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The effect of Position and Availability interventions on adolescents' food choice: An online experimental study

Katie L. Edwards [1*], Jacqueline Blissett [1], James P. Reynolds [1*]

Affiliations

[1]School of Psychology and Institute of Health and Neurodevelopment, Aston University, Birmingham, UK.

***Corresponding authors:** Dr Katie L Edwards (k.edwards4@aston.ac.uk) and Dr James P Reynolds (j.reynolds4@aston.ac.uk), School of Psychology and Institute of Health and Neurodevelopment, Aston University, Birmingham, B4 7ET, UK

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Abstract

Interventions that alter characteristics of the food environment have been found to reduce energy intake in adults. However, few studies have examined the effect of Availability (reducing the number of higher energy options) and Position (altering the order of options) interventions on food choices by younger populations. Hence, this study examined the individual and combined effects of Availability and Position interventions on adolescents' energy selection from restaurant menus. In this online experiment, adolescents (13-17 years; *N*=434) were randomly assigned to one of four groups: (1) Availability and Position absent (control group) = 60% higher energy options, ordered randomly by energy content; (2) Availability present, Position absent = 40% higher energy options, ordered randomly by energy content; (3) Position present, Availability absent = 60% higher energy options, menu options were ordered from lower to higher energy; (4) Availability present, Position present = 40% higher energy options, menu options were ordered from lower to higher energy. The primary outcome was average energy selected per meal (starter, main, and dessert). Findings showed that both the Availability and Position interventions reduced adolescents' meal energy selection, whether presented as individual interventions or combined. Thus, reducing the availability of higher energy menu options, and ordering menu options from low to high energy, appear to be effective strategies for reducing adolescents' energy selection from overall meals. Further research is needed to determine whether these findings translate to real-life food choices.

Keywords: Adolescents; Energy selection; Menu intervention; Food environment[1]

[1] **Abbreviations:** TIPPME = typology of interventions in proximal physical microenvironments

1. Introduction

Childhood obesity rates have been steadily increasing over recent years prompting concerns about long term health and wellbeing. In 2016, the UK government aimed to reduce the rate of childhood obesity within 10 years (Department of Health and Social Care, 2017). Since this aim was announced the rate of childhood overweight and obesity has increased from 28% to 36.6% in children between the ages of 2 and 15 (NHS Digital, 2023). One key period for targeting dietary interventions is adolescence: a developmental period characterised by significant life transitions and increased independence (Viner et al., 2015). While this transitional period has been linked to poor diet quality and increased weight (Winpenny et al., 2020; Winpenny et al., 2018), the autonomy gained by adolescents over their food environment makes this a critical period for interventions to establish lifelong healthy dietary behaviour (Craigie et al., 2011; Nelson et al., 2008).

Tackling childhood obesity requires action on multiple fronts and one key group of interventions include those that change the characteristics of the food environment to improve healthy eating. Fast progress has been made in recent years by evaluating these interventions in adult food environments such as in university cafeterias, worksite cafeterias, and restaurants (Garnett et al., 2019; Pechey et al., 2022; Reynolds et al., 2022; Reynolds et al., 2021). Despite this progress, there has been relatively little attention to testing these interventions within food environments that adolescents are exposed to, such as school cafeterias and restaurants.

A recent Cochrane review focussed on two such interventions for changing eating behaviours: Availability and Position (Hollands et al., 2019). Within the typology of interventions in proximal physical microenvironments (TIPPME; Hollands et al., 2017) an 'Availability by Product' intervention is defined as adding or removing (some or all) products to increase, decrease, or alter their range, variety or number. The evidence suggested that Availability interventions changed behaviour, but there was an overall lack of naturalistic studies at low risk of bias, and even fewer which had been conducted specifically on children or adolescents (Hollands et al., 2019). One study included in this review tested an Availability intervention within vending machines in schools in the Netherlands in which some high energy snacks (> 170kcals) were replaced with lower energy alternatives (< 100kcals; Kocken et al., 2012). The intervention reduced the number of purchases of higher calorie snacks and increased the number of purchases of midrange (100 – 170kcals) snacks. Another study examined the effect of removing the availability of less healthy foods from school cafeterias in the United States (Boehm et al., 2020). When these foods were not available, high-school students were found to select more meals which were compliant with

the state school recommendations. These preliminary studies suggest that Availability interventions in school settings show promise at improving healthier dietary choices among adolescents. However, interventions which remove all, or a large proportion, of less healthy products may not be feasible or acceptable for use in restaurant establishments, where retailers have business targets (e.g., profits) to consider. Furthermore, choices made in restaurant settings are more likely to be driven by indulgence (Screti et al., 2024), therefore interventions which reduce less healthy choices could be less effective in these contexts. Thus, more evidence is needed given the large variance in forms that Availability interventions can take as well as uncertainty regarding the generalisability of such interventions across different food choice contexts.

The second intervention evaluated in the systematic review was Position (Hollands et al., 2019). Within the TIPPME typology (Hollands et al., 2017), 'Position by Product' interventions are those which alter the position, proximity, or accessibility of products. A meta-analysis of 18 studies suggests that Position interventions affect both the selection and consumption of food (Hollands et al., 2019). However, the evidence was of very low certainty, and there were few studies conducted with child populations, and in naturalistic settings. Research conducted in school cafeterias involved placing fruit or vegetables at the front of a school cafeteria line (Cohen et al., 2015; Greene et al., 2017; Marcano-Olivier et al., 2019), however in these studies there were other interventions in place, such as the provision of information, increasing the attractiveness of the packaging and product names, and the use of signage and images to promote the healthier products. This confounding of intervention components makes it difficult to infer causality. When examining the effect of Position interventions alone, Wyse and colleagues (2019) found that positioning fruit and vegetable snacks first or last on an online lunch menu did not increase primary school children's selection of these snacks. Research with adult populations has shown that Position interventions reduce the energy selected from restaurant menus (Bianchi et al., 2023) and grocery shopping (Howe et al., 2022). Given this, and that there has been no evaluation of the effectiveness of Position interventions on adolescent food choice from restaurant menus, it a key target for the current study.

While there is preliminary evidence for the effectiveness of both Availability and Position interventions to change food choices, there is limited evidence in younger populations and no current evidence for how these two interventions work in combination. Combining large numbers of intervention components together may generate an effect, but understanding whether interventions have additive effects, sub-additive effects, or synergistic effects will enable organisations and policy makers to alter environments knowing the range of consequences. To do this requires testing interventions in a stacked manner;

testing each in isolation, and in combination, rather than only in combination. Some existing work has done this with adults with Availability and Portion Size interventions (Reynolds et al., 2021) however this has yet to be done with Availability and Position interventions, in any population, adults or children.

In summary, Availability and Position interventions show promising effects on food choice in adult populations, however, there are few studies conducted with child and adolescent populations, and there is limited evidence examining the individual and combined effects of these interventions. Moreover, most research with younger populations has been conducted in school settings. Eating outside of home is a key source of adolescents' energy intake (Lachat et al., 2012), and whilst schools may be an important target for intervention, another common food environment for adolescents is restaurants. Indeed, one fifth of children consume meals out at least once per week (Adams et al., 2015), which is concerning given that eating outside of home is positively associated with body weight (Bezerra et al., 2012). Considering this, restaurants could be an important venue for implementing low cost, high reach interventions that change the food environment to improve adolescents' healthy eating. Hence, this study aimed to test the individual and combined effects of Availability and Position interventions on food selection by adolescents. We hypothesised that: (1) the Position intervention would reduce the energy selected from restaurant menus by adolescents, compared to groups where the Position intervention was absent; (2) the Availability intervention would reduce the energy selected by adolescents, compared to groups where the Availability intervention was absent; and (3) the Availability and Position combined intervention would reduce the energy selected by adolescents, compared to the control group.

2. Methods

This study was pre-registered on the Open Science Framework prior to data collection (https://osf.io/mqpxk).

2.1. Participants

Sample size calculations were conducted in R v4.1.3 using the WebPower package (Zhang & Yuan, 2018) and are available in the Open Science Framework folder (https://osf.io/2tj7d/). To detect effect sizes larger than d =.36 (based on meta-analyses of the effect of Availability and Position on adults' food selection; Hollands et al., 2019), 90% power, and α = .0167 (applying Bonferroni adjustment for 3 interventions), a minimum of 420 participants were required. In total, 595 participants were recruited from the United Kingdom via an online research agency between July and August 2023. However, the final sample was 434 after excluding participants for not meeting pre-registered eligibility criteria. These

criteria were that adolescents must be between the ages of 13 and 17 years old, and adolescents were not eligible to participate if they were autistic, or if they had severe learning disabilities or a chronic illness that directly influenced their dietary requirements or eating habits. Adolescents who were gluten intolerant were not eligible to participate. Exclusion criteria also included following a vegan or vegetarian diet and/or following a specific diet for religious reasons. Adolescents with a current or previous eating disorder were not eligible to participate. Aston University Health and Life Sciences Research Ethics Committee provided ethical approval (HLS21092). Parents and adolescents provided informed consent for their participation.

2.2. Study design

This study used a 2x2 between-subjects design with 2 factors: Availability intervention (present versus absent) and Position intervention (present versus absent). This study was conducted on the survey platform, Qualtrics. Participants were randomly allocated to one of four groups using the Qualtrics platform: Availability, Position, Availability & Position, or the control condition. Selecting a 2x2 design allows for a test of both the individual and interactive effects of the interventions.

Participants were exposed to three separate restaurant menus each containing starter, main, and dessert options. Real-world restaurant menus were downloaded and adapted for this study. For each section participants were given an image to click on and the following instructions: “Please select a starter/main/dessert from the menu by clicking on the name of the product.” To record the option selected by participants, the heat map feature in Qualtrics was used to specify regions for each option. The heat map feature allowed participants to make selections from the menu itself, rather than using a selection button (e.g., drop down list). Three different restaurant menus were selected to increase the generalisability of the conclusions. Each menu included 5 starter options, 10 main options, and 5 dessert options (see Figures 1-4 for example menus). All menu images are available on OSF. Calorie information was included for each item on all the menus as this is currently legislated for restaurant menus in the United Kingdom, but the price and branding were removed. Side dishes, sharing dishes, or ‘choose your own’ options (e.g., choose your own pizza) were not included. Menu items were then selected to provide a variety of options, including at least one vegetarian option on each menu. Each menu was altered to include the item ‘I don’t want any of the options on this menu’.

Figure 1. Example starter menu (Position intervention)

Figure 2. Example starter menu (Availability intervention)

Figure 3. Example starter menu (Availability & Position group)

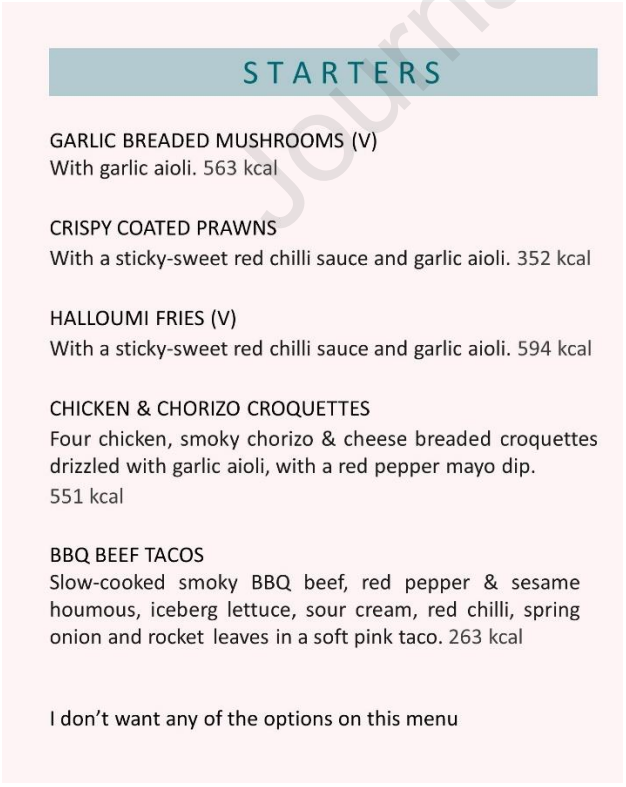

Figure 4. Example starter menu (Control group)

2.4. Interventions

Menus in each group included: (1) Availability and Position absent (control group) = 60% higher energy options, ordered randomly by energy content; (2) Availability present, Position absent = 40% higher energy options, ordered randomly by energy content; (3) Position present, Availability absent = 60% higher energy options, menu options were ordered from lower to higher energy; (4) Availability present, Position present = 40% higher energy options, menu options were ordered from lower to higher energy. Menus can be found on the Open Science Framework (https://osf.io/2tj7d/files/osfstorage). To determine high and low energy options, items from each restaurant were merged into starters, mains, and desserts, and a median split was used to determine the cut off value for high calorie options: 523kcal was the threshold for starters, 1158kcal for mains, and 553kcal for desserts (Table 1).

Table 1. Average energy (kcals) on offer in groups where the Availability intervention was present and absent

	Availability	
	Absent	Present
Meal	2250.07	2016.63
Starter	491.67	424.13
Main	1159.80	1064.23
Dessert	598.60	528.27

2.5. Blinding

Participants did not know the intervention group to which they were randomly allocated. Participants in different groups received different menus and were not aware that other participants did not receive these same menus. The researcher who analysed the data (JPR) was not aware of the intervention applied to any given group. One researcher (KLE) downloaded the data from Qualtrics, changed the group identity to A, B, C, or D (selected using the random rank feature in Excel) and sent the anonymised data to JPR who conducted the analyses.

2.5. Measures

2.5.1. Outcome measures

198 The primary outcome was the total energy (kilocalories) selected for the meal. This
199 was calculated by summing the total energy selected for each meal, and calculating the
200 mean energy selected across the three restaurants. A meal was defined as a starter, main
201 course, and dessert. Secondary outcome measures included the total energy (kilocalories)
202 selected for individual courses. This was calculated as the mean energy selected across the
203 three restaurants, for starters, mains, and desserts, separately.

204 ***2.5.2. Additional measures***

205 Adolescents provided demographic data including sex, age, and whether they were
206 in full time education. Adolescents also rated their subjective appetite with the following
207 measures: hunger ('not hungry at all' to 'very hungry'), fullness ('not full at all' to 'very full'),
208 desire to eat ('very weak' to 'very strong'), and prospective food consumption ('nothing at all'
209 to 'a large amount') (Hammond et al., 2022). Items were measured on a 100mm visual
210 analogue scale. Appetite scores were calculated as the mean of hunger, fullness (reversed),
211 desire to eat, and prospective food consumption scores.

212 **2.6. Procedure**

213 Parents and their 13–17-year-old adolescents consented to take part, separately. If
214 parents had multiple children in this age range, they were told to ask only one child to
215 participate and to provide data about that individual. Participants' eating was not restricted
216 prior to completing the study. To determine eligibility to participate, parents provided
217 information about adolescents' food allergies, food intolerances, medical conditions that
218 affect eating behaviour, and dietary requirements. Parents were then instructed to ask their
219 child to complete the rest of the study. Adolescents provided demographic information and
220 rated their subjective appetite. Following this, adolescents were exposed to three separate
221 menus and were asked to select one starter, main, and dessert from each restaurant menu,
222 as if they were ordering a meal in a restaurant with their family. Participants were told that
223 there was a fixed price for ordering three courses. Finally, parents and adolescents were
224 debriefed and thanked for their participation. After taking part, parents received points
225 through the online research agency.

226 **2.7. Statistical analysis**

227 Statistical analyses were conducted by JPR in R (2022) and the main results were
228 independently reproduced by a second analyst (KLE) in SPSS Version 29. For the primary
229 analysis, a 2x2 ANOVA model examined the effect of each intervention, and the interaction
230 between interventions, on the energy selected from the meal. For the secondary analyses,
231 three separate 2x2 ANOVA models were conducted to examine the effect of each

intervention, and the interaction between interventions, on the energy selected from starter, main, and dessert courses. A Student's t-test was used to examine the combined effect of Availability and Position interventions on the energy selected from the meal. A follow-up sensitivity analysis was conducted to remove outliers (defined using the MAD method (Leys et al., 2013), limit = ±3, b = 1.4826) to confirm that the main results were robust to this statistical decision. For the second sensitivity analysis, a 2x2 ANCOVA was conducted, including adolescents' appetite scores as a covariate.

3. Results

3.1. Sample characteristics

In total, 595 participants completed the study. Participants were excluded due to not meeting eligibility criteria, such as having a food allergy or intolerance (n = 17) or not being aged 13-17 years old (n = 129). Where multiple responses were from the same IP address (n = 15) the first response was included in analyses. Hence, the final sample included 434 participants (Availability n = 109; Position n = 110; Availability and Position n = 105; Control n = 110). Participants included 270 male adolescents, 161 female adolescents, with 2 participants reporting 'Other gender' and 1 participant reporting 'Prefer not to say'. Adolescents had a mean age of 14.75 years (SD = 1.43).

3.2. Primary outcome

For the energy selected on average per meal, a 2x2 ANOVA revealed a significant main effect of the Availability intervention ($p < .001$) and the Position intervention ($p = .006$), whereby the energy selected was significantly lower in the groups containing the interventions, compared to groups that did not contain the interventions. However, there was no significant two-way interaction between Availability and Position interventions ($F(1, 430) = 0.61$, $p = .435$, $\eta_p^2 = .00$). See Table 2 for marginal means and the supplementary material for the full ANOVA model and sensitivity analyses, which replicate the main findings after making different analytical decisions.

Table 2. Energy selected (kcal) from the meal with and without the Availability and Position interventions (two-way ANOVA)

	Absent	Present				
	M (SD)	*M* (SD)	*F*	*p*	$_{partial}\eta^2$	*d*
Availability	2134.26 (460.24)	**1956.18 (367.17)**	20.32	.000	.05	.43
Position	2099.78 (406.51)	**1992.13 (439.12)**	7.57	.006	.02	.25

Note. Bold indicates significantly different from groups without the intervention. Means and SDs

reported represent the estimated marginal means and SDs.

3.2. Combined effect

A Student's t-test revealed that there was a significant difference in the energy selected from the meal between the Availability and Position group and the control group (t(213 = -5.06, p < .001, d = .69). Adolescents' energy selection was significantly lower in the Availability and Position group (M = 1884.44kcal; SD = 384.83), compared to the control group (M = 2173.60kcal; SD = 453.96).

3.3. Secondary outcomes

For the energy selected from the starter course, there was a significant main effect of the Availability intervention (p < .001), whereby the energy selected was significantly lower following the Availability intervention, compared to groups without the Availability intervention. However, there was no significant main effect of the Position intervention (p = .227), and no significant interaction between Availability and Position groups (F(1, 430) = 0.80, p = .373, η_p^2 = .00).

For the energy selected from the main course, there was a significant main effect of the Position intervention (p = .016), whereby the energy selected was significantly lower following the Position intervention, compared to groups without the Position intervention. However, there was no significant main effect of the Availability intervention (p = .066), and the interaction between the Availability and Position groups was not significant (F(1, 430) = 0.03, p = .874, η_p^2 = .00).

For the energy selected from the dessert course, there was no significant main effect of the Availability intervention (p = .164) or the Position intervention (p = .028), and the interaction between the Availability and Position groups was not significant (F(1, 430) = 0.94, p = .334, η_p^2 = .00). See Table 3 for marginal means. See supplementary material for group means and full ANOVA models.

Table 3. Energy selected from the individual courses in Availability and Position groups (two-way ANOVA)

	Absent	Present				
	M (SD)	M (SD)	F	p	$_{partial}\eta^2$	d
Starter						
Availability	470.35 (163.45)	**357.20 (139.55)**	60.24	.000	.12	.74
Position	422.77 (163.51)	406.18 (160.74)	1.46	.227	.00	.10
Main						
Availability	1097.06 (278.02)	1052.20 (235.16)	3.41	.066	.01	.17

Position	1104.17 (242.56)	**1045.16 (271.03)**	5.83	.016	.01	.23
Dessert						
Availability	566.85 (170.90)	546.79 (131.63)	1.95	.164	.00	.13
Position	572.84 (157.57)	540.78 (146.72)	4.87	.028	.01	.21

Note. Bold indicates significantly different from groups without the intervention. Means and SDs reported represent the estimated marginal means and SDs. Note that the alpha was set as 0.167 for these analyses and therefore the position intervention on Desserts is not statistically significant.

4. Discussion

This study aimed to examine the individual and combined effects of Availability and Position interventions on adolescents' energy selection from restaurant menus. Decreasing the availability of high-energy menu options was found to reduce adolescents' energy selection from a three-course meal. Findings also showed that ordering menu options from low to high energy (i.e., adjusting the position) reduced adolescents' energy selection from a three-course meal. Furthermore, findings showed that there was an additive, but not multiplicative, effect of combining Availability and Position interventions on reducing energy selection from a three-course meal.

Consistent with research in school settings (Boehm et al., 2020; Kocken et al., 2012), our findings suggest that Availability and Position interventions may be effective for use in restaurant settings, which are a common out-of-home eating environment for children (Adams et al., 2015). Eating outside of home is associated with greater energy intake (Lachat et al., 2012), thus, restaurants provide an important location for implementing low cost and high reach interventions to improve adolescents' healthy eating and support efforts to reduce population-level obesity. Indeed, reducing daily energy overconsumption by 28kcals, per person, may prevent further weight gain in 90% of the population (Department of Health and Social Care, 2011). While the acceptability of these interventions in restaurant settings is yet to be examined, qualitative research has shown that Availability and Position interventions in high school settings are appealing to adolescents (Murphy et al., 2021). It is also important to consider the acceptability and feasibility of these interventions for restaurant retailers. Although this remains to be examined, research has shown that supermarket retailers are willing to engage in healthy food retail, but their willingness may vary depending on the type of establishment and whether profit margins are impacted (Martinez et al., 2018).

The primary outcome of this study was energy selection from a three-course meal. Research has shown that individuals consume 60% more food when eating a four-course meal, compared to a single-course meal (Rolls et al., 1984). While Availability and Position interventions could have a substantial impact on reducing energy consumption, adolescents

may not choose to eat three-courses in restaurants settings, particularly at more casual food establishments. When examining the energy selected from individual courses, the effectiveness of the Availability intervention appears to be driven by reduced energy selection from the starter course. Thus, the effect of Availability interventions may be limited to situations where three courses are selected. In contrast, the Position intervention was found to be effective for reducing the energy selected from main course, but not the starter or dessert courses. Since most eating occasions involve a main course, research is needed to determine whether Position interventions have a greater impact on reducing adolescents' energy intake in restaurant settings, compared to Availability interventions. As this is the first study to our knowledge that shows that these interventions have differential effects across meal courses it is first a priority to replicate these effects to ensure it is not a statistical artifact or a consequence of the unique food offerings provided in the current menus. Moreover, selecting 3 courses from 3 different restaurants may not reflect real life eating occasions and thus, could have influenced the current results. Research which examines the effect of Availability and Position interventions on main courses only is required to determine whether the current findings are replicated.

Consistent with hypotheses, the combined effect of Availability and Position interventions reduced adolescents' energy selection. Our findings show that while Availability and Position interventions are effective in isolation, combining these interventions may have a greater impact on reducing energy selection. However, there was no evidence of a multiplicative or interaction effect of Availability and Position interventions. This suggests that the effectiveness of the Availability intervention was not increased when Position intervention was implemented, and vice versa. There were no negative interactive effects either; the effect of one intervention was not reduced when the other was present. This should provide confidence for intervention implementers who want to maximise the effectiveness of an intervention by combining multiple components.

4.1. Strengths and Limitations

This experimental study included menus based on real-life restaurants, with a wide variety of options, increasing the ecological validity. The study also used three separate menus to increase the generalisability of results. However, there are several limitations. The online nature of the experiment meant that real-life food selections could not be examined and although some menu ordering does occur via food delivery aps in a similar manner to the task employed here, there was critically no actual measure of eating behaviour. Price information was removed from menus to reduce the influence of cost; however, it is possible that adolescents may have made different food choices if price information was available.

Research in field settings such as restaurants is needed to determine whether the current results translate to real-life food choices and thus to consumption. Moreover, this study examined food choices at a single time-point. To determine the impact of Availability and Position interventions on long-term dietary behaviour, more research is needed to evaluate how adolescents respond to these interventions over time, particularly in naturalistic settings. The generalisability of the current findings to other populations may be limited. For example, the use of Availability and Position interventions for individuals who have dietary restrictions (e.g., following a vegan diet) could be less influential given that there may already be a limited number of suitable menu options. Finally, the experimental task included selecting a three-course meal from restaurant menus. While many young people eat outside of home (Adams et al., 2015), the effect of Availability and Position interventions may be limited to those with the financial resources to eat in restaurants. Indeed, children living in less affluent households may be more likely to eat takeaway meals (Adams et al., 2015). Thus, research is needed to determine whether the current findings generalise to other types of food available in retail settings such as fast-food venues, takeaway venues, and cafes/cafeterias.

5. Conclusion

This study is the first to demonstrate that reducing the availability of higher energy menu options, and ordering menu options from low to high energy, are effective strategies both individually and when combined, for reducing the energy selected from a three-course meal by adolescents. These initial findings suggest that implementing these interventions into restaurants, a common out-of-home food setting, may be a useful strategy to improve healthier eating by adolescents and tackle childhood obesity. However, more research is needed to establish whether these effects translate to food choices in real-life restaurant settings.

Author contributions

KL Edwards: Investigation, Resources, Project administration, Writing – Original draft. **JP Reynolds:** Conceptualisation, Methodology, Funding acquisition, Data curation, Formal analysis, Writing - Review & Editing. **J Blissett:** Conceptualisation, Methodology, Funding acquisition, Writing - Review & Editing.

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Data availability

Data are available on the Open Science Framework (https://osf.io/2tj7d/).

Ethical statement

Aston University Health and Life Science Research Ethics Committee provided ethical approval (#HLS21092). Participants provided informed consent for their participation.

References

Adams, J., Goffe, L., Brown, T., Lake, A. A., Summerbell, C., White, M., . . . Adamson, A. J. (2015). Frequency and socio-demographic correlates of eating meals out and take-away meals at home: cross-sectional analysis of the UK national diet and nutrition survey, waves 1-4 (2008-12). *International Journal of Behavioral Nutrition and Physical Activity*, *12*, Article 51. https://doi.org/10.1186/s12966-015-0210-8

Bezerra, I. N., Curioni, C., & Sichieri, R. (2012). Association between eating out of home and body weight. *Nutrition Reviews*, *70*(2), 65-79. https://doi.org/10.1111/j.1753-4887.2011.00459.x

Bianchi, F., Luick, M., Bandy, L., Bone, J., Kelly, S., Farrington, J., . . . Pechey, R. (2023). The impact of altering restaurant and menu option position on food selected from an experimental food delivery platform: a randomised controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, *20*(1), Article 60. https://doi.org/10.1186/s12966-023-01456-8

Boehm, R., Read, M., Henderson, K. E., & Schwartz, M. B. (2020). Removing competitive foods v. nudging and marketing school meals: a pilot study in high-school cafeterias. *Public Health Nutrition*, *23*(2), 366-373, Article Pii s136898001900329x. https://doi.org/10.1017/s136898001900329x

Cohen, J. F. W., Richardson, S. A., Cluggish, S. A., Parker, E., Catalano, P. J., & Rimm, E. B. (2015). Effects of Choice Architecture and Chef-Enhanced Meals on the Selection and Consumption of Healthier School Foods A Randomized Clinical Trial. *Jama Pediatrics*, *169*(5), 431-437. https://doi.org/10.1001/jamapediatrics.2014.3805

Craigie, A. M., Lake, A. A., Kelly, S. A., Adamson, A. J., & Mathers, J. C. (2011). Tracking of obesity-related behaviours from childhood to adulthood: A systematic review. *Maturitas*, *70*(3), 266-284. https://doi.org/10.1016/j.maturitas.2011.08.005

Department of Health and Social Care. Childhood obesity: A plan for action. (2017). https://www.gov.uk/government/publications/childhood-obesity-a-plan-for-action/childhood-obesity-a-plan-for-action Accessed 20 March 2024.

Department of Health and Social Care. Statement of the calorie reduction expert group. (2011). https://www.gov.uk/government/publications/statement-of-the-calorie-reduction-expert-group Accessed 20 March 2024.

Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., & Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(42), 20923-20929. https://doi.org/10.1073/pnas.1907207116

Greene, K. N., Gabrielyan, G., Just, D. R., & Wansink, B. (2017). Fruit-Promoting Smarter Lunchrooms Interventions: Results From a Cluster RCT. *American Journal of Preventive Medicine*, *52*(4), 451-458. https://doi.org/10.1016/j.amepre.2016.12.015

Hammond, L., Morello, O., Kucab, M., de Zepetnek, J. O. T., Lee, J. J., Doheny, T., & Bellissimo, N. (2022). Predictive Validity of Image-Based Motivation-to-Eat Visual Analogue Scales in Normal Weight Children and Adolescents Aged 9-14 Years. *Nutrients*, *14*(3), Article 636. https://doi.org/10.3390/nu14030636

Hollands, G. J., Bignardi, G., Johnston, M., Kelly, M. P., Ogilvie, D., Petticrew, M., . . . Marteau, T. M. (2017). The TIPPME intervention typology for changing environments to change behaviour. *Nature Human Behaviour*, *1*(8). https://doi.org/10.1038/s41562-017-0140

Hollands, G. J., Carter, P., Anwer, S., King, S. E., Jebb, S. A., Ogilvie, D., . . . Marteau, T. M. (2019). Altering the availability or proximity of food, alcohol, and tobacco products to change their selection and consumption. *Cochrane Database of Systematic Reviews*(9), Article Cd012573. https://doi.org/10.1002/14651858.CD012573.pub3

Howe, H. S., Ubel, P. A., & Fitzsimons, G. J. (2022). Open science online grocery: A tool for studying choice context and food choice. *Journal of the Association for Consumer Research*, *7*(4), 393-402.

Kocken, P. L., Eeuwijk, J., van Kesteren, N. M. C., Dusseldorp, E., Buijs, G., Bassa-Dafesh, Z., & Snel, J. (2012). Promoting the Purchase of Low-Calorie Foods From School Vending Machines: A Cluster-Randomized Controlled Study. *Journal of School Health*, *82*(3), 115-122. https://doi.org/10.1111/j.1746-1561.2011.00674.x

Lachat, C., Nago, E., Verstraeten, R., Roberfroid, D., Van Camp, J., & Kolsteren, P. (2012). Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obesity Reviews*, *13*(4), 329-346. https://doi.org/10.1111/j.1467-789X.2011.00953.x

Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. *Journal of Experimental Social Psychology, 49*(4), 764–766. https://doi.org/10.1016/j.jesp.2013.03.013

Marcano-Olivier, M., Pearson, R., Ruparell, A., Horne, P. J., Viktor, S., & Erjavec, M. (2019). A low-cost Behavioural Nudge and choice architecture intervention targeting school lunches increases children's consumption of fruit: a cluster randomised trial. *International Journal of Behavioral Nutrition and Physical Activity*, *16*, Article 20. https://doi.org/10.1186/s12966-019-0773-x

Martinez, O., Rodriguez, N., Mercurio, A., Bragg, M., & Elbel, B. (2018). Supermarket retailers' perspectives on healthy food retail strategies: in-depth interviews. *Bmc Public Health*, *18*, Article 1019. https://doi.org/10.1186/s12889-018-5917-4

Murphy, M., Mensah, D., Mylona, E., & Oyebode, O. (2021). Acceptability and feasibility of strategies to promote healthy dietary choices in UK secondary school canteens: a qualitative study. *Bmc Research Notes*, *14*(1), Article 365. https://doi.org/10.1186/s13104-021-05778-3

Nelson, M. C., Story, M., Larson, N. I., Neumark-Sztainer, D., & Lytle, L. A. (2008). Emerging adulthood and collegeaged youth: An overlooked age for weight-related behavior change. *Obesity*, *16*(10), 2205-2211. https://doi.org/10.1038/oby.2008.365

NHS Digital National Child Measurement Programme, England, 2022/23 school year. (2023). https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2022-23-school-year/age Accessed 20 March 2024.

Pechey, R., Bateman, P. A., Cook, B., Potter, C., Clark, M., Stewart, C., . . . Jebb, S. A. (2022). Testing the effectiveness of ecolabels to reduce the environmental impact of food purchases in worksite cafeterias: A randomised controlled trial. *Appetite*, *179*, Article 106277. https://doi.org/10.1016/j.appet.2022.106277

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Reynolds, J. P., Ventsel, M., Hobson, A., Pilling, M. A., Pechey, R., Jebb, S. A., . . . Marteau, T. M. (2022). Evaluation of physical activity calorie equivalent (PACE) labels' impact on energy purchased in cafeterias: A stepped-wedge randomised controlled trial. *Plos Medicine*, *19*(11), Article e1004116. https://doi.org/10.1371/journal.pmed.1004116

Reynolds, J. P., Ventsel, M., Kosite, D., Dames, B. R., Brocklebank, L., Masterton, S., . . . Turner, R. (2021). Impact of decreasing the proportion of higher energy foods and reducing portion sizes on food purchased in worksite cafeterias: A stepped-wedge randomised controlled trial. *Plos Medicine*, *18*(9), Article e1003743. https://doi.org/10.1371/journal.pmed.1003743

Rolls, B. J., Van Duijvenvoorde, P. M., & Rolls, E. T. (1984). Pleasantness changes and food intake in a varied four-course meal. *Appetite*, *5*(4), 337-348.

Screti, C., Edwards, K., & Blissett, J. (2024). Understanding family food purchasing behaviour of low-income urban UK families: An analysis of parent capability, opportunity and motivation. *Appetite*, *195*, Article 107183. https://doi.org/10.1016/j.appet.2023.107183

Viner, R. M., Ross, D., Hardy, R., Kuh, D., Power, C., Johnson, A., . . . Batty, G. D. (2015). Life course epidemiology: recognising the importance of adolescence. *Journal of Epidemiology and Community Health*, *69*(8), 719-720. https://doi.org/10.1136/jech-2014-205300

Winpenny, E. M., Smith, M., Penney, T., Foubister, C., Guagliano, J. M., Love, R., . . . Corder, K. (2020). Changes in physical activity, diet, and body weight across the education and employment transitions of early adulthood: A systematic review and meta-analysis. *Obesity Reviews*, *21*(4). https://doi.org/10.1111/obr.12962

Winpenny, E. M., van Sluijs, E. M. F., White, M., Klepp, K. I., Wold, B., & Lien, N. (2018). Changes in diet through adolescence and early adulthood: longitudinal trajectories and association with key life transitions. *International Journal of Behavioral Nutrition and Physical Activity*, *15*, Article 86. https://doi.org/10.1186/s12966-018-0719-8

Wyse, R., Gabrielyan, G., Wolfenden, L., Yoong, S., Swigert, J., Delaney, T., ... & Just, D. (2019). Can changing the position of online menu items increase selection of fruit and vegetable snacks? A cluster randomized trial within an online canteen ordering system in Australian primary schools. *The American Journal of Clinical Nutrition*, *109*(5), 1422-1430.

Zhang, Z., & Yuan, K.-H. (2018). Practical Statistical Power Analysis Using Webpower and R (Eds). Granger, IN: ISDSA Press.

Ethical statement

Aston University Health and Life Science Research Ethics Committee provided ethical approval (#HLS21092). Participants provided informed consent for their participation.

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: