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Calvert, Sian, Dempsey, Robert C, Povey, Rachel and Clark-Carter, David (2022) An in-school Social Norms Approach intervention for reducing unhealthy snacking behaviours amongst 11- to 12-year-olds. *British Journal of Health Psychology*, 27 (3). pp. 891-914. ISSN 1359-107X

DOI: <https://doi.org/10.1111/bjhp.12581>

Publisher: Wiley

Version: Accepted Version

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An in-school Social Norms Approach intervention for reducing unhealthy snacking
behaviours amongst 11- to 12-year-olds

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To appear in: **British Journal of Health Psychology.**

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Abstract

Objectives

Adolescents tend to overestimate the extent of peers' unhealthy snacking consumption and such misperceptions have been associated with increased personal unhealthy snacking. This study aims to test whether a Social Norms Approach (SNA) intervention which challenges these misperceptions of peers' unhealthy snacking will have a positive effect on students' personal unhealthy snacking behaviours, related attitudes, and behavioural intentions.

Design

A quasi-experimental study tested the effectiveness of an in-school SNA intervention (n = 163) compared to a control condition (n = 95) amongst 11– to 12-year-old students.

Method

Both conditions received healthy eating information, while students in the SNA intervention received additional normative feedback (outlining the discrepancies between perceived and actual unhealthy snacking of the majority based on baseline data) delivered through an interactive poster-making session. Students completed self-report measures of personal unhealthy snacking, related-attitudes, behavioural intentions, and normative perceptions (descriptive and injunctive) at baseline, post-intervention, and at a 3-month follow-up.

Results

Students who received SNA feedback were significantly less likely to overestimate peers' unhealthy snacking attitudes post-intervention ($F(1,232) = 16.405, p < .001$), and at 3-month follow-up

consumed fewer unhealthy snacks ($F(1,232) = 6.133, p = .014$) and had less positive attitudes towards unhealthy snacking ($F(1,198) = 8.779, p = .003$). The changes in personal snacking attitudes at 3-month follow-up were mediated by changes in normative misperceptions about peers' unhealthy snacking attitudes post-intervention, which indicated that the reductions in normative misperceptions following SNA messages mediated the effect of the intervention.

Conclusion

The results indicate that in-school Social Norms Approach interventions which challenge normative misperceptions constitute a promising strategy for reducing unhealthy snacking in young adolescents.

Keywords: Adolescents, snacking, normative perceptions, school, intervention.

Data availability statement: We do not have ethical approval for the data of participants (under 16 years of age) to be shared.

Introduction

Health officials have warned that the heavy consumption of unhealthy snacks (both in portion size and frequency) by adolescents may be a main contributing factor to them being overweight or obese (Jebb et al., 2004; Kerr et al., 2008; Public Health England, 2018c). Adolescents, on average, tend to consume three or more unhealthy snacks a day (e.g., chocolate; Public Health England, 2018c), and this contributes to around a third of an adolescent's daily calorie intake (Public Health England, 2018a). Unhealthy snack consumption is a part of diets that are of poorer nutritional quality, as snack foods are often energy-dense, nutritionally-poor, foods that are high in sugar or saturated fat, which can lead to excessive weight gain (Santaliestra-Pasías et al., 2014). Obesity in adolescents is concerning as it can have both immediate (e.g., lower self-esteem and poorer academic ability) and long-lasting implications (e.g., diabetes and cancer) for health and well-being (Cecchini et al., 2010; Savige et al., 2007).

Data indicates that the prevalence of obesity in adolescents is strongly related to socioeconomic status (SES), with adolescents living in the most deprived areas of the United Kingdom being more likely to be overweight or obese compared to those living in the least deprived areas (NHS, 2020b; White et al., 2016). Adolescents from lower SES families tend to consume fewer healthy foods, and more unhealthy snacks, than adolescents from higher SES families (Skårdal et al., 2014: [Authors, Year - blinded for peer review]). Such unhealthy snacking behaviours have been associated with the availability and cost of foods in the local area and may be influenced by adolescents' perceptions about what is acceptable and normative dietary intake (Thomas et al., 2019; Yazdi Feyzabadi et al., 2017; [Authors, Year - blinded for peer review]).

Children transitioning into adolescence (11-12 years old) spend a significant amount of time at school and in the company of peers (Heinsch et al., 2020), and these peers become a main source of information about what socially normative and acceptable dietary behaviours are (Ragelienė & Grønhøj, 2020). These unwritten rules (social norms) that develop from interaction with peers become

an important guide for adolescents as they serve as social cues directing and constraining personal behaviour and attitudes (Hechter & Opp, 2001; Van Hoorn et al., 2017). Adolescents will adjust their dietary behaviour to align with the perceived normative dietary behaviour of peers which is driven by a fundamental need for social connection and peer approval (Foulkes et al., 2018; Perkins et al., 2010, 2018; Stok et al., 2016). These perceptions about peers' normative dietary behaviours are not always accurate, with adolescents tending to overestimate the extent of peers' unhealthy dietary practices and believe that peers to be more approving of these behaviours than the reality (Lally et al., 2011; Perkins et al., 2018; [Authors, Year - blinded for peer review]). These normative misperceptions can lead to personal unhealthy dietary practices as individuals conform to inaccurate social norms (Perkins et al., 2010; Salvy & Bowker, 2014; Stok, 2014).

These exaggerated perceptions may be a result of pluralistic ignorance, where an individual observes a peer performing a highly-memorable behaviour (e.g., eating a large number of unhealthy snacks) on one occasion and inaccurately perceives it to be the norm (Schroeder & Prentice, 1998). This can lead to an individual engaging in an unhealthy behaviour as they align their behaviour to the perceived norm, often because of a fear of social disapproval (Bicchieri, 2016). The Social Norms Approach (SNA) operates on the assumption that if these normative misperceptions were challenged, it should decrease the social pressure to engage in these unhealthy behaviours, consequently leading to a reduction in the behaviour or in the intention to engage in the behaviour (Dempsey et al., 2018). The SNA focuses on two different types of norms which influence behaviour: descriptive norms (perceived typical behaviour of peers) and injunctive norms (perceived attitude or perceived approval of peers) (Perkins & Berkowitz, 1986).

SNA interventions aim to challenge commonly held misperceptions of social norms by highlighting the actual reported healthier norm of the majority based on data collected from the target population (Berkowitz, 2005; McAlaney et al., 2010). SNA feedback, which highlights the difference between perceived and actual norms, should challenge any held misperceptions, reducing the

perceived social pressure to engage in the perceived unhealthy behaviours associated with the majority of peers, thereby promoting more positive behaviours (McAlaney et al., 2010). In support of this, there is evidence that changes in perceived norms mediates the effect of SNA feedback on health-related behaviours, e.g., alcohol use (Neighbors et al., 2009, 2015). SNA interventions conducted in school settings have shown promising results in promoting health behaviours in adolescents, particularly for reducing alcohol and tobacco consumption ([Authors, Year - blinded for peer review]; Balvig & Holmberg, 2011; Haines et al., 2003; Sheikh et al., 2017; Vallentin-Holbech et al., 2018). As adolescents (11-12 years old) spend a significant amount of time with peers in a school setting, schools represent a unique social environment with the potential to promote positive dietary behaviour change in adolescents (Chaudhary et al., 2020).

The current study aims to test whether a school-based SNA feedback intervention is effective in reducing unhealthy snacking behaviours and attitudes, and increasing intentions to reduce unhealthy snacking, amongst students aged 11 to 12 years, compared to a non-normative feedback control intervention. Two schools from areas of high socio-economic deprivation were sampled in this study, since there is evidence that areas of greater deprivation are associated with both higher levels of unhealthy food consumption and higher rates of childhood obesity (Conrad & Capewell, 2012). Based on previous research that has sampled other age groups and targeted other unhealthy behaviours (Haines et al., 2005; Lally et al., 2011; Neighbors et al., 2009, 2015; Perkins et al., 2011; Vallentin-Holbech et al., 2018) it is hypothesised that: 1) students who received snacking-related SNA feedback would (i) report a greater reduction in unhealthy snacking behaviours, (ii) have less positive attitudes towards unhealthy snacking, (iii) have a greater intention to reduce unhealthy snacking, and (iv) have more accurate perceptions about peers' snacking-related behaviours and attitudes, when compared to a control; 2) the improvements in students' snacking-related behaviours, attitudes and intentions will be mediated by changes in normative snacking-related misperceptions.

Method

Design and Participants

A quasi-experimental design was used for the present study. Two secondary schools from the North and Midlands of England were sampled, both of which were located in the 30% most-deprived areas of the UK (Noble et al., 2019). A total of 373 students aged between 11 and 12 years of age (School Year 7) from both schools were invited to take part. Of these, 258 students consented to participate (School A = 163 and School B = 95), of which 252 students completed questionnaires at baseline (School A = 157 and School B = 95), 254 students completed questionnaire at Time 2 (School A = 163 and School B = 91) which dropped to 205 by Time 3 (School A = 137 and School B = 68). Students in School A were allocated to the SNA feedback condition and students in School B were allocated to the control condition. An a-priori power analysis indicated that a minimum of 124 participants (62 participants per condition) was required to achieve a desired power of 0.8 with medium effect size ($\eta^2 = .059$) for a series of one-way ANCOVAs to be conducted for each outcome variable, with the baseline value treated as the covariate (Clark-Carter, 2018). The project was approved by [name removed until accepted for publication] Ethics Committee.

An advisory panel of older students (aged 12- to 13-years; $n = 6$) from School A was formed to help direct and deliver the SNA feedback intervention. School-based interventions have been suggested to be more effective at promoting healthier dietary behaviours in adolescents if they involve peers in both the intervention development and implementation [Authors, Year - blinded for peer review], as peers can provide both key insights into the target student group and can help reinforce the social acceptability and credibility of health promotion messages (McAlaney et al., 2010). The advisory panel met on three occasions to advise on effective ways of engaging students with the SNA messages and to provide feedback on the resources developed for the intervention. All of the resources used in this study were reviewed by the advisory group and by the Head of Year (a teacher)

to check for age-appropriate language and comprehensibility as the school had indicated that students' literacy and understanding were below age-related expectations.

Measures

Previously-conducted focus groups in both schools identified that there were differences between the sexes in dietary-related normative perceptions [Authors, Year - blinded for peer review]. Therefore, questionnaires included social norms items that referred to same-sex same-school peers.

Personal snacking behaviour

The specific snacking behaviours measured in this study were informed by a previous qualitative focus group study which identified a number of commonly-consumed snack foods (i.e., chocolate, sweets, crisps, biscuits, and cake) amongst this target group [Authors, Year - blinded for peer review]. The foodstuffs measured were not only commonly-consumed snacks amongst the target population, but are also nutritionally poor and high in sugar and/or fat, and recommended to only be consumed occasionally and in moderation (NHS, 2020a; Public Health England, 2018b). Students were asked to self-report how frequently they had consumed these snack foods over the previous week using an adapted food frequency questionnaire (Lally et al., 2011). Each snack food had a corresponding description of a single serving (e.g., one small bag of crisps) based on a validated adolescent food frequency questionnaire (Rockett et al., 1995); e.g.: *'thinking back over the past week, how many servings of these foods did you eat?'*. Response options ranged from 'less than one a week' to '4 or more a day'; these were converted into values to reflect frequency of consumption per week, for example, '4 or more a day' was coded as 28 (4 portions a day x 7 days = 28 portions per week). A summary measure of snacking behaviour over a week was constructed by summing responses for the five snack foodstuffs. The higher the score, the greater the number of unhealthy snacks the students

consumed. The internal reliability (Cronbach's alpha) across the three timepoints for these items ranged from 0.64 - 0.74.

Personal snacking attitudes

There were two separate measures of personal attitude towards snacking. The first measure focused on attitudes towards snacking (*'In general, do you think that eating two or more unhealthy snack foods on most days is...?'*) with higher scores indicating more favourable personal attitudes towards unhealthy snacking. The second item measured attitudes toward *reducing* snacking behaviour (*'For me to eat fewer unhealthy snacks over the next month would be...'*), with higher scores indicating more favourable personal attitudes towards reducing unhealthy snacking. The item wording and scales were adapted from existing measures (Lally et al., 2011; Sheridan, 2014). Each measure was formed by summing the responses to two 5-point Likert scales (where 1 is bad/foolish and 5 is good/sensible), which were summed to give a total attitude score ranging from 2-10 for each measure.

Descriptive and injunctive Norms

Students' normative perceptions about same-sex peers' snacking behaviours (descriptive norms) were measured by asking how often over the previous week students thought the majority of same-sex peers at their school consumed each snack food (chocolate, sweets, crisps, biscuits and cake). An example of an item was: *'how many servings of each of the following do you think most of the [boys/girls] at [school name] have eaten over the past week?'* The wording of the social norms items was adapted from previously-used measures (Pischke et al., 2015; Lally et al., 2011). Response options were the same as for personal snacking behaviour. Individual snack food descriptive norm responses were summed to give an unhealthy snacking norm score. The higher the score, the higher the number

of unhealthy snacks students perceived their peers to consume. The internal reliability (Cronbach's alpha) across the three timepoints for these items ranged from 0.82 - 0.85.

Students' normative perceptions about same-sex peer attitudes (injunctive norms) towards snacking were measured using two separate individual measures adapted from existing measures (these measures were not summed together) (Lally et al., 2011; Sheridan, 2014). The first measure assessed normative perceptions about eating unhealthy snacks: *'In general, do you think that most of the [boys/girls] at [school name] think that eating two or more unhealthy snack foods on most days is...?'* A higher score on this measure demonstrates a perception that most same-sex peers had a positive attitude towards eating unhealthy snacks. The second measure explored normative perceptions about eating fewer unhealthy snacks: *'In general, do you think that most of the [boys/girls] at [school name] think that eating fewer unhealthy snacks would be?'* Higher scores on this item indicated that students perceived that most of their same-sex peers had positive attitudes towards reducing their unhealthy snacking. Students indicated their perceptions about peers' attitudes towards snacking using the same Likert scales as personal snacking attitude.

Behavioural Intentions

Intentions to reduce unhealthy snacking were measured using four separate items using a 7-point Likert scale ranging from 1 (unlikely/false) to 7 (likely/true). The wording and scale had been adapted from existing measures (Sheridan, 2014; Verhoeven et al., 2013), e.g.: *'I am determined to eat fewer unhealthy snacks over the next month'*. The four item scores were summed to give a total intention score. The higher the intention score, the stronger the intention to reduce unhealthy snacking. The internal reliability (Cronbach's alpha) across the three timepoints for these items ranged from 0.74 - 0.81.

Procedure

All students in Year 7 (first year) of both schools were invited to participate in the study. Individual schools sent information letters and opt-out consent forms to parents/guardians of all students in Year 7. Students who wished to participate in the study after reading the information sheet were asked to give their own informed consent via a consent form prior to completing the baseline questionnaire and were also asked verbally prior to completing subsequent questionnaires. Only students in the SNA feedback condition were invited to participate in the practical poster-making session and students were asked to give verbal consent before the session commenced; if they did not consent, the school arranged for an alternative activity. Students in both conditions completed questionnaires at baseline (Time 1 – September), post-intervention (Time 2 - January), and at 3 months post-intervention (Time 3 - March). Paper-based questionnaires were administered by teachers and completed during school hours during a timetabled teaching session.

Intervention

Students in both conditions received a copy of the non-normative healthy eating information ('Eatwell Guide') the first week of the Spring term (January). The 'Eatwell Guide' provides age-appropriate UK Government recommendations about the number of individual foodstuffs that should come from each food group (e.g., fruit and vegetables) to achieve a healthy, balanced diet (Public Health England, 2018b). Paper copies of the 'Eatwell Guide' were delivered to the schools and teachers distributed them to participating students.

Students in the SNA feedback condition, in the same week as receiving the healthy eating information ('Eatwell Guide'), also participated in an interactive poster-making session. The poster-making session was one hour long and was led by a teacher following a detailed lesson plan provided by the researcher. The lesson plan provided detailed instructions for the teachers, to be used as a

step-by-step guide for the session to help ensure intervention fidelity was maintained (Appendix 1). There were approximately 25 students in each poster-making session (a total of seven poster-making sessions across the week). To help students engage with the SNA feedback, students were asked to design and create a poster in small groups that included the SNA unhealthy snacking feedback messages (the SNA messages were based on students' own baseline data). The use of an interactive poster-making session was a recommendation made by the student advisory group to help ensure students had attended to and engaged with the SNA feedback. There is some suggestion that studies that include interactive methods to deliver campaign messages are more effective than print-based mass media campaigns: they help ensure students actively engage with the presented feedback (Cuijpers, 2002; Vallentin-Holbech et al., 2018). The SNA messages to be included on the poster were phrased to demonstrate the three most-pronounced discrepancies between the perceived and actual snacking norm for boys and girls. Wording used for the SNA feedback messages was recommended by Perkins (2003) and has been adapted for use by other SNA intervention studies (Neighbors et al., 2011; Vallentin-Holbech et al., 2018). An example message: perceived descriptive norm, *“Did you know **58% of girls** think most other girls at [name of school] eat biscuits **4+ times in a week?**”*; actual descriptive group norm, *“Fact, **69% of girls** at [name of school] eat biscuits **less than 3 times in a week.**”* Percentages were also communicated using pictorial representations to aid in students' understanding based on recommendations made by the advisory group (Appendix 2). To ensure students had read and engaged with the SNA feedback, towards the end of the session students were asked in their small groups to briefly present their posters to the rest of the groups, with the following questions: *‘Why did they design the poster in that way?’*, *‘Was any of the information surprising to them?’*, and *‘Did they learn something new?’*.

To increase exposure to and engagement with the SNA feedback, a prize-based competition for the best poster was held and students voted for the best poster from their session. The seven best posters (one from each session) were then displayed in the school in a location that Year 7 students frequented throughout the day. One month after the posters were displayed, the advisory panel

designed a short PowerPoint presentation (exhibiting the seven best posters) to each class that had participated in a poster-making session which facilitated a class discussion (asking students to consider which poster: displayed the information clearly; was the most eye-catching; and was the easiest to read and understand). Each class voted for the best poster and votes were totalled to give an overall winner for the competition; the winning students received shopping vouchers.

Analysis plan

Normative misperceptions of unhealthy snacking behaviour were calculated by subtracting the median of self-reported unhealthy snacking behaviour of the group (school/sex specific) (actual norm) from each student's reported perception of peers' unhealthy snacking behaviour (descriptive norm) (Perkins et al., 2010). A positive score indicated that students perceived peers to consume the unhealthy snacks more often than the reported group norm. Misperceptions of peers' snacking attitudes were calculated by subtracting the median score of self-reported attitude of the group (school/sex specific) (actual norm) from each student's reported perception score of peers' attitudes (injunctive norm) (Perkins et al., 2010). This approach created two attitude misperception scores: (1) misperceptions of peers' attitude towards unhealthy snacking; and (2) misperceptions of peers' attitude towards consuming fewer snacks. A higher score indicated that students perceived their peers to have a more positive attitude towards the behaviour than was the actual reported group norm.

To test hypothesis one, a series of between subjects ANCOVAs/ANCOHETs were conducted to assess differences between the conditions (SNA feedback versus control condition) on each outcome variable (personal unhealthy snacking, personal attitude towards unhealthy snacking, personal attitude towards reducing unhealthy snacking, intention to reduce snacking and normative misperceptions of peers' snacking-related behaviour and attitudes) at post intervention (Time 2) and at 3-month follow-up (Time 3), whilst controlling for baseline values (Time 1).

To test hypothesis two, change scores values were calculated for each outcome variable (subtracting the outcome variable at Time 1 from the same outcome variable at Time 2 or 3) and correlations were conducted to explore the relationships between these values. A series of mediation analyses examined whether changes in students' personal unhealthy snacking behaviour or changes in students' personal unhealthy snacking attitudes were mediated by changes in normative snacking-related misperceptions.

Results

Data screening

Data were screened to check for: sensible values; missing values; multivariate outliers; normal distribution of residuals; linear relationships between outcome measures and covariates in each condition; homogeneity of regression slope in each dependent variable for each ANCOVA; and for change scores values, equal variance between conditions, normal distribution and a linear relationship between values. There were a number of missing values observed across the data set. Missing values analysis (MVA) was conducted to understand whether there was a pattern to the missing data. Little's missing value analysis was non-significant suggesting that data were missing completely at random (MCAR) ($\chi^2 = 15604.485, p = .307$). Intention to treat (ITT) analysis was used to minimise bias in the sample and address the majority of the missing data. ITT analysis reduces bias as it gives a more realistic estimate of treatment effect, as once participants are allocated to a condition, removal of participants (because of drop-out or incomplete responses) could introduce bias and give a false impression of the reported outcomes (Del Re et al., 2013; Gupta, 2011; Kang, 2013). Missing data post-intervention (Time 2) were replaced with baseline values (Time 1) (last observation carried forward: LOCF) and missing data at 3-month follow-up (Time 3) were also replaced with baseline values (Time 1) (baseline observation carried forward: BOCF).

Following the ITT analysis, twelve multivariate outliers were identified (using scatter plots of Cook's Distance and Uncentered Leverage value for each outcome measure). After further investigation of individual cases, two multivariate outliers (one case from each condition) were removed; their individual response patterns demonstrated systematic reporting of extreme scores across variables and at more than one timepoint, indicating that these participants may have either misunderstood or were not attending to question content (Leys et al., 2018).

The residuals for each analysis were found to be normally distributed and there was a linear relationship between outcome measures and covariates in both the intervention and control conditions, fulfilling the assumptions for ANCOVA. Three of the primary outcome analyses (Time 2 personal unhealthy snacking; Time 3 personal unhealthy snacking; and Time 3 misperception of peers' attitude towards fewer unhealthy snacks) were found to have heterogeneity of regression slope. Therefore, a one-way between-subjects Analysis of Covariance with Heterogeneity (ANCOHET) was conducted (Clark-Carter, 2018), in order to conduct an analysis of covariance whilst taking into account the heterogeneity of regression slope (Maxwell et al., 2017). Lastly, the change scores were found to have equal variance between conditions, were normally distributed, and had a linear relationship between values, fulfilling the assumptions for Pearson's and Point-Biserial correlation.

Baseline differences

The means indicate that at baseline, students in the SNA feedback condition on average reported consuming slightly more unhealthy snack portions per week compared to the control condition. Students' attitudes towards unhealthy snacking were not dissimilar between the two conditions at baseline (Table 1). Baseline measures indicate that students in the SNA feedback condition overestimated peers' weekly unhealthy snack consumption, on average, by 23.50 portions per week (approx. daily overestimation of 3.4 portions) above the reported group norm, and students in the control condition, on average, overestimated peers' weekly consumption by 16.85 portions per week

(approx. daily overestimation of 2.4 portions) above the reported group norm. At baseline, 72% of students in the SNA condition and 77% of students in the control condition overestimated peers' weekly unhealthy snacking consumption above the reported group norm for the respective school (28% in the SNA condition and 21% in the control underestimated peers' weekly unhealthy snacking consumption below the group norm). The means indicated that students in both conditions, at baseline, perceived peers to have more positive attitudes towards consuming unhealthy snacks than the reported group norm, and perceived peers to have more negative attitudes towards reducing unhealthy snacking than the reported group norm (Table 1).

Outcomes post-intervention (Time 2)

Table 1 presents the outcomes of individual ANCOVA/ANCOHET analyses for the seven outcome variables at Time 2 with the baseline scores treated as the covariate. At Time 2, the analyses showed significant differences in misperceptions of peers' attitudes towards unhealthy snacking between the intervention and control conditions. Students who received SNA feedback had significantly more accurate perceptions of peers' attitude towards unhealthy snacking ($M = .12$, $SE = .13$) compared to students in the control condition ($M = 1.20$, $SE = .22$), $F(1, 232) = 16.405$, $p < .001$, $\eta^2 = .059$ (Table 1). There were no other significant effects observed immediately post-intervention (Time 2).

-Table 1 about here-

Outcomes at 3-month follow-up (Time 3)

Table 2 presents the outcomes of individual ANCOVA/ANCOHET analyses for the seven outcome variables at Time 3, with the baseline value treated as the covariate. At Time 3, the analyses showed significant differences in personal unhealthy snacking consumption and personal attitudes towards unhealthy snacking between the conditions. Students who received SNA feedback consumed fewer

unhealthy snacks ($M = 17.66$, $SE = 1.16$) compared to students in the control condition where snacking increased ($M = 19.74$, $SE = 1.49$), $F(1, 232) = 6.133$, $p = .014$, $\eta^2 = .007$ (Table 2). Students who received SNA feedback had less positive attitudes towards unhealthy snacking ($M = 5.10$, $SE = .12$) compared with students in the control condition, whose attitudes towards unhealthy snacking became more positive ($M = 5.68$, $SE = .16$), $F(1, 198) = 8.779$, $p = .003$, $\eta^2 = .002$ (Table 2). There were no other significant effects observed at 3-month follow-up (Time 3). These results partially support hypothesis one. Students who received SNA feedback (1i) reported a greater reduction in their personal unhealthy snacking behaviours, (1ii) had less positive personal attitudes towards unhealthy snacking, and (1iv) had more accurate perceptions of peers' attitudes towards unhealthy snacking compared to the control group. There were no significant differences in (1iii) in intentions to reduce personal unhealthy snacking or (1iv) perceptions about peers' snacking behaviours between the SNA and control group.

-Table 2 about here-

Correlations between the independent, mediator and dependent variables

The relationship between the independent variable (intervention or control condition), mediator (changes in normative misperceptions at Time 2 and 3), and dependent variables (changes in personal unhealthy snacking at Time 3 and changes in personal attitude towards unhealthy snacking at Time 3) were explored using Pearson's and Point-Biserial correlations. Table 3 shows that no variables significantly correlated with changes in personal unhealthy snacking at Time 3 (dependent variable).

-Table 3 about here-

Table 4 shows that all variables significantly correlated with changes in personal attitude towards unhealthy snacking at Time 3 (dependent variable) with the exception of changes in misperceptions of peers' unhealthy snacking behaviour at Time 2 and Time 3.

-Table 4 about here-

Mediation analyses

Testing hypothesis two, a series of mediation analyses were conducted to examine whether changes in students' personal unhealthy snacking consumption, or changes in students' personal attitudes towards unhealthy snacking, at Time 3 were mediated by changes in students' normative misperceptions of peers' snacking-related behaviour and attitudes (at Time 2 or Time 3). The results of the ANCOVA/ANCOHET analyses indicated students who received SNA feedback *did not* have a greater intention to reduce unhealthy snacking compared to the control; therefore, a mediation analysis was not conducted exploring the indirect effect of condition on changes in intentions via changes in normative misperceptions. The mediation analyses were conducted using the PROCESS macro (Hayes, 2013) using model 4 with 5000 bias-corrected bootstrapped resamples. Table 5 presents the results of the mediation analyses for the indirect effect of condition (SNA intervention verses control) on changes in personal behaviour and attitudes via changes in normative misperceptions. The results indicate that changes in normative misperceptions of peers' snacking-related behaviour and attitudes (at Time 2 or Time 3) did not mediate the relationship between condition and changes in personal unhealthy snacking at Time 3.

-Table 5 about here-

There was, however, a significant indirect mediation effect of condition on changes in personal unhealthy snacking attitudes at Time 3 via changes in misperceptions about peers' attitudes towards unhealthy snacking at Time 2 (effect = .18, 95% CI [.04, .36]) (Figure 1). This indicated that students who received normative feedback had a greater change compared to the control in normative misperceptions about peers' attitudes towards unhealthy snacking at Time 2, leading to a greater change in their personal attitudes at Time 3 (Figure 1). The results of the mediation analyses partially support hypothesis two; only changes in students' personal unhealthy snacking attitudes were mediated by changes in perceived attitude norms.

-Figure 1 about here-

Discussion

This study aimed to evaluate the effectiveness of a school-based SNA intervention targeting unhealthy snacking amongst students aged 11 to 12 years old living in two socially deprived areas of the UK. Evidence indicates that adolescents misperceive the unhealthy snacking consumption of their peers, and this is associated with increased personal unhealthy snacking consumption ([Authors, Year - blinded for peer review]; Lally et al., 2011). This SNA intervention tested here attempts to challenge these misperceptions amongst this younger adolescent age group in order to facilitate positive changes in personal unhealthy snacking, related attitudes, and behavioural intentions.

When testing the first hypothesis, exploring the intervention effect on (i) students' unhealthy snacking behaviours, (ii) related attitudes, (iii) behavioural intentions, and (iv) normative perceptions, the results only provide partially support for the hypothesis. Immediately post-intervention, students

who were exposed to SNA feedback had (1iv) significantly more accurate perceptions about peers' attitudes towards unhealthy snacking compared to the control. At the three-month follow-up, students in the SNA intervention (1i) had a greater reduction in unhealthy snacking behaviours and (1ii) had less favourable personal attitudes towards unhealthy snacking compared to the control. There were no significant differences in (1iii) intentions to reduce unhealthy snacking or (iv) in perceived descriptive norms (how much other same-sex peers ate unhealthy snacks) between the SNA and control groups either immediately post-intervention or at three-month follow up.

The findings that students who received SNA feedback had significantly more accurate perceptions about peers' attitudes towards unhealthy snacking post-intervention are in accordance with previous SNA research targeting other populations. Such studies have reported that individuals were less likely to overestimate peers' attitudes towards unhealthy behaviours (e.g. alcohol use) following exposure to normative feedback (Neighbors et al., 2011; Reid & Aiken, 2013). Amongst 11- to 12-year-olds, presenting accurate normative information about peers' snacking-related behaviours changed their perceptions about the social acceptability or perceived approval of unhealthy snacking. Particularly for younger adolescents, healthier dietary behaviours may be more likely to be adopted if they are perceived to be socially approved of by others [Authors, Year - blinded for peer review]. Nevertheless, no other significant intervention effects were observed immediately post-intervention. Dietary behaviour change in adolescents may not be apparent immediately, as modification of well-established unhealthy dietary behaviour patterns can be slower than anticipated, since eating is in large part habitual and habits can take time to change (Conner et al., 2002; Shepherd & Shepherd, 2002).

Our results also indicated that at 3 months post-intervention, students who were exposed to the SNA messages consumed significantly fewer unhealthy snacks and had less positive personal attitudes towards unhealthy snacking, compared to students in the control condition. These results reflect what has been found for other SNA studies targeting adolescents' unhealthy behaviours in a

school setting, most notably concerning alcohol and tobacco consumption; that receiving SNA feedback led to a reduction in the unhealthy behaviour (Haines et al., 2003; Sheikh et al., 2017). School is an important learning environment for social conduct (Chaudhary et al., 2020) and is a key setting that can facilitate the reduction or prevention of unhealthy dietary practices (Foulkes et al., 2018). The findings indicated that although the SNA intervention was successful at reducing snacking at 3 months post-intervention, students still consumed some unhealthy snacks.

When testing the second hypothesis, that the improvements in students' snacking-related behaviours, attitudes and intentions will be mediated by changes in normative snacking-related misperceptions, the results only partially support the hypothesis. Students who received SNA feedback had a greater change in their normative misperceptions about peers' attitudes towards unhealthy snacking post-intervention compared to the control group, leading to a greater change in their personal attitudes at three-months follow-up. The mediation analysis findings lend support for the proposed mechanism of the SNA: that correcting normative misperceptions using SNA feedback leads to positive changes in personal attitudes towards an unhealthy behaviour (Dempsey et al., 2018).

Whilst there was a change in students' unhealthy snacking behaviours after receiving the SNA feedback, this was not mediated by changes in normative misperceptions, therefore not supporting hypothesis two. There is the possibility that there were other factors that influenced changes in personal unhealthy snacking of students, e.g., changes in personal attitudes which may then lead to changes in personal behaviour (Marley et al., 2016). When aiming to change dietary behaviours of younger adolescents, it might be important to first address adolescents' attitudes towards unhealthy snacking before attempting to change more established behaviour patterns. A mediation analysis using intention as an outcome variable was not conducted as there were no significant changes in students' behavioural intentions after receiving the SNA feedback.

Strengths and Limitations

A strength of this study was that it actively engaged the target population in the development of the intervention via an advisory group. One challenge for SNA interventions is ensuring that participants have fully understood the normative feedback being disseminated (Dempsey et al., 2018). Having the advisory group of similarly-aged peers review the SNA feedback helped to ensure that intervention content was age-appropriate and comprehensible for our sample. Whilst it can be difficult to determine whether participants have attended to the feedback during SNA campaigns (Miller & Prentice, 2016), the use of an interactive poster session and prize-based competition here helped encourage students to engage with the SNA feedback. Although the posters were displayed for a month within the school it was not possible to record how many occasions students reviewed a poster outside of these sessions. Whilst other methods to disseminate SNA feedback may have allowed us to record intervention exposure, such as computer-based personalised normative feedback, the schools and the students did not have the equipment to support these types of delivery methods and computerised feedback may still not be fully attended to by participants. A limitation of this study is that, even though students in both conditions received the 'Eatwell Guide', it is unclear whether students fully attended to and processed the information included in the leaflet. Therefore, there may have been a difference in the level of information processed by the students in the SNA feedback condition compared to those in the control condition. Future research could consider asking students in both conditions to design posters (SNA feedback verses healthy eating information) to ensure there can be a direct comparison between the conditions.

Snacking is a complex behaviour, and the term 'snacking' can have different interpretations (Chamontin et al., 2003). Being specific about snack foodstuffs being measured and targeted by interventions should reduce confusion and misunderstanding (Hess et al., 2016). The unhealthy snack foods targeted in the current study were identified as being commonly consumed in both schools. Consultation with teachers and the advisory panel of students led to the recommendation that

intervention messages should be focused on a limited number of food items to ensure students were not overloaded with information. Whilst our SNA feedback messages presented information about three specific snack foods for each sex, the self-reported measures of snacking and perceived snacking consisted of a sum of responses relating to five snack foods. It is unclear whether presenting specific SNA normative messages about individual snack foods, or generic messages about unhealthy snacking, is more or less effective in changing behaviours and attitudes in this age group. Future research could investigate the effect of presenting generic norms versus specific norms messages on younger adolescents' unhealthy snacking behaviours. Lastly, one eligible class from School B (control condition) did not complete a questionnaire at baseline due to reasons beyond our control (an error by the school), but did complete a questionnaire post-intervention and at 3-month follow-up; as the analysis required baseline data to be present, the data from these participants were not included in the analyses.

Conclusion

This study aimed to test whether a school-based SNA feedback intervention is effective in encouraging the reduction of unhealthy snacking behaviours amongst younger adolescents living in a socially-deprived area. The findings provide evidence that receiving SNA feedback led to changes in students' normative perceptions, a reduction in their personal unhealthy consumption, and to students having less positive personal attitudes towards unhealthy snacking. Further changes in personal attitude towards unhealthy snacking were mediated by changes in normative perceptions of peers' attitudes towards unhealthy snacking, thus supporting the proposed mechanism of the SNA, that correcting normative misperceptions using SNA feedback leads to positive changes in personal attitudes towards an unhealthy behaviour (Dempsey et al., 2018). For younger adolescents, the perceived acceptability or approval of unhealthy snacking seems to be an important influencing factor for personal unhealthy snacking attitudes. The findings indicated that delivering an SNA feedback intervention to 11- to 12-

year-old students to reduce normative misperception is an effective behaviour change strategy for reducing personal unhealthy snacking behaviours amongst younger adolescents.

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[Authors, Year - blinded for peer review]

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Table 1. Shows results of the ANCOVA/ANCOHET with adjusted means, standard errors and confidence intervals for each of the outcome variables for the post-intervention data (Time 2).

	SNA feedback			Control			ANCOVA/ANCOHET					
	N	Baseline mean	Follow-up adjusted mean	CI (95%) [LL-UL]	N	Baseline mean	Follow-up adjusted mean	CI (95%) [LL-UL]	F	df (error)	p	η^2
Measures												
Personal unhealthy snacking consumption ^a	148	22.05	17.70	15.20-20.21	90	17.41	20.69	17.46-23.92	3.422	234	.066	.005
Personal attitude towards unhealthy snacking	131	5.42	5.13	4.87-5.39	71	5.17	5.26	4.91-5.61	.320	199	.572	<.001
Personal attitude towards fewer unhealthy snacks	135	6.77	7.02	6.65-7.38	71	6.92	7.13	6.62-7.63	.126	203	.723	<.001
Intention to reduce unhealthy snacking	140	17.76	18.07	17.28-18.87	71	18.38	17.96	16.84-19.07	.029	208	.866	<.001
Misperceptions of peers' unhealthy snacking behaviour ^b	127	23.50	20.15	14.89-25.40	85	16.82	26.80	20.37-33.23	2.477	209	.117	.007
Misperceptions of peers' attitude towards unhealthy snacking ^c	130	.79	.12	-.19-.43	68	.84	1.20	.78-1.64	16.405	195	<.001	.059
Misperceptions of peers' attitude towards fewer unhealthy snacks ^c	128	-.38	-1.067	-1.41-.72	66	-.65	-1.317	-1.80-.84	.693	191	.406	.002

^a ANCOHET

^b Misperception scores were calculated by subtracting the median of personal unhealthy snacking behaviour of the group (school/gender specific) from students' individual normative perception (descriptive) of peers' behaviour.

^c Misperception scores were calculated by subtracting the median of personal snacking attitude of the group (school/gender specific) from the students' individual normative perception (injunctive) of peers' snacking attitudes

LL: Lower limit, UL: Upper limit

η^2 – Eta squared

Author Accepted Version

Table 2. Shows results of the ANCOVA/ANCOHET with adjusted means, standard errors and confidence intervals for each of the outcome variables for the 3-month follow-up data (Time 3).

	SNA feedback				Control				ANCOVA/ANCOHET			
	N	Baseline mean	Follow-up adjusted mean	CI (95%) [LL-UL]	N	Baseline mean	Follow-up adjusted mean	CI (95%) [LL-UL]	F	df (error)	p	η^2
Measures												
Personal unhealthy snacking consumption ^a	146	22.05	17.66	15.38-19.95	90	17.41	19.74	16.81-22.66	6.133	232	.014	.007
Personal attitude towards unhealthy snacking	131	5.42	5.10	4.87-5.33	70	5.17	5.68	5.37-6.00	8.779	198	.003	.002
Personal attitude towards fewer unhealthy snacks	134	6.77	7.13	6.83-7.42	68	6.92	7.18	6.77-7.59	.044	199	.834	<.001
Intention to reduce unhealthy snacking	140	17.76	18.01	17.27-18.75	84	18.38	17.70	16.74-18.66	.254	221	.615	<.001
Misperceptions of peers' unhealthy snacking behaviour ^b	128	23.50	21.50	17.25-25.76	85	16.82	22.28	17.06-27.50	.051	210	.821	<.001
Misperceptions of peers' attitude towards unhealthy snacking ^c	129	.79	.72	.43-1.02	68	.84	.75	.34-1.16	.008	194	.931	<.001
Misperceptions of peers' attitude towards fewer unhealthy snacks ^{ac}	128	-.38	-.804	-1.15- -.46	68	-.65	-1.02	-1.50- -.54	.070	192	.791	<.001

^a ANCOHET

^b Misperception scores were calculated by subtracting the median of personal unhealthy snacking behaviour of the group (school/gender specific) from students' individual normative perception (descriptive) of peers' behaviour.

^c Misperception scores were calculated by subtracting the median of personal snacking attitude of the group (school/gender specific) from the students' individual normative perception (injunctive) of peers' snacking attitudes

LL: Lower limit, UL: Upper limit

η^2 – Eta squared

Author Accepted Version

Table 3. Correlation matrix of intervention condition, changes in normative misperceptions (time 2 and 3) and changes in personal unhealthy snacking at 3 months follow-up (Time 3).

Variables	1	2	3	4	5	6	7	8
1. Intervention condition ^{af}	-							
2. Changes in misperceptions of peers unhealthy snacking - Time 2 ^{bd}	.15*	-						
3. Changes in misperceptions of peers unhealthy snacking- Time 3 ^{cd}	.06	.45**	-					
4. Changes in misperceptions of peers' attitude towards unhealthy snacking - Time 2 ^{be}	.24**	.03	.13	-				
5. Changes in misperceptions of peers' attitude towards unhealthy snacking - Time 3 ^{ce}	-.00	-.18*	-.02	.42**	-			
6. Changes in misperceptions of peers' attitude towards fewer unhealthy snacks - Time 2 ^{be}	-.03	.11	.13	.10	.03	-		
7. Changes in misperceptions of peers' attitude towards fewer unhealthy snacks - Time 3 ^{ce}	-.03	.08	.16*	.03	.13	.36**	-	
8. Changes in personal unhealthy snacking- Time 3 ^c	.10	.14	.11	.13	.03	.09	.08	-

^a Dummy coded (SNA intervention = 1, Control = 2)

^b Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable post-intervention (Time 2) (Time 2 – Time 1).

^c Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable at 3-month follow-up (Time 3) (Time 3 – Time 1).

^d Misperception scores were calculated by subtracting the median of personal unhealthy snacking behaviour of the group (school/gender specific) from students' individual normative perception (descriptive) of peers' behaviour.

^e Misperception scores were calculated by subtracting the median of personal snacking attitude of the group (school/gender specific) from the students' individual normative perception (injunctive) of peers' snacking attitudes.

^f Point-Biserial correlations were conducted when exploring the relationship between the dichotomous and scale variables.

* $p < .05$, ** $p < .001$

Table 4. Correlation matrix of intervention condition, changes in normative misperceptions (time 2 and 3) and changes in personal attitude towards unhealthy snacking at 3 months follow-up (Time 3).

Variables	1	2	3	4	5	6	7	8
1. Intervention condition ^{af}	-							
2. Changes in misperceptions of peers unhealthy snacking - Time 2 ^{bd}	.15*	-						
3. Changes in misperceptions of peers unhealthy snacking - Time 3 ^{cd}	.06	.45**	-					
4. Changes in misperceptions of peers' attitude towards unhealthy snacking - Time 2 ^{be}	.24**	.03	.13	-				
5. Changes in misperceptions of peers' attitude towards unhealthy snacking - Time 3 ^{ce}	-.00	-.18*	-.02	.42**	-			
6. Changes in misperceptions of peers' attitude towards fewer unhealthy snacks - Time 2 ^{be}	-.03	.11	.13	.10	.03	-		
7. Changes in misperceptions of peers' attitude towards fewer unhealthy snacks - Time 3 ^{ce}	-.03	.08	.16*	.03	.13	.36**	-	
8. Changes in personal attitude towards unhealthy snacking - Time 3 ^c	.22**	.04	.07	.28**	.31**	.19**	.15*	-

^a Dummy coded (SNA intervention = 1, Control = 2)

^b Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable post-intervention (Time 2) (Time 2 – Time 1).

^c Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable at 3-month follow-up (Time 3) (Time 3 – Time 1).

^d Misperception scores were calculated by subtracting the median of personal unhealthy snacking behaviour of the group (school/gender specific) from students' individual normative perception (descriptive) of peers' behaviour.

^e Misperception scores were calculated by subtracting the median of personal snacking attitude of the group (school/gender specific) from the students' individual normative perception (injunctive) of peers' snacking attitudes

^f Point-Biserial correlation were conducted when investigating the association between the dichotomous and scale variables.

* $p < .05$, ** $p < .001$

Table 5. Mediation analyses for the indirect effect of condition on changes in personal unhealthy snacking behaviour and unhealthy snacking attitudes at 3-month follow-up, via changes in normative misperceptions.

	Changes in personal unhealthy snacking at Time 3 ^d			Changes in personal attitude towards unhealthy snacking at Time 3 ^d		
	Effect (SE)	95% CI* _e		Effect (SE)	95% CI* _e	
		Boot-LL	Boot-UL		Boot-LL	Boot-UL
Mediators						
Changes in misperceptions ^a of peers' unhealthy snacking Time 2 ^c	.59(.66)	-.37	2.25	.01(.02)	-.03	.07
Changes in misperceptions ^a of peers' unhealthy snacking Time 3 ^d	.21(.44)	-.38	1.39	.01(.03)	-.03	.08
Changes in misperceptions ^b of peers' attitude towards unhealthy snacking Time 2 ^c	.75(.64)	-.27	2.26	.18(.08)	.04	.36
Changes in misperceptions ^b of peers' attitude towards unhealthy snacking Time 3 ^d	-.02(.24)	-.48	.54	.02(.07)	-.12	.17
Changes in misperceptions ^b of peers' attitude towards fewer snacks Time 2 ^c	-.14(.35)	-.86	.66	-.01(.05)	-.13	.09
Changes in misperceptions ^b of peers' attitude towards fewer snacks Time 3 ^d	-.16(.31)	-.90	.38	-.02(.04)	-.11	.06

^a Misperception scores were calculated by subtracting the median of personal unhealthy snacking behaviour of the group (school/gender specific) from students' individual normative perception (descriptive) of peers' behaviour.

^b Misperception scores were calculated by subtracting the median of personal snacking attitude of the group (school/gender specific) from the students' individual normative perception (injunctive) of peers' snacking attitudes

^c Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable at 2-week follow-up (Time 2) (Time 2 – Time 1).

^d Change scores were calculated by subtracting the outcome variable at baseline (Time 1) from the same outcome variable at 3-month follow-up (Time 3) (Time 3 – Time 1).

^e If the bootstrapped confidence interval does not include zero, then the indirect path is significant.

LL: Lower limit, UL: Upper limit

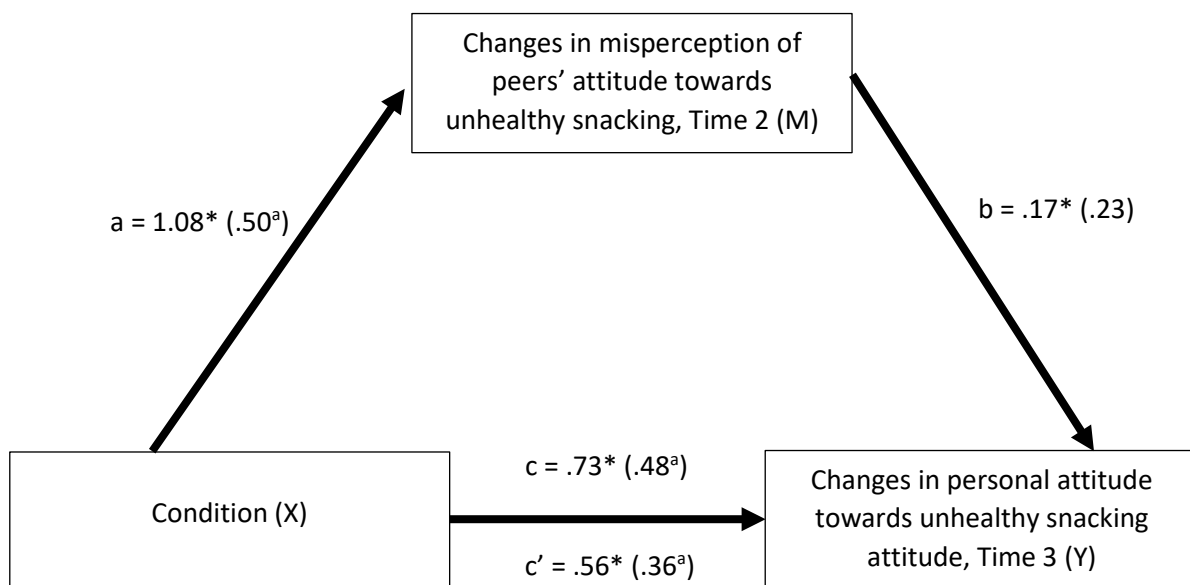


Figure 1. Unstandardized and (in parentheses) standardized regression coefficients for the relationship between condition and changes in personal attitude towards unhealthy snacking at Time 3, mediated by changes in normative misperceptions of peers' attitude towards unhealthy snacking at Time 2.

* $p < .05$

c – total effect

c' – direct effect

^aPROCESS macro (Hayes & Preacher, 2013) reports standardized regression coefficient for dichotomous variable in partial format.