



# A role for enjoyment for encouraging fruit consumption

Katherine M. Appleton<sup>a,b,\*</sup>, Catherine Adams<sup>b,c</sup>

<sup>a</sup> Department of Psychology, Bournemouth University, UK

<sup>b</sup> School of Psychology, Queen's University, Belfast, UK

<sup>c</sup> NICTU, Belfast, UK

## ARTICLE INFO

Handling Editor: Liisa Lähteenmäki

### Keywords:

Enjoyment  
Fruit  
Visualisation  
Health promotion posters  
Consumption behaviours

## ABSTRACT

This work investigated the value of highlighting the enjoyment conferred by fruit for encouraging fruit consumption. Study 1 investigated the effects on fruit consumption of visualizing eating fruit that was either enjoyable, not enjoyable, or was unassociated with enjoyment. Study 2 investigated the effects on fruit consumption of health promotion posters that featured either enjoyable or less enjoyable fruit. Both studies used an independent-groups design, where young adults (Study 1,  $N = 142$ ; Study 2,  $N = 221$ ) were randomized to conditions, and outcomes: intentions to consume fruit, attitudes towards fruit, immediate fruit selection, subsequent fruit consumption; and a range of characteristics likely to be associated with fruit and vegetable consumption were assessed. In Study 1, higher intentions to consume fruit and more positive attitudes towards fruit were associated with higher likely enjoyment of the fruit visualized, higher fruit liking in general and higher fruit-related self-efficacy (smallest Beta = 0.270,  $p = 0.02$ ). In Study 2, similar effects were found for likely enjoyment of the fruit featured on a poster; higher likely enjoyment also predicted greater immediate fruit selection (smallest Beta = 0.122,  $p = 0.03$ ). These outcomes were also associated with variables often associated with fruit and vegetable consumption. Subsequent fruit consumption was only associated with past fruit consumption (smallest Beta = 0.340,  $p = 0.05$ ). These two studies (Study 1 using visualisation, Study 2 using health promotion posters) highlight a role for enjoyment for encouraging fruit consumption. The value of enjoyment and the simplicity of the poster intervention particularly should be noted.

## 1. Introduction

Low fruit and vegetable (FV) consumption is a major public health concern. FV consumption is associated with reduced risk from a number of global health concerns, including cardiovascular disease, type II diabetes and obesity (Aune et al., 2017; Oyebo, Gordon-Dseagu, Walker, & Mindell, 2014; Tohill, 2005; WHO, 2003), yet FV consumption across Western populations is low (European Food Safety Authority (EFSA), 2021; Public Health England (PHE), 2020; United States Department of Agriculture (USDA), 2021). Compared to the World Health Organization (WHO) recommendations of 400g FV/day (WHO, 2022), adults in the UK are reported to consume an average 286g FV/day (PHE, 2020), average consumption in Europe is reported at 386g FV/day (EFSA, 2021), and average consumption in the US totals 2.4 cups FV/day (approx. 325g), compared to a recommended 3.5–5 cups FV/day (USDA, 2021).

One of the most well-known reasons for food consumption relates to

liking, enjoyment or pleasure, or the expectation of these from the foods consumed. While other factors are also known to play a role (Appleton, 2006; Capaldi, 1996; De Graaf et al., 2005; Mustonen, Hissa, Huotilainen & Tuorila, 2007), hedonic factors are reliably associated with food selection and consumption (Appleton, 2006; Capaldi, 1996; De Graaf et al., 2005; Mustonen, Hissa, Huotilainen, Miettinen, & Tuorila, 2007). Overweight, in fact, is often attributed, at least in part, to the pleasure conferred by an overabundance of sweet and/or high fat energy-dense foods (De Macedo, de Freitas, & da Silva Torres, 2016; Johnson & Wardle, 2014; Kenny, 2011). FV however, are also consumed for reasons related to liking and enjoyment. Liking is a well-reported determinant of FV consumption that distinguishes high from low FV consumers at a range of ages (Appleton, McGill, Neville, & Woodside, 2010; Appleton et al., 2017; Appleton et al., 2019; Larson, Laska, Story, & Neumark-Sztainer, 2012; Ramsey, Rudley, Tonnemaker & Price, 2017).

Strategies to develop liking and preferences for FV tastes are known (Capaldi, 1996; Nicklaus, 2016; Wadhwa, Capaldi-Phillips & Wilkie,

\* Corresponding author. Research Centre for Behaviour Change, Department of Psychology, Bournemouth University, Poole House, Fern Barrow, Poole, BH12 5BB, UK.

E-mail address: [k.appleton@bournemouth.ac.uk](mailto:k.appleton@bournemouth.ac.uk) (K.M. Appleton).

<https://doi.org/10.1016/j.appet.2023.106609>

Received 27 November 2022; Received in revised form 21 March 2023; Accepted 15 May 2023

Available online 27 May 2023

0195-6663/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

2015). These strategies largely rely on conditioning principles, and increases in liking and preferences for FV have been found following repeated exposure to FV tastes, following positive experiences of FV consumption as gained via associative conditioning, and following positive or observed positive consequences of FV consumption as gained through instrumental conditioning (Appleton, Hemingway, Rajkska, & Hartwell, 2018; Capaldi, 1996; Nicklaus, 2016; Wadhwa, Capaldi Phillips, & Wilkie, 2015). Limited studies, however, have systematically investigated the value of this liking for then influencing FV consumption (Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018). Some studies are available: Turnwald et al. (2019) emphasized the tasty and enjoyable attributes of foods to increase vegetable selection and intake; Robinson and colleagues employed enjoyable memories to increase vegetable selection and consumption (Robinson, Blissett, & Higgs, 2011; Robinson, Blissett, & Higgs, 2012), and we investigated expressions of enjoyment for increasing vegetable intakes in children (Appleton, Barrie, & Samuel, 2019).

While these studies focused on vegetable consumption, a similar strategy may also be of value for the consumption of fruit; an aspect of FV consumption that may benefit specifically from innate preferences, or an innate enjoyment, of sweet tastes (Beauchamp, 2016).

This work aimed to investigate the value of highlighting the enjoyment conferred by fruit for fruit consumption. Two studies were undertaken. The first study investigated the effects on fruit consumption of visualizing eating fruit that was either enjoyable, not enjoyable, or was unassociated with enjoyment. The second study investigated the effects on fruit consumption of health promotion posters that promoted fruit consumption using either enjoyable or less enjoyable fruit.

Both studies were undertaken in young British adults, the majority of whom were aged 18–30 years. This population group generally have poor healthy eating practices, including low FV consumption (Deliens, Clarys, de Bourdeaudhuij, & Deforche, 2014; Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010; Malinauskas, Raedeke, Aebly, Smith, & Dallas, 2006) and are likely to benefit from long term healthy eating behaviours. Effects on fruit consumption were assessed in both studies using four fruit-based outcomes: intentions to consume fruit, attitudes towards fruit, immediate fruit selection at the end of the study, and subsequent fruit consumption. We hypothesized that all fruit-based outcomes would be greater following enjoyable compared to less enjoyable experimental manipulations. Hypotheses were specified before data were collected.

## 2. Study 1

### 2.1. Methods

Using an independent-groups design, participants were randomly assigned to undertake one of three visualisation tasks, and the four fruit-based outcomes, plus a range of other characteristics likely to be associated with FV consumption, were assessed.

#### 2.1.1. Participants

To increase ecological validity, all participants who volunteered for the study were invited to take part (there were no exclusion criteria). Participants were unaware of the true purpose of the study, and to reduce demand characteristics, information sheets promoted the study as ‘An investigation of the effects of mental imagery’. Ethical approval for the study was given by the Research Ethics Committee of the School of Psychology, Queen’s University Belfast, UK, prior to commencement (ID: Appleton2010). The study was conducted with full adherence to the Ethical Principles of the British Psychological Society. All participants provided written informed consent.

#### 2.1.2. Visualisations

Two enjoyment-based and one control visualisations were used. The enjoyment-based visualisations were: Visualisation of an enjoyable fruit

eating experience (E+) and Visualisation of a non-enjoyable fruit eating experience (E−). These visualisations were requested using the instructions ‘Now picture yourself doing the following action: Snacking on a portion of fruit tomorrow. Choose a fruit that you know that you like, that you think will taste delicious and that you think you will enjoy’ and ‘Now picture yourself doing the following action: Snacking on a portion of fruit tomorrow. Choose a fruit that you know that you don’t like, that you think will taste unpleasant and that you think you will not enjoy’, respectively. A control visualisation that made no reference to enjoyment (NE) was also used. This was requested using the instruction ‘Now picture yourself doing the following action: Snacking on a portion of fruit tomorrow’. In all cases, further instructions to maximize detail and clarity were also provided. These full instructions are given in the Supplementary Materials. All instructions were goal-based, intended to encourage visualisation of a complete and realistic snacking experience, but remained open to allow realistic visualisations for each individual (Adams, Rennie, Uskul, & Appleton, 2015).

#### 2.1.3. Fruit-based outcomes: intentions, attitudes, immediate selection and subsequent consumption

Intentions to consume fruit were assessed immediately after the visualisation using two questionnaire items: ‘I intend to snack on fruit tomorrow’ and ‘I am likely to snack on fruit tomorrow’. Questions were responded to on a 7-point Likert scale anchored ‘strongly disagree’ – ‘strongly agree’.

Attitudes towards fruit were assessed with four questionnaire items: ‘My snacking on fruit tomorrow would be: unpleasant – pleasant; unenjoyable – enjoyable; harmful – beneficial; worthless – valuable’. All items were responded to on a 7-point scale from the negative attitude to the positive.

Immediate fruit selection was assessed by offering participants a choice of one of twelve snacks on completion of the study as a token of thanks: four items of fruit - two apples, two bananas; four fruit-based biscuit bars – two apple Kellogg’s NutriGrain bars, two strawberry Kellogg’s NutriGrain bars; and four non-fruit-based biscuit bars – two golden oats Kellogg’s Elevenses, two ginger bake Kellogg’s Elevenses. The biscuit bars were considered comparable to the fruit snacks in usual use (Appleton et al., 2016; Glasson, Chapman, & James, 2011), and deliberately did not include chocolate to avoid selection of certain snacks specifically as a reward or treat. Snack selection was observed covertly by the researcher, prior to the participant leaving the laboratory. No snack was also permitted as a choice.

Subsequent consumption was assessed by self-report, two days later by email, in response to an email requesting ‘number of portions of fruit consumed yesterday’.

#### 2.1.4. Fruit consumption: additional characteristics

Various characteristics of potential impact on FV consumption were also assessed (Appleton, 2016, 2022; Appleton et al., 2010, 2019; De Bruijn et al., 2007; De Bruijn, 2010; Glasson et al., 2011; Guillaumie, Godin & Vezina-Im, 2010; Herbert, Butler, Kennedy, & Lobb, 2010; Pollard, Miller, Woodman, Meng, & Binns, 2009; Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008). These characteristics were gender; age; past fruit consumption, usual fruit consumption; liking for fruit in general; awareness of fruit consumption; usual motivation towards health; perceived importance of others (4 items); fruit-related perceived behavioural control (PBC) (2 items), self-efficacy over fruit consumption (2 items); and self-efficacy over fruit consumption in the face of threats (3 items). Exact wording for all questions is given in the Supplementary Materials. Following the visualisation, detail and clarity of the visualisation and likely enjoyment of the fruit eating experience were also assessed. Detail was assessed by counting the number of adjectives in the description of each visualisation provided by the participants. Clarity was assessed with the item ‘How clear was your visualisation?’. Likely enjoyment was assessed with 2 items - ‘How much do you like the fruit in your visualisation?’, ‘How enjoyable would it be to eat the fruit in your

**Table 1**

Descriptive statistics (mean (s.d.)) for participant characteristics, details of the visualisation and fruit-based outcomes and measures, per condition, for Study 1. All participant characteristics, details of the visualisation and some fruit-based outcomes and measures were recorded by questionnaire, that was completed by all participants (N = 142). Immediate fruit consumption was assessed at the end of the study by snack choice and recorded for all participants who made a choice (N = 120). Subsequent consumption was reported by email 2–5 days after the study and recorded for all participants who responded (N = 57).

	Study condition		
	E+ (N = 48)	NE (N = 42)	E- (N = 52)
Participant characteristics			
Gender (males: N (%))	7 (15%)	12 (29%)	13 (25%)
Age (years)	26.6 (12.1)	23.5 (8.3)	27.5 (12.3)
Usual mental imagery use and abilities (-3 to +3)	1.6 (1.2)	1.3 (1.5)	1.5 (1.4)
Past fruit consumption (portions)	2.1 (1.6)	2.1 (2.0)	2.5 (1.6)
Usual fruit consumption (portions)	2.2 (1.2)	2.2 (1.6)	2.8 (1.5)
Fruit liking (-3 to +3)	2.1 (1.5)	1.7 (1.7)	2.2 (1.5)
Awareness of fruit consumption (-3 to +3)	0.6 (2.2)	0.7 (2.1)	0.7 (1.9)
Importance of health (-3 to +3)	2.5 (0.8)	1.9 (1.3)	2.2 (0.9)
Importance of others (-3 to +3)	0.2 (1.3)	-0.0 (1.4)	-0.1 (1.3)
Details of the visualisations			
Descriptive words (number)	5.9 (4.0)	5.2 (3.5)	6.1 (3.8)
Clarity of visualisation (-3 to +3)	2.2 (1.2)	1.9 (1.4)	1.9 (1.2)
Liking/enjoyment for the fruit visualized (-3 to +3)	2.4 (1.2)	1.6 (1.2)	-1.8 (1.6)
Fruit-based outcomes assessed by questionnaire			
Intentions to consume fruit (-3 to +3)	1.7 (1.5)	1.7 (1.6)	0.8 (2.0)
Attitudes towards fruit (-3 to +3)	2.5 (0.8)	2.1 (1.0)	1.9 (1.0)
Fruit-related PBC (-3 to +3)	1.9 (1.5)	2.1 (1.2)	2.0 (1.3)
Fruit-related self-efficacy (-3 to +3)	2.1 (1.2)	2.5 (0.7)	2.0 (1.2)
Fruit-related self-efficacy in the face of threats (-3 to +3)	-0.3 (0.9)	-0.5 (1.0)	-0.6 (1.3)
Fruit-based outcome: Immediate fruit consumption			
Snack choice (N choosing)	E+ (N = 39) Fruit: 19 Fruit bar: 12 Biscuit bar: 8	NE (N = 35) Fruit: 19 Fruit bar: 7 Biscuit bar: 9	E- (N = 46) Fruit: 16 Fruit bar: 22 Biscuit bar: 8
Fruit-based outcome: Subsequent fruit consumption			
Subsequent fruit consumption (portions)	E+ (N = 17) 2.1 (1.0)	NE (N = 20) 2.6 (2.0)	E- (N = 20) 3.0 (1.5)

E+: Enjoyment visualisation; E-: No enjoyment visualisation; NE: Visualisation with no reference to enjoyment; PBC: Perceived Behavioural Control.

visualisation?'). All questions were responded to on a 7-point Likert scale anchored 'strongly disagree' – 'strongly agree'. The Theory of Planned Behaviour (Ajzen, 2002) was used to guide our choice of fruit-based outcomes and a number of measures associated with FV consumption, given the extensive use of this theory for understanding food choice, and specifically FV consumption (Astrom & Rise, 2001; Blanchard et al., 2009; Bogers, Brug, van Assema, & Dagnelie, 2004; De Bruijn et al., 2007, 2010). This study however was not a test of the theory. Demonstration of the value of the Theory of Planned Behaviour in understanding FV consumption has previously been undertaken (Astrom & Rise, 2001; Blanchard et al., 2009; Bogers et al., 2004). All fruit-based outcomes, fruit-related PBC and self-efficacy were assessed after the visualisation; all other participant characteristics were assessed prior to the visualisation. Usual fruit consumption and past fruit consumption were measured in portions consumed/day. All other questionnaire items were responded to on a 7-point Likert scale, summed where appropriate, and scaled to result in a score from -3 to +3 (low-high) per characteristic. To reduce demand characteristics, alongside promotion of the study as investigating mental imagery, a range of distractor questions on mental imagery, attributes and preferences were also asked. These questions also served to ensure that the participants in all three imagery groups were similar in their visualisation abilities and preferences, as required for the study and as may otherwise affect the outcomes of the visualisation activity. All measures and procedures were based on previous publications (Adams et al., 2015; Rennie, Uskul, Adams, & Appleton, 2014).

### 2.1.5. Procedure

Participants undertook the study individually, in the Eating Behaviours Research Unit of the School of Psychology, Queen's University, Belfast, or the Eating Behaviours Laboratory of Bournemouth University, from Jan. 2012–July 2013. All instructions and questionnaire items were provided using an online survey tool (SurveyMonkey – [www.surveymonkey.com](http://www.surveymonkey.com)).

Participants completed all aspects of the study in the following order: 1. receive instructions and provide informed consent; 2. complete questions on personal characteristics; 3. undertake a visualisation; 4. provide a description of the picture that was visualized; 5. complete the questionnaire-presented fruit-based outcomes, fruit-related PBC and self-efficacy; 6. select a snack as a token of thanks (no selection was also permitted); 7. complete subsequent consumption outcome measures by email; 8. receive a debrief. Participants were given as long as they wished to complete the study while in the laboratory, to increase the ecological validity of the study, and this included as long as they wished to undertake the visualisation. Study participation took on average 30 min. Visualisation randomization was undertaken by the questionnaire administration software, and remained concealed to researchers throughout the study. Participants were not blinded to the visualisation, but were blinded to the possible alternatives. All participants completed all questionnaire assessments, were offered the thank you snack, and were emailed following the study. Responses to the follow-up email were limited to a five day period, to ensure direct relevance to the study. Email responses received after this were discarded. Similar procedures have been published previously (Adams et al., 2015; Rennie et al., 2014).

### 2.1.6. Analyses

All analyses were pre-specified before data were collected. First, all participant groups were described and differences between visualisation groups in description, clarity and likely enjoyment of the fruit visualized were investigated using 1-way ANOVA. Fruit-based outcomes were then analysed using regression. All fruit-based outcomes were predicted in three regression models, using: 1) visualisation condition, 2) visualisation condition and likely enjoyment; and 3) visualisation condition, likely enjoyment and all participant characteristics, fruit-related PBC and self-efficacy. Separate models were conducted for each outcome. To allow regression analyses to be conducted, intentions and attitudes

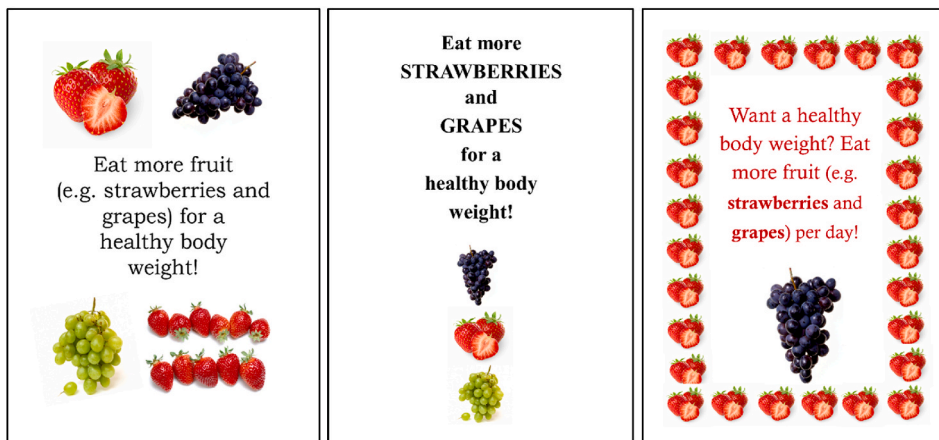
**Table 2**

Results (model equations, significance, Beta values and their significance) for all regression analyses for Study 1. Models were undertaken for four fruit-based outcomes: Intentions to consume fruit, attitudes towards fruit, immediate fruit selection and subsequent fruit consumption. In Model 1, each outcome was predicted by study visualisation condition (E+, NE, E-) only. In Model 2, each outcome was predicted by study visualisation condition (E+, NE, E-) and likely enjoyment as reported by each participant. In Model 3, each outcome was predicted by study visualisation condition (E+, NE, E-), likely enjoyment, and all participant characteristics, fruit-related PBC and self-efficacy.

	Intentions to consume fruit		Attitudes towards fruit		Immediate fruit selection		Subsequent fruit consumption	
Model 1	R = 0.22, R2 = 0.05, adj. R2 = 0.04, F (1,141) = 6.10, p = 0.01		R = 0.27, R2 = 0.07, adj. R2 = 0.06, F (1,141) = 10.66, p < 0.01		R = 0.09, R2 = 0.01, adj. R2 = 0.00, F (1,119) = 1.00, p = 0.32		R = 0.23, R2 = 0.05, adj. R2 = 0.03, F (1,56) = 2.96, p = 0.09	
Condition (E-, NE, E+)	<b>.217</b>	<b>0.01</b>	<b>.266</b>	<b>&lt;0.01</b>	-.092	0.32	.226	0.09
Model 2	R = 0.37, R2 = 0.13, adj. R2 = 0.12, F (2,141) = 10.74, p < 0.01		R = 0.40, R2 = 0.16, adj. R2 = 0.15, F (2,141) = 12.97, p = 0.01		R = 0.10, R2 = 0.01, adj. R2 = 0.01, F (2,119) = 0.63, p = 0.53		R = 0.24, R2 = 0.06, adj. R2 = 0.02, F (2,56) = 1.69, p = 0.19	
Condition (E-, NE, E+)	.139	0.26	.089	0.47	-.030	0.84	.360	0.14
Likely enjoyment (-3 to +3)	<b>.462</b>	<b>&lt;0.01</b>	<b>.461</b>	<b>&lt;0.01</b>	.078	0.60	.161	0.51
Model 3	R = 0.65, R2 = 0.43, adj. R2 = 0.37, F (12,141) = 7.94, p < 0.01		R = 0.67, R2 = 0.45, adj. R2 = 0.40, F (12,141) = 8.91, p < 0.01		R = 0.27, R2 = 0.07, adj. R2 = 0.03, F (12,119) = 0.69, p = 0.76		R = 0.53, R2 = 0.23, adj. R2 = 0.09, F (12,56) = 1.46, p = 0.18	
Condition (E-, NE, E+)	.020	.86	-.001	.99	-.029	.85	.254	.30
Likely enjoyment (-3 to +3)	<b>.270</b>	<b>.02</b>	<b>.304</b>	<b>&lt;.01</b>	.066	.67	.093	.70
Gender (male, female)	.096	.17	.127	.06	.034	.73	-.005	.97
Age (years)	-.094	.20	-.070	.33	.089	.39	.061	.68
Past consumption (portions)	.148	.06	.123	.11	.035	.75	<b>.340</b>	<b>.05</b>
Awareness (-3 to +3)	.109	.12	<b>.212</b>	<b>&lt;.01</b>	.002	.96	-.015	.92
Liking (-3 to +3)	<b>.219</b>	<b>&lt;.01</b>	<b>.278</b>	<b>&lt;.01</b>	.109	.29	.044	.77
Importance of Health (-3 to +3)	.103	.18	<b>.175</b>	<b>.02</b>	-.040	.70	.007	.96
Importance of Others (-3 to +3)	.080	.28	.104	.15	.130	.20	-.003	.98
Fruit-related PBC (-3 to +3)	-.005	.95	-.019	.81	-.166	.19	-.231	.24
Fruit-related self-efficacy (-3 to +3)	<b>.311</b>	<b>&lt;.01</b>	<b>.209</b>	<b>.01</b>	.095	.45	.300	.15
Fruit-related self-efficacy in the face of threats (-3 to +3)	.085	.23	.019	.78	.101	.30	.066	.66

a Conditions were ordered E-, NE, E+ in all regression models to reflect increasing enjoyment; PBC: Perceived Behavioural Control. Significant predictors are given in bold.

## a) Posters aiming to elicit higher likely enjoyment (Posters E+)



## b) Posters aiming to elicit standard enjoyment (Posters E)

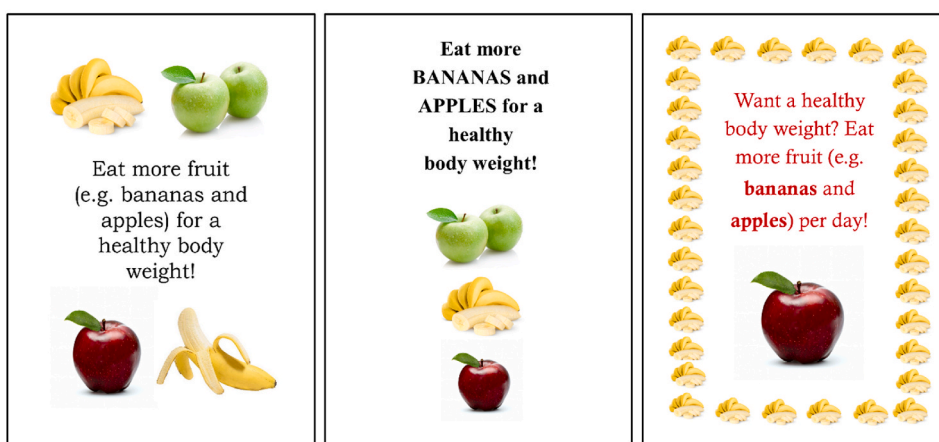


Fig. 1. Health promotion posters.

toward fruit were scored on a seven point scale; subsequent fruit consumption was recorded as number of portions; and for fruit selection, snacks selected were converted into number of portions of fruit selected where fruit = 1, fruit-based biscuit bars = 0.33, and non-fruit-based biscuit bars = 0. In advance of all analyses, checks for multicollinearity revealed high correlations between past fruit consumption and usual fruit consumption ( $r = 0.78$ ), thus only past fruit consumption was included in all regression models. All participants provided questionnaire data and were included in the analyses on intentions and attitudes towards fruit. All responding participants were included in the analyses on immediate selection and subsequent consumption.

### 3. Results

#### 3.1. Participants

One hundred and forty-two students and staff from Queen's University, Belfast and Bournemouth University (32 (23%) male; aged  $26.0 \pm 11.2$  years) took part in the study. Participants were randomized to the three conditions such that 48 participants were asked to visualize an enjoyable fruit eating scenario (E+), 52 participants were asked to visualize an unenjoyable fruit eating scenario (E-), and 42 participants were randomized to visualize a fruit eating scenario without reference to enjoyment (NE). All participants completed all questionnaire measures, 120 (85%) participants choose a thank-you snack, and so provided a measure of immediate fruit selection, and 57 (40%) participants provided subsequent consumption data. Descriptive statistics for all

participant characteristics, details of the visualisations and all fruit-based outcomes and measures from the whole sample, are given, per condition, in Table 1. Details for participants contributing to the measures of subsequent fruit consumption specifically are given in the Supplementary Materials. No differences were found between this subset of participants and the sample as a whole (largest  $t(197) = 1.51$ ,  $p = 0.13$ ).

#### 3.2. Visualisation

No differences were found between visualisation conditions in detail or clarity of the visualisation (largest  $F(2,141) = 1.06$ ,  $p = 0.35$ ). Likely enjoyment was higher ( $F(2,141) = 139.32$ ,  $p < 0.01$ ) in the E+ compared to the NE condition ( $t(88) = 2.88$ ,  $p < 0.01$ ), and in the E+ and NE conditions compared to the E- condition, as intended via the visualisation manipulation (smallest  $t(92) = 11.72$ ,  $p < 0.01$ ).

#### 3.3. Fruit-based outcomes

Results for all regression analyses are given in Table 2. In model 1, intentions to consume fruit and attitudes towards fruit were predicted by visualisation condition (smallest  $\text{Beta} = 0.217$ ,  $p = 0.01$ ). On inclusion in the model of likely enjoyment (model 2), effects of visualisation condition were removed, and greater intentions to consume fruit and more positive attitudes towards fruit are associated only with greater likely enjoyment of the fruit visualized (smallest  $\text{Beta} = 0.461$ ,  $p < 0.01$ ). In model 3, on inclusion of all personal characteristics, fruit-



**Table 3**

Descriptive statistics (mean (s.d.)) for participant characteristics, poster assessments and fruit-based outcomes and measures, per condition, for Study 2. All participant characteristics, poster assessments and some fruit-based outcomes and measures were recorded by questionnaire, as completed by all participants (N = 221). Immediate fruit consumption was assessed at the end of the study by snack choice and recorded for all participants who made a choice (N = 205). Subsequent consumption was reported by email 2–5 days after the study and recorded for all participants who responded (N = 163).

	Study condition	
	E+ (N = 110)	E (N = 111)
Participant characteristics		
Gender (males: N (%))	26 (24%)	17 (15%)
Age (years)	20.5 (5.3)	19.4 (4.1)
Past fruit consumption (portions)	2.0 (1.6)	2.1 (1.5)
Usual fruit consumption (portions)	2.3 (1.2)	2.5 (1.1)
Fruit liking (−3 to +3)	2.0 (1.4)	2.0 (1.3)
Awareness of FV consumption (−3 to +3)	1.3 (1.5)	1.6 (1.4)
Importance of health (−3 to +3)	1.7 (1.1)	1.8 (1.1)
Importance of weight (−3 to +3)	1.6 (1.4)	1.6 (1.3)
Importance of others (−3 to +3)	0.2 (1.4)	0.2 (1.4)
Poster assessments		
Attractiveness of poster (0–1)	0.8 (0.4)	0.8 (0.4)
Liking/enjoyment for the fruit on the poster (−3 to +3)	1.8 (1.4)	1.2 (1.4)
Fruit outcomes assessed by questionnaire		
Intentions to consume fruit (−3 to +3)	1.2 (1.5)	1.5 (1.4)
Attitudes towards fruit (−3 to +3)	2.2 (0.9)	2.1 (0.8)
Fruit-related PBC (−3 to +3)	2.0 (1.2)	2.0 (1.1)
Fruit-related self-efficacy (−3 to +3)	2.3 (0.9)	2.2 (1.0)
Fruit-related self-efficacy in the face of threats (−3 to +3)	−0.4 (1.1)	−0.3 (1.0)
Fruit-based outcome: Immediate fruit consumption	E+ (N = 105)	E (N = 100)
Snack choice (N choosing)	Fruit: 67 Biscuit bar: 38	Fruit: 63 Biscuit bar: 37
Fruit-based outcome: Subsequent fruit consumption	E+ (N = 82)	E (N = 81)
Subsequent fruit consumption (portions)	2.3 (1.4)	2.0 (1.4)

E+: Posters intended to elicit high enjoyment; E: Posters intended to elicit standard enjoyment; PBC: Perceived Behavioural Control.

related PBC and self-efficacy, greater likely enjoyment continued to predict greater intentions and more positive attitudes (smallest Beta = 0.270,  $p = 0.02$ ). Greater intentions were also predicted by higher fruit liking in general and higher fruit-related self-efficacy (smallest Beta = 0.209,  $p = 0.01$ ). More positive attitudes were also associated with greater awareness of fruit consumption, higher fruit liking in general, a higher importance of health and higher fruit-related self-efficacy (smallest Beta = 0.175,  $p = 0.02$ ). Immediate fruit selection and subsequent fruit consumption were not associated with visualisation condition or likely enjoyment of the fruit visualized (largest Beta = 0.226,  $p = 0.09$ ). Greater subsequent consumption was associated only with greater past fruit consumption (Beta = 0.340,  $p = 0.05$ ).

## 4. Summary

Higher intentions to consume fruit and more positive attitudes towards fruit were associated with higher likely enjoyment of fruit, higher fruit liking in general and higher fruit-related self-efficacy. The visualisation condition elicited likely enjoyment, but had no independent effects. Attitudes were also associated with some personal characteristics. Immediate fruit selection was not associated with any measured variable, and subsequent consumption was only associated with past fruit consumption.

## 5. Study 2

### 5.1. Methods

Using an independent-groups design, participants were randomly assigned to view one of two fruit-based health promotion posters, and intentions to consume fruit, attitudes towards fruit, immediate fruit selection, subsequent fruit consumption, and various additional characteristics likely to be associated with FV consumption were assessed. Equivalent measures of biscuit bar consumption were also undertaken as a control.

### 5.1.1. Participants

To increase ecological validity, all participants who volunteered for the study were invited to take part (there were no exclusion criteria). Participants were unaware of the true purpose of the study, and to reduce demand characteristics, information sheets promoted the study as investigating 'Individual preferences for posters for a range of health behaviours'. Ethical approval for the study was given by the Research Ethics Committee of Bournemouth University, UK, prior to commencement (ID 3052/3076/12935). The study was conducted with full adherence to the Ethical Principles of the British Psychological Society. All participants provided written informed consent.

### 5.1.2. Health promotion posters

Two sets of health promotion posters were used, with three posters per set. Both sets of posters recommended eating fruit to aid with a healthy body weight. One set of posters aimed to elicit higher likely enjoyment, and to do this used strawberries and grapes as examples of fruit (Posters E+). One set of posters aimed to elicit standard enjoyment, and to do this used apples and bananas as examples of fruit (Posters E). Strawberries and grapes were chosen as fruits to elicit higher enjoyment, as these fruits were the most often mentioned fruits in the visualisations of an enjoyable fruit eating experience from Study 1 (strawberries: 20% visualisations, grapes: 24% visualisations). These findings also coincide with population based surveys (e.g. YouGov, 2022). Apples and bananas were chosen as the fruits for the standard enjoyment poster as these fruits are also liked and are commonly consumed and purchased in the UK, but are less liked (e.g. Whitworths, 2022). Both posters aimed to elicit some enjoyment to maintain the real-world relevance of the study.

All posters were composed of several images of fruit and a health promotion message. The health promotion messages included reference to the chosen fruit per condition, and promoted fruit consumption for a healthy body weight, e.g. 'Eat more fruit, e.g. strawberries and grapes, for a healthy body weight!'. Body weight was used to motivate fruit consumption following recent studies of ours demonstrating greater effects of body weight-based compared to health-based messages without adverse consequences (Appleton, 2016, 2022). FV are beneficial for

**Table 4**

Results (model equations, significance, Beta values and their significance) for all regression analyses on fruit outcomes for Study 2. Models were undertaken for four fruit outcomes: Intentions to consume fruit, attitudes towards fruit, immediate fruit selection and subsequent fruit consumption. In Model 1, each outcome was predicted by study poster condition (E+, E) only. In Model 2, each outcome was predicted by study poster condition (E+, E) and likely enjoyment as reported by each participant. In Model 3, each outcome was predicted by study poster condition (E+, E), likely enjoyment, and all participant characteristics, fruit-related PBC and self-efficacy.

	Intentions to consume fruit		Attitudes towards fruit		Immediate fruit selection		Subsequent fruit consumption	
Model 1	R = 0.11, R2 = 0.01, adj. R2 = 0.01, F (1,220) = 2.68, p = 0.10		R = 0.04, R2 = 0.01, adj. R2 = 0.01, F (1,220) = 0.43, p = 0.52		R = 0.01, R2 = 0.00, adj. R2 = 0.00, F (1,204) = 0.01, p = 0.91		R = 0.12, R2 = 0.02, adj. R2 = 0.01, F (1,162) = 2.38, p = 0.13	
Condition (E, E+)	Beta	p	Beta	p	Beta	p	Beta	p
	-.110	0.10	.044	0.52	.008	0.91	.121	0.13
Model 2	R = 0.33, R2 = 0.11, adj. R2 = 0.10, F (2,220) = 12.99, p < 0.01		R = 0.43, R2 = 0.19, adj. R2 = 0.18, F (2,220) = 24.67, p < 0.01		R = 0.22, R2 = 0.05, adj. R2 = 0.04, F (2,204) = 4.95, p < 0.01		R = 0.13, R2 = 0.02, adj. R2 = 0.01, F (2,162) = 1.32, p = 0.27	
Condition (E, E+)	-.177	<0.01	.049	0.44	-.040	0.57	.108	0.19
Likely enjoyment (-3 to +3)	.314	<0.01	.437	<0.01	.221	<0.01	.043	0.60
Model 3	R = 0.74, R2 = 0.55, adj. R2 = 0.52, F (14,220) = 18.01, p < 0.01		R = 0.67, R2 = 0.46, adj. R2 = 0.42, F (14,220) = 12.28, p < 0.01		R = 0.31, R2 = 0.10, adj. R2 = 0.03, F (14,204) = 1.43, p = 0.14		R = 0.54, R2 = 0.29, adj. R2 = 0.22, F (14,162) = 4.25, p < 0.01	
Condition (E, E+)	-.120	.02	.025	.65	-.051	.49	.092	.22
Likely enjoyment (-3 to +3)	.122	.03	.191	<.01	.224	<.01	.053	.52
Gender (male, female)	.152	<.01	.100	.08	.075	.33	-.148	.06
Age (years)	.049	.32	.014	.79	.122	.09	-.046	.52
Past consumption (portions)	.275	<.01	-.090	.24	.002	.98	.446	<.01
Usual consumption (portions)	.067	.33	.068	.37	.067	.51	.065	.54
Awareness (-3 to +3)	-.100	.06	.046	.43	-.086	.27	.051	.53
Liking (-3 to +3)	.203	<.01	.429	<.01	-.037	.66	-.017	.84
Importance Health (-3 to +3)	.108	.08	-.017	.80	.127	.16	.105	.22
Importance Weight (-3 to +3)	-.016	.82	.118	.12	-.001	.99	-.045	.62
Importance Others (-3 to +3)	.055	.35	-.009	.89	-.065	.45	.019	.82
Fruit-related PBC (-3 to +3)	.077	.24	-.029	.69	-.076	.43	-.038	.72
Fruit-related self-efficacy (-3 to +3)	.227	<.01	.244	<.01	.017	.87	.001	.99
Fruit-related self-efficacy in the face of threats (-3 to +3)	.073	.15	.049	.37	-.035	.63	.070	.38

PBC: Perceived Behavioural Control. Significant predictors are given in bold.

body weight, both as energy-dilute foods for those who are overweight (Tohill, 2005; WHO, 2003), and as often acceptable nutritious foods for those who are underweight (National Institutes of Clinical Excellence, 2021). Body weight is also known to be important to young adult populations and healthy weight control strategies will likely be of benefit (Deliens et al., 2014; Malinauskas et al., 2006). Each set of posters included three posters. On each poster, the message was displayed centrally and accompanied by coloured pictures of the chosen fruit using different layouts. Three posters were provided to increase viewing time for the posters, so enhancing any likely effects. The two sets of posters were identical, excepting the details of the message and the fruit pictured. All posters are given in Fig. 1.

Posters were provided to participants as part of the study as laminated A4 sheets. Each participant received all three posters in the poster set relevant to their condition, and was allowed to view these as and for as long as they wished. The instructions for viewing the posters were 'Now, please view the posters provided by the researcher. You may take as long as you like.' During this time, participants were also asked two questions to ensure engagement with the posters: 'How attractive are the posters?', 'Which poster do you prefer the most?'. Likely enjoyment was also assessed using the question 'How much would you enjoy eating the fruit in the posters?.'

#### 5.1.3. Fruit-based outcomes: intentions, attitudes, immediate selection and subsequent consumption

Fruit-based outcomes were assessed as in Study 1, with the exception that immediate fruit selection was assessed by offering participants a choice of one of eight snacks on completion of the study as a token of thanks: four items of fruit - two apples, two bananas and four non-fruit-based biscuit bars - two golden oats Kellogg's *Elevenses*, two ginger bake Kellogg's *Elevenses*.

#### 5.1.4. Fruit consumption: additional characteristics

Additional characteristics likely to be associated with FV consumption were also assessed as in Study 1, with the exception that usual motivation towards body-weight concerns and poster perceptions were also assessed, and details of the visualisations were not assessed.

#### 5.1.5. Biscuit bar consumption: intentions, attitudes, subsequent consumption and additional characteristics

Intentions to consume biscuit bars, attitudes towards biscuit bars, subsequent biscuit bar consumption and relevant participant characteristics (past consumption, usual consumption, liking for biscuit bars, awareness, PBC for biscuit bar consumption, self-efficacy and self-efficacy in the face of threats) were assessed using the equivalent questionnaire measures and email requests as for fruit-based outcomes.

#### 5.1.6. Procedure

Participants undertook the study individually, in the Eating Behaviours Laboratory of Bournemouth University, UK, from March 2014–July 2015. Randomization was undertaken and all instructions and questionnaire items were provided using an online survey tool (Qualtrics – [www.qualtrics.com](http://www.qualtrics.com)). The procedure was the same as for Study 1, excepting that procedures related to visualisations were instead applied to the posters.

#### 5.1.7. Analyses

Analyses were undertaken as for Study 1. Checks for multicollinearity revealed no correlations above a cut-off of  $r = 0.70$ , thus all variables were included in all regression models.

## 6. Results

### 6.1. Participants

A total of 221 participants from Bournemouth University, UK (43

(20%) male; aged  $20.0 \pm 4.7$  years) took part. Of these, 110 participants were randomized to view posters E+ and 111 participants were randomized to view posters E. All 221 participants completed all questionnaire measures, 205 (93%) participants chose a snack at the end of the study and so provided data on immediate fruit selection, and 163 (74%) participants responded by email to provide data on subsequent fruit consumption. Details of all participant characteristics are given in Table 3. Participant characteristics for those contributing to the measures of subsequent fruit consumption are given in the Supplementary Materials. No differences were found between this subset of participants and the sample as a whole (largest  $t(382) = 1.45$ ,  $p = 0.15$ ).

### 6.2. Health promotion posters

No differences were found between conditions in perceived attractiveness of the poster ( $t(219) = 0.28$ ,  $p = 0.78$ ). Likely enjoyment was higher for participants in the E+ compared to the E condition, as intended via the poster manipulation ( $t(219) = 3.21$ ,  $p < 0.01$ ).

### 6.3. Fruit-based outcomes

Results for the regression analyses are given in Table 4. In model 1, none of the fruit-based outcomes were predicted solely by poster condition (largest Beta =  $-0.110$ ,  $p = 0.10$ ). In model 2, on inclusion of likely enjoyment, greater intentions to consume fruit were associated with viewing the E posters (Beta =  $-0.177$ ,  $p < 0.01$ ), and greater likely enjoyment of the fruit (Beta =  $0.314$ ,  $p < 0.01$ ). More positive attitudes towards fruit and greater immediate fruit selection were also associated with greater likely enjoyment of the fruit (largest Beta =  $0.221$ ,  $p < 0.01$ ). In model 3, on inclusion of all other variables, these effects remained (smallest Beta =  $0.122$ ,  $p = 0.03$ ). Greater intentions to consume fruit were also predicted by being female, greater past fruit consumption, higher fruit liking in general and higher fruit-related self-efficacy (smallest Beta =  $0.152$ ,  $p < 0.01$ ). More positive attitudes were also associated with higher fruit liking in general and higher fruit-related self-efficacy (smallest Beta =  $0.244$ ,  $p < 0.01$ ). Greater subsequent consumption was associated only with greater past consumption (Beta =  $0.446$ ,  $p < 0.01$ ).

### 6.4. Biscuit bar outcomes

None of the biscuit bar outcomes were predicted by poster condition. Immediate selection of biscuit bars (as the reverse of fruit selection) was associated with lower likely enjoyment of the fruit on the posters (model 2, Beta =  $-0.221$ ,  $p < 0.01$ ), and on consideration of all other biscuit bar characteristics, these effects remained (model 3, Beta =  $-0.217$ ,  $p < 0.01$ ). Full description, analyses and results of the biscuit bar outcomes and measures are given in the Supplementary Materials.

## 7. Summary

Higher intentions to consume fruit, more positive attitudes towards fruit and greater fruit selection were associated with higher likely enjoyment of fruit consumption, higher fruit liking in general and higher fruit-related self-efficacy. Intentions to consume fruit were also associated with health promotion message condition in conjunction with likely enjoyment, and with some personal characteristics. Subsequent fruit consumption was only associated with past fruit consumption.

## 8. Discussion

These two studies investigated the value of highlighting the enjoyment conferred by fruit for encouraging fruit consumption. Higher likely enjoyment of fruit consumption during visualisation was associated with higher intentions to consume fruit and more positive attitudes towards fruit, and higher likely enjoyment when elicited by a health promotion



poster was associated with higher intentions to consume fruit, more positive attitudes towards fruit and greater immediate fruit consumption. Higher intentions to consume fruit and more positive attitudes towards fruit in both studies, were also associated with higher fruit liking in general and higher fruit-related self-efficacy.

These findings demonstrate clear value to highlighting the enjoyment to be gained from fruit for encouraging consumption. Effects for likely enjoyment were found both when visualisations and when health promotion posters were used, and were found for intentions and attitudes. When using health promotion posters, likely enjoyment of the fruit consumed also resulted in changes to fruit consumption behaviour. It may be unsurprising that increased likely enjoyment leads to increased intentions to consume fruit and more positive attitudes, and FV intentions and attitudes are reliably associated with FV consumption, thus these effects are of benefit. The gap between intentions and behaviour, however, is also well-established (Guillaume et al., 2010; Shaikh et al., 2008), thus the effects in immediate consumption are of particular value given the impacts of consumption on health (Aune et al., 2017; Oyebode et al., 2014; Tohill, 2005; WHO, 2003). We have previously suggested that immediate fruit selection may be a more spontaneous and less considered outcome of an intervention than cognitions such as intentions (Appleton, 2016). The size of the effect in our study furthermore, suggests an increase in selection of 0.22 portions of fruit (of a maximum of one portion) for every increase of 1 point in likely enjoyment on a 7-point scale. Other studies have also demonstrated a value of focusing on enjoyment for encouraging FV consumption. Turnwald et al. (2019) found increased vegetable selection and intake with the use of food labels emphasizing tasty and enjoyable food attributes. We previously found increased vegetable liking and intake in children following expressions of enjoyment for vegetables in a children's story (Appleton, Barrie, & Samuel, 2019), and Robinson and colleagues demonstrate increased vegetable selection and consumption following the recall of enjoyable memories of eating vegetables (Robinson et al., 2011; 2012). Kronrod, Hammar, Lee, Thind, and Mangano (2021) also demonstrated increased healthy food selection following changes in food labelling, and suggest this effect to be a result of perceived enjoyment.

Other interventions targeting immediate behaviours, or behaviours at the time that they are being undertaken, have also demonstrated valuable effects on FV consumption. Information or labelling interventions at point of purchase can increase FV selection and consumption in children as well as adults (Kronrod et al., 2021; Morizet, Depezay, Combris, Picard, & Giboreau, 2012; Ogawa et al., 2011; Saulais et al., 2019; Turnwald et al., 2019; Wansink, Just, Payne, & Klinger, 2012), and choice architecture interventions can nudge individuals towards greater FV selection, choice and consumption (Broers, De Breucker, Van den Broucke, & Luminet, 2017; Bucher et al., 2016). The simplicity of the poster intervention for encouraging fruit consumption, like many of these interventions, should be noted. Use of short simple messages, such as those provided on posters, have been found to improve a range of health behaviours (Forberger, Reisch, Kampmann, & Zeeb, 2019; Gallagher & Updegraff, 2011), including FV consumption (Appleton, 2016; Robinson, Fleming, & Higgs, 2014; Thomas et al., 2017). Use of many attractive fruits, such that individual differences in enjoyment are also accommodated could also add to these effects in a public health setting. These types of intervention are applauded as easy, cheap and cost-effective, and while effect sizes can be small, escalation to the general population could have significant population-wide health and societal benefits (Dauchet, Amouyel & Dallongeville, 2005; Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; Lock, Pomerleau, Causser, Altmann, & McKee, 2005). Some efforts to attract and sustain attention may also be required, e.g. based on poster placement, positioning or frequent alternation (Gallagher & Updegraff, 2011).

Higher intentions to consume fruit and more positive attitudes towards fruit in both studies, were also associated with higher fruit liking in general and higher fruit-related self-efficacy. Other studies report a role for liking of FV in general (Appleton et al., 2010; Appleton et al., 2017; Appleton, Barrie, & Samuel, 2019; Larson et al., 2012; Ramsey

et al., 2017). Various studies also demonstrate a role for self-efficacy in FV-related cognitions and behaviours (Gase, Glenn & Juo, 2016; Guillaumie, Godin, & Vézina-Im, 2010; Kushida, Iriyama, Murayama, Saito, & Yoshita, 2017; Rennie et al., 2014; Shaikh et al., 2008; Zhou, Gan, Hamilton, & Schwarzer, 2017). Interventions that target self-efficacy have also been found to demonstrate increased FV outcomes (Luszczynska et al., 2016; Luszczynska, Tryburcy, & Schwarzer, 2007). Self-efficacy is an integral component of many models of health behaviour (Bandura, 2004; Schwarzer, 2008), and the value of self-efficacy for changing health behaviours, including FV consumption, is well recognized (Bandura, 2004; Guillaumie et al., 2010; Schwarzer, 2008; Shaikh et al., 2008).

The use of visualisation has also been suggested as a promising method for improving health behaviours (Conroy & Hagger, 2018), but effects sizes can vary, dependent, at least in part, on the population studied, the instructions given and the extent of follow-up (Conroy & Hagger, 2018). Effects may also depend on the target behaviour (Adams et al., 2015; Rennie et al., 2014). Specific to FV consumption, Knauper et al. (2011) demonstrated increased fruit consumption in low consumers following visualisation, with strong effects where implementation intentions were also used. We (Rennie et al., 2014) also found increased intentions to consume fruit following visualisation in combination with health information, although we found no effects following visualisation alone.

Effects of the poster featuring less enjoyable fruit in Study 2 were only found in conjunction with ratings of likely enjoyment, and most plausibly result from the association between poster type and likely enjoyment, where likely enjoyment of the fruit in the poster with less enjoyable fruit was lower than that for the poster with enjoyable fruit. Effects of the additional characteristics associated with FV consumption as found in intentions to consume fruit in Study 2, and attitudes towards fruit in Study 1 have previously been reported, as have associations between subsequent and past FV consumption (Appleton, 2016, 2022; Appleton et al., 2010, 2019; Astrom & Rise, 2001; Blanchard et al., 2009; Bogers et al., 2004; De Bruijn et al., 2007, 2010; Dijkstra; Neter; Brouwer; Huisman; Visser, 2014; Teschl, Nössler, Schneider, Carlsohn, & Lührmann, 2018). These findings demonstrate the many and varied cognitions and behaviours of relevance to fruit consumption. The absence of effects of the fruit manipulation in our biscuit bar measures also suggests some specificity to these effects for fruit consumption, as opposed to for food consumption in general.

Strengths of our work include the use of the two different techniques (visualisation, health promotion posters) to demonstrate consistent results, the size of our study samples and the use of the behavioural measures. Limitations include the absence of a 'no visualisation' and a 'no poster' control condition in our studies, but our research questions did not relate to the impacts of visualisation or posters *per se*, thus these conditions were considered wasteful. Our studies were also limited by the focus on students. Although this was our intended population group considering current low FV consumption in this group and the benefits of encouraging healthy habits, this focus limits the generalisability of our findings to the wider population. Some limited generalisability may also stem from the specific characteristics of our samples, such as the high proportion of females or their specific age range. Recent results of ours do suggest stronger effects from body-weight-related health promotion messages in young females compared to older females and compared to males (Appleton, 2022), thus the effects found in this study may be more generalisable to young females and may over-represent the effect sizes likely to be found in other population groups. It is possible also that the advertising of the studies was likely to attract those with invested interest in imagery or health promotion posters and this also may have enhanced our effect sizes. The study was conducted over an extended time period, due to the availability of the researchers, dependent on additional commitments. We also gave limited consideration to the possible effects of individual orientations, e.g. approach, avoidance orientations, in our studies. Further study here may be of value.

## 9. Conclusions

In conclusion, these two studies demonstrate a role for enjoyment for encouraging fruit consumption. Both studies (Study 1 using visualisation, Study 2 using health promotion posters) found likely enjoyment of fruit to result in greater intentions and more positive attitudes towards fruit, and in the study using health promotion posters, higher likely enjoyment of fruit consumption also resulted in increased fruit consumption behaviour. The value of enjoyment and the simplicity of the poster intervention for encouraging fruit consumption should be noted.

## Ethical statement

### Study 1:

Ethical approval for the study was given by the Research Ethics Committee of the School of Psychology, Queen's University Belfast, UK, prior to commencement (ID: Appleton2010), and the study was conducted with full adherence to the Ethical Principles of the British Psychological Society. All participants provided written informed consent.

### Study 2:

Ethical approval for the study was given by the Research Ethics Committee of Bournemouth University, UK, prior to commencement (ID 3052/3076/12935), and the study was conducted with full adherence to the Ethical Principles of the British Psychological Society. All participants provided written informed consent.

## Funding

This work received no external funding.

## Author contributions

KMA: Conceptualization; Formal Analysis; Investigation; Writing – First draft, reviewing and editing. CA: Investigation; Writing – Reviewing and editing.

## Declaration of competing interest

There are no conflicts of interest.

## Data availability

Data will be made available on request.

## Acknowledgements

Data are available from the corresponding author on request, and held in Bournemouth University Open Data Repository BoRDAR. Part of this work was undertaken while both authors were employed by Queen's University, Belfast, UK; the latter part was undertaken after the first author had moved to Bournemouth University, UK. This latter part was supported by the Department of Psychology, Bournemouth University, UK. Grateful thanks are also extended to Tessa Harris, Lena Kessler, Charlotte Newton and Anna Stevens, Bournemouth University, for help with data collection.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2023.106609>.

## References

Adams, C., Rennie, L., Uskul, A. K., & Appleton, K. M. (2015). Visualising future behavior: Effects for snacking on biscuit bars, but no effects for snacking on fruit. *Journal of Health Psychology, 20*, 1037–1048. <https://doi.org/10.1177/1359105313506760>

- Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*, 665–683. <https://doi.org/10.1111/j.1559-1816.2002.tb00236.x>
- Appleton, K. M. (2006). Behavioural determinants of daily energy intake during a 28-day outdoor expedition in Arctic Norway. *Scandinavian Journal of Food & Nutrition, 50*, 139–146. <https://doi.org/10.1080/17482970600947522>
- Appleton, K. M. (2016). Greater fruit selection following an appearance-based compared to a health-based health promotion poster. *Journal of Public Health, 38*, 731–738. <https://doi.org/10.1093/pubmed/fdv147>
- Appleton, K. M. (2022). Appearance-based health promotion messages for increasing fruit and vegetable consumption: Gender, age and adverse effects. *Journal of Public Health: Theory Into Practice*. <https://doi.org/10.1007/s10389-022-01746-8>. *in press*.
- Appleton, K. M., Barrie, E., & Samuel, T. J. (2019). Modelling positive consequences: Increased vegetable intakes following modelled enjoyment versus modelled intake. *Appetite, 140*, 76–81. <https://doi.org/10.1016/j.appet.2019.05.003>
- Appleton, K. M., Dinnella, C., Spinelli, S., Morizet, D., Saulais, L., Hemingway, A., et al. (2017). Consumption of a high quantity and a wide variety of vegetables are predicted by different food choice motives in older adults from France, Italy and the UK. *Nutrients, 9*, 923. <https://doi.org/10.3390/nu9090923>
- Appleton, K. M., Dinnella, C., Spinelli, S., Morizet, D., Saulais, L., Hemingway, A., et al. (2019). Liking and consumption of vegetables with more appealing and less appealing sensory properties: Associations with attitudes, food neophobia and food choice motivations in European adolescents. *Food Quality and Preference, 75*, 179–186. <https://doi.org/10.1016/j.foodqual.2019.02.007>
- Appleton, K. M., Hemingway, A., Rajaska, J., & Hartwell, H. (2018). Repeated exposure and conditioning strategies for increasing vegetable liking and intake: Systematic review and meta-analyses of the published literature. *American Journal of Clinical Nutrition, 108*, 842–856. <https://doi.org/10.1093/ajcn/nqy143>
- Appleton, K. M., Hemingway, A., Saulais, L., Dinnella, C., Monteleone, E., Depazay, L., et al. (2016). Increasing vegetable intakes: Rationale and systematic review of published interventions. *European Journal of Nutrition, 55*, 869–896. <https://doi.org/10.1007/s00394-015-1130-8>
- Appleton, K. M., McGill, R., Neville, C., & Woodside, J. V. (2010). Barriers to increasing fruit and vegetable intakes in the older population of Northern Ireland: Low levels of liking and low awareness of current recommendations. *Public Health Nutrition, 13*, 514–521. <https://doi.org/10.1017/S1368980009991790>
- Astrom, A. N., & Rise, J. (2001). Young adults' intention to eat healthy food: Extending the Theory of Planned Behaviour. *Psychology and Health, 16*, 223–237. <https://doi.org/10.1080/08870440108405501>
- Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N., Norat, T., et al. (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality – a systematic review and dose-response meta-analysis of prospective studies. *International Journal of Epidemiology, 46*, 1029–1056. <https://doi.org/10.1093/ije/dyw319>
- Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behaviour, 31*, 143–164. <https://doi.org/10.1177/1090198104263660>
- Beauchamp, G. K. (2016). Why do we like sweet taste: A bitter tale? *Physiology and Behavior, 164*, 432–437. <https://doi.org/10.1016/j.physbeh.2016.05.007>
- Blanchard, C. M., Fisher, J., Sparling, P. B., Shanks, T. H., Nehl, E., Rhodes, R. E., et al. (2009). Understanding adherence to 5 servings of fruits and vegetables per day: A theory of planned behavior perspective. *Journal of Nutrition Education and Behavior, 41*, 3–10. <https://doi.org/10.1016/j.jneb.2007.12.006>
- Bogers, R. P., Brug, J., van Assema, P., & Dagnelie, P. C. (2004). Explaining fruit and vegetable consumption: The theory of planned behaviour and misconception of personal intake levels. *Appetite, 42*, 157–166. <https://doi.org/10.1016/j.appet.2003.08.015>
- Broers, V. J. V., De Breucker, C., Van den Broucke, S., & Luminet, O. (2017). A systematic review and meta-analysis of the effectiveness of nudging to increase fruit and vegetable choice. *The European Journal of Public Health, 27*, 912–920. <https://doi.org/10.1093/eurpub/ckx085>
- Bucher, T., Collins, C., Rollo, M., McCaffrey, T., De Vlieger, N., Van der Bend, D., et al. (2016). Nudging consumers towards healthier choices: A systematic review of positional influences on food choice. *Brit J Nutr, 115*, 2252–2263. <https://doi.org/10.1017/S0007114516001653>
- Capaldi, E. D. (1996). *Why we eat what we eat*. Washington, DC, USA: American Psychological Association. <https://doi.org/10.1037/10291-000>
- Conroy, D., & Hagger, M. S. (2018). Imagery interventions in health behavior: A meta-analysis. *Health Psychology, 37*, 668–679. <https://doi.org/10.1037/hea0000625>
- Dauchet, L., Amouyel, P., & Dallongeville, J. (2005). Fruit and vegetable consumption and risk of stroke: A meta-analysis of cohort studies. *Neurology, 65*, 1193–1197. <https://doi.org/10.1212/01.wnl.0000180600.09719.53>
- Dauchet, L., Amouyel, P., Hercberg, S., & Dallongeville, J. (2006). Fruit and vegetable consumption and risk of coronary heart disease: A meta-analysis of cohort studies. *The Journal of Nutrition, 136*, 2588–2593. <https://doi.org/10.1093/jn/136.10.2588>
- De Bruijn, G.-J. (2010). Understanding college students' fruit consumption: Integrating habit strength in the theory of planned behaviour. *Appetite, 54*, 16–22. <https://doi.org/10.1016/j.appet.2009.08.007>
- De Bruijn, G.-J., Kremers, S. P. J., de Vet, E., de Nooijer, J., van Mechelen, W., & Brug, J. (2007). Does habit strength moderate the intention-behaviour relationship in the theory of planned behaviour? The case of fruit consumption. *Psychology and Health, 22*, 899–916. <https://doi.org/10.1080/14768320601176113>
- De Graaf, C., Kramer, F. M., Meiselman, H. L., Leshner, L. L., Baker-Fulco, C., Hirsch, E. S., et al. (2005). Food acceptability in field studies with US army men and women: Relationship with food intake and food choice after repeated exposures. *Appetite, 44*, 23–31. <https://doi.org/10.1016/j.appet.2004.08.008>

- De Macedo, I. C., de Freitas, J. S., & da Silva Torres, I. L. (2016). The influence of palatable diets in reward system activation: A mini review. *Advances in Pharmacological Sciences*, Article 7238679. <https://doi.org/10.1155/2016/7238679>
- Deliens, T., Clarys, P., de Bourdeaudhuij, I., & Deforche, B. (2014). Determinants of eating behaviour in university students: A qualitative study using focus group discussions. *BMC Public Health*, 14, 53. <https://doi.org/10.1186/1471-2458-14-53>
- Dijkstra, S. C., Neter, J. E., Brouwer, I. A., Huisman, M., & Visser, M. (2014). Misperception of self-reported adherence to the fruit, vegetable and fish guidelines in older Dutch adults. *Appetite*, 82, 166–172. <https://doi.org/10.1016/j.appet.2014.07.021>
- European Food Safety Authority. (2021). *Food consumption data 2021*. Website. <http://www.efsa.europa.eu/en/data-report/food-consumption-data>, 22.06.22.
- Forberger, S., Reisch, L., Kampmann, T., & Zeeb, H. (2019). Nudging to move: A scoping review of the use of choice architecture interventions to promote physical activity in the general population. *International Journal of Behavioral Nutrition and Physical Activity*, 16, 77. <https://doi.org/10.1186/s12966-019-0844-z>
- Gallagher, K. M., & Updegraff, J. A. (2011). Health message framing effects on attitudes, intentions, and behavior: A meta-analytic review. *Annals of Behavioral Medicine*, 43, 101–116. <https://doi.org/10.1007/s12160-011-9308-7>
- Gase, L. N., Glenn, B., & Kuo, T. (2016). Self-efficacy as a mediator of the relationship between the perceived food environment and healthy eating in a low income population in Los Angeles County. *Journal of Immigrant and Minority Health*, 18, 345–352. <https://doi.org/10.1007/s10903-015-0186-0>
- Glasson, C., Chapman, K., & James, E. (2011). Fruit and vegetables should be targeted separately in health promotion programmes: Differences in consumption levels, barriers, knowledge and stages of readiness for change. *Public Health Nutrition*, 14, 694–701. <https://doi.org/10.1017/S1368980010001643>
- Guillaumie, L., Godin, G., & Vézina-Im, L. A. (2010). Psychosocial determinants of fruit and vegetable intake in adult populations: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 12. <https://doi.org/10.1186/1479-5868-7-12>
- Herbert, G., Butler, L., Kennedy, O., & Lobb, A. (2010). Young UK adults and the 5 a day campaign: Perceived benefits and barriers to eating more fruits and vegetables. *International Journal of Consumer Studies*, 34, 657–664. <https://doi.org/10.1111/j.1470-6431.2010.00872.x>
- Johnson, F., & Wardle, J. (2014). Variety, palatability, and obesity. *Advances in Nutrition*, 5, 851–859. <https://doi.org/10.3945/an.114.007120>
- Kenny, P. J. (2011). Reward mechanisms in obesity: New insights and future directions. *Neuron*, 69, 664–679. <https://doi.org/10.1016/j.neuron.2011.02.016>
- Knauper, B., McCollam, A., Rosen-Brown, A., Lacaillie, J., Kelso, E., & Roseman, M. (2011). Fruitful plans: Adding targeted mental imagery to implementation intentions increase fruit consumption. *Psychology and Health*, 26, 601–617. <https://doi.org/10.1080/08870441003703218>
- Krebs-Smith, S. M., Guenther, P. M., Subar, A. F., Kirkpatrick, S. I., & Dodd, K. W. (2010). Americans do not meet federal dietary recommendations. *The Journal of Nutrition*, 140, 1832–1838. <https://doi.org/10.3945/jn.110.124826>
- Kronrod, A., Hammar, M. E., Lee, J., Thind, H. K., & Mangano, K. M. (2021). Linguistic delight promotes eating right: Figurative language increases perceived enjoyment and encourages healthier food choices. *Health Communication*, 36, 1898–1908. <https://doi.org/10.1080/10410236.2020.1805231>
- Kushida, O., Iriyama, Y., Murayama, N., Saito, T., & Yoshita, K. (2017). Associations of self-efficacy, social support, and knowledge with fruit and vegetable consumption in Japanese workers. *Asia Pacific Journal of Clinical Nutrition*, 26, 725–730. <https://doi.org/10.6133/apjcn.062016.06>
- Larson, N., Laska, M. N., Story, M., & Neumark-Sztainer, D. (2012). Predictors of fruit and vegetable intake in young adulthood. *Journal of the Academy of Nutrition and Dietetics*, 112, 1216–1222. <https://doi.org/10.1016/j.jand.2012.03.035>
- Lock, K., Pomeroy, J., Causser, L., Altmann, D. R., & McKee, M. (2005). The global burden of disease attributable to low consumption of fruit and vegetables: Implications for the global strategy on diet. *Bulletin of the World Health Organization*, 83, 100–108.
- Luszczynska, A., Horodyska, K., Zarychta, K., Liszewska, N., Knoll, N., & Scholz, U. (2016). Planning and self-efficacy interventions encouraging replacing energy-dense foods intake with fruit and vegetable: A longitudinal experimental study. *Psychology and Health*, 31, 40–64. <https://doi.org/10.1080/08870446.2015.1070156>
- Luszczynska, A., Tryburcy, M., & Schwarzer, R. (2007). Improving fruit and vegetable consumption: A self-efficacy intervention compared with a combined self-efficacy and planning intervention. *Health Education Research*, 22, 630–638. <https://doi.org/10.1093/her/cyl133>
- Malinauskas, B. M., Raedeke, T. D., Aeby, V. G., Smith, J. L., & Dallas, M. B. (2006). Dieting practices, weight perceptions, and body composition: A comparison of normal weight, overweight and obese college females. *Nutrition Journal*, 5, 11. <https://doi.org/10.1186/1475-2891-5-11>
- Marty, L., Chamberon, S., Nicklaus, S., & Monneray-Patris, S. (2018). Learned pleasure from eating: An opportunity to promote healthy eating in children? *Appetite*, 120, 265–274. <https://doi.org/10.1016/j.appet.2017.09.006>
- Morizet, D., Depey, L., Combris, P., Picard, D., & Giboreau, A. (2012). Effect of labeling on new vegetable dish acceptance in preadolescent children. *Appetite*, 59, 399–402. <https://doi.org/10.1016/j.appet.2012.05.030>
- Mustonen, S., Hissa, I., Huotilainen, A., Miettinen, S. M., & Tuorila, H. (2007). Hedonic responses as predictors of food choice: Flexibility and self-prediction. *Appetite*, 49, 159–168. <https://doi.org/10.1016/j.appet.2007.01.005>
- National Institutes of Clinical Excellence. (2021). Eating disorders: Recognition and treatment. Website <https://www.nice.org.uk/guidance/ng69>, 10.08.21.
- Nicklaus, S. (2016). The role of food experiences during early childhood in food pleasure learning. *Appetite*, 104, 3–9. <https://doi.org/10.1016/j.appet.2015.08.022>
- Ogawa, Y., Tanabe, N., Honda, A., Azuma, T., Seki, N., Suzuki, T., et al. (2011). Point-of-purchase health information encourages customers to purchase vegetables: Objective analysis by using a point-of-sales system. *Environmental Health and Preventive Medicine*, 16, 239–246. <https://doi.org/10.1007/s12199-010-0192-8>
- Oyebode, O., Gordon-Dseagu, V., Walker, A., & Mindell, J. S. (2014). Fruit and vegetable consumption and all-cause, cancer and CVD mortality: Analysis of Health Survey for England data. *Journal of Epidemiology & Community Health*, 68, 856–862. <https://doi.org/10.1136/jech-2013-203500>
- Pollard, C., Miller, M., Woodman, R. J., Meng, R., & Binns, C. (2009). Changes in knowledge, beliefs, and behaviors related to fruit and vegetable consumption among Western Australian adults from 1995 to 2004. *American Journal of Public Health*, 99, 355–361. <https://doi.org/10.2105/AJPH.2007.131367>
- Public Health England. (2020). *National diet and nutrition survey rolling programme years 9 to 11 (2016/2017 to 2018/2019)*. Website [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/943114/NDNS\\_UK\\_Y9-11\\_report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943114/NDNS_UK_Y9-11_report.pdf), 22.06.22.
- Ramsay, S. A., Rudley, M., Tonnemaker, L. E., & Price, W. J. (2017). A comparison of college students' reported fruit and vegetable liking and intake from childhood to adulthood. *Journal of the American College of Nutrition*, 36, 28–37. <https://doi.org/10.1080/07315724.2016.1169233>
- Rennie, L., Uskul, A. K., Adams, C., & Appleton, K. M. (2014). Visualisation for increasing health intentions: Enhanced effects following a health message and when using a first-person perspective. *Psychology and Health*, 29, 237–252. <https://doi.org/10.1080/08870446.2013.843685>
- Robinson, E., Blissett, J., & Higgs, S. (2011). Recall of vegetable eating affects future predicted enjoyment and choice of vegetables in British University undergraduate students. *Journal of the American Dietetic Association*, 111, 1543–1548. <https://doi.org/10.1016/j.jada.2011.07.012>
- Robinson, E., Blissett, J., & Higgs, S. (2012). Changing memory of food enjoyment to increase food liking, choice and intake. *Brit J Nutr*, 108, 1505–1510. <https://doi.org/10.1017/S0007114511007021>
- Robinson, E., Fleming, A., & Higgs, S. (2014). Prompting healthier eating: Testing the use of health and social norm based messages. *Health Psychology*, 33, 1057–1064. <https://doi.org/10.1037/a0034213>
- Saulais, L., Massey, C., Perez-Cueto, F. J. A., Appleton, K. M., Depey, L., Giboreau, A., et al. (2019). When are 'Dish of the Day' nudges most effective to increase vegetable selection? *Food Policy*, 85, 15–27. <https://doi.org/10.1016/j.foodpol.2019.04.003>
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology*, 57, 1–29. <https://doi.org/10.1111/j.1464-0597.2007.00325.x>
- Shaikh, A. R., Yaroch, A. L., Nebeling, L., Yeh, M.-C., & Resnicow, K. (2008). Psychosocial predictors of fruit and vegetable consumption in adults: A review of the literature. *American Journal of Preventive Medicine*, 34, 535–543. <https://doi.org/10.1016/j.amepre.2007.12.028>
- Teschl, C., Nössler, C., Schneider, M., Carlsohn, A., & Lührmann, P. (2018). Vegetable consumption among university students: Relationship between vegetable intake, knowledge of recommended vegetable servings and self-assessed achievement of vegetable intake recommendations. *Health Education Journal*, 77, 398–411. <https://doi.org/10.1177/0017896917751833>
- Thomas, J. M., Ursell, A., Robinson, E. L., Aveyard, P., Jebb, S. A., Herman, C. P., et al. (2017). Using a descriptive social norm to increase vegetable selection in workplace restaurant settings. *Health Psychology*, 36, 1026–1033. <https://doi.org/10.1037/hea0000478>
- Tohill, B. C. (2005). *Dietary intake of fruit and vegetables and management of body-weight. Background paper for the joint FAO/WHO workshop of fruit and vegetables for health*. Geneva: WHO. <https://apps.who.int/iris/handle/10665/43145>.
- Turnwald, B. P., Bertoldo, J. D., Perry, M. A., Policastro, P., Timmons, M., Bosso, C., et al. (2019). Increasing vegetable intake by emphasizing tasty and enjoyable attributes: A randomized controlled multisite intervention for taste-focused labeling. *Psychological Science*, 30, 1603–1615. <https://doi.org/10.1177/0956797619872191>
- United States Department of Agriculture. (2021). *Food consumption and nutrition estimates 2015-2018*. Website. <https://www.ers.usda.gov/data-products/food-consumption-and-nutrient-intakes/food-consumption-and-nutrient-intakes/#Food%20Consumption%20Estimates>, 22.06.22.
- Wadhwa, D., Capaldi Phillips, E. D., & Wilkie, L. M. (2015). Teaching children to like and eat vegetables. *Appetite*, 93, 75–84. <https://doi.org/10.1016/j.appet.2015.06.016>
- Wansink, B., Just, D. R., Payne, C. R., & Klinger, M. Z. (2012). Attractive names sustain increased vegetable intake in schools. *Preventive Medicine*, 55, 330–332. <https://doi.org/10.1016/j.ypmed.2012.07.012>
- Whitworths. (2022). The most popular fruit. Website <https://whitworths.co.uk/the-most-popular-fruit/>, 12.07.22.
- World Health Organization. (2003). *Diet, nutrition and the prevention of chronic diseases. Report of a Joint FAO/WHO Expert Consultation*. [apps.who.int/iris/bitstream/handle/10665/42665/WHO\\_TRS\\_916.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/42665/WHO_TRS_916.pdf?sequence=1). Geneva: WHO, 12.07.22.
- World Health Organization. (2022). Healthy diet. Website. <https://www.who.int/news-room/fact-sheets/detail/healthy-diet>. Accessed 09.05.22.
- YouGov. (2022). The most popular fruits. Website <https://yougov.co.uk/ratings/food/po-pularity/fruits/all>, 12.07.22.
- Zhou, G. Y., Gan, Y. Q., Hamilton, K., & Schwarzer, R. (2017). The role of social support and self-efficacy for planning fruit and vegetable intake. *Journal of Nutrition Education and Behavior*, 49, 100–106. <https://doi.org/10.1016/j.jneb.2016.09.005>