories from healthy minus HSSF items, total items, total healthy items, total HSSF items, difference between healthy minus HSSF items) for control and experimental condition at baseline. After visual assessment of the data distribution using the histograms and boxplots, non-parametric tests were applied.

Since assumptions regarding normality of distribution for conducting independent t-test were not met, non-parametric Mann-Whitney *U* tests were conducted for each time point separately (T0, T1, T2, T3) to test for differences between control and experimental condition on all outcome variables (total calories from all items, calories from healthy items, calories from HSSF items, balance in healthy minus HSSF calories, total number of all food items, number of healthy food items, number of HSSF items, balance of healthy minus HSSF items). The significance level of *p*>.05 was adjusted to >.01 (.5/8 = .01) to account for multiple comparisons (four time-points and two conditions).

As demonstrated by adjusted *p*-values of >.01 for all outcome variables, children’s food intake at baseline (T0) did not differ between control condition and experimental condition, i.e., that the conditions were equal prior to advertising exposure with respect to the variables total calories from all items (*U* = 5, *p* = .22), calories from healthy items (*U* = 5, *p* = .21), calories from HSSF items (*U* = 5, *p* = .22), balance between calories from healthy minus HSSF items (*U* = 8, *p* = .62), total items (*U* = 8.5, *p* = .75), total healthy items (*U* = 6, *p* = .28), total HSSF items (*U* = 10, *p* = 1), balance between healthy minus HSSF items (*U* = 7, *p* = .43).

Mann-Whitney tests were conducted for each time point separately (T1, T2, T3) to test for differences between control and experimental condition on all outcome variables during the intervention period. After adjusting for multiple comparisons and applying a significance threshold of < .01, there were no significant differences between control and experimental condition at any of the time-points (start-point, T1; mid-point, T2; end-point, T3)

Since the normality assumptions for a repeated measures test were not met, non-parametric Friedman’s tests were conducted to test for significant differences in all outcome variables over time, for control and experimental condition separately. Due to insufficient valid cases in the control condition for processing the split file, conducting Friedman’s test by condition was not possible including all time points. As reported in Table 2.1 (see chapter 2), there were too many participants missing at end-point (T3; *n* = 5) in the control condition (*n* = 1). This was due to children leaving the nursery to transfer to primary school. Therefore, T3 was omitted, and Friedman’s tests were conducted for control and experimental condition separately for baseline (T0; *n* = 9), start-point (T1; *n* = 10) and mid-point (T2; *n* = 10). After adjusting for multiple comparisons (*p* < .05 to *p* < .01), none of the changes in children’s food intake remained significant. *P*-values for Friedman’s tests for control and experimental condition are given in Table 2.3.

| Outcome Variable | Control (*p*-values) | Experimental (*p*-values) |
| --- | --- | --- |
| Total calories | 0.78 | 0.78 |
| Healthy calories | 1.00 | 0.53 |
| HSSF calories | 0.78 | 0.78 |
| Balance healthy – HSSF calories | 0.78 | 0.78 |
| Total items | 0.12 | 0.02\* |
| Healthy items | 0.23 | 0.17 |
| HSSF items | 0.09 | 0.04\* |
| Balance healthy – HSSF items | 0.09 | 0.42 |

Table 2.3 *P*-values from Friedman’s tests for control and experimental condition  
\**p* < .05

Changes in food intake in response to advertising exposure were only significant with respect to between-groups-comparisons at one measurement-point, mid-point (T2). At mid-point T2, children in the control group had a greater total calorie intake, greater HSSF calorie intake and displayed a worse balance between healthy minus HSSF calories than children in the experimental group who had been exposed to healthy food advertisements. All other between- and within-group comparisons for the remaining outcome variables and measurement points were not significant.

## Pilot results and discussion

Study 1 was designed as a pilot study to gain experience in conducting experimental research in a nursery setting with young children and to refine methodology and procedures. A quantitative, longitudinal research design with two conditions was employed to investigate the effects of television-style advertising for healthy food versus toys on children’s food intake of healthy and HSSF snacks at a buffet over a period of nine weeks in a nursery in the UK. Study 1 found no differences in children’s food intake in between- or within-group comparisons. The hypothesis that postulated that children who viewed healthy food advertisements (experimental condition) would eat more healthy food than children who viewed toy advertisements (control condition) was therefore rejected. Given the small number of participants in Study 1, for which the primary purpose was to pilot research materials and procedures, any interpretation of findings and comparisons to previous research is limited to a very cautious discussion. Mainly, this section will provide a discussion and a reflective account of the learning outcomes gained from conducting Study 1 and how learning outcomes were applied to refine the methodology, materials and procedures for the following studies in this thesis.

Although the results should be treated with caution, the outcomes from Study 1 are in line with previous studies that found little evidence that healthy food advertising increased children’s intake of healthy foods (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). However, no definite conclusions can be based on data from the small sample in Study 1.

In terms of methodology, Study 1 overcame some of the methodological issues may have led to a lack of healthy food advertising effects in previous studies that focused on television-style food advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). These methodological issues were the use of recorded advertisements (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), unequal numbers of healthy versus HSSF food advertisements during the viewing phase (Dovey et al., 2011), unequal numbers of healthy versus HSSF food options at the eating opportunity (Dovey et al., 2011) and calories as the sole unit of comparing children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

The lack of advertising effects in Study 1 may be explained by the small sample (of just eleven children). Small samples entail a greater risk of finding an effect that is not truly there (false-negative type II error), of missing an effect that may generally be there but has not occurred for those specific participants (false-positive type I error), of being unrepresentative of other children, of higher variability among participants leading to increased risk of bias and low statistical power (Coolican, 2018). Analysis issues relating to a small sample were amplified by missing data due to children being ill or absent (only four children participated in all measurement points). Due to insufficient valid cases in the control condition for processing the split file, conducting Friedman’s test for within-group comparisons was not possible for all time points. In the control condition, there were too many participants missing at end-point (T3). This was because of children leaving the nursery to transfer to primary school. T3 was omitted and Friedman’s tests were conducted for control and experimental condition separately for baseline (T0), start-point (T1) and mid-point (T2). Even at the time-points where Friedman tests were possible, Friedman only takes those cases into account that were present for each time-point, that is, children who attended baseline, start-point, mid-point and end-point, which shrunk the small pilot sample of eleven children down to three or four children in each condition in some instances. Any changes in children’s eating behaviour that could have been attributed to advertising exposure may have been lost given the very small sample size.

Study 1 was conducted as a feasibility study to test response-, recruitment- and dropout-rates; willingness of nurseries, parents and children to collaborate with me (the researcher); suitability of procedures for nursery children in a nursery setting; children’s ability to follow instructions; children’s responses to the research setting; children’s responses to the media materials (group viewing phase); children’s responses to the buffet (individual food and drink selection phase); children’s responses to the eating opportunity (group eating phase) and suitability of children’s food intake measurements (observation, photography).

For Study 1, over 40 nurseries in the Sheffield area were contacted for participation. All nurseries were contacted via e-mail with information materials and asked whether they may be interested to discuss further via telephone or face-to-face meetings. Nursery response rates were low (12.50%). Most nurseries were not interested in discussing research participation further or commented that they were at full capacity due to participation in other projects. Out of the 40 nurseries that had been contacted, one nursery was successfully recruited, and this was due to a parent with children in the same nursery promoting the research project to the nursery and fellow parents. The learning outcome here was that because nurseries felt very little incentive to consider taking part in a research project and many were already involved in other projects, recruitment relied on personal contacts such as parents advocating the project. Therefore, for Study 2, 3 and 4, existing contacts and networks were utilised for recruitment in nurseries in Germany.

The Sheffield nursery that was willing to participate was eager to support the project and collaborate with the researcher, and the nursery invested time into e-mail exchange, telephone calls and face-to-face meetings to agree on a research schedule that would suit the nursery schedule. The learning outcome here was that nurseries adhere to a tight schedule with a strict routine, and any research project must be arranged according to existing scheduling, such as allocated slots for drop-off and pick up of children, breakfast, lunch and snack times, outdoor, nap and play times. Research in naturalistic settings such as nurseries must also consider conditions on site as each nursery will be designed differently architecturally. Anticipated research layouts need to be flexible enough to adapt to differences in research settings.

Out of the one nursery that signed up to the study, this nursery continued with the study until the end (dropout rate = zero). This may suggest in combination with positive feedback from children and nursery staff that participation was enjoyable. At each individual measurement point, however, children were frequently missing due to illness or other commitments. Therefore, the sample sizes in Study 2, 3 and 4 were increased to allow for potentially missing data when children were ill or absent.

In line with Fox (1980), a familiarisation session was held one week prior to the experiments for children to become acquainted with the researcher, the research setting and to receive instruction about the procedures in advance of the experiments. The nursery staff and the researcher agreed that the familiarisation session was useful for children to be prepared for the experiments the following week. Children reacted positively to the researcher. Therefore, for Study 2, 3 and 4, familiarisation sessions were held following the same format as in Study 1.

Randomisation in Study 1 was easy to achieve, because all children were supervised in one big nursery group that could easily be split into two conditions. In Study 1, random allocation was possible due to the small sample of children from one small nursery with only one group of children, where nursery staff was able to supervise children who were participating and those who were not all at the same time.

In Study 1, at the beginning of each session, children were merely told that they would be watching a children’s programme and that there would be snacks afterwards. On some occasions, children appeared distracted and informally observed attention to the screen fluctuated. Since Aardman Studios, who produce Shaun the Sheep, indicate an ideal age range for viewers to be between the ages of four and seven years, children’s lack of attention at the viewings may be due to children being too young to be able to fully understand all the content of the children’s programme and the advertising clips. The learning outcome here was that, ideally, children should be older to participate in media viewings.

Additionally, providing children with more information about the format and content of the screening can help them to understand and enjoy the materials better, thereby increasing attention to the screen. Both learning outcomes, using older children as participants and providing them with more detailed information about the media materials, were employed in the rest of the studies in this thesis.

The design of the eating opportunity may not have been suitable for children aged two to four who were included in Study 1. Some children in Study 1 struggled with the motor task of selecting foods and drinks at the buffet. Those children had difficulty walking from one buffet option to the next while balancing the foods that they had already put on the plate, and they were not able to carry a plate and a cup at the same time without spillage. In such cases, the nursery teacher helped the child. It was concluded that this procedure (handing out plates and allowing children to help themselves from a buffet) would be more suitable for children with better developed motor skills, hence older children were recruited for subsequent Studies 2, 3 and 4. Children also seemed to struggle with waiting patiently in line for their turn at the buffet so that in the following Studies 2 - 4, benches were added to the research setting for children to sit and wait.

Since children in Study 1 were fairly young, the size of the buffet may have been a little overwhelming. Study 1 aimed to present children with a buffet large enough to avoid children’s potential like or dislike of any particular food or drink option as a confounding variable, since Harris et al. (2009) found in a single-item study that children’s liking of the one test food that was offered was a better predictor of children’s food intake than the previous food advertising exposure. The size of the buffet in Study 1 was similar to previous multi-item studies, where children chose and ate from a selection of 6 healthy and 6 HSSF options (Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). From observation during the experiment in Study 1, it seemed as if some children loaded their plate with the foods they encountered first without much concern what else was available. Although plates were rotated between children, the sample of 11 children would have been too small to avoid order effects. Another factor in the procedure in Study 1 that may account for the lack of healthy food advertising effects may be that children were instructed to go to the buffet once and take whatever they wished to eat and drink. Previous studies usually included refills of test foods (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Gorn & Goldberg, 1980; Harris et al., 2009; Halford et al., 2004; 2007; 2008), either through children asking for more (Halford et al., 2008), through automatic refills from the experimenters (Gonçalves et al., 2018) or by children being provided with excessive amounts of test foods (Gorn & Goldberg, 1980). Although children’s food and drink intake was unlimited at the food and drink buffet, children in Study 1 were not able to return to the buffet for refills, and this may have influenced the outcomes.

One step in the procedure that proved unnecessarily time-consuming, and therefore redundant, was to equip children with stickers with their participant numbers that corresponded to the sticker on their plate to be able to match each child with their absolute food intake while protecting their identity. Children needed to be addressed with their names when giving instructions, so that participant numbers were not useful. This step was omitted at the following studies and, instead, data was anonymised after collection was complete.

During food and drink selection, the researcher took notes of each child’s selection. After each child had completed their selection, the researcher took a photograph of the children’s food and drink selection to compare to the food recording via observation. Since the photograph was taken unobtrusively from above while the child walked to the eating area, children were not aware of the recording, and there was no reason to think that photography as a method to measure children’s selection influenced their food intake. After selecting foods and drinks for consumption, children were led to an eating area to eat together with other children who had been allocated to the same condition. Children complied with instructions to not share or swap foods. Nursery staff needed reminding to not tidy up plates and cups before the researcher had a chance to take notes of leftovers. It was concluded that observation and photography were useful methods to reliably monitor children’s food intake and these methods were applied in later studies.

Another point related to the number of tasks that participating nurseries may carry out independently of the researcher is that, upon reflection, all tasks should be carried out by the researcher to ensure consistency. As reported in Table 2.1, the experiment included nine viewing appointments with four eating opportunities. The nursery offered to conduct the viewings without eating opportunity in weeks 3, 4, 6, 7 and 8 independently of the researcher. Appointments with viewings and eating opportunity were always conducted by the researcher and supervised by a nursery teacher. Despite instructions to record children’s attendance for each viewing, nursery staff failed to do so, and the exact advertising exposure for each child remains unknown. The learning outcome here was for the researcher to be present for each step of the experiment and leave as little as possible for nurseries to do themselves. Therefore, for Studies 2, 3 and 4, all steps of the experiments were carried out by the researcher.

Primary learning outcomes from Study 1 included challenges caused by a small sample, missing data from children being ill or absent over a period of nine weeks and limitations in the cognitive and motor abilities of young children that may have led to reduced attention to programme and advertisement clips. Any changes in children’s eating behaviour due to advertising exposure may have been lost given the very small number of participants included in this pilot study whose primary purpose was to test materials and procedures, rather than produce valid findings.

Based on these learning outcomes a number of changes were made to Studies 2, 3 and 4 included in this thesis, including: (1) Recruitment via existing contacts in Frankfurt (Germany) to increase response and recruitment rate; (2) Recruitment of a larger sample to reduce issues with missing data and statistical analysis; (3) Recruitment of older children to reduce issues with cognitive and motor tasks; (4) Implementation of all sessions by the researcher and only accompanied by nursery staff to reduce risk of methodological variation; (5) Anonymisation of participants after data collection instead of using stickers with participant numbers, to avoid unnecessary steps in the procedure; (6) Increasing disclosure and information provision to children to increase children’s attention and understanding of the media materials by informing them about format and content in advance; (7) Inclusion of a follow-up measure to assess for long-term effects and (8) Addition of benches to the research setting for children to be better able to wait their turn at the buffet.

Based on these learning outcomes, Study 2 employed a larger sample of older children to assess the effects of healthy food versus toy advertising on children’s food intake at a 16-item buffet with healthy and HSSF options over a period of seventeen weeks (see chapter 3). In Study 2, it was hypothesised that, at the end point of the intervention, children who had viewed healthy food advertisements (experimental condition) would eat more healthy food than children who had viewed toy advertisements (control condition).

# Study 2

## Introduction

Drawing on previous research literature on digital food advertising and children’s food intake (see chapter 1) and learning outcomes from Study 1 (see chapter 2), the focus of Chapter 3 is on investigating television-style healthy food advertising and children’s intake of healthy and HSSF snacks. Chapter 3 will outline the methods and outcomes of Study 2 used to assess the effects of repeated exposure to healthy food advertising versus toy control advertising on children’s intake of healthy and HSSF snacks.

Exposure to excessive amounts of HSSF food advertising in digital media have been put forward as contributors to unhealthy eating practices and rising levels of obesity in children (Brownell & Horgen, 2004; Nestle, 2013; Pourmoridian et al., 2020). Despite calls to improve children’s diets (WHO, 2020a; PHE, 2020, Robert Koch Institut (RKI, 2018), the available evidence on HSSF and healthy food advertising exposure is limited to approximately 14 studies that focused exclusively on the effect of manipulated exposure to television-style food advertising on food intake in children up to and including 12 years of age, published before the end of 2020 (see chapter 1, section 1.8). Most studies on HSSF food advertising exposure report increases in children’s HSSF snack intake (see chapter 1, section 1.8). As few as four published studies investigated healthy food advertisements and healthy food and drink options in addition to HSSF advertisements and HSSF products and found that exposure to digital healthy food cues did not lead to healthy food intake when other HSSF options were available (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

The lack of healthy food advertising effects may in part be explained by shortcomings in the design of the available studies that made children’s intake of HSSF options more likely than intake of healthy options such as the use of recorded advertisements (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), unequal numbers of healthy versus HSSF food advertisements at the viewing phase (Dovey et al., 2011), unequal numbers of healthy versus HSSF food options at the eating opportunity (Dovey et al., 2011) and calories as the sole unit of measuring children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8.3, 1.8.4, 1.8.5). The conclusions that can be drawn about the potential of television-style healthy food advertising to improve children’s diets are therefore limited and in need of further investigation.

In addition to the methodological issues that may account for some of the lack of healthy food advertising effects in previous studies (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), the effectiveness of HSSF food advertising and the appeal of HSSF foods and drinks may be explained through evolutionary predispositions, learnt preferences and environmental conditions that shape unconscious behavioural mechanisms that make HSSF intake a pleasurable experience (see chapter 1, section 1.6).

In the Reactivity to Embedded Food Cues in Advertising Model (REFCAM, Folkvord et al., 2016) propose *cue reactivity*, or psychological and physiological reactions to food cues, as the mediating process linking presentations of foods such as those placed in digital media, and viewers’ food intake. Cue reactivity theory positions that digital food cues can trigger physiological and psychological responses that increase the chances of food intake (Folkvord et al., 2016). Since unhealthy foods with high sugar, salt and fat content elicit a higher physiological response than healthy foods (Erlanson‐Albertsson, 2005; Folkvord, 2020), it is likely that reactivity to unhealthy food cues is more pronounced than reactivity to healthy food cues. In addition to varying levels of physiological appeal, differences in food cue reactivity between unhealthy versus healthy foods can be attributed to differences in psychological appeal of healthy versus unhealthy foods, with the former being advertised more frequently and more effectively (Boyland & Whalen, 2015; Calvert, 2008; Folkvord et al., 2016; Kraak et al., 2006; Lavriša & Pravst, 2019; Sixsmith & Furnham, 2010). The effectiveness of unhealthy food cues in advertising may then be explained via the interplay of evolutionary predispositions, learnt preferences and environmental conditions that make consumption of unhealthy HSSF products physiologically and psychologically more rewarding than consumption of healthy foods and drinks (Folkvord, 2020).

In line with social learning principles (Bandura & McClelland, 1977), food cue reactivity may be further mediated by the presence of social endorsers, and the level of interaction between social endorser and food product. Similar to the way that physiological processes in the brain direct humans towards energy-dense foods (Folkvord, 2020), mirror neurons in the brain trigger behavioural imitation, including food intake (Chartrand & Lakin, 2013; Nam & Shune, 2020). Food cue integration refers to the level of interaction between the characters or role models and the food and drink product presented in media (Spielvogel et al., 2018). Social Learning Theory (Bandura & McClelland, 1977) positions that children’s liking of a character can influence how effective they are as a role model to influence children’s imitation of the target behaviour. If a liked character handles a food product rather than the food product being passively placed within media, children may be more likely to imitate the target behaviour (Kamleitner & Jyote, 2013). Food placement studies have shown that children’s food intake was higher following interactive integration compared to non-interactive integration (Spielvogel et al., 2018). However, imitation may depend on a large part on attention to the role model, the food cues and the target behaviour (Spielvogel et al., 2018), and this may in turn be influenced by viewers’ individual susceptibility factors (Spielvogel et al., 2018). For instance, hunger has been shown to influence visual attention to food cues in adults (Piech, Pastorino & Zald, 2010), and Anschutz et al. (2009) found hunger to influence food intake following unhealthy food advertising versus non-food advertising exposure in children.

As outlined in Chapter 1, Section 1.7, the Promotion of Healthy Food Model (Folkvord, 2020) points to physiological and psychological drivers of food intake to explain the effectiveness of HSSF food advertising and the appeal of HSSF products. According to the Promotion of Healthy Food Model (Folkvord, 2020), healthy food advertising must increase children’s psychological desire for healthy foods via increasing children’s attention, liking and wanting of such foods to increase their intake until habitual healthy eating elicits physiological rewards linked to improved health. Children’s healthy eating may therefore be supported by exposing children more often to attractive healthy food cues that increase the appeal and status of healthy foods and automatically trigger familiarization processes that enhance the likeliness of children wanting, eating and enjoying healthy foods (see chapter 1, section 1.6). However, to date there are no studies that have assessed children’s food intake in response to repeated exposure to television-style food advertising exposure over time.

Given the limited research base on television-style healthy food advertisements and children’s healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), studies investigating the effects of other digital healthy food cues and children’s healthy eating (Binder et al., 2019, 2020; Coates et al., 2019; Folkvord et al., 2012, 2013; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013; Naderer et al., 2020; Pempek & Calvert, 2009) can contribute to a better understanding of healthy food cues and healthy eating (see chapter 1, section 1.5).

In contrast to television-style food advertising research, studies involving other digital food cues have put an emphasis on investigating healthy food cues (Binder et al., 2019, 2020; Coates et al., 2019; Folkvord et al., 2012, 2013; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013; Naderer et al., 2020; Pempek & Calvert, 2009), with some studies including only healthy food cues (Binder et al., 2019, 2020; Naderer et al., 2020) and only healthy food options (Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013) (see chapter 1, section 1.5). Following exposure to food cues in narrative media (Binder et al., 2019, 2020; Gonçalves et al., 2018), advergames (Folkvord et al., 2012, 2013; Pempek & Calvert, 2009) and social media (Coates et al., 2019), children were asked to select and eat foods and drinks when both healthy and HSSF options were available. Exclusively healthy foods including vegetables and fruit were available in Horne et al. (2004, 2009), in Lowe et al. (2004) and in Upton et al. (2013) following narrative media exposure.

Like television-style advertising for healthy food, most studies involving other digital food cues found healthy food cues to be less effective than HSSF food cues in influencing children’s eating behaviour (Binder et al., 2019, 2020; Coates et al., 2019; Folkvord et al., 2012, 2013; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013; Naderer et al., 2020; Pempek & Calvert, 2009).

Binder et al. (2019) designed three versions of a narrative media cartoon showing children eating raspberries during a scavenger hunt to test the effects of majority and minority peer cues on children’s consumption of healthy or HSSF snacks. Children did not readily switch from HSSF to healthy snacks following fruit cue exposure, suggesting that when prompted to choose one snack over another, children prioritize the HSSF option (Binder et al., 2019). Binder et al. (2020) compared the effect of a nutritional messages provided by experts, celebrities or peers in narrative media cartoons on children’s fruit choice over candy. Binder et al. (2020) found that children selected fruit over candy when the nutritional messages embedded in the narrative media cartoon were communicated by an expert, whereas celebrity and peer endorsers had no effect on children’s food choice, highlighting the role of social endorsers in steering children’s food selection using digital media. Gonçalves et al. (2018) compared children’s intake of chips, chocolates, grapes and baby carrots following either two episodes of a narrative media cartoon about healthy eating or a non-food control cartoon. Children who viewed the cartoons with healthy eating messages ate more healthy foods than children who had viewed the non-food cartoons, but intake of HSSF foods remained high (Gonçalves et al., 2018).

Lowe et al. (2004), Horne et al. (2004, 2009) and Upton et al. (2013) employed a series of specifically-designed promotional video clips presenting the adventures of the ‘Food Dudes’ to test the effect of narrative media exposure on children’s healthy food intake. In these longitudinal studies, Lowe et al. (2004), Horne et al. (2004, 2009) and Upton et al. (2013) found that exposure to narrative media with healthy food cues and healthy eating role models enhanced children’s tasting and eating of fruit and vegetables. Importantly, Horne et al. (2009) found that without encouragement to eat the vegetables and fruit that were available, intake of healthy foods declined in children over time in the control condition. Horne et al. (2004, 2009), Lowe et al. (2004) and Upton et al. (2013) compared the effects of ‘Food Dudes’ programme to fruit and vegetable availability only without any media exposure. Since the ‘Food Dudes’ programme included rewards for tasting and eating foods such as merchandise and stationery, as well as ongoing exposure to a specifically-designed children’s programme with healthy food cues and healthy eating models in the experimental condition but mere availability of vegetables and fruit in the control condition, it is not possibly to separate the effects of the various elements of the ‘Food Dudes’ intervention from healthy food cue exposure versus no healthy food cues.

Despite differences between overt food cues in television-style food advertising and more ‘hidden’ food cues in narrative media, studies assessing the effects of other digital food cues on children’s food intake can provide insight on how advertising stimuli, media types and food choice situations may impact children’s food intake. Horne et al. (2009) found that without encouragement to eat the healthy foods that are available, children’s vegetable and fruit intake declines (Horne et al., 2009). Mere availability of healthy foods is not sufficient to increase children’s intake of healthy foods (Horne et al., 2009), suggesting that healthy food advertising is necessary to improve children’s diets. Asking children to choose one snack over another results in children choosing the HSSF option over the healthy one (Binder et al., 2019), unless the message is communicated by an expert (Binder et al., 2020). This suggests that children benefit from eating opportunities where there is no limitation on healthy food intake (Binder et al., 2019) and that the choice of social endorser in narrative media is likely to influence children’s subsequent food intake (Binder et al., 2020). Gonçalves et al. (2018) found that even when HSSF options alongside healthy ones were offered, exposure to healthy food cues in narrative media helped to increase healthy food intake (Gonçalves et al., 2018), suggesting that healthy food cues can increase healthy food intake even in a mixed food environment, as long as food intake is not limited, and children do not have to make exclusive choices (Binder et al., 2019, 2020).

Taken together, the available studies on children’s food intake in response to overt food cues in television-style food advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) and on more ‘hidden’ food cues in narrative media (Binder et al., 2019, 2020; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013), social media (Coates et al., 2019) or interactive advergames (Folkvord et al., 2012, 2013; Pempek & Calvert, 2009), suggest that healthy food promotion to children is challenging (Hermans & Folkvord, 2020). Healthy food promotion outcomes may be improved through the use of specifically-designed media materials with similarly appealing advertising techniques across conditions including social endorsers (Binder et al., 2020; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013), the use of embedded food cues (Binder et al., 2019, 2020; Coates et al., 2019; Folkvord et al., 2012, 2013; Gonçalves et al., 2018; Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013; Naderer et al., 2020; Pempek & Calvert, 2009), interactive elements (Folkvord et al., 2012, 2013; Pempek & Calvert, 2009) and either unlimited access to healthy and HSSF snacks (Gonçalves et al., 2018) or unlimited access to only healthy snacks (Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013). Study 2 drew on these research outcomes and exposed children to specifically-designed media material with social endorsers, overt and embedded food cues and unlimited access to healthy and HSSF snacks.

The aim of Study 2 was to explore the effects of weekly exposure to specifically-designed, television-style advertising for healthy food (experimental condition) versus toys (non-food control condition) on nursery children’s food and drink intake at a 16-item buffet with equal numbers of healthy and HSSF options in one nursery in Frankfurt/Germany over a period of seventeen weeks. Study 2 incorporated learning outcomes from Study 1 (see chapter 2, section 2.5).

Specifically, methodological changes from Study 1 to Study 2 included study duration, sample size, research location and some alterations to the amount of information provided to children. Study 2 was conducted over a period of seventeen weeks (one week baseline, eight weeks intervention, follow-up eight weeks later), whereas Study 1 spanned nine weeks (one week baseline, eight weeks intervention) only. The rationale for including a follow-up measure was to assess children’s food intake in response to food advertising exposure before, during and after the intervention period. Upton et al. (2013) found that throughout the intervention period, children’s healthy food intake increased in response to healthy food cues in narrative media, but these increases were not maintained at follow-up. The research location was moved from Sheffield/UK in Study 1 to Frankfurt/Germany in Study 2 where the researcher was able to draw on existing contact with nurseries to improve response and recruitment rate. The sample size was increased from 11 children in Study 1 to 26 children in Study 2. Children in Study 2 (mean age = 3.77 years) were slightly older than children in Study 1 (mean age = 3.00 years). Specifically, nursery staff was asked to include only children who they felt were capable of carrying out the experimental procedures to avoid children’s potentially limited cognitive and motor skills as a confounding variable (see chapter 2, section 2.5). In line with Halford et al. (2007), children’s attention during the viewing was improved in Study 2 by telling children that there would be advertising at the beginning, middle and end of the children’s programme. In Study 1, children were merely told that they would be allowed to watch a children’s programme and eat snacks afterwards.

In Study 2, it was hypothesised that, at the end point of the intervention, children who had viewed healthy food advertisements (experimental condition) would eat more healthy food than children who had viewed toy advertisements (control condition).

## Participants

Out of the 115 children that were registered with the participating nursery at the time of the study, an opportunity sample of 26 children (22.61%), including 15 girls and 11 boys between the ages of 2 and 6 years(*M* = 3.71±1.1 years)that nursery staff deemed capable of carrying out the tasks required in the experimental procedures, took part in Study 2. Children were recruited from one nursery located on the University of Frankfurt campus. Children were recruited by contacting nurseries across Frankfurt/Germany with which the researcher was familiar from previous collaboration. Potential participants, including parents and children, were recruited via nursery staff. No payment was made. Native speakers from the university’s psychology department translated recruitment materials from Study 1 from English into Arabic, Dutch, French, German, Italian, Russian, Spanish and Turkish to facilitate recruitment and information provision in the multicultural city of Frankfurt/Germany in Study 2. Ethics followed the same procedures as Study 1 outlined in Chapter 2, Section 2.2. Ethical approval was given for Study 1 from the ethics committee at the University of Sheffield Psychology Department.

## Method

Study 2 was a longitudinal study conducted in one nursery in Frankfurt/Germany over a period of seventeen weeks, including one week baseline, eight weeks of intervention and a follow-up two months later, between January and May 2018. A quantitative research design with two conditions was employed to investigate the effects of digital food advertising on children’s food intake. Random allocation to conditions was carried out via tossing a coin (Gelman & Nolan, 2002). 14 children (11 girls and 3 boys) were randomly allocated to the control condition who viewed toy advertising. 12 children (4 girls and 8 boys) were randomly allocated to the experimental condition who viewed healthy food advertising. The independent variable was the type of advertising clip embedded in a children’s programme that the children were exposed to, which was either healthy food advertising or toy advertising, specifically designed for the purpose of Study 2.

Outcome variables were food intake in calories and items at a buffet measured through observation using a monitoring sheet and photography. As shown in Table 3.1, Food intake measurement points were the same as Study 1 which included baseline (T0), start-point (T1), mid-point (T2) and end-point (T3) with the additional follow-up measurement two months after the final screening of the intervention period (T4). Follow up included the buffet-style eating opportunity but no screenings of programme or advertising.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Week  1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 17 |
| Time-point | Baseline (T0) | Start-point (T1) |  |  | Mid-point (T2) |  |  |  | End-point (T3) | Follow up (T4) |
| Children’s programme | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✕ |
| Advertising exposure | ✕ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✕ |
| Eating opportunity (buffet) | ✓ | ✓ | ✕ | ✕ | ✓ | ✕ | ✕ | ✕ | ✓ | ✓ |

Table 3.1 Study 2 research schedule with programme screenings, advertising exposure and eating opportunities throughout one-week baseline period, eight-week intervention period and follow-up eight weeks post-intervention

The advertising stimuli, the children’s programme, the food and drink buffet and the food intake measurement in Study 2 were the same as in Study 1 (see chapter 2, sections 2.2, 2.3, 2.5, 2.6 and 2.7). As in Study 1, children were exposed to three minutes of advertising per weekly screening, adding up to a total of 24 minutes over the eight-week intervention period. Study 2 included the same number and type of food and drink options presented in the same way as Study 1 (see chapter 2, section 2.6), but food and drink options in Study 2 were adapted to include brands that were available in Germany and familiar to participating children. ‘Healthy’ options included apples, oranges, cherry tomatoes, carrots, cucumbers, peppers, brown bread and still water. HSSF options included Haribo sweets, chocolate pieces, pretzel snacks, butter biscuits, Pringle’s potato crisps, Hoop crisps, white bread and sugary orange lemonade.

The research setting remained the same as in Study 1 and included a viewing area, a food selection area and an eating area (see chapter 2, section 2.8). As shown in Figure 3.1, benches for children to sit and wait their turn were added to the research setting in Study 2, based on learning outcomes from Study 1 that had shown that children struggled with waiting in line.

A picture containing diagram

Description automatically generated

Figure 3.1 Research setting Study 2

Procedures in Study 2 were almost the same as procedures in Study 1 outlined in Chapter 2, Section 2.9. Changes to procedures from Study 1 to Study 2 included greater disclosure of research procedures to children in Study 2 than in Study 1 (see chapter 2, section 2.10). In line with disclosure in Halford et al. (2007), to increase children’s attention during the viewing, children in Study 2 were told that there would be advertising at the beginning, middle and end of the children’s programme. In Study 1, children were merely told that they would be allowed to watch a children’s programme and eat snacks afterwards. Another change to the procedure was that stickers with participant numbers were omitted. In Study 2, children received no stickers for their clothing at all, and stickers on plates had children’s names instead of participant numbers.

## Analysis and results

Despite a larger sample (*N* = 26) in Study 2 compared to Study 1 (*N* = 11), missing data from children being absent from some measurement points throughout the 17-week-period posed challenges for the analyses of the data. In addition, G\*Power calculations (Faul, Erdfelder, Lang & Buchner, 2007) with a conservative effect size (f = 0.10), error probability of 0.05 and power of 0.80 indicated that 122 participants were required to detect significant differences in intake between the two groups across the five time-points. The study was therefore underpowered given the opportunity sample of only 26 children, which undermines the ability to draw firm conclusions from the results from Study 2.

Another issue that warrants caution when interpreting outcomes from Study 2 is that not all children who were included in the analysis were present at baseline or at all measurement points thereafter. Of the total number of children recorded (*N* = 26), only 20 children were present at baseline (T0) and of these only 5 children (control condition *n* = 2; experimental condition *n* = 3) completed all measurement points from baseline (T0) to follow-up (T4). As outlined in Table 3.2, which includes participant numbers for each time-point (T0 – T4) for control and experimental condition, out of the total sample of 26 children in Study 2, 20 were present at baseline (T0), 13 were present at start-point (T1), 19 were present at mid-point (T2), 20 were present at end-point (T3) and 17 were present at follow up (T4). Children who did not participate at baseline were still able to participate in other experiment and were included in measurements and analysis. Drop-out was due to children’s non-attendance at the nursery at test days.

The analysis strategy included descriptive statistics (see table 3.2), data distribution checks and inferential statistics, which were non-parametric Mann-Whitney *U* tests for between-group differences and non-parametric Friedman’s tests for within-group comparisons. Multiple comparisons were accounted for by adjusting the significance level, i.e. *p*-value from .05 to .005 by dividing .05 by 10 comparisons (two conditions and five time-points).

|  |  |  |
| --- | --- | --- |
| Condition | | |
|  | Control | Experimental |
| *n* T0 | 11 | 9 |
| *n* T1 | 8 | 5 |
| *n* T2 | 12 | 7 |
| *n* T3 | 11 | 9 |
| *n* T4 | 9 | 8 |

|  | *M* | *SD* | *M* | *SD* |
| --- | --- | --- | --- | --- |
| Total kcal T0 | 107.5 | 39.6 | 110.5 | 71.9 |
| Healthy kcal T0 | 2.1 | 3.5 | 24.8 | 26.0 |
| HSSF kcal T0 | 105.4 | 40.9 | 85.7 | 52.8 |
| Balance kcal T0 | -103.3 | 42.3 | -60.9 | 41.9 |
| Total items T0 | 7.8 | 2.8 | 7.6 | 7.7 |
| Healthy items T0 | .8 | .9 | 2.7 | 2.6 |
| HSSF items T0 | 7.0 | 2.7 | 4.9 | 3.0 |
| Balance items T0 | -6.1 | 3.0 | -2.2 | 1.9 |
| Total kcal T1 | 146.3 | 36.1 | 163.0 | 117.9 |
| Healthy kcal T1 | 3.5 | 4.3 | 18.0 | 19.8 |
| HSSF kcal T1 | 129.0 | 45.3 | 121.2 | 96.0 |
| Balance kcal T1 | -140.5 | 36.8 | -127.1 | 97.5 |
| Total items T1 | 9.8 | 2.8 | 8.7 | 6.9 |
| Healthy items T1 | 1.1 | .9 | 1.9 | 1.6 |
| HSSF items T1 | 8.7 | 3.1 | 6.9 | 5.6 |
| Balance items T1 | -7.6 | 3.6 | -5.0 | 4.3 |
| Total kcal T2 | 132.5 | 37.6 | 126.3 | 89.8 |
| Healthy kcal t2 | 8.3 | 14.7 | 22.2 | 27.1 |
| HSSF kcal T2 | 124.1 | 42.4 | 104.1 | 77.4 |
| Balance kcal T2 | -115.8 | 51.1 | -81.9 | 73.3 |
| Total items T2 | 9.9 | 2.6 | 9.5 | 6.8 |
| Healthy items T2 | .9 | 1.3 | 2.1 | 2.5 |
| HSSF items T2 | 9.0 | 3.1 | 7.4 | 5.2 |
| Balance items T2 | -8.1 | 3.9 | -5.4 | 4.8 |
| Total kcal T3 | 160.9 | 35.4 | 143.5 | 79.1 |
| Healthy kcal T3 | 7.9 | 14.6 | 10.8 | 9.3 |
| HSSF kcal T3 | 152.9 | 38.1 | 132.6 | 70.0 |
| Balance kcal T3 | -145.0 | 45.5 | -121.8 | 61.9 |
| Total items T3 | 12.1 | 3.6 | 13.1 | 7.6 |
| Healthy items T3 | 1.3 | 1.2 | 3.1 | 3.0 |
| HSSF items T3 | 10.8 | 3.9 | 10.0 | 5.5 |
| Balance items T3 | -9.6 | 4.5 | -6.9 | 4.5 |
| Total kcal T4 | 137.6 | 88.8 | 212.6 | 127.0 |
| Healthy kcal T4 | 15.5 | 21.5 | 19.2 | 18.6 |
| HSSF kcal T4 | 122.2 | 79.5 | 193.4 | 125.0 |
| Balance kcal T4 | -106.7 | 76.4 | -174.2 | 125.8 |
| Total items T4 | 10.1 | 5.7 | 18.5 | 9.7 |
| Healthy items T4 | 1.6 | 1.7 | 3.4 | 2.8 |
| HSSF items T4 | 8.6 | 5.9 | 15.1 | 9.6 |
| Balance items T4 | -7.0 | 6.4 | -11.8 | 10.3 |

Table 3.2 Participant numbers (*n*), means (*M*) and standard deviations (*SD*) for all outcome variables for control and experimental condition at all time-points (T0-T4)

Table 3.2 shows participant numbers (*n*), means and standard deviations for the outcome variables total caloric intake (Total kcal), caloric intake from healthy options (Healthy kcal), caloric intake from HSSF options (HSSF kcal), the balance of caloric intake from healthy – HSSF options (Balance kcal), total intake by items (Total items), intake of healthy options by items (Healthy items), intake of HSSF options by items (HSSF items), the balance of intake of healthy – HSSF options by items (Balance items) for the control and experimental condition at all time-points, which were baseline (T0), start-point (T1), midpoint (T3) and endpoint (T4) in Study 2. Inferential statistics on the outcome variables ‘total calories’ (calories derived from healthy + HSSF food/drink options), ‘healthy calories’ (calories derived from healthy food/drink options), HSSF calories (calories derived from HSSF food/drink options), ‘balance calories’ (healthy – HSSF calories), ‘total items’ (healthy + HSSF food/drink options), ‘healthy items’, ‘HSSF items’ and ‘balance items’ (healthy – HSSF items) were performed. Visual inspection of histograms suggested that data was not normally distributed, thus, non-parametric tests were applied to assess between-group differences using Mann-Whitney *U* tests and within-group differences via Friedman’s tests.

Mann-Whitney tests were applied as between-group comparisons assessing differences between the conditions for each measurement-point (T0 – T4) via delta (T0-T1; T0-T2; T0‑T3; T0-T4) for all outcome variables (‘total calories’, ‘healthy calories’, ‘HSSF calories’, ‘total items’, ‘healthy items’, ‘HSSF items’). After adjusting for multiple comparisons by adjusting the *p*-value from .05 to .005 by dividing .05 by 10 comparisons (two conditions and five time-points), none of the between-group differences were significant (see table 3.3). Given that Study 2 was underpowered due to the small sample size of 26 children compared to the required sample size of 122 children according to G\*Power analysis, results from Study 2 should be treated with caution. Caution is also warranted in consideration of the variability in children’s attendance at each measurement point (T0 – T4), which is displayed for control and experimental group in Table 3.2.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Delta (mean difference) | Total calories | | | Healthy calories | | | HSSF calories | | | Total items | | | Healthy items | | | HSSF items | | |
|  | *U* | *z* | *p* | *U* | *z* | *p* | *U* | *z* | *p* | *U* | *z* | *p* | *U* | *z* | *p* | *U* | *z* | *p* |
| T0 – T1 | 19.00 | -.15 | .88 | 14.50 | -1.09 | .28 | 19.00 | -.146 | .88 | 15.50 | -.66 | .51 | 18.50 | -.56 | .58 | 18.50 | -.22 | .83 |
| T0 – T2 | 27.00 | .00 | 1.00 | 22.00 | -.60 | .55 | 7.00 | -2.36 | .018 | 24.00 | -.36 | .72 | 25.00 | -.24 | .81 | 18.50 | 1.01 | .31 |
| T0 – T3 | 28.00 | -.37 | .71 | 24.00 | -.80 | .43 | 28.00 | -.370 | .71 | 31.00 | -.05 | .96 | 29.00 | -.27 | .79 | 28.50 | -.32 | .75 |
| T0 – T4 | 9.00 | -1.71 | .09 | 15.00 | -.86 | .39 | 7.00 | -2.00 | .05 | 8.50 | -1.79 | .07 | 19.00 | -.29 | .77 | 7.00 | -2.00 | .05 |

Table 3.3 Mann-Whitney *U*, *z*-scores and *p*-values for between-group comparisons of healthy food versus control advertising at T0-T4

Table 3.3 displays the mean differences (Delta) for children’s caloric intake (‘Total calories’, ‘Healthy calories’, ‘HSSF calories’) and children’s intake by items (‘Total items’, ‘Healthy items’, ‘HSSF items’) between baseline (T0) and start-point (T1), baseline (T0) and midpoint (T2), baseline (T0) and endpoint (T3), and baseline (T0) and follow-up (T4) with Mann-Whitney *U*, *z*-scores and *p*-values.

Non-parametric Friedman’s tests for within-group comparisons assessed differences across time (T0 – T4) in the experimental and control condition. There were no significant within-group changes in children’s food intake across time (T0 – T4) in the control condition (see table 3.4) or the experimental condition, after adjusting for multiple comparisons (see table 3.5). Results from Study 2 should be treated with caution given the relatively small sample size and variability in children’s attendance from T0 to T4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcome variable | *n* | χ2 | *df* | *p* |
| Total calories | 2 | 7.20 | 4 | .126 |
| Healthy calories | 3 | 6.10 | 4 | .191 |
| HSSF calories | 2 | 7.20 | 4 | .126 |
| Balance calories | 2 | 7.20 | 4 | .126 |
| Total items | 2 | 7.20 | 4 | .126 |
| Healthy items | 3 | 5.13 | 4 | .274 |
| HSSF items | 2 | 7.26 | 4 | .123 |
| Balance items | 2 | 7.20 | 4 | .126 |

Table 3.4 Friedman’s tests control condition with participant numbers (*n*), Chi-square value (χ2), degrees of freedom (*df*) and asymptotic significance (*p*-value)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcome variable | *n* | χ2 | *df* | *p* |
| Total calories | 3 | 9.87 | 4 | .043 |
| Healthy calories | 3 | 1.56 | 4 | .817 |
| HSSF calories | 3 | 8.53 | 4 | .074 |
| Balance calories | 3 | 8.53 | 4 | .074 |
| Total items | 3 | 11.47 | 4 | .022 |
| Healthy items | 3 | 5.41 | 4 | .248 |
| HSSF items | 3 | 11.19 | 4 | .025 |
| Balance items | 3 | 9.153 | 4 | .057 |

Table 3.5 Friedman’s test experimental condition with participant numbers (*n*), Chi-square value (χ2), degrees of freedom (*df*) and asymptotic significance (*p*-value)

## Discussion

Results from between- and within-group comparisons suggested that in Study 2, there were no changes to children’s food intake over time (T0 – T4). The hypothesis that children who repeatedly viewed healthy food advertisements would eat more healthy food than children who viewed control advertisements at end point of the intervention was rejected. Findings from Study 2 should be treated with caution given the small sample size, missing data and variability in children’s attendance at the measurement points (T0 – T4). Study 2 was underpowered given the small sample size of 26 children compared to the required sample size of 122 children according to G\*Power analysis. Additionally, there was missing date and variability in children’s attendance at baseline (T0), start-point (T1), mid-point (T2), end-point (T3) and follow-up (T4), and not all children whose data was included were present at baseline or at all following measurement points. Hence, any interpretation of findings and comparisons to previous research is limited to a very cautious discussion.

Nevertheless, Study 2 overcame some of the methodological limitations of previous studies, such as the use of recorded advertisements (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), unequal numbers of healthy versus HSSF food advertisements during the viewing phase (Dovey et al., 2011), unequal numbers of healthy versus HSSF food options at the eating opportunity (Dovey et al., 2011) and calories as the sole unit of comparing children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), that may have led to a lack of healthy food advertising effects in previous studies that focused on television-style food advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). However, Study 2 did not find any positive effects in the healthy food advertising condition. The results from Study 2 (and Study 1) were in line with previous studies that found little evidence that healthy food advertising would increase children’s intake of healthy foods (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979).

Although the results should be treated with caution, outcomes from Study 2 are in line with previous studies that investigated the impact of television-style, healthy food advertising on children’s food intake, which found no increases in healthy food intake despite healthy food advertising exposure (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). However, the lack of healthy food advertising effects in Study 2 (and previous studies by Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) contradicts some of the assumptions highlighted in The Reactivity to Embedded Food Cues in Advertising Model (REFCAM, Folkvord et al., 2016), Social Learning Theory (Bandura & McClelland, 1977) and in Benelam (2009) regarding instant gratification of food cue induced appetite.

According to REFCAM (Folkvord et al., 2016), three factors influence food cue reactivity: (1) the type of food, (2) the level of food cue integration and (3) individual susceptibility factors. REFCAM (Folkvord et al., 2016) suggests that type of food plays a role in how strongly individuals react to food cues. Physiological and psychological reactions to food cues that precede food intake are less pronounced for healthy than for HSSF food cues (Folkvord et al., 2016), which may explain the lack of healthy food advertising effects in Study 2. However, according to REFCAM (Folkvord et al., 2016), any food cue (such as healthy food cues in the experimental condition) should still trigger a stronger eating response than no food cue (such as the toy advertising in the control condition). In contrast to this prediction, children in Study 2 were not affected by the (healthy) food cue exposure and did not increase their food intake. Future research with properly randomised controlled trials and sufficient sample sizes may wish to further investigate the effects of healthy food advertisement in the context of REFCAM (Folkvord et al., 2016).

Based on Social Learning Theory (Bandura & McClelland, 1977), REFCAM (Folkvord et al., 2016) also predicts that higher level of food cue integration increases the likelihood of food intake. Food cues in Study 2 were highly integrated since the advertised snacks were handled, eaten, promoted and shown by a range of social endorsers including adult models, peer models and via voice-overs. However, the high level of food cue integration did not increase children’s intake of healthy foods in Study 2. Future research with properly randomised controlled trials and sufficient sample sizes may wish to further investigate the effects of healthy food advertisement in the context of Social Learning Theory (Bandura & McClelland, 1977), social endorsers and food cue integration.

Benelam (2009) would further predict that although food cues in Study 2 were for healthy foods and drink, children will prioritize intake of unhealthy HSSF options to instantly gratify the appetite that the food cues, healthy or not, elicited. Benelam’s (2009) predictions are in line with the physiological and psychological mechanisms outlined by Folkvord (2020) that make the consumption of unhealthy HSSF options more rewarding than consumption of physiologically less pleasing and psychologically less desirable healthy options. However, children in Study 2 did not increase their intake of healthy or HSSF options over the course of the experiment or in comparison to children who had been exposed to control advertisements. Future research with properly randomised controlled trials and sufficient sample sizes may wish to investigate whether healthy food cue exposure could lead, as Benelam (2009) would suggest, in fact, to increases in HSSF food and drink intake to instantly gratify children’s food cue induced appetite.

Research on food cues in digital media demonstrates significant challenges in healthy food and drink promotion to children (Folkvord, 2020; Benelam, 2009; Binder et al., 2019), and, although the results from Study 2 should be treated with caution, outcomes from Study 2 may reflect these challenges. Studies on HSSF food advertisement exposure found that HSSF food cues affect children’s eating by increasing the intake of such foods, and this appears to be the case for overt food cues in television-style food advertising (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8) and for covert food cues embedded in digital media such as advergames (Folkvord et al., 2012, 2014, 2015, 2017; Harris et al., 2012; Pempek & Calvert, 2009) and narrative media (Binder et al., 2019; Gonçalves et al., 2018). Less is known about the effects of healthy food cues (Ogle, Graham, Lucas-Thompson & Roberto, 2017), but the available research base suggests that it may be challenging to direct children towards healthier eating using healthy food cues in television-style food advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), narrative media cartoons (Naderer et al., 2018) or advergames (Folkvord, Anschütz, Buijzen & Valkenburg, 2013). Challenges to improve children’s diets may relate to inherent preferences for HSSF snacks due to physiological responses in the brain’s reward pathways that make consumption of HSSF snacks a pleasurable experience (see chapter 1, section 1.6). The intake of HSSF snacks is further encouraged by the psychologically rewarding experience of consuming foods and drinks that are heavily advertised (Folkvord, 2020). As outlined in The Promotion of Healthy Food Model (Folkvord, 2020), even if healthy foods do not trigger the same pleasurable physiological response as HSSF foods, the reinforcing value of healthy foods can nevertheless be increased by attractive advertising to make healthy food consumption as psychologically rewarding as HSSF consumption. The Promotion of Healthy Food Model (Folkvord, 2020) further argues that over time, healthier eating does improve physiological health outcomes, leading to a reciprocal relationship between healthy food intake and feeling good.

If effective healthy food promotion depends on repeated exposure to attractive healthy food presentations to increase the reinforcing value of healthy foods and elicit felt improvements in health and wellbeing (Folkvord, 2020), the lack of healthy food advertising effects in Study 2 may have been due to the relatively low levels of healthy food advertising exposure compared to children’s usual and concurrent advertising exposure to HSSF products (Landwehr & Hartmann, 2020). Children in Study 2 were exposed to a maximum of 24 minutes of advertising at the end of the 8-week intervention period only, depending on their individual attendance. Considering children’s typical advertising exposure levels (Landwehr & Hartmann, 2020), especially to HSSF products (Landwehr & Hartmann, 2020), 24 minutes of healthy food advertising may not have been sufficient to increase the psychological value of healthy foods to get children to eat them in Study 2.

The Healthy Food Promotion Model (Folkvord, 2020) highlights directing viewers’ attention to healthy foods as the first step in increasing their reinforcing value, which describes the liking and wanting of the advertised product. The lack of imitation of healthy eating behaviours in children in Study 2 may indicate that children did not pay enough attention to the advertising materials to sufficiently observe, interpret and then imitate the healthy eating behaviours of the digital role models correctly. However, Study 2 did not measure children’s attention systematically, and no definite conclusions can be drawn or based on data derived from the relatively small sample in Study 2.

Eye-tracking studies show that healthy food cues do not elicit the same visual attention that HSSF food cues do (Spielvogel et al., 2018), and this may impact children’s subsequent eating behavioural change. If children generally pay less attention to healthy food cues than to HSSF food cues, increasing the reinforcing value of healthy foods is challenging. The advertising clips in Study 2 were produced by a professional filming and editing team and carefully designed in line with the key success factors for marketing healthy foods and drinks to children (Aschemann-Witzel et al., 2012). Still, the healthy food cues used in Study 2 may have failed to elicit sufficient attention to increase the reinforcing value of the healthy foods that were offered at the buffet to the level that may be required for effective healthy food promotion outlined in The Healthy Food Promotion Model (Folkvord, 2020). Lack of attention to the healthy food advertising materials may have reduced both the likelihood of increasing children’s liking and wanting of those foods (Folkvord, 2020) and the likelihood of children observing and imitating the advertised behaviour as proposed in Social Learning Theory (Bandura & Barab, 1971; Bandura & McClelland, 1977). Differences in visual attention between healthy and HSSF food cues are in line with inherent preferences for HSSF products due to their physiologically and psychologically rewarding nature (Folkvord, 2020). Consequently, especially unhealthy foods trigger food cue reactivity in children (Folkvord et al., 2016) even when healthy food cues are integrated, i.e., handled by the social endorsers in the advertisement in the same way. As Study 2 did not measure children’s attention to the screen or children’s liking and understanding of the media materials and its characters, it is unclear whether children paid enough attention to either the food cues to elicit food intake or to the role models to observe and imitate their healthy eating behaviour. Future research with a sufficient sample size may wish to systematically assess children’s attention to various advertising techniques and their impact on children’s health food intake.

The design of the eating opportunity may have been another methodological explanation for the lack of healthy food intake in response to healthy food advertising in Study 2. Like all previous studies on television-style food advertising and children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), the eating opportunity in Study 2 included healthy and HSSF snack options. Children prefer HSSF foods and drinks when they are available (Cohen, 2008), so healthy food advertising exposure may not have been sufficient to override children’s drive to prioritise intake of HSSF snacks rather than the healthy options. However, given that Study 2 was underpowered and did not include a comparison of eating opportunities such as healthy options only versus healthy and HSSF options, no definite conclusions can be drawn regarding the possible effects of the eating opportunity design.

In contrast to previous studies on television-style food advertising, which included healthy as well as HSSF food cues and healthy as well as HSSF snacks (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), narrative media researchers Horne et al. (2004, 2009), Lowe et al. (2004) and Upton et al. (2013) exposed children exclusively to healthy food cues, and the eating opportunity included healthy foods only (vegetables and fruits). While previous studies on television-style healthy food advertising reported no increases in children’s healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), studies on healthy food cues in digital narrative media do (Horne et al., 2004, 2009; Lowe et al., 2004; Upton et al., 2013). Exposure to healthy food cues in narrative media increased children’s healthy food intake while children’s fruit and vegetable intake declined over time in the control condition (Horne et al., 2004). Although differences in format between overt television-style food advertising and stealth food cues that are embedded in the story and character design of narrative media may have contributed to healthy food advertising effects in Horne et al. (2004, 2009), Lowe et al. (2004) and Upton et al. (2013), it is likely that the absence of HSSF options increased children’s healthy food intake (Cohen, 2008). Therefore, the lack of healthy food intake in response to healthy food advertising in Study 2 may have been due to the availability of HSSF alternatives. Since Study 2 was underpowered and only included one eating opportunity (a buffet with healthy and HSSF food and drink options), future research is required to better understand the potential effect of different eating opportunity designs on children’s healthy food intake in response to television-style food advertising.

Although purely speculative, given that Study 2 was underpowered, another methodological reason for the lack of healthy food intake in response to healthy food advertising in Study 2 may have been the instructions given to children at the eating opportunity. Children in Study 2 were told to choose and eat as many or as few snacks as they wished from the buffet but were only allowed to go to the buffet once. In contrast to previous research assessing children’s eating in response to digital food cue exposure (Anschutz et al., 2009, 2010; Boyland et al., 2013; Dovey et al., 2011; Gonçalves et al., 2018; Gorn & Goldberg, 1980; Halford et al., 2004, 2007, 2008; Harris et al., 2009), the procedure in Study 2 did not provide an opportunity for refills, so children may have wanted to eat more foods after their initial selection but were not able to. Refill opportunities were introduced in Study 4.

In terms of weaknesses, insufficient numbers of children (compared to the required sample size indicated by G\*Power analysis) were recruited for Study 2, and there was missing data due to children being ill or absent at the measurement points, which left Study 2 underpowered. Any changes in children’s eating behaviour that could have been attributed to advertising exposure may have been lost given the relatively small sample size. It is therefore not possible to draw any firm conclusions from Study 2, and any interpretation of findings and comparisons to previous research was limited to a very cautious discussion. In terms of strengths, Study 2, uniquely, contributed a quantitative, longitudinal design assessing children’s food intake of a variety of healthy and HSSF snack options in response to healthy, television-style food advertising that was specifically designed for the purpose of research. A large number of television-style food advertising studies have investigated exclusively HSSF food advertisements and children’s HSSF intake (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Harris et al., 2009), and studies of television-style healthy food advertisements and children’s healthy food intake are lacking. The present study did not contain any other food advertisement condition, so it remains unknown as to whether children were simply not susceptible to healthy food cues or whether children were not susceptible to any type of food cue at all, such as HSSF food advertising. Future studies may wish to investigate and compare the effects of various food advertising conditions for healthy foods as well as HSSF products.

In Study 3 the number of conditions was increased from two conditions (healthy food advertisement; toy advertisement) to four conditions (healthy food advertisements; anti-HSSF food advertisement; HSSF food advertisement; toy control advertisements). In Study 3 the sample size was increased in comparison to Study 2. In Study 3, it was hypothesised that children who view HSSF food advertising would eat more HSSF options than children in the control condition.

# Study 3

## Introduction

As outlined in Chapter 1, digital food advertising has been shown to negatively influence children’s food preferences, food choices and food intake due to the high prevalence of HSSF food advertising. Marketing promoting healthy eating is largely absent from commercial advertising and from the research literature on television-style food advertising and children’s food intake (see chapter 1, section 1.8). The aim of Study 3 was to compare the effects of four specifically-designed, television-style food advertisements on nursery children’s food and drink intake at a 16-item buffet with equal numbers of healthy and HSSF options in one nursery in Frankfurt/Germany over a period of seventeen weeks. Study 3 incorporated learning outcomes from Study 2 (see chapter 3, section 3.5) and Study 1 (see chapter 2, section 2.5).

Specifically, Study 2 comprised two conditions only, whereas in Study 3, the number of conditions increased to contain two additional advertising conditions. Children in Study 3 were allocated to one out of four advertising conditions, including (1) healthy food advertising, (2) anti-HSSF food advertising (an advertising clip discouraging the intake of energy-dense foods and drinks high in sugar, salt and fat), (3) HSSF food advertising and (4) toy advertising. Children in Study 2 had been allocated to one out of two conditions only, which were healthy food advertising and toy advertising. The sample size in Study 3 was increased from 26 children in Study 2 to 34 children in Study 3. Children in Study 3 (mean age = 4.64 years) were slightly older than children in Study 2 (mean age = 3.17 years) to avoid very young children’s potentially limited cognitive and motor skills as a confounding variable (see chapter 2, section 2.5). Like Study 2, Study 3 was conducted over a period of seventeen weeks (one week baseline, eight weeks intervention, follow-up eight weeks later).

The rationale for including an HSSF food advertisement in Study 3 was to contribute to the limited evidence base on television-style food advertising and children’s food intake (14 studies in total, see chapter 1, section 1.8) by assessing children’s food intake for the first time in response to specifically-designed for research advertising, as opposed to recorded from television HSSF food advertising. Since children in Study 1 (see chapter 2, section 2.4) and Study 2 (see chapter 3, section 3.4) did not change their food intake in response to healthy food advertising, Study 3 included HSSF food advertising to test if children would react to HSSF food cues – which the majority of the research literature would predict (see chapter 1, section 1.8; and reviews by Boyland et al., 2016; Boyland & Whalen, 2015; Russel et al., 2019; Sadeghirad et al., 2016; Smith et al., 2019). Since all advertising clips in this thesis were specifically designed for the purpose of the studies and matched across conditions, the inclusion of two more food advertising conditions allowed for a greater consideration of the advertising appeals that were used. Based on previous research on television-style food advertising repeatedly demonstrating that exposure to HSSF food advertising increased children’s intake of HSSF foods and drinks (see chapter 1, section 1.8), it was hypothesised in Study 3 that children who view HSSF food advertising would eat more HSSF options than children in the control condition.

Based on previous research outcomes highlighting the lack of healthy food advertising effects on children’s healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), which are in line with outcomes from Studies 1 (see chapter 2, section 2.4) and 2 (see chapter 3, section 3.4), it was not expected that healthy food advertising exposure would increase children’s healthy food intake in Study 3, and there will be no formal hypothesis attached to this condition.

Given the ineffectiveness of healthy food advertising to increase children’s healthy food intake, an advertising clip discouraging the consumption of HSSF foods and drinks was included to assess another potential approach of improving children’s eating behaviour using television-style advertising. Avoidance appeals that frame health messages around cessation have been applied to social marketing campaigns targeting other health behaviours such as smoking, sexual health, road safety and drunk driving or illicit drug use (Kubacki, Rundle-thiele, Lahtinen & Parkinson, 2015). However, Bradley et al. (2020) tested the impact of the ‘Sugar Smart’ health marketing campaign and found that although the campaign raised awareness and initially reduced sugar intake, reductions in sugar intake were not maintained, and this may be due to the use of avoidance versus approach motivational messages (Elliot, 2013). According to Elliot (2013) desire to pursue, acquire or gain objects or outcomes are based on approach motives, whereas desire to circumvent certain outcomes or states refers to avoidance motivation. Social marketing research suggests that gain messages (e.g., ‘eat vegetables’) are more effective than loss messages (e.g., ‘don’t eat sweets’) (Carrero & Redondo, 2019; Scholer, Cornwell & Higgins, 2019). The effectiveness of gain over loss messages may be because approach motivation to carry out a behaviour is rewarded with pleasurable endorphin release, whereas avoidance motivation to abstain from an action is linked to a stress response about potential risks (Elliot, 2008). In Study 3, approach motivation was used in the healthy food advertisement, the HSSF food advertisement and the toy control advertisement and avoidance motivation that was used in the anti-HSSF advertisement.

Since there are no published studies directly testing the effects of television-style advertising discouraging the intake of HSSF food and drink consumption on children’s eating, it may be the case that, firstly, the anti-HSSF food advertisement might reduce HSSF intake, because the negative message may discourage the intake of HSSF foods (Kubacki et al., 2015). It is also possible that, secondly, the anti-HSSF food advertisement might increase the desire for HSSF food, because children are reminded about those palatable foods, and food cue reactivity has been shown to be particularly pronounced for HSSF foods, leading to increased desire to eat and eating (Folkvord et al., 2016). As social marketing research suggests that gain messages (e.g., ‘eat vegetables’) are more effective than loss messages (e.g., ‘don’t eat sweets’) (Carrero & Redondo, 2019; Scholer, Cornwell & Higgins, 2019), it may also be that, thirdly, exposure to anti-HSSF food advertising might not have any effect on children’s eating. Given the lack of previous research testing television-style anti-HSSF food advertising on children’s food intake, no hypotheses were made regarding the anti-HSSF food advertisement in Study 3.

## Participants

Out of the 40 children that were registered with the participating nursery at the time of the study, an opportunity sample of 34 children (85%), 15 boys and 19 girls, between the ages of 3 and 6 years (mean age = 4.64 years), were recruited from one nursery in Frankfurt/Germany. The nursery was in a rural part of Frankfurt/Germany and organized in small groups of approximately 12 children per group, with a total of 65 children in the nursery. Study 3 used the same recruitment strategy and materials as Study 2. Study 3 was approved by the ethics committee of the University of Sheffield Psychology Department. Ethics followed the same procedures as Study 2 outlined in Chapter 3, Section 3.2.

## Method

Study 3 followed the same research schedule as Study 2 (see chapter 3, table 3.1). In light of the lack of longitudinal studies assessing children’s food intake in response to food advertising over time (see chapter 1, section 1.8), Study 3 was intended as a longitudinal study conducted over a period of seventeen weeks, including one week baseline, eight weeks of intervention and a follow-up two months later, between January and May 2018. As in Study 2, food intake measurement points in Study 3 included baseline (T0), start-point (T1), mid-point (T2), end-point (T3) and follow-up (T4). As in Study 2, screenings and food intake measurements were kept to the same time each week. A quantitative research design with four conditions was employed to investigate the effects of digital food advertising on children’s food intake. In line with procedures in Study 2, individual randomisation was used to allocate children to conditions by tossing a coin (Gelman & Nolan, 2002) (see chapter 3, section 3.3). There were nine children in Condition 1 (healthy food advertising), eight children in Condition 2 (anti-HSSF food advertising), nine children in Condition 3 (HSSF food advertising) and eight children in Condition 4 (toy advertisement, i.e., the non-food control condition). The independent variable was the type of advertisement embedded in the children’s programme that children viewed. Outcome variables were food intake in calories and items at a 16-item-buffet measured through observation using a monitoring sheet and photography. Outcome variables were ‘total calories’ (calories derived from healthy + HSSF food/drink options), ‘healthy calories’ (calories derived from healthy food/drink options), HSSF calories (calories derived from HSSF food/drink options), ‘balance calories’ (healthy – HSSF calories), ‘total items’ (healthy + HSSF food/drink options), ‘healthy items’, ‘HSSF items’, ‘balance items’ (healthy – HSSF items). In line with Bonferroni corrections, the significance level was moved from .05 to .002 to account for multiple comparisons (.05 divided by eight outcome variables multiplied by four groups).

In addition to the healthy food advertising clip and the toy control advertisement clip in Study 2, Study 3 included an anti-HSSF food advertising clip (see figure 4.1) and a HSSF food advertising clip (see figure 4.2).

A person and a child sitting at a table with food

Description automatically generated with low confidence

Figure 4.1 Still from the anti-HSSF food advertising clip

A group of kids sitting at a table with food

Description automatically generated with medium confidence

Figure 4.2 Still from the HSSF advertising clip

Like the advertisements in Study 2, the additional advertising clips used in Study 3 were one minute long, used the same setting, actors, story, special effects and logo, and also employed background music and voice-overs. The advertising clips were embedded at the beginning, middle and end of the same children’s programme (‘Shaun the Sheep’) as the advertising clips in Study 2. The anti-HSSF food advertising clip aimed to discourage HSSF snack intake by showing children tasting, but disliking HSSF foods and drinks. Children in the anti-HSSF food advertising clip were shown trying HSSF snacks, but then children wrinkled their noses, pulled faces and tossed HSSF snacks away to indicate that they did not like them. The background music and voice-overs used in the anti-HSSF food advertising clip underscored children’s dislike of the available foods. The HSSF food advertising clip aimed to encourage children to eat HSSF snacks by employing the same food advertising techniques used in the advertising clips for Study 2. Those included peer and parent models, appealing presentation of foods and drinks, uplifting music, a playful atmosphere and themes of magic, fantasy and fun. The advertising clips are available to view at: https://tinyurl.com/kids-media-and-eating.

Study 3 used the same eating opportunity and food intake measurements as Study 2. ‘Healthy’ options included apples, oranges, cherry tomatoes, carrots, cucumbers, peppers, brown bread and still water. HSSF options included Haribo sweets, chocolate pieces, pretzel snacks, butter biscuits, Pringle’s potato crisps, Hoop crisps, white bread and sugary orange lemonade. Food and drink options were presented in the same way as in Study 2 (see chapter 3, section 3.3). The procedures for Study 3 were the same as for Study 2 (see chapter 3, section 3.3).

## Analysis and results

G\*Power calculations (Faul, Erdfelder, Lang & Buchner, 2007) with a conservative effect size (f = 0.10), error probability of 0.05 and power of 0.80 indicated that 180 participants were required to detect significant differences in intake between the four groups across the five time-points. The study was therefore underpowered with only 34 children, which undermines the ability to draw firm conclusions from the results from Study 3. Another issue that warrants caution when interpreting outcomes from Study 3 is that not all children who were included in the analysis were present at baseline or at all measurement points thereafter. Of the total number of children recorded (*N* = 34), only 29 children were present at baseline (T0), 31 were present at start-point (T1), 16 were present at mid-point (T2), 28 were present at end-point (T3) and 25 were present at follow up (T4). Table 4.1 displays participant numbers for each time-point (T0 – T4) for control and experimental condition. Children who did not participate at baseline were still able to participate in other experiment and were included in measurements and analysis. Drop-out was due to children’s non-attendance at the nursery at test days. Missing data from children being absent from some measurement points throughout the 17-week-period posed challenges for the analyses of the data and outcomes should be treated with caution due to the insufficient sample size overall and even smaller sample size in each condition in addition to the variability in children’s attendance at the measurement points (T0 – T4).

Analysis strategy included descriptive statistics (see table 4.1), data distribution checks and inferential statistics, which were non-parametric Kruskal-Wallis tests to assess differences between the conditions at each measurement-point (T0 – T4) via delta (T0-T1; T0-T2; T0‑T3; T0-T4) for each of the outcome variables (‘total calories’, ‘healthy calories’, ‘HSSF calories’, ‘total items’, ‘healthy items’, ‘HSSF items’) and Friedman’s tests to assess between-condition differences. The significance level was set at *p* < .05.

Descriptive statistics are reported in Table 4.1 which shows means and standard deviations for all conditions (C1 = healthy food advertising; C2 = anti-HSSF food advertising; C3 = HSSF food advertising; C4 = control toy advertising) on all outcome variables. Outcome variables were ‘total calories’ (calories derived from healthy and HSSF food/drink options), ‘healthy calories’ (calories derived from healthy food/drink options), HSSF calories (calories derived from HSSF food/drink options), ‘balance calories’ (healthy calories subtracted from HSSF calories), ‘total items’ (healthy and HSSF food/drink options), ‘healthy items’, ‘HSSF items’and ‘balance items’ (healthy items subtracted from HSSF items) for all time-points. Time-points were baseline (T0), start-point (T1), mid-point (T2), end-point (T3) and follow-up (T4). As outlined in Section 4.3, the ‘healthy’ options included vegetables, fruits, whole grain bread and water, and the HSSF options included sweet and savoury snacks that were high in sugar, salt and fat such as sweets, crisps and lemonade.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcome variable | Condition 1 | Condition 2 | Condition 3 | Condition 4 |
| *n* T0 = 29 | 8 | 6 | 7 | 8 |
| *n* T1 = 31 | 9 | 6 | 8 | 8 |
| *n* T2 = 16 | 6 | 5 | 0 | 5 |
| *n* T3 = 28 | 9 | 7 | 6 | 6 |
| *n* T4 = 25 | 6 | 4 | 7 | 8 |

|  | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Total kcal T0 | 150.2 | 89.3 | 52.1 | 42.6 | 105.6 | 56.4 | 137.1 | 69.4 |
| Healthy kcal T0 | 17.5 | 27.1 | 2.3 | 3.2 | 7.1 | 15.7 | 9.7 | 18.2 |
| HSSF kcal T0 | 132.6 | 79.2 | 49.8 | 43.1 | 98.5 | 54.2 | 127.3 | 75.2 |
| Balance kcal T0 | -155.1 | 77.8 | -47.5 | 43.9 | 91.4 | 56.4 | -177.6 | 84.6 |
| Total items T0 | 13.0 | 9.6 | 5.5 | 3.5 | 10.6 | 4.3 | 12.0 | 4.6 |
| Healthy items T0 | 3.0 | 3.9 | 1.3 | 2.0 | 1.6 | 1.3 | 2.1 | 2.3 |
| HSSF items T0 | 10.0 | 7.2 | 4.2 | 2.7 | 9.0 | 4.6 | 9.9 | 5.4 |
| Balance items T0 | -7.0 | 6.4 | -2.8 | 3.3 | -7.4 | 5.3 | -7.8 | 6.9 |
| Total kcal T1 | 108.9 | 48.8 | 168.0 | 104.1 | 160.4 | 86.1 | 161.4 | 64.4 |
| Healthy kcal T1 | 13.4 | 23.2 | 4.3 | 4.8 | 1.0 | 2.8 | 10.8 | 22.8 |
| HSSF kcal T1 | 95.5 | 29.1 | 163.7 | 104.3 | 159.4 | 86.6 | 150.6 | 56.9 |
| Balance kcal T1 | -82.1 | 19.9 | -159.3 | 104.7 | -158.4 | 87.3 | -139.8 | 57.9 |
| Total items T1 | 9.8 | 5.3 | 15.3 | 8.9 | 15.6 | 12.0 | 16.5 | 6.9 |
| Healthy items T1 | 1.9 | 2.4 | 1.5 | 1.2 | .4 | .5 | 1.6 | 2.5 |
| HSSF items T1 | 7.9 | 3.7 | 13.8 | 8.2 | 15.3 | 12.1 | 14.9 | 7.8 |
| Balance items T1 | -6.0 | 3.4 | -12.3 | 7.6 | -14.9 | 12.2 | -13.3 | 9.3 |
| Total kcal T2 | 113.2 | 50.2 | 88.1 | 16.4 | N/A | N/A | 129.8 | 76.7 |
| Healthy kcal T2 | 0 | 0 | 2.6 | 3.7 | N/A | N/A | 16.0 | 21.8 |
| HSSF kcal T2 | 113.2 | 50.2 | 85.5 | 18.3 | N/A | N/A | 113.8 | 55.7 |
| Balance kcal T2 | -113.2 | 50.2 | -82.8 | 20.6 | N/A | N/A | -97.7 | 35.6 |
| Total items T2 | 11.3 | 6.3 | 9.0 | 4.0 | N/A | N/A | 13.0 | 3.5 |
| Healthy items T2 | 0.3 | .5 | 1.0 | .7 | N/A | N/A | 2.8 | 1.9 |
| HSSF items T2 | 11.0 | 6.2 | 8.0 | 4.1 | N/A | N/A | 10.2 | 2.1 |
| Balance items T2 | -10.7 | 6.5 | -7.0 | 4.2 | N/A | N/A | -7.4 | 2.1 |
| Total kcal T3 | 178.3 | 81.2 | 186.2 | 96.7 | 132.4 | 38.4 | 239.6 | 110.3 |
| Healthy kcal T3 | 11.7 | 15.3 | 2.9 | 5.1 | 6.3 | 8.7 | 17.0 | 23.0 |
| HSSF kcal T3 | 166.61 | 78.52 | 183.29 | 98.17 | 126.14 | 43.30 | 222.57 | 104.20 |
| Balance kcal T3 | -154.96 | 78.75 | -180.38 | 99.91 | -199.83 | 49.30 | -205.55 | 102.96 |
| Total items T3 | 20.72 | 15.95 | 20.29 | 12.28 | 15.00 | 5.14 | 21.83 | 9.56 |
| Healthy items T3 | 1.78 | 1.99 | 1.14 | 1.07 | 3.83 | 3.66 | 2.17 | 2.40 |
| HSSF items T3 | 18.94 | 16.39 | 19.14 | 12.63 | 11.17 | 4.17 | 19.67 | 10.07 |
| Balance items T3 | -17.17 | 17.06 | -18.00 | 13.05 | -7.33 | 5.92 | -17.50 | 11.10 |
| Total kcal T4 | 202.22 | 40.46 | 107.41 | 48.06 | 166.29 | 64.41 | 180.61 | 69.21 |
| Healthy kcal T4 | 25.12 | 22.15 | 4.36 | 7.73 | 3.94 | 6.87 | 20.51 | 16.95 |
| HSSF kcal T4 | 177.10 | 41.82 | 103.05 | 41.48 | 162.35 | 62.22 | 160.10 | 62.78 |
| Balance kcal T4 | -151.98 | 53.82 | -98.69 | 35.36 | -158.42 | 60.73 | -139.59 | 60.56 |
| Total items T4 | 23.17 | 11.32 | 11.50 | 6.35 | 17.29 | 12.30 | 20 | 7.98 |
| Healthy items T4 | 3.17 | 2.23 | 1.25 | .96 | 1.00 | 1.15 | 2.63 | 1.69 |
| HSSF items T4 | 20 | 11.78 | 10.25 | 5.85 | 16.29 | 11.67 | 17.38 | 8.02 |
| Balance items T4 | -16.83 | 12.62 | -9 | 5.48 | -15.29 | 11.13 | -14.75 | 8.40 |

Table 4.1 Participant numbers (*n*), means (*M*) and standard deviations (*SD*) for all outcome variables at all time points (T0, T1, T2, T3, T4)

Inferential statistics on the outcome variables (see section 4.3) were performed. Histograms suggested that assumptions of normality were not met, hence, non-parametric tests were applied. The significance level was moved from .05 to .002 to account for multiple comparisons (.05 divided by eight outcome variables multiplied by four groups). Non-parametric Kruskal-Wallis tests were applied to assess differences between the conditions at each measurement-point (T0 – T4) via delta (T0-T1; T0-T2; T0-T3; T0-T4) for each of the outcome variables (‘total calories’, ‘healthy calories’, ‘HSSF calories’, ‘total items’, ‘healthy items’, ‘HSSF items’). For Condition 3, no analysis was possible at T2 due to missing participants (see table 4.1). As shown in table 4.3, none of the comparisons were significant. Results from Study 3 should be treated with caution given the relatively small sample size and variability in children’s attendance from T0 to T4.

| Outcome variable | Kruskal-Wallis | Delta (mean difference) | | | |
| --- | --- | --- | --- | --- | --- |
|  |  | T0 – T1 | T0 – T2 | T0 – T3 | T0 – T4 |
| *n* |  | 26 | 15 | 23 | 22 |
| Total calories (kcal) | *H* | 7.23 | 3.50 | 2.37 | 1.36 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .07 | .17 | .50 | .71 |
| Healthy calories (kcal) | *H* | 2.51 | 5.29 | 1.06 | 1.34 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .47 | .07 | .79 | .72 |
| HSSF calories (kcal) | *H* | 7.60 | 3.42 | 2.64 | 2.19 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .06 | .18 | .45 | .53 |
| Total items | *H* | 7.06 | 3.22 | .87 | 1.68 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .07 | .20 | .83 | .64 |
| Healthy items | *H* | 1.39 | 3.55 | 2.20 | .37 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .71 | .17 | .53 | .95 |
| HSSF items | *H* | 6.87 | 3.91 | 1.99 | 1.79 |
| *df* | 3 | 2 | 3 | 3 |
| *p* | .08 | .14 | .58 | .62 |

Table 4.2 Participant numbers (*n*), H-value (*H*), degrees of freedom (*df*) and *p*-value (*p*) for non-parametric Kruskal-Wallis *H* test outcomes

Non-parametric Friedman’s tests for within-group comparisons were not possible for Conditions 2 and 3 due to small sample sizes. In Condition 1 (healthy food advertising) and in Condition 4 (control) non-parametric Friedman’s tests were used to test for within-group differences on the outcome variables (‘total calories’, ‘healthy calories’, ‘HSSF calories’, ‘balance healthy-HSSF calories’, ‘total items’, ‘healthy items’, ‘HSSF items’and ‘balance healthy – HSSF items’) to assess within-group differences across time (T0-T4). After applying the adjusted *p*-value of .002 (originally .05) to account for multiple comparisons, there were no within-condition differences across time on any of the outcome variables in Condition 1 (see table 4.3) or Condition 4 (see table 4.4). Results from Study 3 should be treated with caution given the relatively small sample size and variability in children’s attendance from T0 to T4.

| Outcome variable | *n* | χ2 | *df* | *p* |
| --- | --- | --- | --- | --- |
| Total calories | 4 | 9.00 | 4 | .06 |
| Healthy calories | 4 | 6.36 | 4 | .17 |
| HSSF calories | 4 | 7.00 | 4 | .14 |
| Balance calories | 4 | 8.00 | 4 | .09 |
| Total items | 4 | 12.05 | 4 | .02 |
| Healthy items | 4 | 6.55 | 4 | .16 |
| HSSF items | 4 | 11.29 | 4 | .02 |
| Balance items | 4 | 11.13 | 4 | .03 |

Table 4.3 Friedman’s tests Condition 1 (healthy food advertising) with participant numbers (*n*), Chi-square value (χ2), degrees of freedom (*df*) and asymptotic significance (*p*-value)

| Outcome variable | *n* | χ2 | *df* | *p* |
| --- | --- | --- | --- | --- |
| Total calories | 4 | 3.00 | 4 | .56 |
| Healthy calories | 4 | 4.62 | 4 | .33 |
| HSSF calories | 4 | 3.00 | 4 | .56 |
| Balance calories | 4 | 1.40 | 4 | .84 |
| Total items | 4 | 2.18 | 4 | .70 |
| Healthy items | 4 | 1.54 | 4 | .82 |
| HSSF items | 4 | 3.07 | 4 | .55 |
| Balance items | 4 | 1.13 | 4 | .89 |

Table 4.4 Friedman’s tests Condition 4 (control) with participant numbers (*n*), Chi-square value (χ2), degrees of freedom (*df*) and asymptotic significance (*p*-value)

## Discussion

Study 3 was a nursery-based, longitudinal design exposing four groups of children to either healthy food advertising (Condition 1), anti-HSSF food advertising (Condition 2), HSSF food advertising (Condition 3) or control (toy) advertising (Condition 4) once a week for an intervention period of eight weeks, plus one week pre-intervention baseline measures and a follow-up eight weeks after the intervention period. Children’s intake of a selection of 16 snacks, including eight healthy and eight HSSF options, was measured in items and energy (kcal) at a buffet before (T0), during (T1, T2, T3) and after the intervention (T4).

Study 3 found no changes in children’s food intake within or between the four conditions over time. The hypothesis predicting that children who viewed HSSF food advertising would increase their HSSF intake compared to children in the toy advertising control condition (between-group comparison) was rejected.

Study 3 was compromised by a number of weaknesses, and any interpretation of findings and comparisons to previous research is limited to a very cautious discussion: (1) Study 3 was underpowered given the small sample size of 34 children compared to the required sample size of 180 children for four conditions according to G\*Power analysis; (2) Due to small sample sizes in each of the four study groups and missing data from children being absent from various measurement points throughout the 17-weeks study period, statistical analysis of Condition 3 (HSSF food advertising) was not possible for within-group comparisons (see table 4.1). Attrition and non-participation have been cited by previous longitudinal studies with child participants as a significant research obstacle, with some researchers citing attrition rates of up to 56.4% (McQuaid, Barton & Campbell, 2003); (3) The advertisements in Study 3 were produced for the purpose of this research thesis. Although the advertisements were produced by professional filmmakers and editors in line with commercial advertising techniques (see chapter 2, section 2.3.1 and 2.3.2), it may be that they were still not sufficiently persuasive or able to compete with naturalistic commercial advertising; (4) The advertisements were embedded into a popular children’s programme to create a realistic viewing experience, but the experiments may still have created an artificial situation in which children did not display their typical eating behaviour; (5) Although the eating opportunity in Study 3 was designed in line with children’s typical breakfast routine and aimed to mirror the nursery routine as closely as possible, the lack of refill opportunity may have contributed to the lack of children’s food intake despite food advertising exposure. Children in Study 3 may have wished to eat more but did not have the opportunity to do so and (6) Although care was taken to let children select foods at the buffet individually, the study was conducted in groups, and children did eat in groups, and this may have influenced children’s food intake (Bublitz, Peracchino & Block, 2010). Social facilitation suggests that people tend to eat more in groups compared to when they are alone, especially when the social experience of eating in groups enhances enjoyment (Bublitz et al., 2010; Ruddock, Brunstrom, Vartanian & Higgs, 2019). In a study with adult participants, Hetherington, Anderson, Norton and Newton (2006) tested energy intake when eating alone, when eating with others (friends or strangers) and when eating in front of the television. Participants ate more in the presence of familiar others and when watching television compared to eating alone, which may have been explained in terms of distraction from satiety signals. Since eating with strangers also drew attention away from the food, but did not result in increased energy intake, Hetherington et al. (2006) suggested that social facilitation effects can only in part be explained through distraction from self-monitoring. Enhanced enjoyment, impression management and modelling may influence eating behaviour in the presence of others (Tice, Butler, Muraven & Stillwell, 1995). Due to these limitations, especially the fact that Study 3 was underpowered, it is not possible to draw any firm conclusions from Study 3, and the following interpretation of findings and comparisons to previous research is limited to a very cautious discussion.

Although the results should be treated with caution, findings from Study 3 which show that children did not increase their HSSF food or drink intake despite HSSF food advertising exposure are in line with a small number of previous studies that also reported no increases in children’s HSSF snack intake despite HSSF food advertising exposure (Gorn & Goldberg, 1980; Lorenzoni et al., 2017). In Gorn and Goldberg (1980) the lack of ice cream intake following ice cream advertising exposure was explained by overwhelming levels of advertising exposure (see chapter 1, section 1.8). In Lorenzoni et al. (2017) issues with the study procedures may have biased children towards minimal chocolate intake (see chapter 1, section 1.8). However, most previous research studies on television-style HSSF food advertising reported HSSF food advertising to increase HSSF intake in children (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979), but Study 3 did not find evidence to support these findings. The lack of HSSF snack intake in response to HSSF food advertising in Study 3 may have been due to insufficiently persuasive advertisements, an artificial viewing and eating situation that may have undermined children’s food intake or the insufficient sample size. Any changes in children’s eating behaviour that could have been attributed to advertising exposure may have been lost given the relatively small sample size.

In Study 3, children who viewed healthy food advertising did not increase their healthy food intake. Although the results should be treated with caution, the lack of healthy food intake in response to television-style healthy food advertising exposure that was found in Study 3 is in line with outcomes from Study 1 (see chapter 2, section 2.4), Study 2 (see chapter 3, section 3.4) and previous research on television-style healthy food advertising and children’s healthy food intake in which similar eating opportunities to Study 3, i.e., unlimited access to a selection of healthy and HSSF snacks were employed (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8). The lack of healthy food intake despite healthy food advertising (Condition 1) may relate to children’s inherent preference for HSSF snacks (see chapter 1, section 1.6), a preference that has been put forward as a major obstacle to media-based healthy food promotion to children (Dovey et al., 2011). However, no definite conclusions can be drawn from Study 3 given the limitations outlined above, especially insufficient sample size.

In addition to healthy food advertising and HSSF food advertising, Study 3 tested the effectiveness of an anti-HSSF food advertisement that aimed to discourage children’s HSSF food intake. Advertising clips aiming to discourage the consumption of HSSF snacks have not been empirically tested before. The purpose of including an advertising clip aiming to discourage the consumption of HSSF snacks was to explore whether (1) children would listen to and comply with the marketing message to avoid HSSF products, (2) whether, in line with food cue reactivity (Folkvord et al., 2016) children would increase their HSSF snack consumption simply due to the visual HSSF cues in the advertisement regardless of the negative message about HSSF products or (3) whether anti-HSSF food advertising would have no effect on children’s food intake, because social marketing research has suggested that loss messages and avoidance motives are less effective than gain messages and approach motives (Carrero et al., 2019; Scholer et al., 2019).

Considering the lack of relevant previous research studies, no predictions were made regarding the effects of anti-HSSF food advertising on children’s food intake in Study 3. Study 3 found that children’s food intake in response to anti-HSSF food advertising (Condition 2) did not differ from children’s food intake in the control condition (Condition 4). Due to small sample sizes in each of the four study groups in Study 3 and missing data, because children were absent at some measurement points (see table 4.1), statistical analysis of Condition 2 (anti-HSSF food advertising) was not possible for within-group comparisons at T2, hence, any interpretation of findings and comparisons to previous research is limited to a very cautious discussion.

Although Study 3 was not sufficiently powered to draw any firm conclusions, the outcomes from Study 3 regarding the effects of anti-HSSF advertising may still indicate that food advertising employing an avoidance approach did not affect children’s food intake, which is in line with previous social marketing research demonstrating the effectiveness of gain over loss messages. In contrast to typical social marketing campaigns that may frame promotional messages around health risks (Kubacki et al., 2015), the anti-HSSF food advertisement in Study 3 did not refer to the potential health risks of HSSF intake. The anti-HSSF food advertisement in Study 3 employed the same advertising techniques as the healthy food advertising clip, the HSSF food advertising clip and the toy advertising clip (see chapter 2, sections 2.3.1 and 2.3.2) which focused on peer and parent role models and highlighting sensory features over health messages (since the latter have been shown to be largely ineffective or counterproductive with children; see chapter 1, section 1.4). The anti-HSSF food advertisement targeted avoidance motives via voice-overs that commented on HSSF products being ‘yucky’ or ‘not tasty’, and actors modelled not enjoying eating them. It may be that the negative reactions modelled in the anti-HSSF food advertisement in Study 3 were not in line with children’s own experiences of eating sweets, and children therefore did not reduce their HSSF intake at the buffet. Sufficiently powered and properly randomised controlled trials may wish to further explore the effects of avoidance versus approach messages in television-style food advertising on children’s food intake.

Despite the aforementioned limitations, Study 3 entailed several strengths. Study 3 addressed some of the methodological issues in previous studies such as the use of recorded advertisements (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), unequal numbers of healthy versus HSSF food advertisements during the viewing phase (Dovey et al., 2011), unequal numbers of healthy versus HSSF food options at the eating opportunity (Dovey et al., 2011) and calories as the sole unit of comparing children’s food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). Study 3 is a novel contribution to the existing evidence base on television-style food advertising and children’s food intake in a number of ways. First, Study 3 employed a longitudinal design, tracking children’s food intake in response to television-style food advertising over a period of seventeen weeks including four measurement points. Previous research on television-style food advertising exposure and children’s food intake has been limited to cross-sectional (Anschutz et al., 2009, 2010; Boyland et al., 2013; Fox., 1980; Gilbert-Diamond et al., 2017; Harris et al., 2009; Lemnitzer et al., 1979; Lorenzoni et al., 2017) and repeated measures (Dovey et al., 2011; Halford et al., 2008, 2007, 2004) designs. Research highlights a dose response relationship between food advertising exposure and children’s health (Veerman et al., 2009) by comparing heavy versus light television viewers (Dixon et al., 2007), but more longitudinal studies are needed to better understand the accumulative effects of food advertising on children’s food intake over time. Second, Study 3 employed four television-style advertising clips that were specifically designed and matched across conditions to avoid previous exposure effects and differences in advertising techniques, including a healthy food advertisement and an anti-HSSF advertisement, both of which are unique contributions to the research field that has predominantly assessed the effects of recorded HSSF food advertising (Anschutz et al., 2009; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017) on children’s HSSF intake (Anschutz et al., 2009, 2010; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Harris et al., 2009; Lorenzoni et al., 2017). Third, Study 3 was an opportunity to measure children’s food intake following food advertising exposure when healthy and HSSF options were available, which has previously been tested in only four studies, none of which provided contemporary evidence (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). Fourth, Study 3 was conducted in a novel research setting, i.e., a nursery. Compared to previous research conducted in laboratories (Fox, 1980; Gilbert-Diamond et al., 2017, Kaser-Boyd, 1978), schools (Boyland et al., 2013; Dovey et al., 2011; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017) and camps (Gorn & Goldberg, 1980; Harris et al., 2009), Study 3 was carried out in a relatively naturalistic manner in line with children’s typical food environment and eating routines in the nursery.

Outcomes from Study 3 suggest that television-style food advertising was not effective at altering children’s food intake. However, any changes in children’s eating behaviour that could have been attributed to advertising exposure may have been lost given the relatively small sample size. The conclusions that can be drawn from Study 3 about the potential of television-style food advertising to improve children’s diets are therefore limited by the weaknesses entailed in this study and further research is needed. Future studies may wish to employ a larger sample to achieve sufficient power and to overcome statistical issues relating to missing data.

To address power and avoid issues relating to children’s irregular attendance in Study 3, Study 4 (see chapter 5) employed a larger sample size, reduced conditions from four to two and reduced the research period from seventeen weeks to a pre-/post-intervention design to increase. Given the focus of previous research on HSSF food advertising and children’s HSSF snack intake, Study 4 focused on children’s healthy food intake in response to healthy food advertising. The eating opportunity was reduced from a 16-item buffet with healthy and HSSF foods and drinks in Study 3 to an exclusively healthy buffet with seven food options. In contrast to Study 3, children in Study 4 were allowed to return to the buffet for refills. Observation was the sole method of food intake measurement in Study 4 to reduce hesitation to participate by nurseries and parents and to expedite study procedures. In Study 4, it was hypothesised that children who viewed healthy food advertising would increase their healthy food intake.

# Study 4

## Introduction

The impact of HSSF advertising on children’s food preferences, purchase requests, purchase intentions, purchase behaviours and consumption behaviour is well documented (Boyland et al., 2016; Cairns et al., 2013; Folkvord et al., 2016; Russel et al., 2019; Smith et al., 2019). In contrast, the effects of healthy food advertising on children’s eating, and children’s healthy food intake in particular, present as a largely under-researched area of inquiry with relatively few published studies (Boyland & Whalen, 2015; Boyland et al., 2016; Cairns et al., 2013; WHO, 2006; Young, 2003).

The aim of Study 4 was to compare the effects of two specifically-designed, television-style advertisements on nursery children’s food intake at a 7-item buffet with exclusively healthy food options in five nurseries in Frankfurt and Offenbach/Germany using a pre-post-intervention design. Study 4 incorporated learning outcomes from Study 3 (see chapter 4, section 4.5). Study 4 was conducted as a pre-intervention/post-intervention design over two weeks to overcome statistical issues related to missing data from children being absent over the study duration of seventeen weeks in Study 3. The sample size in Study 4 was increased from 34 children in Study 3 to 172 children in Study 4. In contrast to random allocation of individual children to conditions in Study 3, Study 4 employed cluster allocation of nursery groups to meet the scheduling and safeguarding requirements of the nurseries. Study 4 focused on the effects of healthy food advertising compared to control advertising that had previously been used in Studies 1 and 2, whereas Study 3 included four advertisements (see chapter 4, section 4.3). For Study 4, the eating opportunity was reduced from sixteen buffet options (eight healthy and eight HSSF food options, including fourteen food options and two drink options) to seven healthy food options, which were vegetables, fruit and whole grain, to assess the effects of healthy food versus control advertising on children’s healthy food intake.

The available studies on children’s healthy eating in response to healthy food cues in television-style food advertising (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), narrative media (Binder et al., 2019; Gonçalves et al., 2018; Horne et al., 2004, 2009, 2011; Naderer et al., 2018; Lowe et al., 2004) and digital games (Folkvord et al., 2012; Harris et al., 2012; Pempek & Calvert, 2009) suggest that regardless of the digital media type in which food cues are embedded, instilling healthy food choices in children is challenging – particularly when healthy and HSSF option are available (Binder et al., 2019; Dovey et al., 2011; Folkvord et al., 2012; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979; Naderer et al., 2018).

Although narrative media approaches differ from overt and explicit television advertising, narrative media studies can help to gain a better understanding of children’s healthy eating in response to healthy food cues in digital media (see chapter 1, section 1.5). As outlined in Chapter 4, Section 4.1, amongst the narrative media studies (Binder et al., 2019; Gonçalves et al., 2018; Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Naderer et al., 2018; Upton et al., 2011), healthy food cues increased children’s healthy food intake in studies that offered healthy foods only (Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Upton et al., 2011) and in studies that offered unlimited amounts of healthy and HSSF foods (Gonçalves et al., 2018). In narrative media studies that required children to decide between healthy and HSSF options, children picked candy over fruit (Binder et al., 2019; Naderer et al., 2018). Healthy food cues in narrative media did not reduce children’s intake of HSSF options (Gonçalves et al., 2018). Narrative media studies highlight the importance of food availability and choice architecture in influencing children’s food intake using digital food cues.

In television-style food advertising studies (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), healthy food advertising exposure did not lead to any increases in children’s healthy food intake. However, as discussed in Chapter 1, Section 1.8, the evidence base on television-style advertising for healthy foods and children’s healthy food intake is limited to four studies (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), which were compromised by methodological issues discussed in Chapter 1, Sections 1.8.3, 1.8.4 and 1.8.5. In all of the available television-style food advertising studies that included healthy food advertisements, children’s *ad libitum* intake of a selection of healthy and HSSF snacks was measured, so that the lack of healthy food intake despite healthy food advertising exposure may be attributed to the design of the eating opportunity.

Due to neurophysiological mechanisms, children may prioritise the intake of HSSF over healthy snacks when both options are available (Cohen, 2008). Investigations of healthy and unhealthy food promotion may then benefit from separate analysis, since they are likely to correspond with different cognitive responses and possibly target inherently-different behaviours (Dovey et al., 2011). To date, no studies have been published that tested the effects of television-style healthy food advertising on children’s food intake when only healthy options were available.

As outlined in The Promotion of Healthy Food Model (Folkvord, 2020) (see chapter 1, section 1.7), digital media and food advertising can help to increase children’s familiarity, liking and consumption of healthy foods via healthy food cues and positive role models (see chapter 1, section 1.2). Consequently, children should be presented with more healthy food cues rather than fewer food cues altogether (Strachan & Pavie-Latour, 2008). Kraak et al. (2006, p. 1) argued that ‘food and beverage marketing to children represents, at best, a missed opportunity, and at worst, a direct threat to the health of the next generation’. Rather than reducing food advertising towards children altogether, Cairns et al. (2013) called for ‘rebalancing the food marketing landscape’ (p.1) and suggested that we should change the type of food advertising to which children are exposed.

Study 4 aimed to contribute to the research literature required to inform a ‘rebalancing of the food marketing landscape’ (Cairns et al., 2013, p. 209) by providing a television-style food advertising study with exclusively healthy food cues and healthy food options. Study 4 aimed to overcome several limitations of existing research on food advertisements. First, most studies have measured the effect of television-style food advertising on food preferences, purchase requests or behavioural intentions (Smith et al., 2019) and have not assessed children’s actual food intake. Second, studies that have measured actual food intake have relied on advertisements that were recorded from television rather than advertising stimuli that were designed for research purposes and matched across conditions (see chapter 1, section 1.8.3). Third, the large majority of available studies on television-style food advertising exposure and children’s food intake investigated exclusively HSSF advertising and assessed only HSSF intake (see chapter 1, section 1.8.3). In contrast to narrative media studies that focused on embedded healthy food cues and children’s intake of healthy foods (Horne et al., 2004, 2007, 2009; Lowe et al., 2004; Upton et al., 2011), there are no published studies investigating exclusively television-style, healthy food advertisements and healthy food intake in children. Fourth, despite issues detecting changes to healthy foods with very low caloric intake compared to HSSF products with very high caloric content, changes in food intake were reported in kcal only (see chapter 1, section 1.8.5). Fifth, research locations and settings of studies assessing children’s healthy food intake in response to television-style healthy food advertisements were limited to classrooms in schools, classrooms that were made to look like a living room (‘semi-naturalistic setting’), mobile research laboratories, research laboratories and summer camps, all of which may not reflect children’s naturalistic eating behaviour (see chapter 1, section 1.8.2).

Study 4 aimed to address some of the gaps and limitations of previous research on food advertising and children’s eating by contributing a study on children’s intake of a selection of exclusively healthy foods in response to healthy food versus control advertising exposure. It was hypothesised that children who viewed the healthy food advertisement would increase their intake of healthy food both from pre-intervention (T1) to post-intervention (T2), and that healthy food intake would be greater at T2 compared to children who viewed control advertisements. It was hypothesised that children in the control condition would not change their food intake between T1 and T2.

## Participants and design

A total of 434 children were registered with the five participating nurseries at the time of the study. An opportunity sample of 172 children (39.63%) aged 3 to 7 years (M: 4.72 ± 0.99) was recruited from five nurseries in the neighbouring cities of Frankfurt and Offenbach in Germany. Recruitment procedures and ethics in Study 4 were the same as in Studies 1 - 3.

A 2 (condition: healthy food advertising clip, control) x 2 (time point: pre-exposure, post-exposure) mixed design was used with condition as a between-subjects factor and time point as a within-subjects factor. Cluster randomisation of nursery groups was used to allocate children to condition via toss of a coin (Gelman & Nolan, 2002). The study was carried out on two test days, including one test day for pre-exposure (T1) and one test day for post-exposure (T2) measurements, with a two-day break in between test days. Food intake in items and energy (kcal) were the main outcome measures. Like previous Studies 1, 2 and 3, Study 4 took place in nursery activity rooms, which were large, bright and friendly rooms familiar to the children. Experimental areas included a viewing area, a buffet area and an eating area. The time of day when testing took place was the same across test sites. Study 4 was carried out between 9.30am and 11.30am at T1 and at T2.

## Materials

The advertising stimuli were the same specifically-designed advertising clips used in Studies 1, 2 and 3. To ensure that advertisements were comparable across conditions, the healthy food advertisement and the control advertisement were identical in setting, story, actors, music, lighting, special effects, length and logo. Study 4 included the one-minute healthy food advertisement for the experimental condition and the one-minute toy advertisement for the control condition, embedded at the beginning, middle and end of the same seven-minute children’s programme (‘Shaun the Sheep’) as Studies 1, 2 and 3.

The food buffet included seven healthy food options, which were bite-size, standardised portions (‘items’) of apples, oranges, carrots, cucumbers, peppers, cherry tomatoes and whole grain bread, presented on medium-sized, white plates. Test foods were refilled in between children to ensure consistent available portion sizes for each child. The food options in Study 4 were the same as the healthy food options used in Studies 1, 2 and 3 minus the HSSF options. Each child received a medium-size, white plate to use at the buffet. A clipboard and monitoring sheets with a picture of a table displaying all the food options were used by the researcher to record children’s food selection at the buffet, any leftovers and children’s total food intake. The researcher stood by the side of the buffet and observed children unobtrusively. Children’s food intake was recorded in items and later converted into caloric value using the product information provided by the manufacturer.

## Procedure

Following the same procedure as children in Studies 1, 2 and 3, groups of children were accompanied by familiar nursery teachers to the activity room and sat down in the viewing area. Children were welcomed by the researcher, who introduced herself to the children and explained the procedure. Children were given a summary of the ‘Shaun the Sheep’ episode prior to viewing and were told that there would be advertising breaks at the beginning, middle and end of the episode.

After viewing the programme, the children were told to sit on the benches in front of the buffet. The benches were positioned at a sufficient distance from the queuing children so that children were not able to observe the exact food choices of their peers, while still being able to observe one another at the buffet to ensure all the children followed the procedure the same way. Children were told that they could eat what and how much they wanted, that they could return to the buffet for more and that they did not have to take anything at all. Children were told not to swap or share foods and to leave any food they did not want to eat on their plate.

Children ate their food in the eating area, which consisted of group tables with four to five chairs each for children to sit down together. Drinking water was provided at all tables. Children who had finished eating were asked once if they wanted more and were then allowed to return to their nursery groups to avoid distracting children still eating. Each group was allocated 30 minutes in the eating area. Children were not aware of the time limit, and most of the children finished within the 30 minutes. Children who were still eating after 30 minutes were gently told to finish their plate or leave leftovers and return to their nursery group. Children’s food intake was recorded during the buffet, and leftovers were accounted for after all children had left the room.

## Analysis and results

G\*Power calculations (Faul, Erdfelder, Lang & Buchner, 2007) with a conservative effect size (f = 0.10), error probability of 0.05 and power of 0.80 indicated that 160 participants were required to detect significant differences in intake between groups across the two time-points. Allowing for an estimated 30% attrition rate, the aim was to ideally recruit 208 children. Children’s food intake at pre-intervention (T1) and post-intervention (T2) was calculated as the sum of all foods consumed and analysed as caloric (kcal) and item consumption (measured portions). Histograms and skewness and kurtosis were used to determine whether the data were normally distributed. Values of skewness between − 3 and + 3 and kurtosis in a range from a range of − 10 to + 10 (Brown, 2006) were acceptable to indicate a normal distribution. Based on visual inspection of histograms and assessment of skewness and kurtosis, data were normally distributed, and parametric tests were applied. Data across the five nurseries was merged, as a one-way ANOVA showed that there were no differences between nurseries in item consumption at T1, F(4, 167) = 1.89, p = .11 or caloric consumption at T1, F(4, 167) = 0.37, p = .83. Data are presented as means ± standard deviation, unless specified. Results were considered significant if *p* < 0.05 unless multiple comparisons were conducted (e.g., t-tests exploring significant interactions), in such cases a conservative *p* < .01 was used. Partial eta squared (η2) is reported for effect sizes and interpreted as 0.01 small, 0.06 moderate and 0.14 as large (Field, 2005).

In total, 267 children were recruited at T1, and of those 172 completed both T1 and T2 measures (*M*: 4.72 ± 0.99 years; healthy food advertisement *n* = 103; control *n* = 69). Children’s absence at T2 was due to illness and to other commitments—none of the children declined participation.

A mixed ANOVA for the overall model showed that the main effect of time *F*(1, 170) = 2.17, *p =* .14, *ηp2 =* .01, and the main effect of condition were not significant *F*(1, 170) = 1.81, *p =* .18, *ηp2 =* .01. However, the condition x time interaction was significant, *F*(1,170) = 26.91, *p* < .001, *ηp2 =* .14. Paired t-tests showed that the healthy food advertisement group significantly increased item consumption from T1 (*M*: 6.24 ± 4.41) to T2 (*M*: 9.36 ± 7.12), t(102) = -4.90, *p* < .001, and significantly increased caloric consumption from T1 (*M*: 90.28 ± 72.31) to T2 (*M*: 119.02 ± 81.66), t(102) = -3.33, *p =* .001). The control group significantly decreased item consumption from T1 (*M*: 7.61 ± 6.88) to T2 (*M*: 5.87 ± 4.62), t(68) = 2.73, *p =* .008, but change in calorie consumption was not significant, T1: *M*: 79.66 ± 66.74; T2: *M*: 81.71 ± 58.13, t(68) = -0.23, *p =* .82 (see figures 5.1 and 5.2). Independent t‑tests showed that while at T1 food intake did not significantly differ between groups (item: t(170) = 1.59, *p =* .11; kcal: t(170) = -0.97, *p =* .33), at T2 the healthy food advertising group consumed significantly more (item and kcal) compared to the control group (item: 9.4 ± 7.1 vs. 5.9 ± 4.6, t(170) = -3.60, *p* < .001; kcal: 119 ± 81.7 vs.81.1 ± 58.1, t(170) = -3.28, *p =* .001].

Therefore, the children who viewed healthy food advertisements ate significantly more healthy foods following healthy food advertising exposure than did the children in the control condition who viewed toy advertisements, and these differences were evident for both caloric and for item consumption.

*Chart, box and whisker chart

Description automatically generated*

Figure 5.1 Consumption of items before (T1) and after (T2) exposure to healthy food or control advertisements. Error Bars: 95% CI  
\*\*\**p* < .001

*Chart, box and whisker chart

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Figure 5.2 Caloric consumption before (T1) and after (T2) exposure to healthy food or control advertisements. Error Bars: 95% CI  
\*\*\**p* < .001

## Discussion

Study 4 investigated the effects of healthy food advertisements versus toy advertisements on children’s intake of a selection of healthy foods. Three exposures to a one-minute-advertisement for healthy food were sufficient to increase children’s healthy food intake by as much as three portions, helping children to meet daily recommended amounts of vegetables, fruit or whole grain (NHS, 2020; PHE, 2020). In contrast, children in the control group who were exposed to toy advertising decreased their healthy food intake by approximately two portions. Decreases in children’s healthy food intake in response to control advertising were significant when measured in portions but not in energy (kcal).

Differences in children’s food intake outcomes depending on the measurement units used for analysis have been reported in previous studies. For example, Halford et al. (2007) found that when children’s food intake was measured in energy (kcal) the food item with the greatest intake was chocolate. However, when measured in weight (g) children’s intake was greatest for grapes. Since energy (kcal) entails no information about the nutritional composition of foods such as vitamins, minerals or fibre (Carels, Harper & Konrad, 2006), other researchers have prioritised the use of portions as a unit to measure children’s food intake (Gonçalves, et al., 2018). As predicted, children who viewed advertisements for healthy foods increased the intake of healthy food items.

Findings from Study 4 contradict previous research that found no links between exposure to television-style healthy food advertising and increases in children’s healthy food intake (Dovey et al., 2011; Fox, 1980) (see chapter 1, sections 1.7 and 1.8.3). Dovey et al. (2011) found that exposure to healthy food advertisements only decreased unhealthy food intake but did not affect healthy food intake, and Fox (1980) reported no changes to healthy food intake in response to healthy food advertisements. The difference in outcomes between Study 4 and Dovey et al. (2011) and Fox (1980) may be due to previous research using recorded advertisements for healthy foods that were less appealing or relevant to children. A novel aspect of the Study 4 was that the healthy food advertisements were specifically developed in line with key success factors of commercial marketing (Aschemann-Witzel et al., 2012). Such advertisements may have successfully created a desire for the healthy foods that were offered, especially without the presence of HSSF alternatives. For instance, the healthy food advertisements included the use of peer and adult role models, uplifting music and encouraging voice-overs. As such, the findings from Study 4 align with the first assumption of the Promotion of Healthy Food Model (Folkvord, 2020), which suggests that directing attention toward fruit and vegetables through food promotion may increase their reinforcing value—which is a child’s liking for and wanting the advertised fruit and vegetables.

In Studies 1, 2 and 3, exposure to the healthy food advertisement had no effect on children’s food intake generally or of healthy foods specifically, so that the change from a mixed 16-item buffet to a 7-item healthy food only buffet may have contributed to the increases in children’s healthy food intake that were observed in Study 4. In Study 4, children who did not see the healthy food advertisement, however, decreased their healthy food intake from pre- to post-intervention, which suggests that children’s increased healthy food intake in Study 4 may be explained as a combination of healthy food promotion via television-style food advertising and an exclusively healthy food environment.

In addition to using specifically-designed advertisements, differences between the findings of Study 4 and Dovey et al. (2011) may be explained by methodological variation in the eating opportunity. In contrast to Dovey et al. (2011), where offering more unhealthy than healthy snacks may have accounted for the lack of healthy food intake despite healthy food advertisements, Study 4 offered healthy food options only. The lack of healthy food intake in Fox (1980) might be explained in the same way, namely the use of recorded advertisements and offering healthy as well as unhealthy foods to children. Additionally, Fox (1980) recorded food intake in calories only, which makes it harder to detect changes in healthy food intake compared to unhealthy food intake. In contrast, Study 4 recorded food intake in calories and items.

Contrary to predictions made in Study 4, children’s intake of healthy foods did not remain stable in the control group. When measured in food items, children who viewed toy advertisements and were therefore not encouraged to eat vegetables, fruit and whole grain by digital peers and parents, reduced their healthy food intake. This supports Horne et al. (2009) and Upton et al. (2013), who also offered healthy foods only and found that exposure to narrative media with healthy food cues increased children’s vegetable and fruit intake, while mere availability of vegetables and fruits led to a decline in intake over time (Horne et al., 2009; Upton et al., 2013). The Promotion of Healthy Food Model (Folkvord, 2020) suggests that the consumption of healthy foods is experienced as less physiologically and psychologically rewarding than HSSF food consumption. Therefore, mere availability of healthy foods without advertising aiming to increase their reinforcing value may account for decreases in healthy food intake in the control group. The findings from Study 4 suggest that digital food advertising promoting unbranded healthy foods may be an effective way of increasing children’s vegetables, fruit and whole grain intake in a best-choice environment restricted to such healthy food options. Findings from Study 4 also suggest that mere availability of healthy foods is not sufficient to get children to eat them and that children benefit from encouragement to eat healthily using digital healthy food advertising.

Study 4 entailed a number of limitations. First, Study 4 used a pre-test/post-test design which did not allow for a long-term assessment of children’s food intake in response to food advertising exposure. Instead, Study 4 assessed the acute effects of healthy food advertisements on food intake. As described in the Promotion of Healthy Food Model (Folkvord, 2020), once advertisements successfully establish attention to healthy foods and increase children’s liking and wanting for those products, a reciprocal relationship emerges that leads to normalisation, automatisation and habit formation (Folkvord, 2020). Future research using longitudinal designs is required to assess long-term effects of healthy food advertising exposure on children’s healthy food intake and to assess the remaining assumptions in the Promotion of Healthy Food Model (Folkvord, 2020), relating to the creation of a reciprocal relationship between desire for healthy foods, eating healthy foods and experiencing improvements in health and wellbeing following dietary improvements, which in turn lead to increased eating of healthy foods until this behaviour becomes automatic and habitual. Second, individual and societal factors in individual susceptibility to food marketing are features of the Promotion of Healthy Food Model (Folkvord, 2020), but those were not assessed in Study 4. Future researchers could explore the impact of such factors on the relationship between healthy food advertising exposure and children’s healthy food intake. Third, Study 4 screened the media materials on television screens, and whether these effects generalise to other devices such as smart phones, tablets or laptops is not known. If television ceased to be the main medium to reach children, the video format may be used on other media devices such as tablets and smartphones, through novel channels including television-on-demand, streaming sites and social media. Future research is required to test the effectiveness of video-based healthy food advertisements on a range of different media devices. Fourth, Study 4 assessed the effect of specifically-designed food advertisements, but the specific effect of individual the advertising elements that were used in the advertisements is unknown. Since the advertisements in Study 4 combined a range of different advertising techniques such as mere exposure, positive associations, themes of fun and fantasy, special effects, music, voice-overs and role models, future research is required to elucidate which features are particularly effective to increase children’s healthy food intake. Finally, although food selection at the buffet was individual, Study 4 was conducted in groups and children viewed and ate in groups. Viewing and eating was conducted in groups and children may have influenced one another’s attention levels and eating behaviour (Gonçalves et al., 2018). Although the design of the eating opportunity was selected to reflect children’s typical breakfast setting and routine in the nursery, the design of the food selection and eating area may have influenced children’s food intake and undermined a display of children’s typical eating behaviour.

Since Study 4 did not contain any other food advertisement condition, it may be argued that the mere presence of any food cue rather than the presence of healthy food cues specifically may have caused increases in children’s healthy food intake. Food cue exposure suggests that exposure to food cues triggers desire to eat and, ultimately, increases food consumption (Boyland et al., 2016), but food cue exposure as an alternative explanation for the current findings is unlikely, because neither Studies 1, 2 and 3, nor previous research outcomes on television-style food advertisement exposure and children’s food intake, found any evidence for food cue reactivity in response to healthy food cues. In Halford et al. (2007) exposure to HSSF food cues in television-style advertisements increased children’s intake of all processed foods (high-fat savoury, low-fat savoury, high-fat sweet, low-fat sweet), but not fruit. In Halford et al. (2008) exposure to the same HSSF food advertisements as in Halford et al. (2007) increased intake of all available foods, but most increases were reported for the HSSF options (chocolates, jellies, crisps, snack-a-jacks) and least increases for fruit (grapes).

Findings from Halford et al. (2007, 2008) may suggest that food cue reactivity may not be present for healthy foods or may be less pronounced. Even studies that have exposed children to healthy food cues in television-style advertising have found little to no evidence for increases in healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), suggesting that food cue reactivity in response to healthy food cues is unlikely. In Dovey et al. (2011) healthy food advertisements decreased children’s intake of HSSF options in children with low neophobia levels only, but healthy food advertisements did not increase healthy food intake. In Fox (1980), HSSF food advertisements increased HSSF intake in boys, but healthy food advertisements had no effect on snack intake on either gender. In Kaser-Boyd (1978) and Lemnitzer et al. (1979) HSSF food cues increased HSSF intake, but healthy food advertisements did not lead to healthier eating. Since healthy food cues in previous television-style food advertisements studies did not increase children’s intake of healthy of HSSF options, it is unlikely that increases in children’s healthy food intake in Study 4 were due to food cue reactivity. Rather, the increases in children’s healthy food intake in Study 4 can be attributed to the combined approach of using professional, specifically-designed, television-style healthy food advertisements and limiting children’s food choice to a best-choice situation with healthy food options only. While future studies may investigate and compare the effects of various food advertising conditions for healthy foods as well as HSSF products, explorative studies focusing exclusively on healthy food advertisements and healthy food intake are also needed. A large number of television-style food advertising studies have investigated exclusively HSSF food advertisements and children’s HSSF food intake (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Harris et al., 2009), but studies of television-style healthy food advertisements and children’s healthy food intake are restricted to Study 4.

Since healthy food advertisements in Study 4 increased children’s healthy food intake when only healthy foods were available, future researchers could assess at what point exposure to healthy food advertisements can increase healthy food intake, even when other HSSF options are available, to better equip children in their food abundant environments. Until then, children may benefit from best-choice environments filled with healthy food options, where children are actively encouraged to consume the healthy foods that are available to them.

In conclusion, Study 4 responded to calls for further research on healthy food cues and children’s healthy eating (Folkvord & Hermans, 2020). Study 4 extends the existing research by applying a pre/post-test design to children’s actual intake of exclusively healthy foods in response to healthy food advertisement exposure in five nurseries in Germany. Uniquely, Study 4 used specifically-designed advertising stimuli that were similar in design, advertising techniques, target group across conditions and modelled on key success factors commonly used in commercial food marketing and, specifically, underscored for healthy food marketing (Aschemann-Witzel et al., 2012). Study 4 provided children with a wide selection of healthy foods to avoid potential bias from children’s food dislikes, and food intake was reported in portions as well as in calories. Study 4 is a first exploration into children’s eating behaviour in the context of healthy food advertising and healthy food availability and, as such, is a unique contribution to the existing evidence base on food advertising effects and children’s eating. Findings from Study 4 suggest that exposure to as little as three healthy food advertisements can contribute to children achieving daily recommended amounts of vegetables, fruit and whole grain (NHS, 2020; PHE, 2020), which may positively affect weight status, dietary health and overall wellbeing (NHS, 2020; PHE, 2020). Study 4 demonstrated that without digital encouragement to consume the healthy foods that are available, children’s healthy food intake declines, and digital healthy food marketing is not only effective, but also needed.

# Discussion

## Background and thesis summary

Food cues in traditional and new media influence children’s eating behaviour (Boyland et al., 2016; Folkvord et al., 2016; Young, 2003). Despite omnipresent food cues in digital media and television advertising (Boyland & Whalen, 2015; Calvert, 2008; Folkvord et al., 2016; Kraak, Gootman & McGinnis, 2006; Lavriša & Pravst, 2019; Sixsmith & Furnham, 2010), the evidence base on children’s actual food intake in response to television-style food is with approximately 14 studies altogether relatively small (see chapter 1, section 1.8). As outlined in Chapter 1, Section 1.8, most available studies focus on the promotion of HSSF products. Much less is known about children’s food intake in responses to healthy food advertising and opportunities for utilising healthy food advertising to support children’s healthy eating remain under researched (see chapter 1, section 1.8). This thesis included four studies assessing television-style food advertising and children’s food intake. This thesis investigated the effects of HSSF food advertising, anti-HSSF advertising, healthy food advertising and toy control advertising on children’s intake of a variety of HSSF and healthy foods and drinks.

Study 1, conducted in the UK, was designed as a pilot study to assess the methods that were to be used in the subsequent studies. Study 1 hypothesised that children in the experimental condition who viewed healthy food advertisements would eat more healthy food than children in the control condition who viewed toy advertisements. There were no changes in children’s food intake in Study 1, and, thus, the hypothesis was rejected. No firm conclusions could be made due to the small sample and missing data, which form the biggest limitations of Study 1. As a pilot study, Study 1 demonstrated the feasibility of most of the procedures, but some changes were made before the start of Study 2. The most important change was to recruit a larger sample of older children via pre-existing nursery contacts for the subsequent Studies 2, 3 and 4 to avoid missing data and very young children’s immature motor skills as confounding variables. In Studies 2, 3 and 4, all sessions were carried out by the researcher whereas in Study 1 nursery staff had carried out some of the procedures. Studies 2 and 3 also included a follow-up measure to investigate long-term effects of television-style food advertising on children’s intake of healthy and HSSF food and drink options.

Study 2 used the same television-style food advertisements and the same 16-item buffet as Study 1 with a sample from a nursery in Germany. Study 2 hypothesised that children who viewed healthy food advertisements would eat more healthy food than children who viewed control advertisements. In Study 2, results from between- and within-group comparisons suggested that there were no changes to children’s food intake over time. The hypothesis that children who viewed healthy food advertisements would eat more healthy food than children who viewed toy advertisements was rejected. Outcomes from Study 2 should be treated with caution given the limitations outlined in Chapter 3, Sections 3.3 and 3.4, particularly limitations linked to insufficient sample size and missing data, which undermine the ability to draw any firm conclusions from Study 2. Any interpretations of findings and comparisons to previous research are therefore limited to a careful discussion. Nevertheless, Study 2 extended previous research on television-style food advertising and children’s food intake by contributing a longitudinal study of children’s healthy and HSSF food intake in response to specifically-designed healthy food versus control advertising in a nursery setting conducted over seventeen weeks.

Following the same methods and procedures of Study 2, Study 3 compared the effects of television-style food advertisements on children’s food and drink intake at a 16-item buffet with equal numbers of healthy and HSSF options in another nursery in Frankfurt/Germany over a period of seventeen weeks. In addition, Study 3 increased the number of conditions from two conditions (healthy food advertisement, control advertisement) to four conditions (healthy food advertisements, anti-HSSF food advertisement, HSSF food advertisement, control advertisements). Based on previous studies (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8.3), Study 3 hypothesised that children who viewed HSSF food advertising would eat more HSSF options than children in the control condition. Following the results of Study 2, it was not expected that healthy food advertising exposure would increase children’s healthy food intake in Study 3. Given the lack of previous research testing television-style anti-HSSF food advertising on children’s food intake, no hypotheses were made regarding the effects of exposure to anti-HSSF food advertising on children’s food intake in Study 3.

Study 3 found no changes in children’s food intake within or between the four conditions over time. The hypothesis that children who viewed HSSF food advertising would increase their HSSF intake compared to children in the control condition was rejected. Outcomes from Study 3 should be treated with caution given the limitations outlined in Chapter 4, Section 4.4 and 4.5 – specifically, insufficient sample size and missing data over the course of the study. Any interpretations of findings, comparisons to previous research or conclusions are therefore limited to a careful discussion. Study 3 extended previous research on television-style food advertising and children’s food intake by testing the effects of four television-style food advertisements on children’s food intake of healthy and HSSF options over a period of seventeen weeks. Uniquely, Study 3 included an advertisement discouraging the consumption of HSSF products to test the effect of an avoidance approach on children’s food intake. Such an advertisement had not been tested in television-style food advertising promoting healthier eating practices.

Study 4 entailed several methodological changes based on the outcomes from Studies 1 - 3. Specifically, the study duration was shortened from longitudinal designs in Studies 1, 2 and 3 to a pre-/post-intervention design in Study 4 to reduce the risk of missing data. Study 4 was carried out in Germany and included two test days, with one test day for pre-exposure (T1) and one test day for post-exposure (T2) measurements, and a two-day break in between test days. Study 4 used the same number of conditions as Studies 1 and 2 (healthy food advertisement versus control advertisement), but Study 4 reduced the buffet from sixteen to seven exclusively healthy options and allowed children to return for refills. Study 4 included a larger sample that Studies 1 - 3, drawn from five nurseries and two different cities. In Study 4, children who viewed healthy food advertisements ate significantly more healthy foods following healthy food advertising exposure than children in the control condition, and these differences were evident for both caloric and item consumption. The main limitations of Study 4 were the lack of long-term assessment of advertising exposure and the lack of a HSSF food advertising condition. Study 4 extended previous studies by applying a cluster randomized, controlled pre-/post-intervention design to children’s intake of exclusively healthy foods in response to healthy food versus toy advertisement exposure in Germany.

## Research gaps in the literature and how this thesis addressed those gaps

All the studies in the present thesis aimed to overcome several key limitations of existing research on food advertisements. Most previous studies have measured the effect of television-style food advertising on food preferences, purchase requests or behavioural intentions (Smith et al., 2019) and have not assessed children’s actual food intake. All the studies measured children’s actual food intake via observation, which has been used in previous studies with children on food advertising effects (Gonçalves et al., 2018) and shown to be a more reliable and robust method of measuring dietary intake than self-report measures of food consumption and dietary habits in young children (Livingstone & Robson, 2000).

Previous studies that have measured actual food intake have only used advertisements recorded from television (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Dovey et al., 2011; Fox,1980; Galst, 1979; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2004; Halford et al., 2007; Halford et al., 2008; Harris et al., 2009; Lemnitzer et al., 1979; Lorenzoni et al., 2017), which may cause methodological issues due to advertising stimuli not being matched across conditions (see chapter 1, section 1.8.3). A novel aspect of this research is that the studies included in this thesis used specifically-designed advertising stimuli that were identical in design, advertising techniques and target group across conditions. The stimuli were modelled on key success factors commonly used in commercial food marketing and healthy food marketing to children specifically (Aschemann-Witzel et al., 2012) (see chapter 1, section 1.7).

Previous studies that have assessed the effects of food advertisements on children’s food intake have almost exclusively investigated children’s intake of HSSF snacks (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2004, 2007, 2008; Harris et al., 2009; Lemnitzer et al., 1979; Lorenzoni et al., 2017). Studies investigating opportunities to improve children’s eating behaviour via television-style food advertising have been limited to four studies (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). There are currently no published studies investigating exclusively television-style, healthy food advertisements and healthy food intake in children. Studies 1 and 2 included a healthy food advertisement (and control advertising) and healthy food options as well as HSSF options at the buffet. Study 3 included an advertisement for healthy foods and an advertisement against HSSF foods as well as a HSSF food advertisement (and control advertising) and healthy food options as well as HSSF options. Study 4 investigated the effect of healthy food advertisements (and control advertising) on children’s exclusively healthy food intake.

Despite the difficulty of detecting changes in intake of healthy foods with very low caloric intake compared to HSSF products with very high caloric content, changes in food intake have been reported in energy (kcal) only (Anschutz et al., 2009; Anschutz et al., 2010; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Gorn & Goldberg, 1980; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979; Lorenzoni et al., 2017). All the studies in this thesis reported children’s food intake in items and calories. All the studies provided children with a selection of healthy foods to avoid a potential bias from children’s particular food dislikes.

Previous research settings for studies assessing children’s healthy food intake in response to television-style healthy food advertisements have been limited to classrooms in schools (Boyland et al., 2013; Dovey et al., 2011; Halford et al., 2008, 2007, 2004; Harris et al., 2009; Lorenzoni et al., 2017), classrooms that were made to look like a living room (‘semi-naturalistic setting’, Anschutz et al., 2009, 2010), mobile research laboratories (Fox, 1980; Kaser-Boyd, 1978), research laboratories (Gilbert-Diamond et al., 2017; Kaser-Boyd, 1978) and summer camps (Gorn & Goldberg, 1980; Harris et al., 2009), none of which necessarily reflect children’s naturalistic eating behaviour (Anschutz et al., 2009, 2010). All the studies in this thesis benefitted from relatively high external validity, because the studies were conducted in the children’s nurseries in familiar rooms, accompanied by familiar peers and staff and in line with children’s usual nursery breakfast routines and schedules. Studies 1 - 3 contributed longitudinal designs to the research on television-style food advertising and children’s food intake that was previously limited to cross-sectional studies; Study 4 contributed a pre-test/post-test design of exclusively healthy food advertising (versus control advertising) and healthy food options.

## Thesis outcomes in the context of previous findings on television-style food advertising exposure and children’s food intake

Given the insufficient sample sizes in Studies 2 and 3 (compared to the sample size indicated by G\*Power, see chapters 3 and 4, sections 3.4 and 4.4), Studies 2 and 3 were not sufficiently powered to draw any firm conclusions. Any interpretation of findings and comparisons to previous research is limited to a careful discussion to highlight future research opportunities. Outcomes from Study 3 regarding the lack of HSSF food advertising effects may contradict the majority of previous research on children’s eating responses to television-style HSSF food advertising, but the small sample size undermines any firm conclusion. As outlined in Chapter 1, Section 1.8, most previous studies found that HSSF food cue exposure increased children’s HSSF food intake (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979). There are some exceptions because a few studies had similar outcomes to Study 3 and reported no increases in HSSF intake following HSSF food cue exposure (Anschutz et al., 2010; Gorn & Goldberg, 1980; Lorenzoni et al., 2017) (see chapter 1, section 1.8.3). The exceptions included studies that exposed children to large numbers of repetitive ice cream advertisements that may have overloaded children (Gorn & Goldberg, 1980), studies that targeted adult audiences and were therefore less relevant to children (Anschutz et al., 2010) and one cross-sectional study that included relatively low advertising exposure overall (Lorenzoni et al., 2017) and was categorized as having high risk of bias in a review by Russel et al. (2019). The discrepancy in findings regarding HSSF food advertising exposure and children’s HSSF intake between the previous research studies cited here and Study 3 may be attributed to differences in research methodology such as small sample size and no opportunity for refills after initial food selection at the buffet in Study 3. However, a sufficiently-powered study would be required to draw any firm conclusions.

Since Study 3 found no effect for HSSF food advertising, Study 3 cannot make a case against HSSF food advertising to children, but caution should be practiced when interpreting outcomes from Study 3 given the limitations outlined in Chapter 4, Sections 4.4 and 4.5, specifically the insufficient sample size. Treated with caution, outcomes from Study 3 contrast from previous research frequently demonstrating that HSSF food cues increase children’s HSSF food and drink intake (Anschutz et al., 2009; Boyland et al., 2013; Dovey et al., 2011; Fox, 1980; Gilbert-Diamond et al., 2017; Halford et al., 2008; Halford et al., 2007; Halford et al., 2004; Harris et al., 2009; Kaser-Boyd, 1978; Lemnitzer et al., 1979) (see chapter 1, section 1.8.3). Future researchers could consider whether the lack of HSSF intake following HSSF food advertising exposure in Study 3 relates to factors like the HSSF food advertisements lacking some common HSSF food advertising features such as visible brands, or factors like the HSSF options at the buffet and the lack of refill opportunity. Perhaps, Study 3 may have yielded different results if the study had been sufficiently powered. Further, children may have wished to consume more foods and drinks but were not able to go back to the buffet given the procedures in Studies 1, 2 and 3.

Outcomes from Studies 1, 2 and 3 regarding the lack of healthy food advertising effects are in line with previous research that also found no links between exposure to television-style healthy food advertising and increases in children’s healthy food intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979), however, these outcomes should be treated with caution given insufficient sample sizes in Studies 1 - 3. As noted in Chapter 1, Section 1.8.4, Dovey et al. (2011) offered children more HSSF than healthy food options which may have primed children to select unhealthy snacks via food variety effects (Brondel, Romer, Van Wymelbeke, Pineau, Jiang, Hanus & Rigaud, 2009) and via majority food cues (Pechey & Marteau, 2018). Presenting more HSSF than healthy food options made the choice of HSSF options more likely in Dovey et al. (2011). However, Fox (1980), Kaser-Boyd (1978) and Lemnitzer (1979) did offer equal numbers of healthy versus HSSF options, and children still preferred HSSF snacks regardless of HSSF or healthy food advertising exposure. Studies 1 - 3 also applied this improved methodology and offered equal numbers of healthy versus HSSF options, but outcomes suggested no changes in children’s food intake in response to healthy food advertising. However, this may have been a result of insufficient sample sizes from which no firm conclusions can be drawn. As outlined by Halford et al. (2011) and Folkvord (2020) (see chapter 1, section 1.6), healthy foods do not have the same intrinsic appeal as HSSF products, and providing equal numbers of healthy and HSSF options may not be sufficient to counteract children’s preference for HSSF options. Future research may wish to systematically assess the effect of the ratio of healthy versus HSSF foods and drinks in children’s intake responses to food advertising.

Kaser-Boyd (1978) explained the lack of healthy food advertising effects in her study via the high prevalence of HSSF food advertising in children’s everyday life and the low quality of healthy food advertising due to smaller budgets being available to healthy food producers and marketers. The lack of healthy food advertising effects in previous studies where children were exposed to recorded healthy food advertisements intake (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979) may be due to the inability of those advertisements to create sufficient motivation to make healthy choices (Folkvord, 2020; Ghoniem et al., 2020) – when healthy and HSSF options were available. Actual healthy food advertising is compromised by smaller budgets than HSSF food marketers have available to them. To date, health communication has favoured rational argumentation to improve health behaviours but with limited success (Brusse et al., 2016; Hinyard & Kreuter, 2007). Healthy food advertising tends to utilise advertising appeals and promotional messages that focus on health gains and disease avoidance (Dovey et al., 2011), although such advertising appeals have been found ineffective, counterproductive (Raghunathan et al., 2006) or cognitively demanding (Dastidar & Bhadra, 2017) (see chapter 1, section 1.4). In contrast, HSSF food marketing has relied almost exclusively on emotional advertising and appealing narratives, which are highly effective in influencing children’s eating (Boyland et al., 2016; Cairns et al., 2013; Folkvord et al., 2016; Russel et al., 2019; Smith et al., 2019). If healthy food promotion is to compete with HSSF food marketing, healthy food advertising needs to improve (Dovey et al., 2011). Studies 1 - 4 attempted such a shift in healthy food advertising appeals and techniques but should perhaps rather be treated as a first step in the right direction, and future research is required to develop healthy food advertisements that can effectively compete with common commercial HSSF food advertising.

Aiming to replicate the effectiveness of HSSF food advertising, the advertising stimuli used in this thesis were designed in line with recommendations by Folta et al. (2006) regarding HSSF food advertising techniques used in the commercial sector and key success factors (KSFs) ‘data and knowledge’, ‘emotions’, ‘endorsement’, ‘community’, ‘media’ and ‘why and how’ in healthy food marketing to children as outlined in Aschemann-Witzel et al. (2012). The advertisements in this thesis focused on emotional appeals, peer and parent models, positive atmosphere and music and comments by actors and via voice-overs that emphasized taste, enjoyment, fun, play and eating for pleasure. Still, in the mixed food environment with healthy and HSSF options that was used in Studies 1 - 3, the healthy food advertisements were not effective at increasing children’s healthy food intake, and this is in line with previous studies that exposed children to healthy food advertisements and offered mixed food options. However, since Studies 1 - 3 were underpowered, outcomes from Studies 1 - 3 should be treated as preliminary and more research is required to assess the effect of healthy food advertising on children’s food intake in a range of different eating opportunities.

In contrast to these preliminary outcomes from Studies 1, 2 and 3 that do require caution when interpreting outcomes and comparing them to other research given the limitations of underpowered studies, Study 4 found that three exposures to the same one-minute advertisement for healthy food can increase children’s healthy food intake by as much as three portions, helping children to meet daily recommended amounts of vegetables, fruit or whole grain (NHS, 2020; PHE, 2020). Children in the control group in Study 4 who were exposed to toy advertising decreased their healthy food intake by approximately two portions. The main methodological differences between Studies 1, 2, 3 and Study 4 were the sample sizes, the longitudinal design used in Studies 1, 2 and 3 that compounded issues relating to missing data when children were ill or absent and the design of the eating opportunity. Study 4 was a sufficiently-powered study, utilised a pre-intervention/post-intervention design with a much larger sample with cluster random allocation rather than individual random allocation and had no missing data. Importantly, Studies 1, 2 and 3 used a 16-item buffet of healthy and HSSF food and drink options without refill opportunities, while Study 4 used a 7‑item buffet of exclusively healthy food options with refill opportunities. It may be that a larger sample size, reduced issues with missing data (due to shorter study duration) and the use of exclusively healthy food advertising and unlimited refills to exclusively healthy food options contributed to healthy food advertising increasing healthy food intake in Study 4. However, comparisons between Studies 1 - 3 and Study 4 are limited to a careful discussion given the insufficient sample sizes in Studies 1 - 3.

As discussed in Chapter 1, Section 1.8.3, television-style food advertising studies including healthy food cues are limited to four studies that offered a variety of healthy and HSSF food and drink options to choose from (Dovey et al., 2011; Fox, 1980; Kaser-Boyd, 1978; Lemnitzer et al., 1979). Studies assessing the impact of television-style healthy food advertising on children’s healthy food intake when only healthy foods are available, are absent from previous research. Study 4 fills that research gap by contributing a study on television-style healthy food cues and exclusively healthy food choices but is limited by the lack of long-term assessment of advertising effects and the lack of a HSSF food advertising condition.

## Thesis outcomes in the context of previous findings on digital food cues in narrative media and children’s food intake

Given the lack of previous studies with a comparable methodology to Study 4 (television-style healthy food advertising and exclusively healthy food options), studies that have embedded healthy food cues in other digital media, such as narrative media programmes, may be useful to understand the outcomes of Study 4. Specifically, some narrative media studies (Horne et al., 2004, 2009, 2011; Lowe et al., 2004; Upton et al., 2011) exposed children exclusively to healthy food cues and created a best-choice-scenario, where only healthy food options were available, which is similar to the advertising exposure and eating opportunities in Study 4. As discussed in Chapter 1, Section 1.5, television-style food advertising and narrative media with food cues share some common features but differ in regards to others, such as the level of food cue integration. Food integration refers to the way in which food cues are embedded in the character design and story line of a narrative media programme that is designed to communicate health messages without overt promotion (Shen, Sheer & Li, 2015). Television-style food advertising and narrative media programmes share advertising techniques such as social endorsers, appealing stories, engaging atmospheres and attractive presentations to create positive associations with the products or behaviours that are being promoted (Folkvord, 2020; Shen, Sheer & Li, 2015).

Outcomes from Study 4 are in line with findings from a series of studies using a narrative media programme with healthy food cues and healthy eating role models (‘Food Dudes’) that Horne et al. (2004, 2009, 2011), Lowe et al. (2004) and Upton et al. (2011) created to assess children’s intake of exclusively healthy food options in response to digital healthy food cues. Horne et al., Lowe et al. and Upton et al. found that exposure to healthy food cues increased children’s fruit and vegetable intake compared to children who were provided with vegetables and fruits only. Children who participated in the ‘Food Dudes’ programme consumed more fruit than at baseline and three times as many vegetables during the intervention phase (Horne et al., 2004). Children in the control condition showed a decline in fruit and vegetable consumption (Horne et al., 2009). Findings from Study 4 are in line with findings from Horne et al., Lowe et al. and Upton et al., as children in Study 4 increased their healthy food intake by as much as three portions following healthy food cue exposure. Horne et al., reported that children in the control condition who were not exposed to digital healthy food cues decreased their healthy food intake, and Study 4 replicated these findings. Children in the control group in Study 4 decreased their healthy food intake by approximately two portions.

Given the decline in healthy food intake in the control conditions in Study 4, which is similar to the outcomes from Horne et al. (2009), outcomes from Study 4 may suggest that mere availability of healthy foods without healthy food promotion is not sufficient to get children to eat healthy foods. Rather, children’s healthy food intake may rely on healthy food promotion, with the specifically-designed, television-style advertising used in Study 4 or the specifically-designed narrative media programmes used in Horne et al. (2004, 2009, 2011), Lowe et al. (2004) and Upton et al. (2013) being examples of effective tools to encourage children to increase their healthy food intake. Given the lack of previous studies on television-style healthy food advertising and children’s healthy food intake, further research is required to confirm the results of Study 4.

## Children’s healthy eating may rely on a combined approach of healthy food promotion and exclusively healthy food availability

Although limited by their small sample sizes, Studies 1 - 3 may suggest that healthy food promotion without an exclusively healthy food buffet may not be sufficient to increase children’s health food intake. Study 4 found increases in children’s healthy food intake in the context of an exclusively healthy food environment, so that prevention and intervention efforts are likely to benefit from involving parents, caretakers, nurseries and other stakeholders that determine children’s food environments and the selection of foods and drinks that children get to choose from. Larson and Story (2009) suggested that individual change is facilitated and sustained if the environment within which choices are being made support the healthy food options in an easily accessible way. Ghoniem, van Dillen and Hofmann (2020) underscore choice architecture and the role of food availability on food choice and intake. Future research may wish to further explore the influence of food availability on the link between food advertising exposure and children’s food intake, specifically, at which point healthy food advertising exposure may still lead to healthy food choices even when HSSF options are available.

Especially if children’s healthy eating relied on a combined approach of healthy food promotion and exclusively healthy food availability, research and intervention would benefit from targeting adults as well as children. Regardless, parents are key influencers in young children’s media consumption and advertising exposure (Golan, Kaufman & Shahar, 2006; Gruber & Hademan, 2009). Due to parents’ and caregivers’ role in shaping children’s eating behaviour via the home food environment including feeding and communication techniques, role modelling, home food availability but also home viewing behaviours, benefits have been demonstrated from parental involvement in healthier eating and obesity prevention strategies (Golan et al., 2006; Gruber & Hademan, 2009). Future researchers could investigate avenues for media-based healthy eating programmes such as television-style healthy food advertising that address children as well as parents and caregivers.

Including adults, parents, families and nursery staff in media-based healthy eating campaigns may be particularly important when viewing food advertising effects through the lens of automatic, unconscious processes that unfold in reaction to food cues regardless of viewer age, experience or media literacy. As discussed in Chapter 1, Section 1.4, the ability to cope with advertising effectively may not depend on rational processing and correct interpretation of marketing materials (Cohen, 2008). Rather, automatic processes beyond conscious awareness may guide children’s food advertising responses and the ability to recognise and understand advertising may not protect children or adults from the negative effects of food advertising exposure (Cohen, 2008). If emotional HSSF food advertising techniques deactivate media literacy skills and bypass any rational processing that children may have available to them (see chapter 1, section 1.4), policy makers may want to consider whether emotional appeals in HSSF advertising targeting children or adults should be considered ethical at all.

In addition to choice architecture, Ghoniem et al. (2020) highlight the role of internal, intraindividual factors such as motivation that interact with availability to shape consumption. Nudging effects may be most pronounced when choice architecture (specifically food availability) and internal factors such as motivations are considered (Ghoniem et al., 2020). The reason why the same healthy food advertisements that were ineffective in Studies 1 - 3 increased children’s healthy food intake in Study 4 may be the combination of healthy food advertisements and exclusively healthy food availability. In line with Ghoniem et al. (2020), The Promotion of Healthy Food Model (Folkvord, 2020) underscores the importance of increasing the reinforcing value of healthy foods, which is the psychological desire or wanting, in order for healthy foods to be able to compete with HSSF foods whose intake is physiologically more rewarding due to the positive ways in which our brains react to sugar, fat and calories. It may be that exposure to the healthy food advertisement in Study 4 sufficiently increased children’s psychological desire for healthy foods to increase children’s intake of healthy foods – when they were the only options available at the buffet. However, comparisons between Studies 1 - 3 and Study 4 should be treated with caution given the insufficient sample sizes in Studies 1 - 3. Further research is required to allow firm conclusions regarding the effect of choice architecture on children’s eating behavioural responses to food advertising.

## Thesis limitations and future research directions

Studies 1 - 4 included in this thesis display a number of limitations that future research may wish to tackle.

### Underpowered studies, small samples and missing data

Study 1 was designed as a pilot study with a small sample to primarily test research procedures and materials for the subsequent studies included in this thesis. Studies 2 and 3 were underpowered due to insufficient sample sizes, missing data from children being ill or absent due to other commitments. This caused statistical challenges for data analyses and limits the conclusions that can be drawn from these studies. Attrition and nonparticipation have been cited by previous longitudinal studies with child participants as a significant research obstacle, with some researchers citing attrition rates of up to 56.4% (McQuaid, Barton & Campbell, 2003). Study 4 included a large enough sample to produce a sufficiently-powered study.

### The food selection and eating environment

Although great care was taken to design the eating opportunity and food intake measurements as natural and unobtrusive as possible, children’s behaviour during the experiments may not have been representative of their typical behaviour outside of an experimental situation. Studies 1 - 4 were carried out in line with nursery schedules and procedures so that the experiments took place during breakfast hours, children took part in their usual nursery groups (rather than being individually assessed or split into unfamiliar groups) and were accompanied by their familiar nursery teacher. The usual nursery breakfasts were served as buffets too, just with more options (muesli, milk and savoury bread spreads, in addition to the fresh fruit, vegetables, whole-grain bread and water that was offered at the experimental buffets). The buffet, therefore, included only foods that were already part of the nurseries’ daily food offers.

One difference between Studies 1 - 3 and the usual nursery routine was that under non-experimental circumstances, children can return to the nursery buffet for refills as often as they wish. In this thesis, refills were only introduced as part of the procedure in Study 4, while in Studies 1 - 3, children had one opportunity for food and drink selection only, and this may have influenced children’s eating behaviour. Another difference between Study 4 and the usual nursery routine was that under non-experimental circumstances, children do not have to wait at a distance to go to the usual nursery buffet one by one, but children do still have to wait their turn when other children are helping themselves to food to avoid overcrowding. Although Studies 1 - 4 were conducted in children’s nurseries as closely aligned with their usual environments, routines and schedules as possible, the experimental situation may have undermined children displaying their typical eating behaviour. As Studies 1 - 4 were confined to the nursery setting, generalisability to other environments such as children’s homes requires further research.

Furthermore, since healthy food advertisements in this thesis increased children’s healthy food intake when only healthy foods were available, future researchers could consider at what point exposure to healthy food advertisements can increase healthy food intake even when other HSSF options are available to better equip children in their usual food-abundant environments. Until then, caregivers might aim to create best-choice environments filled with healthy food options where children are encouraged to consume the healthy foods that are available to them.

### External validity and generalisability of the stimulus material

Another point of concern may be the external validity of the stimulus material and subsequent generalisability of the research outcomes, considering that they lack some features of commercial advertising, such as brand or product names. However, the thesis did not aim to investigate brand effects of food advertising but, rather, the effects of television-style food advertising focusing on the actual foods (not on the branding of those foods).

As discussed in Chapter 2, Sections 2.3.1 and 2.3.2, the advertisements were modeled on key success factors for healthy food promotion outlined in Aschermann-Witzel et al. (2012) and took into account research on children’s motivation to consume. Research investigating the effectiveness of health goals as a motivation to consume has shown that messages about health, wellbeing and functionality may be ineffective (Hausman, 2012), or even counterproductive (Golloway et al., 2005; Raghunathan, Naylor & Hoyer, 2006), when trying to increase children’s vegetable, fruit, whole grain and water intake. Rather than for health reasons, children eat for pleasure (Marty, Chambaron, Nicklaus & Monnery-Patris, 2018), and marketers design marketing messages and content to prime viewers on hedonic product properties (Folkvord, 2020) by focusing viewers’ attention on the sensory aspects of the product such as great taste and smell or interesting and exciting texture (Boyland et al., 2016; Cairns et al., 2013; Folkvord et al., 2020; Hastings et al., 2007; Kelly, Smith, King, Flood & Bauman, 2007; Kim, Chen & Cheon, 2019; Lynn & Zolkepli, 2019). Hence, the advertisements used in this thesis are intentionally unlike commercial healthy food advertising, because they focus on video images and voice-overs that communicated enjoyment, taste, peer and parent models and themes of fun and fantasy rather than rational health appeals.

In addition to incorporating advertising techniques that research would indicate to be effective for healthy food marketing to children, the advertisements in this thesis demonstrate common features with commercial food marketing. Similar to commercial food advertising, children in the advertisements are shown handling, playing with, eating, enjoying and talking about the foods. Like commercial food advertising, the advertisements in this thesis prioritise emotional appeals (taste, enjoyment) over rational appeals. Given the voice-overs that were used (‘Yummy!’, ‘Delicious!’, ‘Look at all those colours’, ‘I eat fruit and vegetables every day!’), the advertisements employed a specific promotional message. There is a clear verbal and non-verbal message that eating healthy foods is fun, and parents and peers enjoy it. The advertisements also used a logo at the beginning and end of each advertising clip to help children distinguish between programme and advertising.

Since the advertisements used in this thesis were designed and produced for the purpose of research, they may not meet the qualitative standard of commercial food advertising. However, this gap is present in healthy versus HSSF food advertising outside of experimental settings given the lower budgets for healthy food marketing (Kaser-Boyd, 1979). The advertisements that were designed and produced for the purpose of research may be best understood as a first step towards effective healthy food advertising that is based on empirical research evidence regarding healthy food advertising to children specifically – and more research is needed to further develop television-style healthy food advertising that could be used in actual advertising campaigns.

### Assessing digital food advertising effects on a range of devices

Since television remains the most popular media device (IZI, 2020) among marketers and children alike, television would be an effective tool of mass communication. Dazeley and Houston-Price (2015) found that ‘just looking’ helped children to overcome food fussiness and taste, eat and enjoy previously unknown or disliked vegetables and fruits. Equally, television-style healthy food advertising could be distributed via other devices that have gained popularity, such as smart phones, tablets and computers or laptops (Hastings et al., 2007; IZI, 2020), and video-based healthy eating communication could be included in other channels such as social media, on-demand content and in streaming sites. However, this thesis assessed the effects of video-based food advertising screened on television only, and the effects may not be generalisable to other digital devices such as smart phones, tablets and laptops. Future research could test the effectiveness of video-based healthy food advertisements on a range of media devices.

### Attention to the stimulus material

The Healthy Food Promotion Model (Folkvord, 2020) highlights directing viewers’ attention to healthy foods as the first step in increasing their reinforcing value, which describes the liking and wanting of the advertised product. Although viewings were supervised by nursery staff and the researcher, children’s attention to the advertising stimuli and the children’s programme were not systematically assessed, so that it remains unknown if children paid sufficient attention to the screen to cognitively engage with the advertising messages. However, it is possible that some children may have been distracted by others during the group viewings, and this may have affected exposure times to the advertisements.

Especially in Studies 2 - 4 with older children compared to Study 1, children appeared attentive to the advertisements, hummed along to the music and called out names of foods when they were shown, which may indicate that the advertisements were suitable for children and captured their attention.

### Individual advertising techniques entailed in the stimulus material

Since the advertisements that were created for this thesis included a range of different advertising techniques, it remains unknown which advertising techniques were particularly effective and future research may wish to assess individual advertising elements. Television advertisements may change norms relating to food and eating using positive role models (Cruwys, Bevelander & Hermans, 2015), emotional appeals that override rational and critical processing of the argument (Nairn & Fine, 2008) and affective conditioning linking enjoyable media consumption with the target behaviour (Monahan, Murphy & Zajonc, 2000). As discussed in Study 1 (see chapter 2, section 2.3.1), the advertisements in the present study combined a range of different advertising techniques such as mere exposure, positive associations, themes of fun and fantasy, special effects, music, voice-overs and role models. Future researchers could explore which of these features are most effective in increasing children’s vegetable, fruit and whole grain intake and whether real or fictitious actors may be more effective role models. Future researchers could assess children’s responses to healthy food advertisements with different message appeals and executional characteristics to provide insight into the most effective methods for promoting favourable attitudes to healthy foods among children. Effective healthy food advertisements could then be used to counteract the imbalance in children’s media and advertising environments which favour HSSF foods over healthy products (Russel et al., 2019; Smith et al., 2019).

### Long-term effects of food advertising exposure on dietary habit and health

Improved dietary health depends on healthy habits rather than on making isolated healthy food choices (Folkvord, 2020). Studies 1 - 3 were longitudinal studies that investigated children’s food intake in response to advertising exposure over a period of nine weeks (Study 1) and seventeen weeks (Studies 2 and 3). Children in Studies 1 - 3 were exposed to a maximum of 24 minutes of food advertising at the end of the 8-week intervention period only, depending on their individual attendance. Considering children’s typical advertising exposure levels (Landwehr & Hartmann, 2020), especially to HSSF products (Landwehr & Hartmann, 2020), 24 minutes of food advertising may not have been sufficient to assess advertising effects that can be generalised to children’s natural media environments. Study 4 was designed as a pre-test/post-test design spanning two weeks only to avoid issues with missing data that became apparent in the longitudinal designs used in Studies 1 - 3, hence, children in Study 4 were exposed to a maximum of three minutes of food advertising. Therefore, an assessment of truly long-term effects of naturalistic food advertising exposure, both in intensity and duration, was outside of the scope of this thesis. Future research using longitudinal designs is required to assess the remaining assumptions in the Promotion of Healthy Food Model (Folkvord, 2020), relating to the creation of a reciprocal relationship between desire for healthy foods, eating healthy foods and experiencing improvements in health and wellbeing following dietary improvements, which in turn lead to increased eating of healthy foods until this behaviour becomes automatic and habitual.

### Individual susceptibility factors

Folkvord (2020) highlights the role of individual and societal factors in individual susceptibility to food marketing (Folkvord, 2020), but such control variables that were accounted for in previous food advertising studies such as hunger (Harris et al., 2009) or BMI (Halford et al., 2008) were not assessed in this thesis. Based on preliminary conversations with nursery staff and parents, BMI as a control variable was excluded from this thesis. Measurements for BMI calculations appeared to be a barrier to recruitment, as parents and nursery staff felt that measuring children’s height and weight were inappropriate in consideration of children’s body esteem. Although parents’ self-reports of their children’s weight and height for BMI calculations is common in obesity research, self-report did not appear a suitable alternative for this thesis, given its unreliability. Studies have shown that parents misjudge their children’s body size and weight, raising questions regarding the usefulness and reliability of parental weight and height reports for child BMI calculations. For instance, mothers in Dubois and Girad (2007) overestimated their child’s body size. In Chaimovitz, Issenman, Moffat and Persad (2008), almost half of parents underestimated their child’s body size. As BMI measurements may have presented a challenge to recruitment and self-report from parents may have resulted in erroneous data, BMI was not included in this thesis, although BMI may be an important control variable. Future research may wish to include individual susceptibility factors to better understand children’s eating behaviour in response to advertising exposure. In line with Dovey et al. (2011), Gorn and Goldberg (1980) and Harris et al. (2009), hunger levels were controlled by carrying out experiments at the same time of day each time.

Environmental conditions such as advertising exposure and food availability can be altered to shape food preferences for the better (Cohen, 2008; Berridge & Kringelbach, 2015). In light of global and national obesity rates and the relatively low numbers of children that eat a healthy and nutritious diet every day (see chapter 1, section 1.1), outcomes from Study 4 present as a promising research, prevention and intervention avenue. Digital media-based prevention and intervention efforts that consider environmental factors have the potential to improve children’s diets, reduce the risk of developing obesity and associated illnesses and to enhance children’s physical and psychological health. Healthy food advertising could be used to rebalance the food and marketing landscape to reflect eating habits that support rather than undermine children’s health.

Study 4 highlighted the value of healthy food advertising to children to increase healthy food intake. Given the lack of healthy food advertising effects in Studies 1 - 3 when healthy and HSSF options were available, it may be that an exclusively healthy food environment is essential for healthy food promotion to have a positive impact. But this comparison is made cautiously, given the limitations of Studies 1 - 3. A healthy and diverse diet increases the chances of ideal nutrition by exposing the child to a large variety of different vitamins and minerals (Ventura & Worobey, 2013). Television-style healthy food advertising is one way of exposing children to healthy foods by triggering familiarisation processes that enhance children’s willingness to taste and eat healthy foods. A combined approach of healthy food promotion and exclusively healthy food availability may be required to improve children’s eating behaviour, but future research is required to investigate the effect of food availability in children’s eating behavioural responses to food advertising. Based on the outcome from the sufficiently powered Study 4, this thesis suggests that exposure to television-style healthy food advertising increased children’s immediate healthy food intake in an exclusively healthy food environment. Future research is required to test the effects of television-style healthy food advertising on children’s healthy food intake long-term. Consistent policies, strong incentives for compliance, systematic monitoring and an acknowledgement of the broader eating environment including media, advertising and the nursery or home environment may be needed (Lucas et al., 2017) to provide children with a food environment and eating norms that make healthy eating the easy, and possibly the only, choice.

Improving the nature of the food marketing that children are exposed to on television and online is one of the aims of UK’s Better Health campaign (Gov UK, 2021). Better Health aims to ban HFSS products on television and online before 9pm. Reducing children’s exposure to HSSF food advertising that has been shown to negatively impact children’s food choices is an important step to reducing unhealthy eating practices and obesity. However, efforts to actively promote healthy and balanced eating through television and online advertising are not yet part of the campaign. In response to children and adults consuming too many calories and not knowing the caloric values of common foods and drinks, Better Health underscores the importance of empowering everyone with the right information to make healthier choices as a primary goal of their campaign. Outcomes from this thesis suggest that if Better Health campaign efforts to create healthier food environments are limited to improved information provision, labelling about calories and ending HSSF product promotion by volume (such as two-for-one offers), increases in healthy food intake are unlikely. As outlined in Chapter 1, Section 1.6, most food choices are not conscious choices, and better information provision may therefore not reduce overeating and obesity. Findings from Study 4 suggest that increases in healthy eating are possible in an exclusively healthy food environment when healthy foods are overtly promoted, and this is not yet reflected in current campaigns that primarily focus on reducing HSSF food advertising and increasing product information.

Media-based health prevention and intervention efforts could focus on communicating the importance of combining a healthy food environment with healthy food promotion and encourage caretakers to actively promote the healthy foods that they make available to children. Nurseries may be particularly effective settings. In Germany, 3.5 million children visit a nursery daily (NQZ, 2021). Half of those children visit their nursery for seven hours or more each day. Nurseries have, therefore, the opportunity to make a positive and lasting impact on children’s exposure to and experiences with foods (NQZ, 2021). Particularly when nurseries and parents collaborate over food and drink options, sensible food education and child-appropriate health communication, children can build a positive relationship to food and establish healthy eating as the norm (NQZ, 2021).

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