Examining the influence of nudges on children's fruit and vegetable consumption

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The authors report no conflicts of interest

Abstract

Purpose: Children's fruit and vegetable consumption is lower than recommended and increasing consumption is important for children's health. Nudges influence children's eating behaviour, but less is known about their influence on children's fruit and vegetable consumption. Two studies were conducted to examine this.

Methods: Study 1 examined whether a fruit nudge (an image of grapes) on a plate influenced children's fruit (grapes) consumption relative to a control condition (no image). In a between-subjects design, children ($n=63$, Mean age=8.9 years, $SD=1.41$, 38 females, 25 males, 73% had a healthy-weight) were randomly assigned to one of two conditions (fruit nudge vs. control). Study 2 examined the influence of a large portion nudge (an image of a large portion of carrots) vs. a small portion nudge (an image of a small portion of carrots) vs. control (no nudge) on children's vegetable (carrot) consumption. In a between-subjects design, children ($n=60$, Mean age=8.53 years, $SD=2.14$, 31 females, 29 males, 85% had a healthy-weight) were randomly assigned to a condition.

Results: In Study 1 children consumed significantly more fruit in the fruit nudge condition than the control condition. In Study 2 children exposed to the large portion nudge ate significantly more vegetables than the other two conditions. The small portion nudge did not affect children's vegetable consumption relative to control.

Conclusions: The results indicate that nudges influence children's fruit and vegetable consumption, and that the portion size of the nudge may be key to whether the nudge influences children's eating behaviour.

Keywords: nudging; eating behaviour; children; portion size

Introduction

Children do not eat a sufficient amount of fruit and vegetables. In 2016 only 16% of children aged 5-15 years old ate the recommended five or more portions of fruit and vegetables per day [1]. Fruit and vegetable consumption is associated with a reduction in the risk of a number of chronic diseases [2–4]. A meta-analysis showed that the risk of all-cause mortality decreased by 5% for each additional serving of fruit and vegetables, up to five portions per day [5]. Since eating behaviours track from childhood into adolescence and adulthood [6, 7], increasing fruit and vegetable consumption at an early age is important.

Nudging is a potential strategy for increasing children’s fruit and vegetable consumption. Nudging involves altering aspects of the environment with the intention of changing health-related behaviour [8, 9], and has been shown to influence children’s fruit and vegetable consumption [10–13]. In one study, Reicks et al [14] placed images of carrots and green beans on a school dinner tray during one school lunch time. Children selected and consumed more carrots and green beans when the images were present in comparison to a control day when no images were present. To our knowledge, this is the only study to examine this type of nudge, and while the results indicate that an image of vegetables on tableware (e.g. a school dinner tray) may be a way of increasing children’s vegetable consumption, consumption of both fruit and vegetables is beneficial for health [2]. Therefore, understanding whether this type of nudge may influence children’s fruit consumption would be of value.

Furthermore, from the previous research [14] it is not clear how the nudges influenced children’s eating behaviour. One possibility is that the portion size of the nudge image may affect the amount that children eat. Research has consistently shown that children eat more

when served a large portion of food than when served a small portion [15–17], which is known as the portion size effect. Nudges may act in a similar way, whereby a nudge containing an image of a large portion may encourage children to eat more of that food compared to a nudge containing an image of a small portion. Understanding whether nudges elicit the portion size effect will be informative for the development of nudges to increase children’s fruit and vegetable consumption.

In this paper we aimed to understand the influence of nudges on children’s fruit and vegetable consumption. In study 1 we examined whether a fruit nudge influenced children’s fruit consumption. We expected that the nudge would influence children to increase their consumption of fruit relative to control (no image on a plate). In study 2 we examined whether the portion size of a vegetable nudge influenced children’s vegetable consumption. We expected that if the nudge influenced children’s vegetable consumption through eliciting the portion size effect, then children in the large portion nudge condition would consume more vegetables than children in the other two conditions.

81 *Study 1*

82 *Method*

83 *Design*

84 Children attended a single experimental session on an individual basis in their primary
85 school. Children were randomly assigned (using the online random number generator
86 <http://www.randomizer.org>) to one of two conditions (fruit nudge vs. control) in a between-
87 subjects design. In both conditions children were given a plastic white plate (22cm diameter)
88 and a plastic white bowl containing green seedless grapes (approximately 150 grams). In the
89 fruit nudge condition a laminated photographic image of green grapes (which constituted a
90 large portion and weighed approximately 240 grams) was placed on the plate (this image was
91 placed on the plate at the start of fruit nudge condition session and was loose and not stuck to
92 the plate). No image was present on the plate in the control condition (see figure 1). The plate
93 and the bowl were weighed using digital scales pre and post-consumption to measure
94 children's consumption.

95

96 *Ethics*

97 Study 1 and study 2 were approved by Coventry University Research Ethics Committee
98 (P69532 and P67529), and have been performed in accordance with the ethical standards laid
99 down in the 1964 Declaration of Helsinki and its later amendments. Fully-informed parental
100 consent was provided, and children who had food allergies, or a history of food allergies were
101 unable to participate in both studies.

102

103 *Questionnaire measures*

104 *Manipulation check*

105 To examine whether children noticed the image on their plate (manipulation check) children
106 were presented with the question ‘You were given a plate to eat off, what did your plate look
107 like?’ with two image options; a plate containing no image or a plate containing an image of
108 grapes.

109

110 *Liking of the test food*

111 Liking of grapes was assessed using a smiley face Likert-style scale by asking ‘How much do
112 you like grapes?’ with five response options ranging from ‘not at all’ to ‘a lot’, based on a
113 question previously used by Sharps & Robinson (2015).

114

115 *zBMI*

116 In both studies, height was measured to the nearest 0.5cm using a Stadiometer (Seca 213,
117 Seca GmbH & Co.) and weight was measured to the nearest 0.1kg using a digital scale (Seca
118 813, Seca GmbH & Co.). BMI was calculated as weight (kg)/height (m²). Using
119 internationally recognised criteria for children [20], healthy-weight, overweight and obesity
120 were defined based on age and sex-specific BMI cut-off points equivalent to adult BMI of
121 25-30 kg/m² respectively.

122

123 *Procedure*

124 Children were tested individually during weekdays at a primary school. Children sat at a table
125 in a quiet area of the school and were told a cover story (children were informed that the

researcher was interested in how well they played a game). The researcher explained that they needed to 'sort out the game' so the child could have a snack while they waited. The child was presented with a plate (which either contained a fruit nudge or no nudge depending on the condition), and a bowl of grapes. The child was informed that they could help themselves to as much as they liked, and the researcher asked the child to put however much they wanted to eat onto the plate and eat from the plate. The child was left alone for 7 minutes. On return the researcher removed the plate and bowl and presented the child with the game, which involved matching pairs of animals. The child was left for 3 minutes to play the game. The researcher then congratulated the child on their performance on the game to corroborate the cover story, and asked the child the questionnaire measures, and measured their height and weight. All children were debriefed once all the children had been tested in that school.

Analysis strategy

Pearson's correlations were conducted to examine whether any of the variables (age, zBMI, and liking of grapes) correlated with grape consumption. Variables which significantly correlated with grape consumption were included as covariates. A one-way ANCOVA was conducted to examine the influence of condition on grape consumption. A chi-square examined whether children correctly identified the image on their plate (manipulation check).

Results

Participants

65 children aged 6-11 years were recruited from one primary school in the Midlands. A power calculation using g-power indicated that for a medium-large effect size at 80% power ($\alpha = .05$), a minimum of 60 children were required. One child was excluded due to fasting on the day of testing, and one child did not correctly identify their plate in the manipulation check, so the final sample consisted of 63 children (Mean age = 8.9 years, SD = 1.41, 38 females, 25 males, 73% had a healthy-weight). See Table 1 for mean grape consumption, age, zBMI and gender distribution across the two conditions.

Manipulation check

There was no significant effect of condition with regard to whether children correctly identified the image on their plate, $X^2(1) = 1.02, p = .31$. The majority of children correctly identified the image on their plate. One child did not correctly identify the image on their plate and was excluded.

Co-variates

Grape liking significantly correlated with grape consumption [$r = .45, n = 63, p = < .001$] and was included as a covariate in the ANCOVA. There were no other significant correlations ($ps > .05$).

Grape consumption

There was a significant main effect of condition on grape consumption [$F(1, 60) = 6.06, p = .02, \eta^2 = .09$]. Children in the fruit nudge condition selected and consumed significantly

more grapes than children in the control condition. See Table 1 for means and range, and figure 2 for means and standard error.

Study 2

Method

Design

As in study 1, children were randomly assigned (using the online random number generator <http://www.randomizer.org>) to a condition in a between-subjects design. Children were either assigned to the large portion nudge condition, the small portion nudge condition, or the control condition. Children in all conditions were given a plastic white plate and a plastic white bowl containing raw carrot batons (approximately 130 grams). In the large portion nudge condition the plate contained a laminated photographic image of a large portion of carrots (raw carrot batons, 250 grams), in the small portion nudge condition the plate contained a photographic image of a small portion of carrots (raw carrot batons, 27 grams), and in the control condition there was no image (see Figure 3). The plate and bowl were weighed pre and post-consumption to measure children's carrot consumption.

Questionnaire measures

Manipulation check

To examine whether children noticed the image on their plate (manipulation check) children were presented with the question 'You were given a plate to eat off, what did your plate look

like?’ with three image options; a plate containing no image, a plate containing an image of a small portion of carrots, or a plate containing an image of a large portion of carrots.

Typical Fruit and Vegetable consumption and liking of the test food

To ensure that children’s habitual fruit and vegetable consumption did not systematically influence their behaviour, children’s typical fruit and vegetable consumption was measured using the Day in the Life Questionnaire (DILQ). The DILQ is a valid and reliable twenty-four hour recall measure for use in children [21]. Liking of carrots was assessed using a smiley face Likert-style scale by asking ‘How much do you like carrots?’ with five response options ranging from ‘not at all’ to ‘a lot’. This was based on a question used by Sharps and Robinson [18].

zBMI

Children’s zBMI was calculated in the same way as Study 1.

Procedure

Children were tested individually and were sat at a table in a private section of a larger room at a family science event. The researcher explained the cover story that they had designed a plate and wanted the child’s opinion. The researcher presented the child with the plate (either containing a large or small portion nudge or no nudge depending on condition) and asked the child questions about the plate (their opinion on the colour, texture and size). The researcher then explained that they wanted the child to design their own plate but that they were going to

have a break first. The researcher placed the plate and the bowl containing the carrots in front of the child. As in study 1 the researcher informed the child that they could eat as much as they wanted, and asked the child to put whatever they wanted to eat onto the plate and eat from the plate. The child was left child alone for 7 minutes. After 7 minutes, the researcher returned and removed the plate and the bowl and presented the child with a worksheet where they could design their own plate. The child was left alone for 3 more minutes to design their plate to corroborate the cover story. On return, the researcher congratulated the child on their plate design and the child completed the questionnaire measures with the researcher. Children were debriefed at the end of their participation in the study.

Analysis strategy

As in study 1 Pearson's correlations were conducted to examine whether any of the variables (age, zBMI, typical fruit and vegetable intake, and liking of carrots) correlated with the carrot consumption. Variables which significantly correlated with carrot consumption were included as covariates. A one-way ANCOVA was conducted to examine the influence of condition on carrot consumption. A chi square was conducted to examine whether the children could correctly identify the nudge that had been present on their plate (manipulation check).

Results

Participants

75 children aged 5-13 years participated in the study which took place at a family science event in the Midlands, United Kingdom. Based on the results of study 1, we conducted a power calculation for a medium-large effect size at 80% power, with $\alpha = .05$. A minimum of

74 children were required. This study took place in a private section of a larger room, and children completed the study individually. Parents were asked not to be present during the study, however, in ten cases, the parents remained present and these ten children were excluded. Five children were excluded as they did not correctly identify their plate in the manipulation check. The final sample consisted of 60 children (Mean age = 8.53 years, SD = 2.14, 31 females, 29 males, 85% had a healthy-weight). See Table 2 for mean carrot consumption, age, zBMI and gender distribution across the conditions.

Manipulation check

There was no significant effect of condition with regard to whether children correctly identified their plate $X^2(2) = .520, p = .77$. The majority of children correctly identified the image on their plate. Five children incorrectly identified which image their plate contained and were excluded.

Co-variates

Carrot liking significantly correlated with carrot consumption [$r = -.52, n = 60, p < .001$] and was included as a covariate in the ANCOVA. There were no other significant correlations ($ps > .05$).

Carrot consumption

There was a significant main effect of condition on carrot consumption [$F(2, 56) = 3.64, p = .03, \eta^2 = .12$]. Children in the large portion nudge condition ate significantly more carrots

than children in the other two conditions, but there was no significant difference between the small portion nudge condition and the control condition. See Table 2 for means and range, and Figure 4 for means and standard error.

General discussion

Across two studies we examined the influence of nudges (photographic images of fruit or vegetables) placed on a plate on children's fruit and vegetable consumption. In study 1 children consumed more grapes when exposed to a fruit nudge (an image of grapes on a plate) in comparison to the control condition (no image on the plate). In study 2, children increased their consumption of carrots when exposed to a large portion nudge (an image of a large portion of carrots on a plate) in comparison to a small portion nudge (an image of a small portion of carrots on a plate) and control (no image). The results build on the work by Reicks et al [14] through providing the first evidence that nudges influence children's fruit consumption, and demonstrate for the first time, that the portion size of the nudge may be key to whether nudges influence children's eating behaviour.

The results of study 2 are consistent with the portion size literature [17, 22] and indicate that the nudges in these studies may have influenced children's vegetable consumption through the portion size effect. The portion size effect has been suggested to occur due to the portion acting as a cue or social norm about the appropriate amount to eat [23]. Thus, in study 2 the large portion nudge may have indicated that eating a large amount of vegetables was appropriate. The results of study 1 may also be explained by the portion size effect. Although we did not measure the impact of different portion size nudges on children's fruit consumption in study 1, the fruit nudge constituted a large portion and may have

communicated that the appropriate course of action was to eat a large amount of grapes. In study 2, the small portion nudge did not affect children's carrot consumption relative to a control condition. In the control condition children ate around 30 grams (approximately 3-4 raw carrot batons) on average, which is very similar the portion size shown in the small portion nudge image (27 grams). Therefore, the norm may be to eat approximately 30 grams of carrots, and the small portion nudge may have reinforced this norm, which the children stuck to. However, we did not measure normative perceptions regarding children's beliefs about the amount of vegetables eaten by other children, or what they perceived to be the appropriate amount to eat. This would be a valuable addition in future studies and would allow for the investigation of whether the nudge communicates normative information.

Due to the novelty of this approach it is important to gain a deeper understanding of how the nudges influence children's eating behaviour. In the present studies the nudge presented to the children was the same as the food on offer and children were only offered one food option. Therefore, it is not clear whether these nudges may influence children's food choice, encouraging children to select the food depicted in the nudge over options of varying healthfulness. It is also not clear whether an image of fruit or vegetables may generalise and influence children's consumption of other types of fruit and vegetables (for example, whether an image of carrots may influence consumption of broccoli or is specific to carrot consumption). Furthermore, since the research to date has only examined the influence of nudges on one occasion, examining the longer-term impact of these nudges would be of value. Understanding these factors would enable a greater understanding of how and when nudges influence children's eating behaviour, and would be informative for interventions using the nudge approach.

306

307 In conclusion, the results of these studies provide the first evidence that nudges influence
308 children's fruit consumption, and indicate that the portion size of the nudge may be key to
309 whether children are influenced. Future research investigating whether the nudges
310 communicate normative information, whether the nudges influence children's food choice or
311 are specific to the image depicted, and whether the influence of the nudges persist over time,
312 would be of value.

313

314 *Conflict of interest*

315 On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Tables and figures

Fig. 1 The plates in the fruit nudge condition (left) and the control condition (right)

Fig. 2 Mean grape consumption

¹The error bars represent standard error.

Fig. 3 The plates in the large portion nudge condition (left), small portion nudge condition (middle) and the control condition (right)

Fig. 4 Mean carrot consumption (including standard error bars)

¹The error bars represent standard error.

Table 1. Mean (Min-Max) grape consumption in grams, age, zBMI, and gender per condition

Variable	Condition	
	Fruit nudge (n=32)	Control (n=31)
Grape consumption ¹	91.53 (0.0 – 153.0)	67.56 (0.0 -151.0)
Age ²	8.97 (6.40 – 11.04)	8.80 (6.11 – 11.08)
Gender	17 Females 15 Males	21 Females 10 Males
BMI z-score	0.27 (-3.25 – 2.97)	0.09 (-2.61 – 1.75)

¹Grape consumption is reported in grams.

²Age is reported in years.

Table 2. Mean (Min-Max) carrot consumption, age, gender and zBMI.

Condition	Large portion nudge (n = 22)	Small portion nudge (n = 20)	Control (n = 18)
Carrot consumption ¹	46.00 (0.0 – 127.0)	29.85 (0.0 – 81.0)	29.67 (0.0 – 76.0)
Age ²	8.75 (5.10 – 12.60)	8.54 (5.11 – 12.80)	8.26 (5.11 – 12.80)
Gender	12 Males 10 Females	9 Males 11 Females	8 Males 10 Females
zBMI	1.12 (-2.14 – 2.37)	1.15 (-2.15 – 2.56)	-.14 (-2.09 – 1.62)

¹Carrot consumption is reported in grams.

²Age is reported in years.