

OPRU Briefing Paper- Critical reasoning and advertising in children and adolescents

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Executive Summary

KEY MESSAGES

Young people are exposed to an abundance of advertising for unhealthy products which has harms (e.g. unhealthy foods, tobacco, alcohol). Evidence shows that the attitudes of children and adolescents were positively influenced by advertising. Critical reasoning abilities did not appear to be fully developed during adolescence and were not found to be protective against the impact of advertising. We found little evidence for a ceiling or threshold effect around 12 years of age. Evidence suggests that consideration should be given by policymakers to ensure marketing

Background

Many countries enact regulations that only seek to protect children aged 12 years and younger from food marketing, but this cut off has been questioned since it is largely based on outdated models of cognitive development. The nature of advertising has also changed with boundaries between content and advertising becoming less clear. Adolescents may be particularly vulnerable to the effects of advertising for food or other unhealthy products given the importance of media in social identity development and their high level of engagement with digital technology.

Aims

The aim of this review was to explore whether advertising influences children and adolescents' critical reasoning and decision-making in relation to health behaviours such as food choice, alcohol consumption, and smoking.

Methods

We undertook a systematic review of literature relating to the effects of advertising on understanding and judgement in children aged 6-17 years inclusive. Since the extent of the literature was largely unknown, the inclusion criteria were initially broad (experimental, intervention, cross-sectional, longitudinal, and qualitative methodologies; with no restrictions on language or date), before being refined to include studies from 2010 with an administered exposure that measured understanding or attitudinal outcomes. We searched ten databases; articles were double screened on title and abstract and EPPI-Reviewer 4 systematic review software used to manage the review and apply machine learning to the screening. We completed a narrative synthesis and meta-analysis. We also conducted a Patient and Public Involvement (PPI) session with Young Research Advisors facilitated by the National Children's Bureau to discuss the key findings of the review and their views on a potential policy response.

Key findings

- Understanding of advertising was found to increase across childhood and into adolescence; there is no strong evidence that understanding reaches adult levels by age 12 years.
- Digital advertising formats appear more difficult for younger children to understand.
- Advertising was able to significantly influence teenagers' understanding of health risks.
- Advertising brought about more positive attitudes about the product in both younger children and teenagers, but there were no clear relationships with age.
- It was not clear what impact manipulating aspects of advertising has on attitudes, but more engaging formats (e.g., advergames and 'tie ins') seem to particularly resonate with younger children.

- Meta-analysis of nine studies with attitudinal outcomes indicated that unhealthy product advertising generated more positive brand and product attitudes compared to neutral or no advert control in all ages.
- Significant effects were found for both digital and non-digital advertising formats.
- We found greater understanding did not protect against the impact of advertising on brand or product attitudes.
- Young people from the PPI session agreed that advertising impacts them, regardless of understanding, and were supportive of a pre-watershed ban on unhealthy food advertising.

Background

A greater understanding of children's responses to advertising/marketing in terms of their critical reasoning capacities would be helpful for policymakers in planning potential policy change. Many countries enact regulations that only seek to protect children aged 12 years and younger from food marketing.¹ However, such distinctions are largely based on dated models of cognitive development.² There have been substantial changes in marketing practice (e.g., greater digital marketing where the boundaries between content and marketing are unclear)³ and studies have shown that older children struggle to identify marketing^{2,4} (e.g., adolescents may be particularly vulnerable to the effects of advertising since the media can play an important role in social identity development at this stage of the life-course, additionally teenagers have a high level of engagement with digital tech.^{1,2} This is an important issue in the context of determining the extent to which advertisements may be exploitative of young people and inherently unfair.⁵

Children and adolescents are exposed to an abundance of advertising and marketing of unhealthy products, particularly food and drink, which is associated with a number of detrimental effects.⁶ Longitudinal studies show that exposure to alcohol advertising is associated with greater alcohol consumption and associated negative consequences.⁷ Direct tobacco advertising is banned in most countries, but many young people are exposed to indirect advertising, for example, through viewing tobacco use on television (TV), shown to result in smoking initiation in young people.⁸ Electronic cigarettes (e-cigarettes) have also grown in popularity over the last decade and pro-vaping messages are advertised on social media, with emerging evidence of harm.^{9,10} Research on the impacts of advertising on children over the past decade has focused particularly on high in fat, salt and sugar

¹WHO, "Evaluating Implementation of the Who Set of Recommendations on the Marketing of Foods and Non-Alcoholic Beverages to Children. Progress, Challenges and Guidance for Next Steps in the Who European Region.," http://www.euro.who.int/__data/assets/pdf_file/0003/384015/food-marketing-kids-eng.pdf.

²WHO, "Tackling Food Marketing to Children in a Digital World: Trans-Disciplinary Perspectives. Children's Rights, Evidence of Impact, Methodological Challenges, Regulatory Options and Policy Implications for the Who European Region.," http://www.euro.who.int/__data/assets/pdf_file/0017/322226/Tackling-food-marketing-children-digital-world-trans-disciplinary-perspectives-en.pdf.

³S. De Jans et al., "Advertising Targeting Young Children: An Overview of 10 years of Research (2006–2016)," *International Journal of Advertising* (2017).

⁴Moondore Ali et al., "Young Children's Ability to Recognize Advertisements in Web Page Designs," *British Journal of Developmental Psychology* 27, no. 1 (2009).

⁵M. Story and S. French, "Food Advertising and Marketing Directed at Children and Adolescents in the Us," *Int J Behav Nutr Phys Act* 1, no. 1 (2004).

⁶M. A. Lapiere et al., "The Effect of Advertising on Children and Adolescents," *Pediatrics* 140, no. Supplement 2 (2017).

⁷D. Jernigan et al., "Alcohol Marketing and Youth Alcohol Consumption: A Systematic Review of Longitudinal Studies Published since 2008," *Addiction* 112, no. S1 (2017).

⁸F. El-Awa et al., "Tobacco Advertising, Promotion and Sponsorship in Entertainment Media: A Phenomenon Requiring Stronger Controls in the Eastern Mediterranean Region," *East Mediterr Health J* 24, no. 1 (2018).

⁹K. McCausland et al., "The Messages Presented in Electronic Cigarette-Related Social Media Promotions and Discussion: Scoping Review," *J Med Internet Res* 21, no. 2 (2019).

¹⁰Sareen Singh et al., "E-Cigarettes and Youth: Patterns of Use, Potential Harms, and Recommendations," *Preventive Medicine* 133 (2020).

(HFSS) food advertising.¹¹ This is likely due to the high levels of interest in children's diet and obesity, with obesity rates in the UK increasing to 14.4% for reception and 25.5% Year 6 in 2020/21.¹² Young people are exposed to large amounts of food advertising through various media, which is often child-targeted, is mostly for HFSS foods,^{13,14} and is effective at increasing acute consumption in children.^{15,16}

There is a substantial literature around the understanding of advertising. A prominent framework has been the 'Persuasion Knowledge Model' (PKM) which proposes that in order to resist advertising, individuals must first recognise that an advert is trying to sell something (persuasion knowledge).¹⁷ Various aspects of understanding have been identified: recognising advertising; perception of who pays for advertising and audience targeting; understanding the selling intent of advertising (i.e. that advertisers are trying to sell products), persuasive intent (i.e., that advertisers are trying to influence behaviour via changing attitudes towards products/brands), tactics (i.e., specific strategies used), and bias regarding the product (i.e., discrepancies between advertised and actual product).¹⁸ Overall evidence suggests that 'advertising literacy' (i.e., knowledge and understanding of advertising) is not fully developed during childhood; therefore, children do not possess the necessary cognitive ability to resist advertising.¹⁸ Much of the work around children and advertising, as well as children's broader position as consumers, has been informed by Piagetian theory, which presents age-specific stages in children's development that are driven by cognitive ability.^{19,20} This suggests that as children get older, cognitive ability increases along with an increased ability to understand and resist advertising. This understanding was largely developed when TV was the main advertising medium, where research has shown there is a progressive growth in understanding, but the applicability to the digital age of advertising, where the entertainment and advertising content is not so clearly distinguished, has been questioned (even for older children).⁴

Social-cognitive models present the effects of advertising occurring automatically without any information processing, suggesting that understanding alone is insufficient to counteract potentially harmful effects of advertising.²⁰ In relation to food, the Food Marketing Defense Model posits that awareness, understanding, ability (including cognitive capacity), and motivation (to resist advertising) are all required to withstand food advertising.²⁰ Advertising, especially when digitally embedded, is designed to bypass conscious and rationale decision making and instead relies on emotional responses and non-conscious processing, thereby inhibiting the ability to effectively resist.^{2,21}

¹¹ P.C. Coleman et al., "A Rapid Review of the Evidence for Children's Tv and Online Advertisement Restrictions to Fight Obesity," *Preventive Medicine Reports* 26 (2022).

¹² NHS Digital, "National Child Measurement Programme, England 2020/21 School Year," (2021).

¹³ E. J. Boyland and R. Whalen, "Food Advertising to Children and Its Effects on Diet: Review of Recent Prevalence and Impact Data," *Pediatric Diabetes* 16, no. 5 (2015).

¹⁴ R. Smith et al., "Food Marketing Influences Children's Attitudes, Preferences and Consumption: A Systematic Critical Review," *Nutrients* 11, no. 4 (2019).

¹⁵ S. J. Russell, H. Croker, and R. M. Viner, "The Effect of Screen Advertising on Children's Dietary Intake: A Systematic Review and Meta-Analysis," *Obes Rev* 20, no. 4 (2019).

¹⁶ E. J. Boyland et al., "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," *The American Journal of Clinical Nutrition* 103, no. 2 (2016).

¹⁷ M. Friestad and P. Wright, "The Persuasion Knowledge Model: How People Cope with Persuasion Attempts," *Journal of Consumer Research* 21, no. 1 (1994).

¹⁸ E. Rozendaal et al., "Reconsidering Advertising Literacy as a Defense against Advertising Effects," *Media Psychology* 14, no. 4 (2011).

¹⁹ D. R. John, "Consumer Socialization of Children: A Retrospective Look at Twenty-Five Years of Research," *Journal of Consumer Research* 26, no. 3 (1999).

²⁰ J. L. Harris, K. D. Brownell, and J. A. Bargh, "The Food Marketing Defense Model: Integrating Psychological Research to Protect Youth and Inform Public Policy," *Social Issues and Policy Review* 3, no. 1 (2009).

²¹ E. Boyland and M. Tatlow-Golden, "Exposure, Power and Impact of Food Marketing on Children: Evidence Supports Strong Restrictions," *European Journal of Risk Regulation* 8, no. 2 (2017).

Reasoning abilities are not fully developed by the age of 16, older than the 12 year threshold used in many regulations; other faculties associated with decision-making also continue to develop into adulthood.²² It is established that adolescents engage in riskier behaviour than both children and adults; attributed in part to changes in reward sensitivity occurring from early adolescence and the later development of self-regulatory competence.^{Error! Bookmark not defined.} Recent neuroscience discoveries relating to the adolescent brain emphasise the continuing vulnerability of teenagers to social situations and social emotions, meaning that young people are vulnerable to making risky decisions in social situations.²³ In addition, young adolescents may be particularly susceptible to the social influence of other young people.²⁴

This evidence may be relevant to the critical reasoning of advertising, since developmentally, children and young people may not be cognitively equipped to protect themselves from the potentially harmful effects of advertising. This makes understanding advertising a challenge and studies indicate that children of all ages have difficulties identifying digital marketing.^{2,4} Adolescents are to be particularly vulnerable to advertising as they have high engagement with digital technology and media can play an important role in social identity development.^{1,2} This literature suggests that there are two key areas of interest, one relating to the *ability* of young people to understand advertising and the second relating to how they *respond to* advertising in terms of attitudes towards the advertised brand or product.

This review aimed to explore whether evidence supports the notion that critical reasoning ability affects behavioural responses. Critical reasoning relates to the former, but response is likely to include broader factors which could impact on what decisions young people make and their subsequent behaviour; for example, attitudes to the advertised product or brand and level of motivation to resist the impact of advertising exposure.

Study aims and objectives

Aim

This review aimed to explore whether advertising influences children and adolescents' critical reasoning and decision-making in relation to health behaviours such food choice, alcohol consumption, smoking/vaping.

Objectives

1. To undertake a systematic review of current knowledge of the development and function of critical reasoning faculties in children and adolescents in relation to understanding and processing advertisements, including all advertising (i.e., not be restricted to food advertising).
2. To assess evidence for a threshold around age 12 for critical reasoning relating to advertisements or whether thresholds exist at other ages.
3. To assess if level of understanding impacts on attitudinal outcomes.

Research question

Does advertising influence children and adolescents' critical reasoning and decision-making in relation to health behaviours such food choice, alcohol consumption, or smoking/vaping?

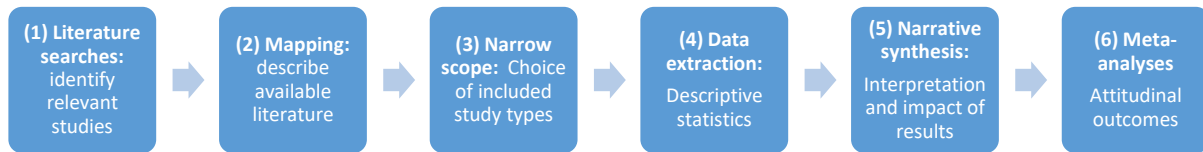
²²L. Steinberg, "Risk Taking in Adolescence: What Changes, and Why?," *Ann N Y Acad Sci* 1021 (2004).

²³S. J. Blakemore and T. W. Robbins, "Decision-Making in the Adolescent Brain," *Nat Neurosci* 15, no. 9 (2012).

²⁴ L. J. Knoll et al., "Social Influence on Risk Perception During Adolescence," *Psychol Sci* 26, no. 5 (2015).

What we did

The methods are split into six main phases.



We searched ten databases covering the research disciplines of medicine, psychology, science, social science and business and included all studies which fulfilled the criteria outlined below:

Participants: young people aged 6-17 years inclusive

Exposure: any form of advertising (TV, online, poster)

Study type: experimental, cross-sectional, longitudinal, qualitative

Outcome: a measure of 'understanding' or 'judgement' required

We include the list of databases included in the search, the search terms and the screening criteria in the appendices (Appendix 1). Searches were conducted on 7th November 2018 and updated on 10th December 2020. Given the large number of studies identified during the screening stage, a mapping exercise was carried out to characterise the studies and narrow the focus of the review to experimental studies (see Appendix 2 for details on the mapping stage and diagram). EPPI-Reviewer 4 software with a machine learning algorithm was used to screen the studies. Firstly, a random sample of studies were screened on title and abstract by two reviewers (HC & JP) using an 'active learning approach' and then the algorithm applied a classifier score to the unscreened articles (see Appendix 3 for full details of the machine learning method). Data extraction was carried out by one author (JP) and all checked by another reviewer (HC). The following information was extracted from these studies: author, year, language, country, sample size, age (range, mean, SD), study design, comparison groups, topic, administered exposure type and description, outcome measure/s, results.

We conducted three meta-analyses comparing an unhealthy advert exposure to a control or neutral advert, by attitude type (brand or product), advertising format (digital or non-digital) and impact of advertising by mean age (≤ 12 years, > 12 years due to legislation cut-offs). For this review we define brand attitude as the attitudes toward the advertised brand and product attitude as the attitudes toward the advertised product. Digital advertising formats included advergames, webpages, social media platforms and influencer marketing, while non-digital advertising formats included TV and printed adverts, and product placement on TV or in movie clips. Due to the different attitudinal outcomes measures (e.g., different scales), the DerSimonian-Laird random-effects model was used to allow for synthesis of studies and standardized mean difference (SMD) was used as the outcome for the meta-analyses. Further details for inclusion in the meta-analyses are provided in Appendix 4.

Bias assessment was carried out independently by two of three authors (HC, JP, MS) using Cochrane methods, either RoB 2.0 for randomized trials²⁵ or ROBINS-I tool for non-randomized studies.²⁶

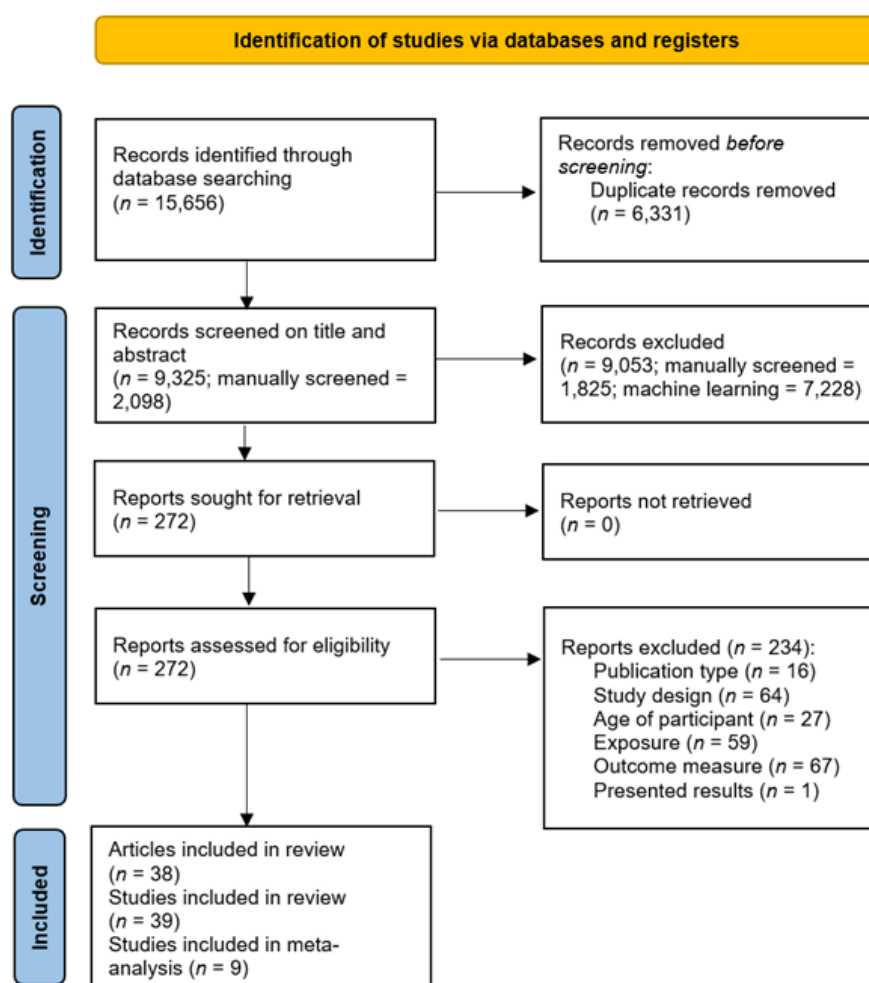
Public and Patient Involvement (PPI) session

We carried out a user-involvement session with Young Research Advisors (YRAs), facilitated by the National Children's Bureau, in April 2019 (see reference for further details).²⁷ The session was conducted with young people from across England, who were all trained as YRAs. The group consisted of nine young people aged 10-23 years old. We presented findings from the review and facilitated a group discussion to discuss proposed and potential policy initiatives; the session lasted two hours where.

What we found

Figure 1 shows the flowchart of studies through the review.

Figure 1. Flowchart



²⁵ J. P. T. Higgins et al., "A Revised Tool for Assessing Risk of Bias in Randomized Trials In: Chandler J, Mckenzie J, Boutron I, Welch V (Editors)," *Cochrane Database of Systematic Reviews*, no. Issue 10 (Suppl 1) (2016).

²⁶ J. A. C. Sterne et al., "Robins-I: A Tool for Assessing Risk of Bias in Non-Randomised Studies of Interventions," *BMJ* 355 (2016).

²⁷ J. Packer et al., "Effects of Advertising on Children's Understanding and Attitudes: Use of Public and Patient Involvement to Understand Young People's Response to a Systematic Review," *Obesity Abstracts* 1, no. P25 (2019).

Description of studies

A summary of the studies is provided in Table 1. Participant ages ranged from 6-17 years (although the included studies had participants ranging from 4 to 18, as we were unable to separate by age) and were broadly categorised as 12 years and under (n=19), over 12 years (n=7) or had participants in both age groups (n=13). Most of the studies were conducted in Europe (n=16; Austria n=5, Netherlands n=4, Belgium n=3, UK n=3, Portugal n=1), followed by the United States (n=12), Australia (n=6), Chile (n=2), and Israel (n=1), India (n=1), South Korea (n=1). Studies were mostly conducted in classroom settings (n=21). Advertising exposure was most commonly for food (n=29; all included a HFSS product or brand e.g., fast food or sugary cereal; in addition to some non-HFSS products), followed by tobacco (n=7) or an assortment of products (n=3, including games, banks and a financial services company).

The majority of advertising exposures were non-digital (n=25, including TV adverts, product placement, print advert, TV sponsorship or movie trailers), compared to digital (n=18, including advergames, banner/pop-ups, social media).

Outcomes, related to the advertised product, were measures of understanding (n=10, e.g., identification of commercial content, selling intent, persuasive intent, perceived advertising intentions) or attitudinal (n=23, e.g., product liking, product perceptions, perceived benefits, appeal) or studies that measured both (n=13).

Understanding Findings – narrative synthesis

Impact of age on understanding

When compared across age groups, understanding of advertising increased significantly with age (eight studies),^{28,29,30,31,32,33,34,35} although no significant effects were found in four studies,^{36,37,38,39} and understanding decreased with age in one.⁴⁰ Most of these studies were conducted with children under 12 years, so evidence was limited for teenagers. Of two studies conducted with teenagers, one study directly compared children aged 9, 12 and 15 years and found that advertising recognition significantly increased with age;³¹ the other found 12-14 years olds had significantly higher

²⁸O. B. Carter et al., "Children's Understanding of the Selling Versus Persuasive Intent of Junk Food Advertising: Implications for Regulation," *Social Science & Medicine* 72, no. 6 (2011).

²⁹L. Owen et al., "Is Children's Understanding of Nontraditional Advertising Comparable to Their Understanding of Television Advertising?," *Journal of Public Policy & Marketing* 32, no. 2 (2013).

³⁰N. J. Rifon et al., "Age-Dependent Effects of Food Advergame Brand Integration and Interactivity," *International Journal of Advertising* 33, no. 3 (2014).

³¹R. Uribe and A. Fuentes-García, "Disclosing Product Placements of Fast Food to Children: The Importance of Reinforcing the Use of Disclosures and the Age of Children," *Health Communication* 35, no. 11 (2020).

³²J. Castonguay, "Portraying Physical Activity in Food Advertising Targeting Children," *Health Education* 115, no. 6 (2015).

³³L. Hudders and V. Cauberghe, "The Mediating Role of Advertising Literacy and the Moderating Influence of Parental Mediation on How Children of Different Ages React to Brand Placements," *Journal of Consumer Behaviour* 17, no. 2 (2018).

³⁴E. Neyens, T. Smits, and E. J. Boyland, "Transferring Game Attitudes to the Brand: Persuasion from Age 6 to 14," *International Journal of Advertising: The Review of Marketing Communications* 36, no. 5 (2017).

³⁵S. An and H. Kang, "Korean Children's Understanding of Social Media Advergames: An Exploratory Study of Ad Recognition and Skeptical Attitudes toward Advertising," *Journal of Consumer Behaviour* 18, no. 5 (2019).

³⁶M. A. Lapiere, "Development and Persuasion Understanding: Predicting Knowledge of Persuasion/Selling Intent from Children's Theory of Mind," *Journal of Communication* 65, no. 3 (2015).

³⁷L. Tarabashkina, P. Quester, and O. Tarabashkina, "Perceived Informative Intention in Advertising and Its Attenuating Effect on Persuasion Attribution among Children," *Psychology and Marketing* 35, no. 10 (2018).

³⁸M. K. J. Waiguny, M. R. Nelson, and R. Terlutter, "The Relationship of Persuasion Knowledge, Identification of Commercial Intent and Persuasion Outcomes in Advergames-the Role of Media Context and Presence," *Journal of Consumer Policy* 37, no. 2 (2014).

³⁹L. Tarabashkina et al., "When Persuasive Intent and Product's Healthiness Make a Difference for Young Consumers," *Young Consumers* 19, no. 1 (2018).

⁴⁰E. A. van Reijmersdal and S. van Dam, "How Age and Disclosures of Sponsored Influencer Videos Affect Adolescents' Knowledge of Persuasion and Persuasion," *Journal of Youth and Adolescence* 49, no. 7 (2020).

recognition of sponsored content in a YouTube video compared to 15-16 year olds, but there was no significant difference between age groups for understanding persuasive intent.⁴⁰

Impact of advert features

One study reported that persuasion knowledge increased with higher brand integration (in relation to advergames) but persuasion knowledge was very low across all groups and the magnitude of differences modest.³⁰ In relation to child 'involvement' with advertising (i.e. engagement with advergame), one study showed that children more involved with an advergame were less likely to identify commercial content.³⁸ One study looked at differences in recognition of commercial content in advergames between a familiar HFSS brand and a fictitious or unbranded pizza game and found that recognition of the familiar brand was significantly greater than the unbranded game.⁴¹ A similar study assessed persuasion knowledge between a branded advergame and a non-commercial advergame and found no significant difference.⁴² Two studies measured different types of understanding, and found that awareness of selling intent was significantly higher than persuasive intent in children aged 4-12 years (unable to separate by age).^{32,36} Four studies measured the impact of advertising format and found significantly greater understanding with TV advertising compared to digital advertising (primarily advergames).^{34,29,38}

Attitudinal Findings – Meta-analyses

Children's attitude to the advertised brand or product were significantly more positive overall when exposed to an advert compared to no advert or neutral advert control (+0.4, 95%CI 0.15, 0.64; $p = 0.001$; **Figure 2**).^{34, 43,44,45,46,47,48,49} Similar results were found when we looked at brand and product attitudes separately. There was high heterogeneity, but we used a random-effects model and no evidence of publication bias.

⁴¹ Z. M. C. van Berlo, E. A. van Reijmersdal, and E. Rozendaal, "Adolescents and Handheld Advertising: The Roles of Brand Familiarity and Smartphone Attachment in the Processing of Mobile Advergames," *Journal of Consumer Behaviour* 19, no. 5 (2020).

⁴² K. Panic, V. Cauberghe, and P. De Pelsmacker, "Comparing Tv Ads and Advergames Targeting Children: The Impact of Persuasion Knowledge on Behavioral Responses," *Journal of Advertising* 42, no. 2-3 (2013).

⁴³ A. A. Padon et al., "A Randomized Trial of the Effect of Youth Appealing E-Cigarette Advertising on Susceptibility to Use E-Cigarettes among Youth," *Nicotine & Tobacco Research* 20, no. 8 (2018).

⁴⁴ D. C. Petrescu et al., "What Is the Impact of E-Cigarette Adverts on Children's Perceptions of Tobacco Smoking? An Experimental Study," *Tobacco Control* 26, no. 4 (2017).

⁴⁵ L. Tarabashkina, P. Quester, and R. Crouch, "Food Advertising, Children's Food Choices and Obesity: Interplay of Cognitive Defences and Product Evaluation: An Experimental Study," *International Journal of Obesity* 40, no. 4 (2016).

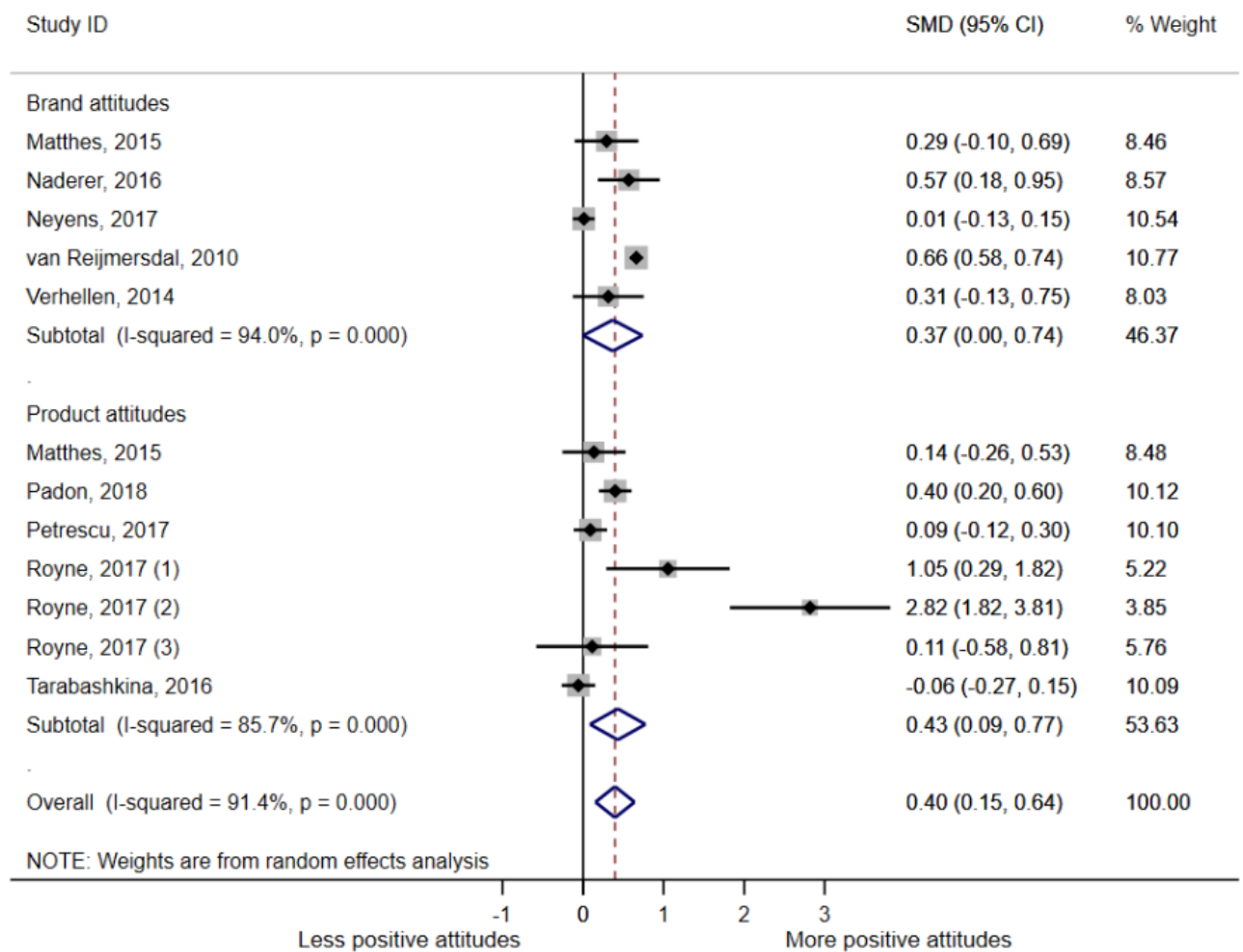
⁴⁶ Y. Verhellen et al., "Children's Responses to Traditional Versus Hybrid Advertising Formats: The Moderating Role of Persuasion Knowledge," *Journal of Consumer Policy* 37, no. 2 (2014).

⁴⁷ M. B. Royne et al., "Milk, Juice, or Cola? Exploring the Effect of Product Placement on Children's Attitudes and Behavior," *Health Marketing Quarterly* 34, no. 2 (2017).

⁴⁸ J. Matthes and B. Naderer, "Children's Consumption Behavior in Response to Food Product Placements in Movies," *Journal of Consumer Behaviour* 14, no. 2 (2015).

⁴⁹ B. Naderer, J. Matthes, and M. Mestas, "Do You Take Credit Cards? The Attitudinal and Behavioral Effects of Advergames Targeted at Children," *ibid.* 15, no. 6 (2016).

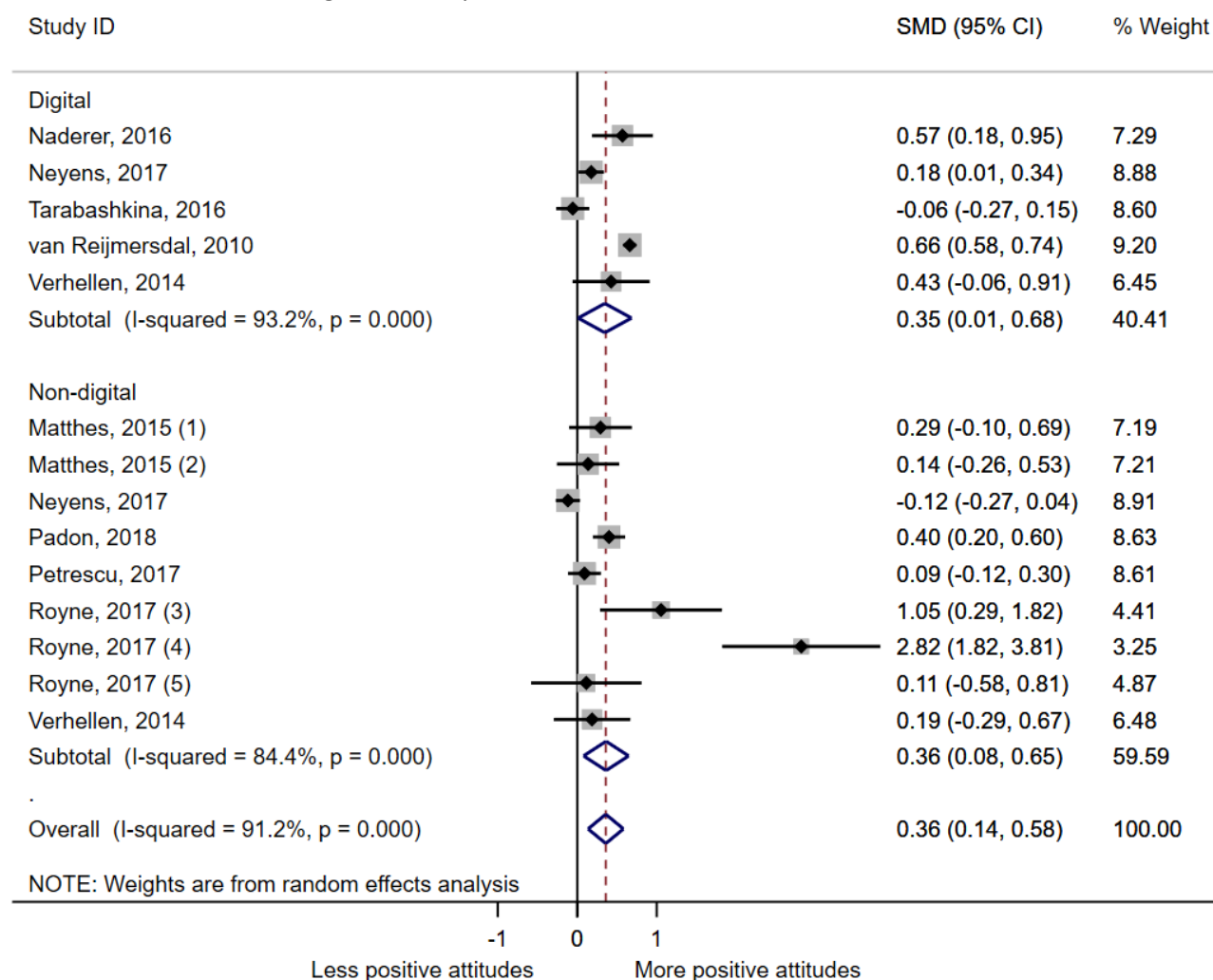
Figure 2. Forest plot showing SMD in brand and product attitudes between any advertising exposure and no advert or neutral advert controls; 95% CIs and study weights are indicated. Overall SMD was generated by a random effects model.



Royne, 2017 (1) Data from cola product placement vs control with cola attitude question
 Royne, 2017 (2) Data from juice product placement vs control with juice attitude question
 Royne, 2017 (3) Data from milk product placement vs control with milk attitude question

We also explored the effect of advertising by format and found that both digital advertising exposure and non-digital advert exposures had a significant positive effect on attitudes, compared to no advert or neutral control (digital SMD = 0.35, $p = 0.005$; 95%CI 0.01, 0.68; non-digital SMD = 0.36, $p = 0.005$; 95%CI 0.08, 0.65; **Figure 3**).

Figure 3. Forest plot showing SMD in brand or product attitudes between digital and nondigital advertising exposure and no advert or neutral advert controls; 95% CIs and study weights are indicated. Overall SMD was generated by a random effects model



Matthes, 2015 (1) Brand attitude outcome

Matthes, 2015 (2) Product attitude outcome

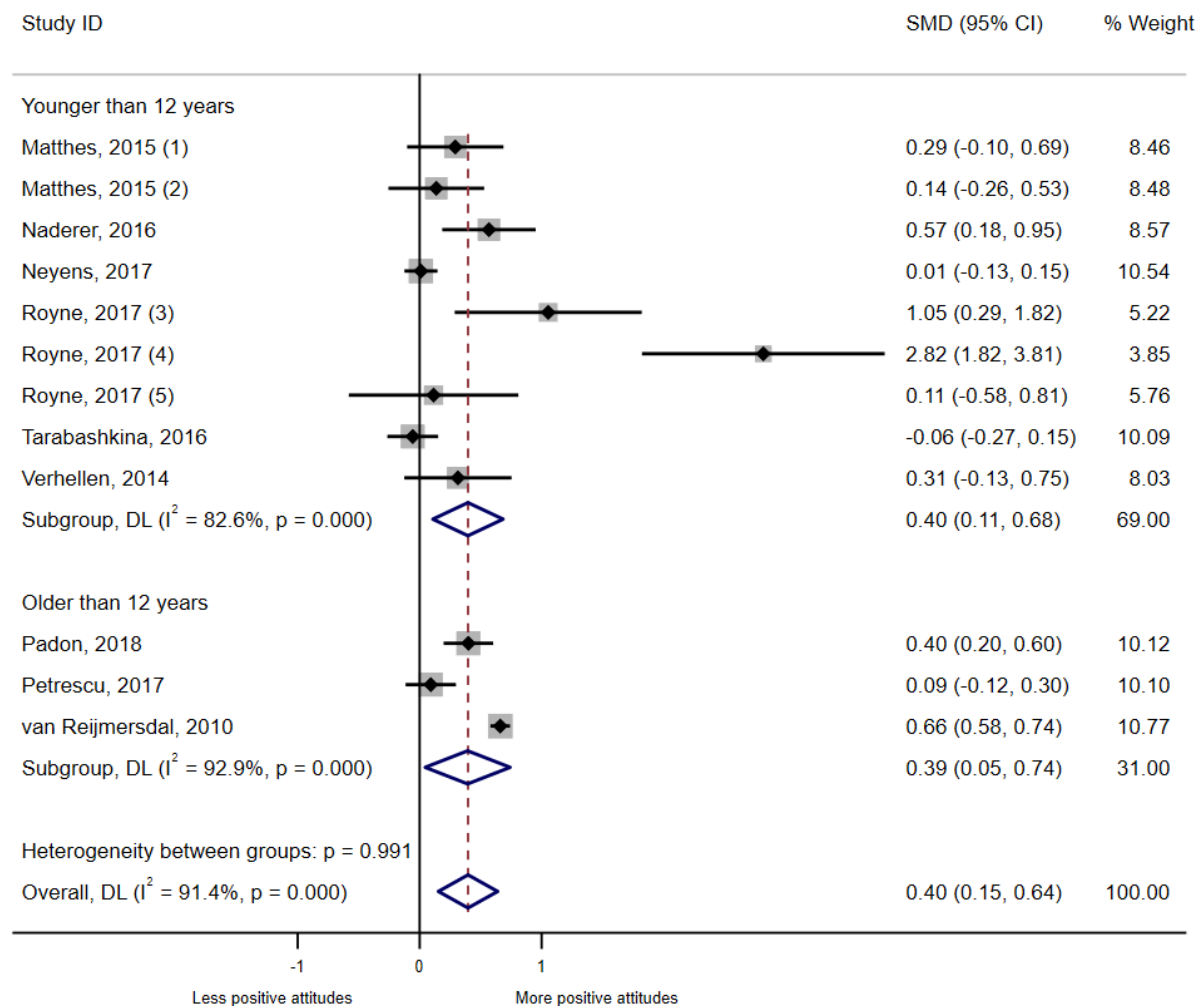
Royne, 2017 (3) Data from cola product placement vs control with cola attitude question

Royne, 2017 (4) Data from juice product placement vs control with juice attitude question

Royne, 2017 (5) Data from milk product placement vs control with milk attitude question

We also looked at the impact of advertising on attitudes by age (**Figure 4**). Advertising had a positive impact on attitudes compared to the control condition for both age groups (i.e., >12 years and ≤12 years). Additionally, we looked at the impact of settings, school or non-school, a similar pattern was seen for both groups (see Appendix 5).

Figure 4. Forest plot showing SMD in brand or product attitudes between any advertising exposure and no advert or neutral advert controls by age of participants (mean age under or over 12 years); 95% CIs and study weights are indicated. Overall SMD was generated by a random effects model



NOTE: Weights and between-subgroup heterogeneity test are from random-effects model

Matthes, 2015 (1) Brand attitude outcome

Matthes, 2015 (2) Product attitude outcome

Royne, 2017 (3) Data from cola product placement vs control with cola attitude question

Royne, 2017 (4) Data from juice product placement vs control with juice attitude question

Royne, 2017 (5) Data from milk product placement vs control with milk attitude question

Attitudinal Findings - Narrative synthesis

Seven of 12 studies that were not suitable for meta-analysis supported the above findings, namely that adverts brought about more positive attitudes compared to control;^{30,38,50,51,52,53,54} however, five

⁵⁰ M. Dias and L. Agante, "Can Advergaming Boost Children's Healthier Eating Habits? A Comparison between Healthy and Non-Healthy Food," *ibid.* 10, no. 3 (2011).

⁵¹ H. Dixon et al., "Food Marketing with Movie Character Toys: Effects on Young Children's Preferences for Unhealthy and Healthier Fast Food Meals," *Appetite* 117 (2017).

⁵² J. C. Duke et al., "Exploring Differences in Youth Perceptions of the Effectiveness of Electronic Cigarette Television Advertisements," *Nicotine & Tobacco Research* 18, no. 5 (2016).

⁵³ M. C. Farrelly et al., "A Randomized Trial of the Effect of E-Cigarette Tv Advertisements on Intentions to Use E-Cigarettes," *American Journal of Preventive Medicine* 49, no. 5 (2015).

⁵⁴ E. A. Vogel et al., "Effects of Social Media on Adolescents' Willingness and Intention to Use E-Cigarettes: An Experimental Investigation," *Nicotine & Tobacco Research* 23, no. 4 (2021).

studies found no significant differences between groups.^{41,55,56,57,58} One study explored the impact of e-cigarette adverts designed with low and high youth appeal and found the low youth appeal advert resulted in more positive attitudes than a non-e-cigarette control advert, but there was no difference between the high youth appeal and control adverts.⁴³ This effect was only observed for younger children (aged 5-6 years, unable to separate by age) and not in children aged 10-11 years. Further research with the same sample and method found that the younger group had significantly more positive product attitudes compared to the older group.⁵⁹ Another study found that brand preference following exposure to product placement decreased significantly with increasing age (9 vs 12 vs 15 years).³¹

Two studies examined the impact of “glamorised” e-cigarette advertising on perceptions of cigarette smoking or e-cigarettes, compared to neutral or no advert control. They found the adverts led to occasional cigarette smoking being perceived as less dangerous and harmful^{44,60} and the use of e-cigarettes by children as being more common.**Error! Bookmark not defined.** One also found there was no difference in the appeal of e-cigarettes between adverts that “glamorised” e-cigarettes compared to adverts that associated e-cigarettes with health.**Error! Bookmark not defined.**

Impact of understanding on attitudinal outcomes

Seven studies measured both understanding and attitudinal outcomes and reported interactions; five studies showed that greater understanding did not limit favourable attitudes towards the advertised product^{30,33,38,41,45} and two found some evidence of an interaction.^{34,39} Conversely, one study found that lack of persuasion knowledge led to significantly more positive brand attitude than children with persuasion knowledge.⁴⁶ Another study found that understanding persuasive intent and the unhealthiness of the snack led to significantly lower preferences; however, a group of children who believed the snack was healthy reported higher preferences, despite understanding the persuasive intent.³⁹ Another study, which did not test the interaction between persuasion knowledge and brand attitude, found significantly higher persuasion knowledge for the TV advert vs advergame, whereas brand attitude was significantly lower for the TV advert compared to the advergame.³⁴

Results of PPI session

YRAs agreed that their attitudes and behaviours are impacted by advertising and were strongly supportive of protective policy changes. The YRAs were surprised that advertising restrictions were self-regulated and suggested future policy initiatives to provide clear labelling on social media posts; stricter rules for ‘influencers’; and increased availability of affordable healthier foods. Further details have been published elsewhere.²⁷

Bias assessment

The overall risk of bias was low to moderate/some concerns, due to lack of methodological transparency and reporting (see Appendix 6). The majority of studies that stated they were

⁵⁵ R. Uribe and A. Fuentes-Garcia, "The Effects of Tv Unhealthy Food Brand Placement on Children. Its Separate and Joint Effect with Advertising," *Appetite* 91 (2015).

⁵⁶ Z. M. C. van Berlo, E. A. van Reijmersdal, and E. Rozendaal, "The Rules of the Game. The Role of Brand Familiarity in Mobile Advergames [Dutch]," *Tijdschrift Voor Communicatiewetenschap* 45, no. 3 (2017).

⁵⁷ B. Naderer, J. Matthes, and P. Zeller, "Placing Snacks in Children's Movies: Cognitive, Evaluative, and Conative Effects of Product Placements with Character Product Interaction," *International Journal of Advertising* 37, no. 6 (2018).

⁵⁸ R. Smith et al., "Advertising Placement in Digital Game Design Influences Children's Choices of Advertised Snacks: A Randomized Trial," *Journal of the Academy of Nutrition and Dietetics* 120, no. 3 (2020).

⁵⁹ J. Castonguay, "Sugar and Sports: Age Differences in Children's Responses to a High Sugar Cereal Advertisement Portraying Physical Activities," *Communication Research* 46, no. 5 (2015).

⁶⁰ M. Vasiljevic et al., "E-Cigarette Adverts and Children's Perceptions of Tobacco Smoking Harms: An Experimental Study and Meta-Analysis," *BMJ Open* 8, no. 7 (2018).

randomised did not specify which method of randomisation was used, or if there were any allocation or blinding methods.

Discussion

In this systematic review, the evidence suggests that children's understanding of advertising intent was limited and not nuanced i.e., children could recognise that adverts intended to sell a product but not that these were intended to change their attitudes and behaviour. There was limited evidence that understanding increased with age, but more research is needed in this area. Understanding was lower for digital compared to non-digital formats, and lower when children were more involved with the medium (e.g., advergames or online advertising). In terms of attitudes, meta-analyses indicated that advertising brought about more positive attitudes to both brands and products compared to controls; this was observed across all age groups. There was no evidence that adverts with high 'youth appeal' were more effective, but evidence was limited for these exposures. Findings suggested that greater understanding of advertising is not protective, with evidence that attitudinal outcomes were impacted positively regardless of level of understanding. These findings collectively indicate that advertising impacts children, regardless of age, level of understanding, format, or specific targeting towards youth appeal.

Our findings indicate that children and adolescents across all ages have some difficulties in understanding advertising. This fits with the developmental perspective that young people's critical reasoning abilities continue developing into late adolescence. **Error! Bookmark not defined.** We found that greater understanding does not necessarily protect against advertising, consistent with the Food Marketing Defence Model, which challenges the focus on understanding to counteract the effects of advertising. The model instead proposes that advertising influences young people without conscious processing and that motivation to resist is also required, which may be lower among young people.²⁰ We did not include disclosure or media literacy intervention exposures in this review, but our findings suggest that the inclusion of disclosures (e.g., declarations stating "this is an advert") or media literacy training would not necessarily protect children and adolescents from the influence of advertising and may even increase the effects.⁶¹ Media literacy programmes are a strategy often suggested by the food and beverage industry to increase persuasion knowledge in children, in lieu of improved regulations, such as industry-funded Media Smart (see <https://mediasmart.uk.com/>).^{62,63}

Our findings that advertising had a positive impact on attitudes are consistent with previous research on food advertising.^{11,14,64,65} Further supporting these findings, adverts (TV and advergames) for 'unhealthy' unfamiliar food products have been found to elicit positive attitudes in children (aged 7-12 years); to a greater extent with advergames compared to TV advertising.⁶⁶ We found effects on attitudes regardless of age, consistent with other studies in different age groups. There is evidence that pre-school children exposed to adverts for a range of child-directed foods had

⁶¹ A. E. Coates et al., "The Effect of Influencer Marketing of Food and a "Protective" Advertising Disclosure on Children's Food Intake," *Pediatric Obesity* 14, no. 10 (2019).

⁶² M. Caraher, J. Landon, and K. Dalmeny, "Television Advertising and Children: Lessons from Policy Development," *Public Health Nutr* 9, no. 5 (2006).

⁶³ T. O'Sullivan, "Get Mediasmart®: A Critical Discourse Analysis of Controversy around Advertising to Children in the UK," *Consumption Markets & Culture* 10, no. 3 (2007).

⁶⁴ Y. Qutteina, C. De Backer, and T. Smits, "Media Food Marketing and Eating Outcomes among Pre-Adolescents and Adolescents: A Systematic Review and Meta-Analysis," *Obesity Reviews* 20, no. 12 (2019).

⁶⁵ WHO., "Food Marketing Exposure and Power and Their Associations with Food-Related Attitudes, Beliefs and Behaviours: A Narrative Review," ed. World Health Organization (2022).

⁶⁶ J. Norman et al., "Remember Me? Exposure to Unfamiliar Food Brands in Television Advertising and Online Advergames Drives Children's Brand Recognition, Attitudes, and Desire to Eat Foods: A Secondary Analysis from a Crossover Experimental-Control Study with Randomization at the Group Level," *J Acad Nutr Diet* 120, no. 1 (2020).

positive attitudes about these foods,⁶⁷ and that adolescents reported positive attitudes after viewing online adverts for fast food and confectionary.⁶⁸

Comparing digital and non-digital advertising formats, we found no difference in impact on attitudes in sub-group meta-analysis, but narrative synthesis indicated that understanding was lower for digital formats. This is unsurprising given that digital advertising is often less explicit and more difficult to identify and understand.^{17,20} This is important given the ubiquity of these formats, especially for adolescents, who are likely to use digital media to a greater extent than younger children and with less supervision. For adolescents, media also plays an important role in their social identity development and their sense of belonging; therefore, despite having greater understanding, they may be more vulnerable to advertising on social media platforms as their perception of what their peers are doing is important.^{1,2,3} There is also emerging evidence that adolescents may be more susceptible than younger children to the impacts of online adverts, due to their increased engagement, the unique effects and exposure to digital marketing through social media.⁶⁹

Implications

The findings from this review supports the idea that understanding of advertising is not fully developed during childhood or adolescence. We also found that advertising influences the attitudes of young people of all ages, suggesting a need to protect older as well as younger children. Our results suggest that understanding does not protect children from the harmful impacts and influence of advertising, as per the Food Marketing Defense Model.²⁰ Our work with young people also showed that they feel impacted by advertising and showed strong support for further protections and restrictions. Existing regulations typically only apply to children up to 12 years of age, as they have historically been regarded as more vulnerable to advertising and need greater protection.⁷⁰ Our findings do not support lesser restrictions for advertising to teenagers, as there is no clear evidence-based threshold for understanding that supports a cut-off of 12 years, and suggest that appropriate protection from advertising exposure would benefit all young people.¹ Reducing exposure to advertising is likely to be more effective than improving understanding through disclosures or media literacy training.

Strengths and Limitations

This study meets a key evidence gap, and addresses the policy relevant question of age thresholds for critical reasoning capacity and the ability to resist the effects of advertising. We were also able to quantitatively assess the impact of advertising on attitudinal outcomes. The search was carefully planned and executed, with double screening and data extraction. Studies were contemporary, adding to the relevance for current policy. Due to the delay observed in research, we found fewer studies using digital advertisement exposures, which is an area where more primary research is needed.

The limitations of this review include a lack of suitable data/studies to meta-analyse the impact of advertising on understanding or the influence of age. Meta-analysis limitations include the high heterogeneity of studies, despite using a random effects model and standardised mean difference outcome. The machine learning method has limitations, as a large number of articles were excluded

⁶⁷ J. L. Harris and S. S. Kalnova, "Food and Beverage Tv Advertising to Young Children: Measuring Exposure and Potential Impact," *Appetite* 123 (2018).

⁶⁸ N. Critchlow et al., "Adolescents' Reactions to Adverts for Fast-Food and Confectionery Brands That Are High in Fat, Salt, and/or Sugar (Hfss), and Possible Implications for Future Research and Regulation: Findings from a Cross-Sectional Survey of 11–19 Year Olds in the United Kingdom," *International Journal of Environmental Research and Public Health* 17, no. 5 (2020).

⁶⁹ J. L. Harris, S. Yokum, and F. Fleming-Milici, "Hooked on Junk: Emerging Evidence on How Food Marketing Affects Adolescents' Diets and Long-Term Health," *Current Addiction Reports* 8, no. 1 (2021).

⁷⁰ L. S. Taillie et al., "Governmental Policies to Reduce Unhealthy Food Marketing to Children," *Nutrition Reviews* 77, no. 11 (2019).

without screening on title and abstract, but we did checks and do not believe relevant articles were not included. The majority of the included studies were assessed as having some concerns of bias, which needs to be taken into consideration when interpreting the findings.

Conclusion

This systematic review and meta-analysis provides evidence that advertising impacts upon the attitudes of children and adolescents of all ages, regardless of their level of understanding and critical reasoning abilities. Reducing exposure to advertising is likely to be more effective than improving understanding through disclosures or media literacy training.

Table 1. Descriptive summary of included studies

Author, year, country	Sample description	Design	Advertising exposure	Comparison/ control	Outcome	Key Findings
An, 2019, South Korea	n = 556 Age range = 7-11 Mean age = NS	Experimental (school), between-subject	3 images of advergame play with HFSS food exposure (Caffé Bene, a national coffee chain, with branded food products = ice cream, sandwiches, bagels, and drinks)	Grade level (age proxy- 2nd and 3rd grade vs 4th and 5th grade)	Ad recognition Skeptical attitudes to advertising	Grade level (age) was significantly associated to ad recognition and skeptical attitudes, with lower grades (2nd and 3rd) less likely to recognise the advergame as advertising and less likely to have skeptical attitudes, than higher grades (4th and 5th).
Carter, 2011, Australia	n = 594 Age range = 4-12 Mean age = NS	Experimental (school), between-subject	TV advert for HFSS food brand (McDonald's)	Age (years)	Selling intent Persuasive intent	All three measures of understanding increased significantly with age. Understanding of selling intent was greater than understanding of persuasive intent, which was still only 40% in 11-12 year olds.
Castonguay, 2015,* US, [S2]	n = 68 Age range = 5-11 Mean age = NS	Experimental (NS), between-subject	3 TV advert conditions: HFSS cereal (Frosted Flakes); TV Network; computer game. All 30 second adverts placed within 5-minute cartoon	Age (5-6 vs 10-11)	Recognition of juxtaposed beliefs	Recognition was significantly greater in older children (10-11 years) compared to younger children (5-6 years).
Castonguay,* 2015, US	n = 136 Age range = 5-11 Mean age = NS	Experimental (research laboratory), within-subject, random assignment	3 TV advert conditions: HFSS cereal (Frosted Flakes); TV Network; computer game. All 30 second adverts placed within 5-minute cartoon	Age (5-6 vs 10-11)	Product attitude	Younger children in physical activity condition had significantly greater product attitudes than younger without physical activity and both older children groups. The overall difference between combined younger and older groups was not tested.
Dias & Agante 2011, Portugal	n = 231 Age range = 7-8 Mean age = NS	Experimental (school), between-subject, random assignment	Advergame for HFSS products (ice cream, potato chips, cookies, soda, pizza, lollipop, hamburger + chocolate mousse), 5-minute play in groups of 1-4	Non-commercial game with healthy products (fruit, vegetables, milk, bread)	Food liking Nutritional knowledge	Children exposed to the advergame had significantly higher preference for the HFSS products compared to those exposed to the non-commercial game. No impact on nutritional knowledge.
Dixon, 2017, Australia	n = 904 Age range = 5-9 Mean age = 7	Experimental (school), between-subject, random assignment	TV adverts for HFSS food (McDonald's) shown after a 30-second movie trailer with movie tie in premium for 1) unhealthy meals 2) healthy meals or 3) both	Neutral TV advert (leisure activity)	Meal preference Product perceptions	Significantly higher preference for healthier meal if only healthy meals had movie tie in premium compared to other conditions. Significantly more positive perceptions when the healthier meals had movie tie in premium, compared to having none.
Duke, 2016,^ US	n = 3665 Age range = 13-17 Mean age = NS	Experimental (online), between-subject, random assignment	4x TV adverts for e-cigarettes (3x 60-second and 1x 30-second)	No advert	E-cigarette attitudes	Significantly more positive e-cigarette attitudes in the treatment condition compared to control.
Farrelly, 2015,^ US	n = 3665 Age range = 13-17 Mean age = NS	Experimental (online), between-subject, random assignment	4x TV adverts for e-cigarettes (3x 60-second and 1x 30-second)	No advert	Perceived benefits of e-cigarettes	TV ads positively and significantly impacted on e-cigarette beliefs compared to control.

Harris, 2018, US	n = 138 Age range = 7-11 Mean age = 9.4	Experimental (research centre), between-subject, random assignment	TV adverts for HFSS food (Ribena drink, Kellogg's choc snack bar, McVitie's biscuits) with a healthy message (health halo) or non-health message or healthy products (milk, pistachios, cheesesticks)	Age (7-9 vs 10-11)	Perceived risks and benefits	Age was not a predictor. Health halo advert condition perceived nutrient poor products as significantly healthier than the other 2 conditions.
Hudders & Cauberghe, 2018, Belgium	n = 180 Age range = 7-12 Mean age = 8.69	Experimental (school), between-subject	TV advert (90-seconds) for Wii within a movie excerpt (4-minute cartoon, Alvin and the Chipmunks: The Squeakquel)	Age (7-9 vs 10-12)	Identification of commercial content Advertising Literacy Brand attitude (interaction only)	Identification of commercial content and advertising literacy was significantly greater in older children compared to younger children. Found advertising literacy was not significantly related to brand attitude.
Kim, 2017, US	n = 802 Age range = 13-17 Mean age = NS	Experimental (online), between-subject, random assignment	3 x TV adverts for e-cigarettes from a pool of 14 (30-seconds to 2-minutes)	3x neutral TV adverts (bottled water) from a pool of 7 (30-seconds to 2-minutes)	Perceived risks and benefits	In never-smokers only, perceived risk of cigarettes was significantly lower in intervention compared to control.
Lapierre, 2015, US	n = 79 Age range = 6-9 Mean age = 7.7	Experimental (Camp, afterschool centre), between-subject	3 x 30-second TV adverts (2 for toys and 1 for HFSS cereal- HoneyNut Cheerios)	Age (years)	Persuasive intent Selling intent	Age was not a significant predictor of understanding measures. Understanding of selling intent was significantly higher than persuasive intent.
Matthes & Naderer, 2015, Austria	n = 121 Age range = 6-14 Mean age = NS	Experimental (school), between-subject, random assignment	Product placement for HFSS food (UTZ Cheese Balls) within 7-minute movie excerpt (cartoon, Alvin and the Chipmunks) with moderate or high frequency product placement	No advert control Age (years)	Brand attitude Product attitude	No effect of placements on brand or product attitudes, compared to control. Brand attitude decreased with age.
Naderer, 2016, Austria	n = 109 Age range = 8-13 Mean age = 10.76	Experimental (school), between-subject, random assignment	Advergame (Visa branded Monopoly), approximately 30 minutes play time	Unbranded game (Monopoly), approximately 30 minutes play time Age (years)	Brand attitude	Brand attitude was significantly higher in the advergame condition compared to no advert control. Age was not a significant predictor.
Naderer, 2018, Austria	n = 363 Age range = 6-15 Mean age = 10.55	Experimental (school), between-subject, random assignment	Product placement of HFSS product (M&Ms) in movie (7-minute clip of Smurfs) with static placement (shown in background) OR character product involvement (interacts with the product)	Control, 7-minute clip of Smurfs with no product placement	Brand evaluation	No difference in brand evaluation between the placement conditions or no advert control.
Neyens, 2017, UK	n = 940 Age range = 6-14 Mean age = 9.8	Experimental (school), between-subject, random assignment	Advergame for HFSS food (Kellogg's Coco-Pops, 10-minute play time) OR TV advert for HFSS food (Kellogg's Coco-Pops, 19-seconds embedded within 10-minute TV clip for youth series)	No advert control Age (years)	Persuasion knowledge Brand attitude Brand preference	Persuasion knowledge was significantly higher for the TV ad vs advergame. Children who played the advergame reported significantly more positive brand attitudes compared to children who had watched the TV ad and children in the no advertising exposure control group. Age was significantly positively related to persuasion knowledge and negatively related to brand attitude.

Owen, 2013, UK	n = 134 Age range = 6-10 Mean age = NS	Experimental (school), between-subject	Shown 2/5 following HFSS adverts: -Brand placement in movie (Dr Pepper in Spiderman) -TV sponsorship (Cadbury chocolates in Coronation Street) -Product licensing (Shrek on Nestlé cereal) -Advergame (McDonald's website) -In-game product placement (Red Bull energy drink on PlayStation 2 game)	Age (6-7 vs 9-10)	Understanding of advertising	Understanding of advertising was significantly higher among older children compared to younger. Understanding of TV advertising was significantly greater than non-traditional advertising in all children.
Padon, 2018 US	n = 417 Age range = 13-17 Mean age = 15	Experimental (online), between-subject, random assignment	4 x TV adverts for e-cigarettes either low or high youth appeal (each less than 30 seconds)	4 x neutral TV adverts (food/ drink)	Product attitude Product beliefs	Positive product beliefs increased significantly in low youth appeal ads compared to control, high youth appeals increased positive product beliefs but it was not significant.
Panic, 2013, Belgium, [S2]	n = 128 Age range = 7-10 Mean age = 8	Experimental (school), between-subject, random assignment	Advergame for HFSS food (Lay's crisps, 2-minute play)	Non-commercial game (healthy food- fruit and vegetables)	Persuasion knowledge	No significant differences in persuasion knowledge between the commercial and non-commercial advergames.
Petrescu, 2017, US	n = 411 Age range = 11-16 Mean age = 13.09	Experimental (home), between-subject, random assignment	10 x printed advert for e-cigarettes either glamourised or associated with health	No advert control	Appeal of smoking or e-cigarettes Prevalence estimates Perceived attributes of smoking Perceived harms of smoking	Significantly increased estimation in prevalence of e-cigarette use in glamour condition compared to control and health condition. In both experimental conditions perceived danger and harm of occasional smoking were rated lower than control.
Rifon, 2014, US	n = 376 Age range = 5-10 Mean age = 7.3	Experimental (test site), between-subject, random assignment	Advergame for HFSS food (Honey O's cereal) which children played or watched (designed to mimic tv ad) and with brand integrated in game or shown in background (play time determined by child)	Unbranded game Age (5-7 vs 8-10)	Persuasion knowledge Brand attitude Perceived healthiness Taste expectations	Persuasion knowledge increased with age, playing exposure and brand integration. Integrated brand conditions had increased taste expectations, perceived healthiness, but this was moderated by play and age. Treatment conditions had significantly more positive taste expectations in treatment compared to control.
Royne, 2017, US	n = 64 Age range = 6-11 Mean age = NS	Experimental (research facility), between-subject, random assignment	Product placement for cola, juice or milk embedded in TV cartoon (SpongeBob SquarePants, 15-minute clip)	No product placement control (same 15-minute TV clip)	Product liking Perceived healthiness	For 'likes juice' outcome, all treatments conditions had significantly higher results than control. For the 'perceived healthiness of juice' outcome the milk and cola conditions were significantly greater than control. No other results were significant.
Sharma, 2015, India	n = 1050 Age range = 10-17 Mean age = NS	Experimental (NS), between-subject, random assignment	Printed advert for HFSS food (biscuit) OR mobile handset with picture, caricature or product information	Age (10-12 vs 13-17)	Brand attitude	Teenagers had significantly lower brand attitude towards biscuits in the model's picture and product information settings compared to tweenagers.
Smith, 2020, Australia	n = 156 Age range = 7-12 Mean age =	Experimental (university), between-subject, random assignment	3 advert conditions for HFSS product (unfamiliar confectionery) 1) banner advertisement 2) advergame (4-minute play time) 3) rewarded video advertisement	Control group with no advertising	Brand perception Awareness of advertising	Across groups there were no significant differences between pre- and post-game ratings of taste or fun. Awareness of advertising was highest in rewarded video advertising condition 80% (only significant finding) then, advergame condition

						60%, compared to just 31% of participants in the banner advertisement condition.
Tarabashkina, [†] 2016, Australia	n = 354 Age range = 7-13 Mean age = NS	Experimental (agricultural event), between-subject, random assignment	Pop-up advert for HFSS food (biscuit) within a 10-minute internet exposure	Neutral pop-up advert (toy) within a 10-minute internet exposure Age (7-8 vs 9-10 vs 11-12 vs 13)	Selling intent Persuasive intent Product evaluation Nutritional knowledge	No differences in cluster membership based on age, including selling and persuasive intent, product evaluation and nutritional knowledge. A trend towards choosing the advertised product was seen in the experimental group compared to control but was not significant.
Tarabashkina, [†] 2018, Australia P	n = 326 Age range = 8-13 Mean age = NS	Experimental (agricultural event), between-subject	Poster advert on a bus stop for a fictitious HFSS food product (burger)	Age (8-9 vs 10-11 vs 12-13)	Informative intention Product liking intention Attention capturing intention Persuasion attribution of the advertisement	There were no significant differences in any perceived advertising intention variables by age group.
Tarabashkina, [†] 2018, Australia WP	n = 175 Age range = 7-13 Mean age = NS	Experimental (agricultural event), between-subject	Online pop-up advert for HFSS food (cookie) shown 3 times during a 10-minute internet search session (2nd, 5th and 8th minute)	Age (7-8 vs 9-10 vs 11-13)	Perceived informative intent Perceived affective intent Persuasive intent Product preference Product taste Product healthiness	There were no significant differences in any of the variables by age group, except for product healthiness which the oldest age group rated as significantly lower compared to the youngest age group. Higher persuasive intent understanding led to decreased favourable food preference and lower healthiness evaluation.
Te'eni-Harari, 2014, Israel	n = 252 Age range = 4-15 Mean age = 9.45 (3.24)	Experimental (school), between-subject	TV advert for four fictitious products named "ZOZO" HFSS food (hot dog), phone, book or toothpaste (each 20-seconds)	Age (4-7 vs 8-11 vs 12-15)	Brand attitude	Age had a significantly negative effect on brand attitude.
Uribe & Fuentes-García, [~] 2015, Chile	n = 483 Age range = 9-15 Mean age = NS	Experimental (school), between-subject, random assignment	3 advert conditions for HFSS brand (McDonald's) embedded in movie clip (Richie Rich, 45-minutes) -Product placement (2 scenes) -2 x TV adverts -1 x product placement and 1 x TV advert All for HFSS food (McDonald's) within 45-minute film (Richie Rich)	No advert or product placement, same 45-minute film (Richie Rich) Age (9 vs 12 vs 15)	Brand attitude	There were no significant differences in brand attitude between any of the treatment or age groups.
Uribe & Fuentes-García, [~] 2020 Chile	n = 376 Age range = 9-15 Mean age = 12	Experimental (school), between-subject, random assignment	Product placement for HFSS product (McDonald's) embedded in movie clip (Richie Rich, 45-minutes, 2 scenes)	Age (9 vs 12 vs 15)	Recognition of the commercial nature of the message Brand preference	Recognition of advertising significantly increased as the age of the children increased (9 vs 12 vs 15). Brand preference significantly decreased as age of the children increased (9 vs 12 vs 15).

van Berlo,* 2017, Netherlands	n = 73 Age range = 13-18 Mean age = 15.48	Experimental (school), between-subject, random assignment	Advergame (making pizzas) with an unknown or well-known pizza brand	Unbranded game (making pizzas)	Advertising wisdom Brand attitude	No significant differences in brand attitude between the conditions.
van Berlo,* 2020, Netherlands	n = 98 Age range = 13-18 Mean age = 14.95	Experimental (school), between-subject, random assignment	4-min advergame play with HFSS food (making pizza) -familiar brand (Domino's) -unfamiliar brand (Nonna's pizza)	4-min game play with HFSS food (making pizza) with no brand logo	Recognition of commercial intent Brand attitude (unfamiliar and familiar brand)	Recognition of commercial intent in the familiar brand condition was significantly greater than game without a brand No difference in recognition between familiar or unfamiliar brands or unfamiliar brand and no brand condition. There were no differences in brand attitude toward the familiar or unfamiliar brands between any of the conditions.
van Reijmersdal, 2010, Netherlands	n = 2453 Age range = 10-17 Mean age = 12.68	Experimental (online, at home), between-subject, random assignment	Advergame play ("GoSupermodel") with product placement (Dutch bank) time determined by child	No game play control or non-commercial game play (time determined by child)	Brand image	Brand image results were significantly greater in the advergame play condition.
van Reijmersdal, 2020, Netherlands	n = 406 Age range = 12-16 Mean age = 14	Experimental (school), between-subject, random assignment	YouTube video with well-known YouTuber sponsored by HFSS product (Fanta)	Age (12-14 vs 15-16)	Recognition of sponsored content as advertising Understanding persuasive intent	In the no disclosure group, 12-14 years olds had significantly higher recognition of sponsored content as being advertising compared to 15-16-year-olds. No significant difference between age groups for understanding persuasive intent.
Vasiljevic, 2018, UK	n = 1449 Age range = 11-16 Mean age = NS	Experimental (school), between-subject, random assignment	10 x printed glamorous e-cigarette advert	Neutral advert (non-smoking related)	Perceived harm of occasional and regular use Prevalence estimates of e-cigarettes and cigarettes	Children exposed to glamorous e-cigarette adverts perceived the harms of occasional smoking of one or two tobacco cigarettes to be lower than those in the control group. No significant differences between the experimental conditions for perceived harm of or prevalence estimates for e-cigarettes or cigarettes.
Verhellen, 2014 Belgium	n = 125 Age range = 11-14 Mean age = 11.98	Experimental (school), between-subject, random assignment	4 advert conditions for HFSS food (Ola popsicles): -Traditional TV ad -Trailer -Advergame -Trailer + advergame	No advert control	Persuasion knowledge Brand attitude	No significant differences in brand attitude or persuasion knowledge between the experimental conditions. Children without persuasion knowledge developed a significantly more positive attitude towards the brand than children with persuasion knowledge.
Vogel, 2020, US	n = 135 Age range = 13-18 Mean age = 15.3	Experimental (online), between-subject, random assignment	Instagram advert posts for e-cigarettes with heavy e-cigarette content (three e-cigarette posts and three unrelated posts) OR light e-cigarette content (one e-cigarette posts and five unrelated posts)	No advert control, shown peer generated posts for e-cigarettes with heavy or light e-cigarette content	Attitudes about using e-cigarettes Risk perceptions of e-cigarettes	Participants in advert source condition had significantly greater positive attitudes toward e-cigarettes, compared to peer generated source. No difference in perceived risks between sources conditions. No difference in perceived risks between e-cig conditions.

Waiguny, 2014, Austria, [S1]	<i>n</i> = 51 Age range = 8-10 Mean age = NS	Experimental (school), between-subject, random assignment	2 advert conditions for HFSS food (Nesquik Duo, cereal) -Advergame (7:24-minute play time) -TV advert (30-seconds)	Age (year)	Persuasion knowledge Identification of commercial content	No effect of age on the measure of persuasion knowledge or identification of commercial content. Greater identification of commercial content in TV advert compared to advergame.
Waiguny, 2014, Austria, [S2]	<i>n</i> = 149 Age range = 7-10 Mean age = NS	Experimental (school), between-subject	Advergame for HFSS food (Nesquik Duo, cereal, 10-minute play time),	No advert control	Persuasion knowledge Identification of commercial content Brand beliefs Brand reference	Advergame exposure significantly positively influenced children's brand beliefs and preferences, compared to control. Difference in persuasion knowledge between the conditions was not separately assessed. Identification of commercial content was generally higher with a higher level of persuasion knowledge but was negatively overridden by presence in the game.

NS= not stated; *Half of the sample may be reported in both; ^Same sample, but reporting of different outcomes; † May be the same participants across all three studies; ‡ May be the same participants across the two studies; § Three out of the four schools may be reported in both

Appendix 1- Details about the search

Databases searched

Ovid Medline

Cochrane

Scopus

Psych Info

ProQuest (Central)- ASSIA

Web of Science- social science and emerging sources

Social Policy and Practice

Child Development and Adolescent Studies

Search terms

Concept 1 Participants	Concept 2 Exposure	Concept 3 Outcomes
Subject headings: <i>Cochrane/ Medline</i> Adolescent (13-18y) Child (6-12y) <i>ProQuest</i> Children Young people Adolescents	<i>Cochrane/ Medline</i> 'Advertising as topic' (marketing N/A from definitions) <i>PsychInfo</i> Advertising <i>ProQuest (ASSIA)</i> Advertising Advertisements	<i>Cochrane/ Medline</i> Comprehension Judgment Decision making Cognition Thinking Psychology, child Psychology, adolescent <i>PsychInfo</i> Comprehension Judgment Decision making Cognitive processes Adolescent attitudes Child attitudes <i>ProQuest (ASSIA)</i> Comprehension Decision making Cognitive processes
Keywords: child* adolescen* youth* young person*/ people* schoolchild* "school child*"	advert* marketing advergam* commercials "television commercial*" "TV commercial*"	judgement* judgment* attitud* cogniti* reasoning media literacy

boy* girl* teen* school*child (N/A for every database)	"radio commercial*" " media commercial*"	advertising literacy appraisal* recognition* psychology decision* understanding* belief* perception* comprehension*
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Screening criteria

Participants	6-17y (in order to distinguish from pre-school and adult samples)
Intervention (exposure)	Adverts (any form e.g. TV, advergames, online, poster)
Comparison	Experimental and intervention studies: Advert vs. non-advert Food advert vs. non-food advert (incl group comparisons where data available- age, gender, SES) Between-group comparisons (age, gender, SES) with advert exposure (i.e. no control group) If the literature is very limited, we could include within-child changes (i.e. change over the intervention or experiment in the sample)- but would be difficult to interpret Real-world studies: cross-sectional Between-group comparisons (age, gender, SES) Between-group comparisons with different levels of advert exposure Sub-groups combining these (i.e. different levels of advert exposure and different age/ gender/ SES groups) Real-world studies: longitudinal Between-group comparisons (age, gender, SES) over time Between-group comparisons over time with different levels of advert exposure at baseline Sub-groups combining these (i.e. different levels of advert exposure and different age/ gender/ SES groups) Within-child comparisons over time in a sample (no breakdown by characteristics or advert exposure)- again suggest doing this only if other literature is limited
Outcome measure	must have some measure of 'judgement'; we will additionally record other more distal outcomes (e.g. behaviour, opinion)
Study designs	experimental; intervention; 'real-world' (cross-sectional/ longitudinal)
Other Geography Languages Time	All All All until 09/12/2020

Appendix 2: Mapping exercise details and diagram

The search was purposively inclusive, as the scope of the literature was largely unknown. The initial inclusion criteria were studies of any design (including experimental, intervention, cross-sectional, longitudinal, qualitative) with participants aged 6-17 years of age (inclusive), an advertising exposure for any product (e.g., TV advertisement, advergame) and a measure of 'understanding' (e.g., understanding of advertising intent, recognition of advertising) or 'attitudes' (e.g., liking of the brand/product advertised). Since the literature identified in the search was extensive and heterogenous (531 studies were identified as potentially relevant on title and abstract from the original search), a mapping exercise was undertaken to narrow the literature to best address the study aims (see Figure S3). Following consultation with the wider research team, experimental studies with an administered exposure were chosen as the focus, to manage the large number of heterogenous studies. This yielded 272 studies eligible for full text screening.

Articles excluded during mapping stage (*n* = 301)

- Brain imaging (*n* = 11)
- Year (*n* = 108)
- Public service announcement (*n* = 77)
- Media training (*n* = 27)
- Branding (*n* = 26)
- Self esteem/ body image (*n* = 22)
- Qualitative (*n* = 19)
- Models (*n* = 7)
- Scale/ tool development (*n* = 1)
- Charity (*n* = 3)

Appendix 3: Details about machine learning

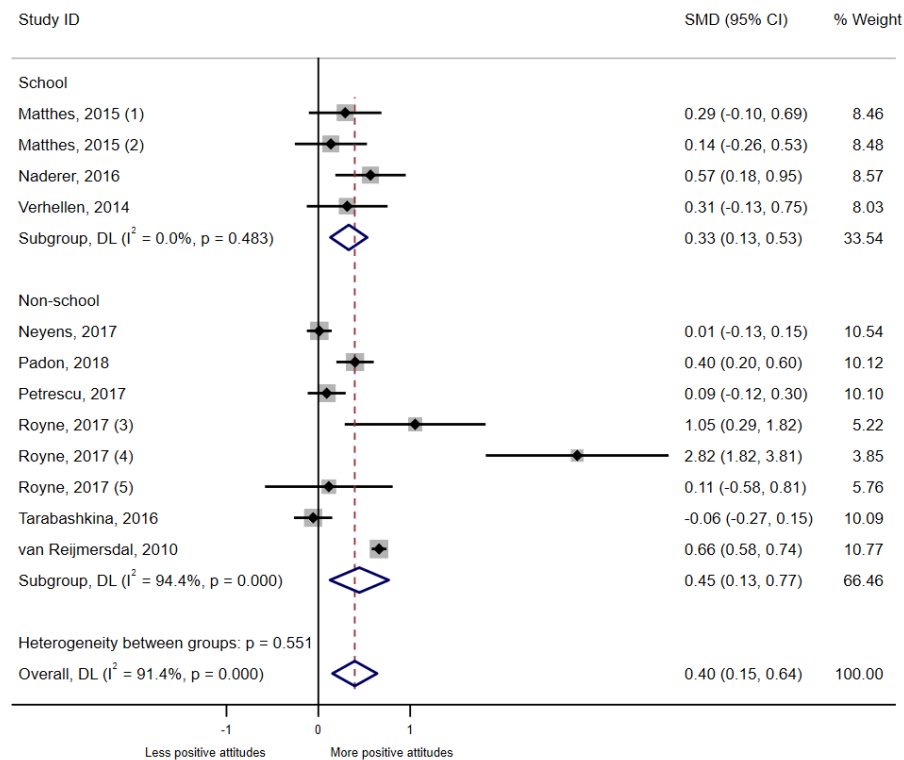
Relevance scores for each study based on a random sample of studies that had been manually screened were generated using the review management software, with higher scores indicating greater relevancy. Duplicate screening on the highest relevancy scores continued manually until six irrelevant studies in a row were screened (score = 47). All studies with this relevance score or higher were screened and all studies with lower scores were excluded (a random sample of excluded studies below this threshold were checked, *n* = 50). For the updated search, the classifier model was applied to the new studies (once duplicates were removed) and relevancy scores generated. The same cut-off score was applied, with studies above that score included for full-text screening and studies below that score excluded (a random sample of excluded studies was screened, *n* = 50).

Appendix 4: Rationale for meta-analysis inclusion and data processing

Author, year	Data	Outcome measure	Scale	Comparison
Matthes, 2015	Y	<u>Brand attitude</u>	0-2	Control (same movie clip w/ no placement) vs combined experimental (mod/high freq)
		-children were shown a picture of the UTZ brand logo and asked whether or not they found the picture "likeable" and "funny." Both items were combined		
		<u>Product attitude</u>	0-2	

		-children were asked whether or not they found UTZ Cheese Balls “likeable” and “funny”		
Naderer, 2016	Y	<u>Brand attitude</u> -“preference for Visa” -Children were requested to: evaluate the Visa logo; pick which of the three credit card-brands they liked the most; and which one they would prefer to use in the future. Three items were on the same scale 0 = I like it not at all to 3= I like it very much, combined.	0-3	Control vs branded intervention
Neyens, 2017	Y	<u>Brand attitude</u> -asked to indicate how much they liked the brand on a one-item, 5-point Likert smiley-scale ranging from ‘not at all’ to ‘very much’	1-5	Control (no advert) vs combined experimental condition (advergame/TV)
Padon, 2018	Y	<u>Product beliefs</u> -Participants reported their agreement on 5-point Likert scales ranging from strongly disagree to strongly agree with the following items, “E-cigarettes are...cool, enjoyable, healthy, helpful in social situations, visually appealing, fun, and high tech”	1-5	Control (food ad) vs combined experimental (e cig ads)
Tarabashkina, 2016	Y	<u>Product evaluation</u> -‘Do you think this food (that is, biscuit 1) is tasty/healthy/could make you popular among other children?’ Dichotomous questions.	0-3	Control (toy ad) vs food ad
van Reijmersdal, 2010	Y	<u>Brand image</u> - “I think [bank name] is...” followed by 13 different characteristics, including friendly, modern, dedicated, and trendy, on a scale ranging from 1 (completely disagree) to 7 (completely agree).	1-7	Control (game w/ no placement) vs combined experimental
Verhellen et al, 2014	Y	<u>Brand attitude</u> -3 qs (i.e., “I like ...,” “... popsicles taste good,” and “... popsicles are fun”) on a four point smiley scale. Calculated a summated scale.	1-4	Control (no ad exposure) vs combined experimental
Petrescu, 2017	Y	<u>Appeal of using e-cigarettes</u> -3 bipolar items: unattractive versus attractive, not cool versus cool and boring versus fun. Responses were recorded on scales ranging from 1 to 5, with higher scores denoting greater appeal.	1-5	Control (no ads) vs combined experimental conditions of e-cigarette adverts (glamor/health)
Royne, 2017	Y	<u>Attitude</u> - -How much they liked each of the three drinks tested -How healthy they perceived each of the drinks. 5-point, facial recognition scale. -kept as individual data points	1-5	Control (SpongeBob clip with no placement) vs randomly assigned experimental conditions with placements (juice, milk, cola)

Appendix 5. Forest plot showing SMD in brand or product attitudes between any advertising exposure and no advert or neutral advert controls by experiment setting, school or non-school; 95% CIs and study weights are indicated. Overall SMD was generated by a random effects model



1. Brand attitude outcome 2. Product attitude outcome 3. Data from cola product placement vs control with cola attitude question 4. Data from juice product placement vs control with juice attitude question 5. Data from milk product placement vs control with milk attitude question

Appendix 6: Bias assessment for non-randomised experimental studies using ROBINS-I

	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall	
An 2019	+	+	+	+	+	+	+	+	
Carter 2011	?	+	?	+	+	+	+	?	
Castonguay 2015 (S2)	?	+	+	+	+	?	+	?	+
Hudders 2018	?	+	+	+	+	+	+	?	?
Lapierre 2015	+	+	+	+	+	+	+	+	!
Owen 2013	?	+	+	+	?	+	+	?	-
Sharma 2015	?	+	+	+	-	+	?	?	
Tarabashkina 2016	+	+	+	+	-	?	+	?	
Tarabashkina 2018	+	+	+	+	-	+	+	?	
Tarabashkina 2018	+	+	+	+	-	?	+	?	
Te'eni-Harari 2014	?	+	+	+	+	+	?	?	
van Reijmersdal 2010	?	+	+	?	+	+	+	?	
Waiguny 2014 (S2)	?	+	+	+	-	+	+	?	

Low risk

Some concerns

High risk

No information

Bias assessment for randomised experimental studies using RoB-2

	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall
Castonguay 2019	+	+	+	+	+	+
Dias 2011	?	+	+	+	?	?
Dixon 2017	+	+	+	+	+	+
Duke 2016	+	+	+	+	+	+
Farrelly 2015	+	+	+	+	+	+
Harris 2018	?	+	+	+	+	?
Kim 2017	?	+	+	+	?	?
Matthes 2015	?	+	+	+	?	?
Naderer 2016	+	+	+	+	?	?
Naderer 2018	?	+	+	+	+	?
Neyens 2017	+	+	+	+	?	?
Padon 2018	?	+	-	+	+	-
Panic 2013 (S2)	?	+	+	+	?	?
Petrescu 2017	+	+	+	+	+	+
Rifon 2014	?	+	+	+	?	?
Royne 2017	?	+	-	+	?	-
Smith 2020	+	+	+	+	+	+
Uribe 2015	?	+	+	+	?	?
Uribe 2020	+	+	+	+	?	?
van Berlo 2017	+	+	+	+	+	+
van Berlo 2020	+	+	+	+	+	+
van Reijmersdal 2020	+	+	+	+	+	+
Vasiljevic 2018	+	+	+	+	+	+
Verhellen 2014	+	+	+	+	?	?
Vogel 2020	+	+	-	+	+	-
Waiguny 2014 (S1)	?	+	+	+	?	?

 Low risk
 Some concerns
 High risk

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