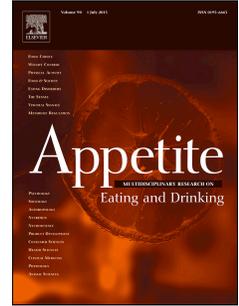


# Accepted Manuscript

Children's self-regulation of eating provides no defense against television and online food marketing

Jennifer Norman, Bridget Kelly, Anne-T. McMahon, Emma Boyland, Louise A. Baur, Kathy Chapman, Lesley King, Clare Hughes, Adrian Bauman



PII: S0195-6663(17)31735-X

DOI: [10.1016/j.appet.2018.02.026](https://doi.org/10.1016/j.appet.2018.02.026)

Reference: APPET 3802

To appear in: *Appetite*

Received Date: 16 November 2017

Revised Date: 10 January 2018

Accepted Date: 23 February 2018

Please cite this article as: Norman J., Kelly B., McMahon A.-T., Boyland E., Baur L.A., Chapman K., King L., Hughes C. & Bauman A., Children's self-regulation of eating provides no defense against television and online food marketing, *Appetite* (2018), doi: 10.1016/j.appet.2018.02.026.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## Children's self-regulation of eating provides no defense against television and online food marketing

### Authors:

Jennifer Norman, Early Start, School of Health and Society, Faculty of Social Sciences, University of Wollongong, NSW, 2522, Australia

Bridget Kelly, Early Start, School of Health and Society, Faculty of Social Sciences, University of Wollongong, NSW, 2522, Australia

Anne-T McMahon, Faculty of Science, Medicine and Health, University of Wollongong, NSW, 2522, Australia

Emma Boyland, Appetite & Obesity Research Group, Department of Psychological Sciences, University of Liverpool, L69 7ZA, UK

Louise A Baur, Prevention Research Collaboration, School of Public Health, University of Sydney, NSW, 2006, Australia

Kathy Chapman, Cancer Programs Division (at time of writing), Cancer Council NSW, 153, Dowling Street, Woolloomooloo, NSW 2011, Australia

Lesley King, Prevention Research Collaboration, School of Public Health, University of Sydney, NSW, 2006, Australia

Clare Hughes, Cancer Council NSW, 153, Dowling Street, Woolloomooloo, NSW 2011, Australia

Adrian Bauman, Prevention Research Collaboration, School of Public Health, University of Sydney, NSW, 2006 Australia

Correspondence to Jennifer Norman, Early Start, School of Health and Society, Faculty of Social Sciences, University of Wollongong, NSW 2522, Australia Email: jan20@uowmail.edu.au

### Abstract

Exposure to unhealthy food marketing stimulates children's food consumption. A child's responsiveness is influenced by individual factors, resulting in an increased vulnerability to advertising effects among some children. Whether these differential responses may be altered by different parental feeding behaviours is unclear. The purpose of this study was to determine the relationship between parental feeding practices and children's food intake responses to food advertising exposure. A randomised, crossover, counterbalanced, within subject trial was conducted across four, six-day holiday camps in New South Wales, Australia between April 2016 and January 2017 with 160 children (7-12 years, n=40/camp). Children were randomised to either a multiple media (TV and Internet) or single media (TV) condition and exposed to food (3 days) and non-food (3 days) advertising in an online game and/or a cartoon. Children's food consumption (kilojoules (kJ)) was measured at a snack immediately after advertising exposure and then at lunch later in the day. Parents completed the Child Feeding Questionnaire, and 'restriction' and 'pressure to eat' subscale scores were calculated. While food advertising affected all children in the multiple media condition, there was an increased effect on snack intake among children whose parents reported pressuring them to eat, with children consuming an additional 356kJ after food advertising compared with non-food advertising. This was 209kJ more than children whose parents did not pressure them to eat. In the single media condition, only children whose parents reported restrictive feeding practices ate more at lunch on food advertising days than non-food advertising days (240kJ). These data highlight an increased susceptibility to food advertising among children whose parents report controlling feeding practices.

**Keywords:** Food advertising; food intake; children; parental feeding practice; Child Feeding Questionnaire

## Introduction

Environmental factors strongly influence the establishment of a child's eating behaviours (Hawkes et al., 2015) and play a critical role in the development of childhood overweight (Swinburn et al., 2011). Food environments are increasingly dominated by cheap, ultra-processed food products, high in fat, sugar and salt; foods which are intrinsically unhealthy yet intensely palatable (Monteiro, Moubarac, Cannon, Ng, & Popkin, 2013). The widespread availability of these foods means that we are persistently faced with opportunities to overeat and, furthermore, encouraged and prompted to do so by their heavy promotion across an increasingly wide range of media and settings (Swinburn et al., 2011). As such, we are constantly challenged to self-regulate food intake (Stoeckel et al., 2017).

It is unsurprising that, born into this obesogenic food environment, the present generation of young people are more vulnerable to overweight than ever before (Allman-Farinelli, Chey, Bauman, Gill, & James, 2007). A sustained daily positive energy balance as small as 200-300 kilojoules (kJ) can lead to the development of overweight in children (Plachta-Danielzik et al., 2008; van den Berg et al., 2011). With this in mind, a plausible expectation would be that all children would develop overweight, and yet not all children do. While this individual variation can be partly explained by gene expression (epigenetics), other individual-level factors may also influence how responsive a child is to environmental influences (Gluckman & Hanson, 2008). Therefore, it is important to understand how stimuli that can prompt food intake, such as food advertising, (Boyland et al., 2016) may affect some children more than others.

There is a commonly held belief that as children increase in age and attain greater cognitive maturity, they become more aware of advertising's persuasive intent and become better equipped to defend themselves against advertising's negative effects (Calvert, 2008). However, in addition to the highly emotive themes and tempting food cues present in food advertising, the subtle and embedded nature of contemporary advertising approaches blurs the distinction between media content and advertising, making critical evaluation of marketing more difficult. A prime example is online branded games ("advergimes"), commonly found on food industry websites, where cues, in the form of the brand or food item, are integrated into the game play, and as such are less likely to be consciously processed (Terlutter & Capella, 2013). This type of advertising can influence behaviour, such as eating, without there being a deliberate or conscious processing of the information presented (Harris & Graff, 2012).

Psychosocial theoretical models propose that when children process persuasive messages with low cognitive elaboration (implicit processing), such as those found in advergimes, the cues are likely to have a greater effect on their eating behaviour than if they use greater cognitive elaboration (explicit processing) (Buijzen, Van Reijmersdal, & Owen, 2010; Folkvord, Anschutz, Boyland, Kelly, & Buijzen, 2016; Nairn & Fine, 2008). Intra-individual variations among children, arising from individual susceptibility factors such as attentional bias and impulsivity, lead to differential responses (Folkvord et al., 2016; Valkenburg & Peter, 2013).

Short term experimental studies, where children are exposed to food advertising, embedded in a cartoon or online game, consistently show that children have a significantly greater food intake after food advertising exposure compared with non-food advertising (Boyland et al., 2016). In addition, some children appear to respond to food advertising to a greater extent (Anschutz, Engels, & Van Strien, 2010; Folkvord, Anschutz, Nederkoorn, Westerik, & Buijzen, 2014; Folkvord, Anschutz, Wiers, & Buijzen, 2015; Halford et al., 2008). Increased effects of food advertising on children's food consumption have been observed among children with overweight and obesity (Halford et al., 2008; Norman et al., 2017); those whose mothers exhibit encouragement to be thin (Anschutz et al., 2010); who have high impulsivity (Folkvord et al., 2014); and who show increased attentional bias to food displayed in advertisements (Folkvord et al., 2015).

Interactions between parents and children within the family and home environment shape the development and establishment of children's eating behaviours and dietary self-regulation (Birch, 2006). The approaches that parents use to promote healthy eating habits have been found to influence children's food behaviours. Feeding practices, such as restricting foods deemed as unhealthy, and pressuring or coercing children to eat healthier foods such as fruit and vegetables, can be counterproductive (Gerards & Kremers, 2015); with both food restriction and pressure to eat shown to be significantly related to a child's preference for foods high in fat and sugar (Vollmer & Baietto, 2017). Additionally, research suggests that children subject to these feeding practices are less successful in self-regulating their energy intake than children whose parents encourage them to focus on their internal satiety and hunger cues, and as a consequence these children may be more influenced by external food cues (Stoeckel et al., 2017). This gives rise to the question whether children who experience controlling parental feeding practices may be more responsive to unhealthy food advertising. Eating studies that explore relationships between parental feeding practices and children's food behaviours are typically conducted in the absence of parental supervision (Lansigan, Emond, & Gilbert-Diamond, 2015). Hence, a school holiday program, which children attend without parents, presents an ideal environment in which to perform a study of this nature.

This paper reports on data collected from a randomised controlled trial (RCT) which investigated whether exposure to food advertising from a single media or a multiple media source increased children's immediate food consumption (kJ) at a snack directly after exposure compared with non-food advertising, and whether any immediate increased energy intake was compensated for at a later lunchtime meal (Norman et al., 2017). The aim of the present study was to explore the relationships between parental feeding practices and children's food intake responses after the different advertising exposures.

## **Methods**

### *Study design and participants*

The within-subject, crossover, counterbalanced RCT was conducted across four, six-day school holiday camps from April 2016 to January 2017 in New South Wales, Australia. Children attended the morning sessions of the holiday camp every day from 8am to 1.30pm. The full study protocol and main results have been published elsewhere (Norman et al., 2017). We recruited 160 children (78 female, 82 male), aged 7-12 years ( $9.3 \pm 1.6$  (mean  $\pm$  SD)) via local schools, community and university networks and social media, with 40 children attending each holiday camp. Inclusion criteria included no reported food allergies or dietary restrictions. Incentives for participants included payment for their holiday camp fees.

Within each holiday camp, children were allocated to one of two groups of 20, balanced by age and sex, and randomised to participate in either the single media (TV) or multiple media (TV plus Internet advergame) condition. Within each media condition was an experimental condition (unhealthy food advertising (three days)) and a control condition (non-food advertising (three days)). Within each camp children participated in both the experimental and control conditions, with the sequence of advertising condition counter-balanced across holiday camps.

Informed written consent was obtained for all study participants. The study was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12617001230347) and approved by the University of Wollongong Human Research Ethics Committee.

## *Materials and measures*

### *Media and advertising*

*TV*: six age-appropriate, ten minute cartoons were selected; one for each day of the camp. These were embedded with either ten food related TV advertisements or ten non-food related TV advertisements (approximately 30 seconds/advert). The ten TV advertisements were the same each day of the camp, changing only according to experimental or control condition. Pictures or references to food did not appear in any of the cartoons. *Internet*: an online advergame featuring either a food brand or a non-food brand (five minute game play). The advergames featured the advertised brand or product as active game components, present throughout the duration of the game. The advertised food products were categorised as unhealthy in line with the nutrient profiling criteria developed by Food Standards Australia New Zealand (Food Standards Australia New Zealand, 2015). In order to determine the influence of the study advertising, all branded food products in the experimental condition were for items available for purchase overseas but not in Australian supermarkets. The TV advertisements are not aired on Australian commercial TV stations and the advergames are only available for download through international app stores.

### *Foods and intake measurement*

*Snack-time*: children were offered individual trays with six small bowls of preweighed assorted snack foods. Each bowl contained 50 grams (g) of a different food option: high fat savoury, low fat savoury, high fat sweet, low fat sweet, fruit and vegetable. The snack choices were in line with previous study designs (Halford et al., 2008), and none of the brands featured in any of the advertisements shown. Children were told that they could eat as little or as much as they would like, and were given more of any food item on request. The snack period was strictly limited to 15 minutes. For each child the leftovers of the individual foods were weighed (g).

*Lunch-time*: children were presented with a tray of pre-prepared, pre-weighed standardised food items. There were three different lunch menus: items included fruit, vegetables, yoghurt and healthier types of fast food eg cheese and tomato pizza, oven baked chips and chicken pieces. Menus on Days One to Three were repeated on Days Four to Six of the camp. As with snack-time, extra food items were available on request and there was a thirty minute time limit. All leftovers were individually weighed (g).

Gram amounts were converted to kJs using FoodWorks nutrient analysis software (Version 8, Xyris Pty Ltd, Australia). Each child's mean snack and lunch intakes for the three days of food advertising exposure and three days of non-food advertising exposure were calculated.

### *Children's hunger*

Children reported how hungry they felt before snack-time and lunch each day using a validated 5-point picture-rating scale; with the anchors "I am really hungry" (1) and "I am not hungry at all" (5) (Bennett & Blissett, 2014). Mean hunger scores were calculated for snack and lunch for the two advertising conditions.

### *Children's weight and height*

Children's weight and height were measured on Day 1 of the camp. Children's body mass index (BMI;  $\text{weight}/\text{height}^2$ ) and BMI z-scores (World Health Organization, 2007) were calculated. The BMI for age was used to classify weight status into underweight, normal weight, overweight or obesity categories using international standardised cut-points (Cole & Lobstein, 2012).

### *Daily procedure*

At mid-morning on each day of the holiday camp, children were shown to either the single media or multiple media intervention room, according to randomisation. Each day children in both rooms watched the same cartoon with the same TV advertisements embedded. The children in the multiple media condition then played an Internet advergame for five minutes. Snack-time immediately followed children's advertising exposure. Lunch was served in the main camp dining room at 1pm, after which children went home for the day. Camp leaders ensured that the duration and intensity of children's camp activities, which were conducted between meal periods, were similar each day.

### *Parental feeding practices*

Parental feeding practices were self-reported online by parents at baseline using the Child Feeding Questionnaire (CFQ) (Birch et al., 2001). The controlling feeding practices 'restriction' and 'pressure to eat' are two of the most commonly researched subscales of the CFQ and were the two that were used in this analysis. There are eight questions relating to the restriction subscale (e.g. "If I did not guide or regulate my child's eating he/she would eat too much of their favourite foods") and four questions relating to the pressure to eat subscale (e.g. "My child should always eat all of the food on his/her plate"). Item response options were rated as 1 = disagree, 2=slightly disagree, 3 = neither disagree nor agree, 4=slightly agree, and 5 =agree. The internal consistency of items within these subscales has been confirmed in earlier research (pressure to eat:  $\alpha = 0.70$ ; restriction:  $\alpha = 0.73$  (Cronbach's alphas)) (Birch et al., 2001). Mean scores for each subscale were calculated. Subsequently, the subscale mean feeding scores were dichotomised into 'no' for scores of 3 or lower for each child and 'yes' for greater than 3, with 'yes' indicating that parents exerted a higher level of parental control on their children's eating behaviours, either by restricting or pressuring food intake. A similar approach to dichotomising responses to the CFQ has been used in earlier studies (Park, Li, & Birch, 2015).

### *Outcome variables*

The main outcomes were children's mean snack intake (kJ) after food advertising exposure (3 days) and non-food advertising exposure (3 days), their mean lunch intake (kJ) on food advertising and non-food advertising days, and combined mean snack and lunch intakes (kJ) on food advertising and non-food advertising days.

### **Statistical analysis**

Data were analysed separately by media condition. Linear mixed models with repeated measures were used to examine relationships between children's consumption responses (kJ) at the different eating occasions and dichotomised feeding practice scores. The three different primary outcomes were kJ consumed at the snack, lunch, and snack and lunch combined repeated across the two advertising conditions. The fixed-factor effects used in all models were advertising condition (food or non-food advertising) and feeding practice scores. The interaction between advertising condition and feeding practice scores was tested for significance in all models. Camp identifier was included as a random intercept in the models in order to adjust for the clustered nature of the data. Any influence of the impact of age, sex, weight status (BMI z-score), or hunger on snack and lunch intake were investigated by adding these variables as covariates to the models.

Descriptive statistics are reported as means ( $\pm$ SDs) for continuous variables or as percentages for categorical variables. Results from the linear mixed models analyses are presented as means (95% CIs) unless otherwise indicated. Reported p values are two-sided, and  $p < 0.05$  was considered significant in all tests. Analyses were completed using SPSS Statistics version 23.0 for Windows (SPSS Inc., Chicago, IL, USA).

## Results

Six children did not complete all six days of the camp, leaving 154 children in the final analysis (78 female, 76 male,  $9.3 \pm 1.6$  years (mean  $\pm$  SD)). Participant characteristics and parental feeding practice scores are shown in Table 1. There were no significant differences between the descriptive statistics for the two media condition groups.

As previously reported, the increase in snack intake after food advertising (compared with non-food advertising) was significantly greater in the multiple media condition than the single media condition ( $p < 0.01$ ) (Norman et al., 2017); hence data were analysed separately by media condition. Age and sex had no significant main effect or interaction on food consumption and were removed from further analyses. In the single media condition BMI z-score was positively related to the difference in mean lunch food intake ( $p < 0.05$ ) and mean snack plus lunch intake ( $p < 0.01$ ) between food advertising and non-food advertising days. There were no associations between parental feeding practice scores, either restriction or pressure to eat, and BMI z-score, nor were restriction and pressure to eat scores related.

In the single media condition all children ate similar amounts at the snack after food advertising and non-food advertising, with no differential effect among different feeding practice sub-groups (Table 2).

	Single media (n=76)	Multiple media (n=78)
Sex, n (%)		
Girls	40 (51.3)	38 (48.7)
Boys	37 (48.7)	39 (51.3)
Mean age (years) <sup>1</sup>	$9.5 \pm 1.5$	$9.1 \pm 1.75$
Mean WHO BMI z-score <sup>1</sup>	$0.27 \pm 1.2$	$0.29 \pm 1.1$
BMI for age, n (%)		
Underweight	4 (5)	1 (1)
Normal weight	61 (80)	63 (81)
Overweight	10 (13)	9 (12)
Obesity	1(1)	5 (6)
Mean Restriction subscale score <sup>1</sup>	$3.1 \pm 1.1$	$3.3 \pm 1.0$
Restrictive parents (dichotomised), n (%)	36 (47)	45 (58)
Mean Pressure to eat subscale score <sup>1</sup>	$2.4 \pm 1.0$	$2.6 \pm 1.0$
Pressure to eat parents (dichotomised), n (%)	19 (25)	20 (26)

<sup>1</sup> Values are means  $\pm$  SDs

However there was a positive significant association between restrictive parental feeding practices and increased lunch intake ( $p < 0.01$ ) and snack plus lunch intake ( $p < 0.05$ ) on the food advertising days compared with non-food advertising days. Children whose parents were restrictors ate 240kJ more at lunch on food advertising days versus non-food advertising days ( $p < 0.01$ ), remaining significant after controlling for hunger and BMI z-score ( $p < 0.01$ ). The children whose parents were non-restrictors did not consume any additional kJ at lunch in response to the food advertising, with a difference observed between the two groups (restrictors vs. non-restrictors) of 287kJ ( $p < 0.01$ ). Children with restrictive parents in this media condition ate an additional 288kJ overall (snack plus lunch) ( $p < 0.05$ ) on food advertising days compared with non-food advertising days. This was an additional 334kJ more than the children with non-restrictive parents, who did

not consume any additional kJ overall in response to the food advertising ( $p < 0.05$ ). Pressure to eat did not have a differential effect on children's lunch consumption in the single media condition.

As previously reported, all children in the multiple media condition ate more at the snack after food advertising than after non-food advertising (201kJ,  $p < 0.0001$ ) (Norman et al., 2017). This was not compensated for at lunch which led to an additional daily food intake of 194kJ ( $p < 0.001$ ) (snack plus lunch) on food advertising days for children within this media condition. There was an increased effect seen among children whose parents reported high pressure to eat feeding practices. These children ate an additional 356kJ ( $p < 0.0001$ ) at the snack after food advertising exposure compared with non-food advertising exposure, remaining significant after controlling for hunger and BMI z-score ( $p < 0.0001$ ); an extra 209kJ ( $p < 0.05$ ) more than children whose parents did not pressure them to eat. This led to a total additional daily food intake of 342kJ ( $p < 0.01$ ) on food advertising days among children whose parents pressured them to eat. Children in both the restrictive and non-restrictive groups ate more at a snack after food advertising compared with non-food advertising, with no significant difference in snack intake between these two groups. Children consumed similar amounts at lunch on food and non-food advertising days in the multiple media condition, with no differential effect among the feeding practice sub-groups.

**Table 2**

The effects of advertisement condition on the kJ intake in all children and by feeding practices across media conditions (means (95% CIs))

	Difference in mean kJ intake between food and non-food advertisements SNACK	Difference in mean kJ intake between food and non-food advertisements LUNCH	Daily additional kJs consumed at the holiday camp after food advertising
<b>Single media</b>			
All children (n=76) <sup>#</sup>	19 (-85–125)	89 (-5–183)	108 (-30–246)
No restriction (n=40)	-7 (-161–147)	-47(-161–67) <sup>a</sup>	-54 (-215–108) <sup>c</sup>
Restriction (n=36)	48 (-101–197)	240** (96–384) <sup>b</sup>	288* (65–511) <sup>d</sup>
No pressure to eat (n=57)	50 (-70–169)	66 (-35–166)	115 (-36–266)
Pressure to eat (n=19)	-71 (-309–166)	159 (-85–403)	88 (-431–256)
<b>Multiple media</b>			
All children (n= 78) <sup>#</sup>	201**** (113–288)	-6 (-91–79)	194*** (80–308)
No restriction (n=33)	257*** (114–399)	56 (-79–191)	313*** (145–480)
Restriction (n =45)	160** (46–274)	-52 (-163–59)	108 (-263–48)
No pressure to eat (n=58)	147** (44–251) <sup>e</sup>	-4(-101–93)	143* (7–280)
Pressure to eat (n =20)	356**** (197–515) <sup>f</sup>	-14(-205–177)	342** (135–548)
* $p < 0.05$ , ** $p < 0.01$ , *** $p < 0.001$ , **** $p < 0.0001$			
Significant differences between b and a ( $p = 0.002$ ); d and c ( $p = 0.013$ ); f and e ( $p = 0.038$ )			
<sup>#</sup> Results published in (Norman et al., 2017)			

## Discussion

This study identifies that children who experience parental feeding practices that impede their self-regulation of eating have an increased vulnerability to the effects of unhealthy food advertising; with these children consuming more in response to food advertising exposure over a sustained period, compared with non-food advertising. In the multiple media condition, parental pressure to eat did heighten the effect of advertising, however all children had increased snack intakes after food advertising exposure, compared with non-food advertising, which was not compensated for at a later meal. This suggests that marketing effects override children's learned self-regulatory responses to eating, especially when this is sustained and repeated across multiple media platforms. It also highlights that none of the parental feeding practices children experienced, whether controlling or non-controlling, were sufficient to negate the impact of food advertising on their eating behaviours. As this multiple media advertising condition is closer to children's real world exposures (Boyland & Whalen, 2015), this is a particularly important finding. The differential susceptibility was most pronounced in the single media group and resulted in children who experienced restrictive parental feeding practices eating more at a lunchtime meal following food advertising exposure.

Previous studies have identified other groups of children who also have increased vulnerability to the effects of food advertising, including those with heavier weight status (Halford et al., 2008; Norman et al., 2017) and those whose mothers exhibit encouragement to be thin (Anschutz et al., 2010). BMI z-score was not associated with parents' restriction or pressure to eat in our study, and so was not a confounder in the relationship between controlling feeding practices and children's responses to marketing. We have separately found weight status to influence the magnitude of children's responses to food advertising (Norman et al., 2017). This study finds a separate group of vulnerable children whose responses to marketing occur independently of weight status.

Psychosocial processing models propose that unhealthy food advertising prompts cravings for food and induces subsequent food intake via previously conditioned responses, with the level of processing of the embedded food cues influencing the magnitude of the effect of the food advertising (Buijzen et al., 2010; Folkvord et al., 2016; Nairn & Fine, 2008). This may explain the different intake responses at the snack after advertising exposure across the two media conditions and why all children were affected by the food advertising in the multiple media condition. The integrated nature of the food advertising within the advergame may have had a greater effect on children's food intake as the promotional content involved low levels of elaborative processing, initiating physiological responses which motivated food consumption without children being aware that they were being cued to eat (Buijzen et al., 2010; Folkvord et al., 2016). Of course, children in the multiple media condition also received double the dose of advertising exposure compared with the single media condition, so it may be that volume of exposure, as well as the different media platforms, is also important in influencing the magnitude of responses. Empirical data on sustained exposures to food advertising are scarce, however, an early study found that repetitive exposures to an ice cream TV advertisement embedded within a cartoon did not increase children's subsequent food consumption compared with single exposure (Gorn & Goldberg, 1980). The authors report that this could have been a factor of study design, with children appearing irritated by the repetitive nature of the advertisement and that this may have directly affected children's eating behaviours. More recent research suggests that when online and offline media marketing communications are used in tandem, their interaction can enhance consumer behavioural responses through synergistic cross-effects (Batra & Keller, 2016). Indeed, an aim of integrated multimedia campaigns is to increase consumer effects in such a way that the coordinated effect is greater than if the individual marketing platforms were experienced independently

of each other (Keller, 2016). The lack of an 'advergame-only' single media condition means that we were unable to confirm this effect.

Identifying increased vulnerability to food advertising among children who experience controlling parental feeding practices is a novel finding. Not only does it highlight a group of children with differential susceptibility to the negative effects of food advertising but it emphasises the importance of promoting feeding practices that help support a child's self-regulatory development in regards to their eating. It has been suggested that responsive, structure-based feeding practices, where parents offer guidance, provide routines, set boundaries and take into account the child's perspective, can be helpful in promoting self-regulation (Frankel, Powell, & Jansen, 2017; Rollins, Savage, Fisher, & Birch, 2015). It is questionable, however, given the immersive nature of the promotional messages within contemporary food advertising, and in light of our findings for multiple media exposures particularly, whether the results of any parenting practices could be effective in protecting children from advertising's negative influences.

The sustained energy imbalances observed in this study after food advertising exposure are of a magnitude that could contribute to the development of overweight (Plachta-Danielzik et al., 2008; van den Berg et al., 2011). Our findings clearly highlight the requirement for more stringent regulatory policy to restrict children's exposure to unhealthy food marketing across offline and, particularly, online media. Despite restriction of food marketing to children being identified at the highest levels of international policy—making (United Nations General Assembly, 2011; World Health Organization, 2010), few territories have enforced statutory restrictions, with most countries relying on industry-led codes for responsible marketing (Galbraith-Emami & Lobstein, 2013). Evidence indicates that industry self-regulation has not been effective in protecting children from food advertising exposures (Galbraith-Emami & Lobstein, 2013), with children continuing to be exposed to high levels of food marketing across a wide range of media platforms (Boyland & Whalen, 2015; Vandevijvere, Soupen, & Swinburn, 2017).

There were different responses to food advertising on snack and then on meal consumption across the single and multiple media groups. While the multiple media group ate more snack food in the food advertising condition, the single media group ate more at the next meal and not at the snack. In these children it is possible that the activation of prior advertising-based memory structures could have been triggered in the presence of palatable lunch foods, prompting a greater intake of foods (Büttner, Florack, & Serfas, 2014). Both restrictive and pressure to eat feeding practices were associated with greater intakes at the lunchtime meal for children in the single media condition, however this was only significant for children who experienced restrictive practices. Posteriori calculations estimate that a sample of 80 children in the pressure to eat subgroup would be needed to detect this effect on lunch consumption.

As previously reported, a study limitation may have been the time-limited, undisclosed snack eating period of 15 minutes, which may have accounted for the lack of effect on children's snack intake in the single media condition (Norman et al., 2017). Previous studies, where significant consumption responses after TV food advertising exposure were observed had unlimited snack eating times (Halford et al., 2008; Halford, Gillespie, Brown, Pontin, & Dovey, 2004). As children within the single media condition ate similar amounts at the snack after both food and non-food advertising (Norman et al., 2017), it is unsurprising that no interactions with advertising condition or feeding practices were found here.

A possible limitation in using the CFQ was the reliance on parental report which may have been subject to social desirability bias. A former study which utilised a child version of the CFQ, in addition to the parents' version of the CFQ, found a lack of agreement between parental and child reports and perceptions of

restrictive eating habits (Carper, Orlet Fisher, & Birch, 2000); though this may have simply related to subjective differences between the two groups.

In conclusion, this study indicates that children who experience controlling parental feeding practices may be less able to self-regulate their food intake after exposure to food advertising than children who experience less controlling feeding practices. However our findings show that all children within the multiple media condition, no matter their parents' feeding practices, ate more at a snack after food advertising, which was not compensated for at the next meal. The ubiquitous nature of contemporary food marketing means that children are frequently faced with unhealthy food cues in their daily lives. While structure-related parental feeding practices hold promise in supporting a child's self-regulatory development (Frankel et al., 2017), if children respond to real world marketing stimuli the same way they did to the food advertising in our study, then their responses could, indeed, lead to weight gain. These data clearly suggest that policy interventions that focus singularly on improving the at-home feeding environment will be ineffective in the absence of broader regulatory controls on food marketing. A more practicable solution is for policy makers to enforce stronger regulations on children's food advertising exposure, across all media platforms, particularly online media.

### **Contributors**

BK is the Chief Investigator of the study and led the writing of the initial study protocol and successful funding application. All authors contributed to the conception and design of the study. BK and A-T M supervised JN. JN is a PhD Candidate who primarily implemented the study protocol, including recruitment. JN led the statistical analysis, supervised by BK and with advice from AB and LB. All authors contributed to critical revision of this manuscript and have approved the final version.

### **Funding**

This research has been funded by an Australian Research Council Linkage Grant (LP 140100120). Cancer Council NSW contributed funding as the Linkage Partner organisation.

This research has been conducted with the support of the Australian Government Research Training Program Scholarship.

The Australian Research Council played no part in the study design, collection, analysis and interpretation of data; or the writing of the report; or the decision to submit the paper for publication. The corresponding author has full access to all the data in the study and had final responsibility for the decision to submit for publication. Two researchers from Cancer Council NSW (KC and CH) were study collaborators.

### **Competing interests**

All authors have completed the ICMJE uniform disclosure form at <http://www.icmje.org/conflicts-of-interest/> (available on request from the corresponding author). JN, BK, EB, LB, AB, KC, LK and CH all declare that they have no conflicts of interest.

A-T M reports grants from Australian Meals on Wheels Association, personal fees from Pork CRC, personal fees from Proportion Foods, personal fees from YUM Corp, personal fees from PhD examinations, personal fees from Flagstaff Fine Foods, personal fees from IRT, grants from University of Wollongong grant funds; outside the submitted work.

## Acknowledgements

We wish to acknowledge Lee Murray and his team at the University of Wollongong Sports Holiday Camp for their flexibility and willingness to partner with us to bring this study to fruition. We thank the operations team at Early Start and all our research assistants for their support and hard work throughout the study. Finally, we wish to acknowledge all our study participants, without whom the successful completion of this study would not have been possible.

## References

- Allman-Farinelli, M. A., Chey, T., Bauman, A. E., Gill, T., & James, W. P. T. (2007). Age, period and birth cohort effects on prevalence of overweight and obesity in Australian adults from 1990 to 2000. *European Journal of Clinical Nutrition*, *62*(7), 898-907.
- Anschutz, D. J., Engels, R. C., & Van Strien, T. (2010). Maternal encouragement to be thin moderates the effect of commercials on children's snack food intake. *Appetite*, *55*(1), 117-123.
- Batra, R., & Keller, K. L. (2016). Integrating marketing communications: new findings, new lessons, and new ideas. *Journal of Marketing*, *80*(6), 122-145.
- Bennett, C., & Blissett, J. (2014). Measuring hunger and satiety in primary school children. Validation of a new picture rating scale. *Appetite*, *78*, 40-48.
- Birch, L. L. (2006). Child feeding practices and the etiology of obesity. *Obesity (Silver Spring, Md.)*, *14*(3), 343-344.
- Birch, L. L., Fisher, J. O., Grimm-Thomas, K., Markey, C. N., Sawyer, R., & Johnson, S. L. (2001). Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*, *36*(3), 201-210.
- Boyland, E. J., Nolan, S., Kelly, B., Tudur-Smith, C., Jones, A., Halford, J. C., & Robinson, E. (2016). Advertising as a cue to consume: a systematic review and meta-analysis of the effects of acute exposure to unhealthy food and nonalcoholic beverage advertising on intake in children and adults. *American Journal of Clinical Nutrition*, *103*(2), 519-533.
- Boyland, E. J., & Whalen, R. (2015). Food advertising to children and its effects on diet: A review of recent prevalence and impact data. *Pediatric Diabetes*, *16*(5), 331-337.
- Buijzen, M., Van Reijmersdal, E. A., & Owen, L. H. (2010). Introducing the PCMC model: an investigative framework for young people's Processing of Commercialized Media Content. *Communication Theory*, *20*(4), 427-450.
- Büttner, O., Florack, A., & Serfas, B. (2014). A dual-step and dual-process model of advertising effects: implications for reducing the negative impact of advertising on children's consumption behaviour. *Journal of Consumer Policy*, *37*(2), 161-182.
- Calvert, S. L. (2008). Children as consumers: advertising and marketing. *The Future of Children*, *18*(1), 205-234.
- Carper, J. L., Orlet Fisher, J., & Birch, L. L. (2000). Young girls' emerging dietary restraint and disinhibition are related to parental control in child feeding. *Appetite*, *35*(2), 121-129.
- Cole, T. J., & Lobstein, T. (2012). Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatric Obesity*, *7*(4), 284-294.
- Folkvord, F., Anschutz, D. J., Boyland, E., Kelly, B., & Buijzen, M. (2016). Food advertising and eating behavior in children. *Current Opinion in Behavioral Sciences*, *9*, 26-31.
- Folkvord, F., Anschutz, D. J., Nederkoorn, C., Westerik, H., & Buijzen, M. (2014). Impulsivity, "advergames," and food intake. *Pediatrics*, *133*(6), 1007-1012.
- Folkvord, F., Anschutz, D. J., Wiers, R. W., & Buijzen, M. (2015). The role of attentional bias in the effect of food advertising on actual food intake among children. *Appetite*, *84*, 251-258.

- Food Standards Australia New Zealand. (2015). Food Standard 1.2.7; Nutrient Profiling Scoring Criterion. from <http://www.foodstandards.gov.au/industry/labelling/Pages/nutrientprofilingcalculator/Default.aspx>
- Frankel, L. A., Powell, E., & Jansen, E. (2017). The relationship between structure-related food parenting practices and children's heightened levels of self-regulation in eating. *Childhood Obesity, 14*(2), 1-8.
- Galbraith-Emami, S., & Lobstein, T. (2013). The impact of initiatives to limit the advertising of food and beverage products to children: A systematic review. *Obesity Reviews, 14*(12), 960-974.
- Gerards, S. M. P. L., & Kremers, S. P. J. (2015). The role of food parenting skills and the home food environment in children's weight gain and obesity. *Current Obesity Reports, 4*(1), 30-36.
- Gluckman, P. D., & Hanson, M. A. (2008). Developmental and epigenetic pathways to obesity: an evolutionary-developmental perspective. *International Journal of Obesity (2005), 32 Suppl 7*, S62-71.
- Gorn, G. J., & Goldberg, M. E. (1980). Children's responses to repetitive television commercials. *Journal of Consumer Research, 6*(4), 421-424.
- Halford, J. C., Boyland, E. J., Hughes, G. M., Stacey, L., McKean, S., & Dovey, T. M. (2008). Beyond-brand effect of television food advertisements on food choice in children: the effects of weight status. *Public Health Nutrition, 11*(9), 897-904.
- Halford, J. C., Gillespie, J., Brown, V., Pontin, E. E., & Dovey, T. M. (2004). Effect of television advertisements for foods on food consumption in children. *Appetite, 42*(2), 221-225.
- Harris, J. L., & Graff, S. K. (2012). Protecting young people from junk food advertising: implications of psychological research for First Amendment law. *American Journal of Public Health, 102*(2), 214-222.
- Hawkes, C., Smith, T. G., Jewell, J., Wardle, J., Hammond, R. A., Friel, S., . . . Kain, J. (2015). Smart food policies for obesity prevention. *The Lancet, 385*, 2410-2421
- Keller, K. L. (2016). Unlocking the power of integrated marketing communications: how integrated is your IMC program? *Journal of Advertising, 45*(3), 286-301.
- Lansigan, R. K., Emond, J. A., & Gilbert-Diamond, D. (2015). Understanding eating in the absence of hunger among young children: A systematic review of existing studies. *Appetite, 85*, 36-47.
- Monteiro, C. A., Moubarac, J. C., Cannon, G., Ng, S. W., & Popkin, B. (2013). Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews, 14*, 21-28.
- Nairn, A., & Fine, C. (2008). Who's messing with my mind? The implications of dual-process models for the ethics of advertising to children. *International Journal of Advertising, 27*(3), 447-470.
- Norman, J., Kelly B., McMahon A-T., Boyland E., Baur L., Chapman K., . . . Bauman A. (2017). Sustained impact of energy-dense food advertising on children's dietary intake: a within-subject, randomised, crossover, counter-balanced trial. *Manuscript submitted for publication*.
- Park, S., Li, R., & Birch, L. L. (2015). Mothers' child-feeding practices are associated with children's sugar-sweetened beverage intake. *Journal of Nutrition, 145*(4), 806-812.
- Plachta-Danielczik, S., Landsberg, B., Bosy-Westphal, A., Johannsen, M., Lange, D., & Muller, M. (2008). Energy gain and energy gap in normal-weight children: longitudinal data of the KOPS. *Obesity (Silver Spring), 16*(4), 777-783.
- Rollins, B. Y., Savage, J. S., Fisher, J. O., & Birch, L. L. (2015). Alternatives to restrictive feeding practices to promote self-regulation in childhood: a developmental perspective. *Pediatric Obesity, n/a-n/a*.
- Stoeckel, L. E., Birch, L. L., Heatherton, T., Mann, T., Hunter, C., Czajkowski, S., . . . Savage, C. R. (2017). Psychological and neural contributions to appetite self-regulation. *Obesity, 25*, S17-S25.
- Swinburn, B. A., Sacks, G., Hall, K. D., McPherson, K., Finegood, D. T., Moodie, M. L., & Gortmaker, S. L. (2011). Obesity 1: The global obesity pandemic: shaped by global drivers and local environments. *The Lancet, 378*(9793), 804-814.
- Terlutter, R., & Capella, M. L. (2013). The gamification of advertising: Analysis and research directions of in-game advertising, advergames, and advertising in social network games. *Journal of Advertising, 42*(2-3), 95-112.
- United Nations General Assembly. (2011). Prevention and control of non-communicable diseases. Report of the Secretary-General. Sixty-sixth session. Item 119 of the preliminary list.

- Valkenburg, P. M., & Peter, J. (2013). The differential susceptibility to media effects model. *Journal of Communication, 63*(2), 221-243.
- van den Berg, S. W., Boer, J. M., Scholtens, S., de Jongste, J. C., Brunekreef, B., Smit, H. A., & Wijga, A. H. (2011). Quantification of the energy gap in young overweight children. The PIAMA birth cohort study. *BMC Public Health, 11*(1), 1-8.
- Vandevijvere, S., Soupen, A., & Swinburn, B. (2017). Unhealthy food advertising directed to children on New Zealand television: extent, nature, impact and policy implications. *Public Health Nutrition, 1-12*.
- Vollmer, R. L., & Baietto, J. (2017). Practices and preferences: Exploring the relationships between food-related parenting practices and child food preferences for high fat and/or sugar foods, fruits, and vegetables. *Appetite, 113*, 134-140.
- World Health Organization. (2007). Growth Reference Data for 5–19 years from <http://www.who.int/growthref/en/index.html>
- World Health Organization. (2010). Set of recommendations on the marketing of foods and non-alcoholic beverages to children.