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Do perceived norms of social media users' eating habits and preferences predict our own food consumption and BMI?

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Abstract

In laboratory studies, exposure to social norm messages conveying the typical eating behaviour of others has influenced participants' own consumption of food. Given the widespread use of social media, it is plausible that we are implicitly exposed to norms in our wider social circles, and that these influence our eating behaviour, and potentially, Body Mass Index (BMI). This study examined whether four perceived norms (perceived descriptive, injunctive, liking and frequency norms) about Facebook users' eating habits and preferences predicted participants' own food consumption and BMI. In a cross-sectional survey, men and women university students (n = 369; mean age = 22.1 years; mean BMI = 23.7) were asked to report their perceptions of Facebook users' consumption of, and preferences for, fruit, vegetables, energy-dense snacks and sugar sweetened beverages (SSBs), their own consumption of and preferences for these foods, and their BMI. Multiple linear regression revealed that perceived descriptive norms and perceived frequency norms about Facebook users' fruit and vegetable consumption were significant positive predictors of participants' own fruit and vegetable consumption (both *p*s < .01). Conversely, perceived injunctive norms about Facebook users' energy-dense snack and SSB consumption were significant positive predictors of participants' own snack and SSB consumption (both *p*s < .05). However, perceived norms did not significantly predict BMI (all *p*s > .05). These findings suggest that perceived norms concerning actual consumption (descriptive and frequency) and norms related to approval (injunctive) may guide consumption of low and high energy-dense foods and beverages differently. Further work is required to establish whether these perceived norms also affect dietary behaviour over time.

KEY WORDS: Social norms, social media, Facebook, perceptions, food, BMI

Introduction

Obesity represents a major risk factor for developing other chronic diseases such as type 2 diabetes, certain forms of cancer, coronary heart disease and other respiratory problems (Kopelman, 2000). As poor dietary behaviour and eating habits are significant contributing factors towards obesity, global public health interventions, such as the '5 a day' programme in the UK, have attempted to encourage fruit and vegetable consumption through health education and advertising campaigns (World Health Organization, 2003). However, these approaches have achieved only limited success (Rekhy & McConchie, 2014).

Another approach could be to utilise social influences, such as exposure to social norms, implicit rules that communicate the behaviour of the majority. According to Cialdini's social norm theory (e.g. 1998), one way that norms may work is through normative influence, whereby behaviour is copied because it is seen as socially approved of, accepted, or where there is a concern to 'fit in' with a certain group (Cialdini & Goldstein, 2004, Cialdini & Trost, 1998, Deutsch & Gerard, 1955). Another possibility is that norms provide a form of informational social influence, whereby they communicate what is appropriate behaviour in uncertain situations (Cialdini & Trost, 1998; Deutsch & Gerard, 1955). Providing normative information about how the majority of others typically behave has been an effective way of encouraging pro-environmental behaviours, such as towel reuse (Goldstein, 2008), as well as discouraging behaviours which may negatively impact health, such as lowering alcohol consumption in young adults, and risky behaviours such as drink-driving (Neighbors, Larimer & Lewis, 2004; Perkins, Linkenbach, Lewis & Neighbors, 2010).

Social norms have also had an effect on eating behaviour. In cross-sectional work, participants' perceptions of what others eat have been found to influence their own

consumption of calorific foods (Robinson, Ottens & Hermans, 2016) and fruit and vegetables (e.g. Lally, Wardle & Bartle, 2011; Pelletier, Graham & Laska, 2014). Further, using ecological momentary assessments, momentary injunctive norms, or perceptions about whether others present approved of snacking in a specific situation, mediated the relationship between social facilitation and participants also snacking in similar contexts (Schüz, Papadakis & Ferguson, 2018). This suggests that, across various contexts, participants will adjust their own intake to be in line with what they perceive others typically consume.

Related to this point, experimental evidence has also shown that exposure to normative information can change participants eating behaviour. For example, in experimental studies, descriptive norms reporting that others typically consume a lot of fruit and vegetables or little junk food resulted in participants also eating more fruit and vegetables or fewer calories from junk food (Robinson, et al. 2013; Robinson, Fleming & Higgs, 2014). Thus, exposure to norms about what others actually do (descriptive norms) can result in the corresponding behaviour, including blunting intake of energy-dense foods, as well as increasing fruit and vegetable consumption. These results have also been extended into field settings (e.g. Mollen, Rimal, Ruiter & Kok, 2013; Thomas et al., 2017), where exposure to descriptive norms conveying that other workers chose vegetables with their meals, led to an increase in participants choosing vegetables with meals 6 weeks later (Thomas et al., 2017). Therefore, active manipulation of social norm messaging has been used to nudge participants' actual eating behaviour towards healthier choices. It may also be that in laboratory settings, perceptions of how others actually behave are used as a guide to how much is appropriate to eat in these unfamiliar and novel situations (Higgs, 2015).

Further, different types of norms may have different effects on food intake. For example, injunctive norms (i.e. what others should do or approve of doing) have been found to have negative effects on intended fruit consumption, as well as having no association with fruit, vegetable, unhealthy snack and sugar sweetened beverage (SSB) consumption (Lally et al., 2011; Stok, de Ridder, de Vet & de Wit, 2014). This could suggest that perceived injunctive norms may be less likely to influence food consumption than other norms. However, injunctive norms have predicted healthy food choices (Mollen et al., 2013) as well as snacking in specific situations (Schüz et al., 2018), suggesting instead that the effects of injunctive norms may depend upon the context in which participants' food choice takes place, and may warrant further investigation.

Additionally, other perceived norms, such as perceptions that peers *frequently* consumed SSBs and sweet pastries have also predicted young adults' own consumption of these foods (Robinson et al., 2016). Similarly, liking norms, that is, suggesting that others enjoy eating vegetables, have also been shown to increase broccoli consumption (Thomas, Liu, Robinson, Aveyard & Higgs, 2016). This suggests that while there is little research considering the associations of these types of norms with food intake, they may be having an impact on our eating behaviour. Thus, more research is needed to investigate if such associations exist. Further, no studies to date have considered all of these perceived norms in a single model, to compare their comparative predictive ability and understand further how they may predict the consumption of different food types.

Given the rapidly changing landscape for social interactions in the 21st Century, it may also be important to consider the ways that social norms about what we eat and how much we eat are communicated in the digital age. For instance, a relatively new format by which social

norms about food choice and intake may now be communicated is through social media. Social media, such as social networking sites, have become an important part of many people's lives in the UK, with the Office for National Statistics (ONS, 2017) reporting that use of the internet for social media has increased from 45% in 2011 to 66% in 2016. Social media use is highly prevalent amongst young adults, with 96% of 16-24-year olds and 88% of 25-34-year olds using social media, compared to 27% of over 65-year olds. Of the social media platforms, Facebook is the most popular across the US and UK (SmartInsights, accessed, 6/2019). According to Barre, Cronin and Thompson (2016) 75% of 107 food-related posts analysed on Facebook were of unhealthy foods, suggesting that exposure to energy-dense foods on social media is high. It is therefore plausible that exposure to these posts on platforms such as Facebook, where there is a social context, may be influencing perceptions about eating norms and implicitly influencing our eating behaviour.

In addition, it is possible that if norms on social media are influencing eating behaviour, that this may have consequences for body weight. Obesity has been found to cluster within social networks, suggesting that our social circles may have an impact on body weight (Christakis & Fowler, 2007), although the mechanism that underpins this remains unclear. As the diets of those we are socially connected to influence our eating behaviour (Higgs & Thomas, 2016; Pelletier et al., 2015), social norms may also influence weight. Indeed, individuals on weight loss programmes whose social networks had norms that encouraged acceptance of unhealthy eating behaviour had poorer weight loss (Leahey, Doyle, Xu, Bihuniak & Wing 2015; Leahey, Kumar, Weinberg & Wing 2012). Thus, if norms are perceived as promoting the consumption of certain foods, social networks could also be influencing body weight as a consequence. However, very few studies have considered the relationship between perceived

eating norms, communicated via social media, and young adults' eating habits and their body weight.

In order to study the effects of perceived norms further, this study aimed to investigate whether four different perceived norms, including perceived descriptive, injunctive, liking and frequency norms, about Facebook users' food and drink consumption, predicted participants own food and drink consumption, and BMI. It was predicted that the four perceived norms about Facebook users' consumption of fruit, vegetables, high energy-dense (HED) snacks and SSBs would positively predict participants own consumption of these foods, as well as positively predict participants body weight (BMI).

Method

Participants

A total of 494 undergraduate and postgraduate students were recruited through a Psychology Research Participation Scheme, flyers and university mailing lists, and took part in an online survey. Adverts stated that participants should have no current or previous food allergies, diabetes or eating disorders (as this could confound dietary measures) and should be between 18-65 years old. Of the 494 participants who signed up, 83 were excluded for incomplete data (i.e. discontinuing the survey before completion), and a further 42 were excluded based on the exclusion criteria (food allergies, diabetes or eating disorders, and age) leaving a final sample of 369 (49 men and 320 women). Participants took part in exchange for course credits or entry into a prize draw for one of three £50 Amazon vouchers. The study was approved by Aston University Life and Health Sciences Committee (#1273) and conducted in accordance with the ethical standards of the 1975 Declaration of Helsinki, as revised in 1983. Informed consent was obtained from all participants.

Sample size

Using G*Power (3.1.9.3), with power at 80%, alpha = .05, f squared = .04 (small-medium effect size), the minimum number of participants required was 304, but to account for any exclusions/incompletes, we aimed to recruit over this number and so recruited for a period of 10 months to ensure a sufficient sample size. Similar studies have used reasonably comparable sample sizes (e.g. Lally et al., 2011; N = 264).

Design

The study used a cross-sectional design, with a regression model consisting of four predictors: perceived descriptive norms (perceived number of servings that *are* consumed by Facebook users), perceived injunctive norms (number of servings that participants perceive *should* be consumed by Facebook users), perceived liking norms (perceived *liking* of food by Facebook users), and perceived frequency norms (perceived *frequency* of consumption by Facebook users). The outcome variables were participants' own consumption of fruit and vegetables and HED snacks and SSBs, as well as participants' BMI (see 'Main analysis' section for more details). Theoretical covariates included mood and appetite and eating style as these are likely to affect participants food consumption (as used in Robinson et al., 2013). Further, time spent on social media and affiliation with Facebook users were also included as covariates as these may determine participants' perceptions of what Facebook users consume.

Materials

Participants completed the following measures, as part of an online survey, delivered via Qualtrics. The order of these was fixed as follows, for all participants:

The Student Food and Drink Attitudes Form (SFDAF) was adapted from Thomas et al., (2016) to measure normative perceptions about Facebook users' consumption of the different foods and drink. The term 'Facebook users' was left open to interpretation to the participants, to gain insight into perceptions of Facebook users from those with and without accounts. This scale uses open-ended questions to measure perceived descriptive and injunctive norms for each food and drink. For example, '*How many servings of [vegetables] do you think a typical Facebook user [should] eat a day?*, where participants respond with a number (e.g. 3), to indicate number of servings. A Visual Analogue Scale (measured from 0, 'Not at all', to 100 'Very much') was also used to measure perceived liking norms for each food type (e.g. '*How much do you think a typical Facebook user enjoys eating vegetables*?'). To measure norms about frequency of consumption, the question '*how often do you think a typical Facebook user eats/drinks…*' was used (as in Robinson et al., 2016). Answers were rated on a 5-point scale from 'Never' (0) to 'Daily, or almost daily' (4).

Social Networking/Social media use was assessed using 9-items adapted for use with Facebook (as in Slater, Varsani & Diedrichs, 2017). This measured whether participants had a Facebook account, frequency of Facebook use (e.g. '*How often do you post a picture to your account?*'), time spent using Facebook, the types of posts made, number of accounts 'followed' and 'followed by', other social media accounts used and how much time was spent on these. Participants responses were indicated on Likert scales, for example from 1 (Never) to 6 (Daily), or through open-ended questions.

Mood and Appetite Visual Analogue Scales (VAS) were used to assess mood and appetite. Participants were asked to indicate on a scale from 0 (Not at all) to 100 (Very much) how

alert, drowsy, light-headed, anxious, happy, nauseous, sad, withdrawn, faint, hungry, full, desire to eat and thirsty they felt at the time of the study (as in Thomas et al., 2015).

The 21-item revised version of the Three-Factor Eating Questionnaire (TFEQ-21R; Cappelleri et al., 2009) measured three different forms of eating style, including cognitive restraint (e.g. 'I don't eat some foods because they make me fat'), emotional eating (e.g. 'I start to eat when I feel anxious') and uncontrolled eating (e.g. 'Sometimes when I start eating, I can't seem to stop'). Responses were measured on a Likert scale (i.e. 'definitely true', 'mostly true', 'mostly false', 'definitely false').

A Lifestyle Questionnaire (as used in Thomas et al., 2016) was used to obtain demographic information such as gender, age and ethnicity, as well as lifestyle habits such as dietary preferences, medical conditions, alcohol use, whether participants smoked and self-reported height and weight to calculate BMI. This information was also used to verify that participants met the study criteria.

The Short-Form Food Frequency Questionnaire (SFFFQ; Cleghorn et al., 2016; University of Leeds) measured frequency of food consumption of various food types, such as fruit and vegetables, snack foods, dairy, fresh and processed meats and fish, on a Likert scale from 'Never' (0) to '5+ times a day' (7). This was used as a measure of broader dietary behaviour. The questionnaire has been found to be valid compared to longer food frequency questionnaires (Cleghorn et al., 2016).

The Multicomponent In-Group Identification Scale (Leach et al., 2008) was adapted to measure whether participants identify as and affiliate themselves with Facebook users.

Questions (e.g. *'The fact that I am a Facebook user is an important part of my identity'*) were measured on a Likert-scale from Strongly Disagree (0) to Strongly Agree (7). These items have been found to be reliable across different identities with Cronbach's α ranging from .86 to .93 (Leach et al., 2008).

The Usual Food and Drink Intake Questionnaire (UFDIQ) as in Robinson et al., (2013) was used to measure participants' own consumption of fruit, vegetables, HED snacks and SSBs. Usual consumption was recorded using two open ended questions (e.g. '*How many servings of [vegetables] do you normally eat a day [did you eat yesterday]?'*), participants liking of foods was measured using VAS (e.g. From 0 (*'Not at all') to 100 ('Very Much', how much do you like eating vegetables?*') and frequency of consumption (e.g. *'How often do you eat vegetables?'*) was measured on a 5-point Likert scale ('Never' to 'Daily, or almost daily').

Demand Awareness. Finally, participants were asked what they thought the aims of the study were using an open-ended question ('*What do you think the aims of this study were?*').

<u>Procedure</u>

Participants were told that they were taking part in a study on social media and lifestyle habits. The exact aims of the study were withheld until the end of the study, in order to not bias behaviour. Participants completed the survey online using Qualtrics. After reading a participant information sheet and providing informed consent, the following measures were completed: SFAF, Social Networking Use, Mood and appetite VAS, TFEQ-21, Lifestyle Questionnaire (including self-reported height and weight), SFFFQ, Student/Facebook Affiliation Questionnaire, UFDIQ and Demand Awareness. Participants were debriefed,

thanked for their time and credited or entered into the prize draw. The study took approximately 20 minutes to complete. Data collection took part from February 2018-November 2018.

Analysis

Main analysis

Multiple linear regression was used to investigate whether the four perceived norms (descriptive, injunctive, liking, frequency) of Facebook users' consumption of fruit and vegetables and HED snacks and SSBs predicted participants' own consumption of these, as well as their BMI, as outlined in the design. To create a parsimonious model and based on significant positive correlations, fruit and vegetables were combined into a single metric, as were HED snacks and SSBs. This was done for both consumption of these foods (by the participant) and perceived consumption (by the Facebook users). So, for example, the four perceived norms (descriptive, injunctive, liking and frequency) about Facebook users' fruit *and* vegetable consumption combined, were entered as predictors, and participants' consumption of fruit *and* vegetables combined, was entered as an outcome.

Principal component analyses

Principal component analysis (PCA) was carried out with Varimax rotation for measures of Facebook affiliation. This yielded 3 factors with eigenvalues >1, which explained a total of 67% of the variance. Factors included 'positive aspects of Facebook use' (items related to being pleased, glad, proud, feeling good, having things in common and being similar to Facebook users), 'affiliation to Facebook users' (items related to being committed to being a Facebook user, Facebook as an important aspect of participants identity and how they see themselves, having a bond and solidarity with Facebook users and often thinking about their

identity as a Facebook user) and 'similarity of Facebook users' (items related to Facebook users being similar and having things in common with each other). A PCA was also conducted on the VAS (mood and appetite). This yielded 4 factors with eigenvalues >1, which accounted for a total of 69% of the variance. Factors included 'feeling unwell' (light headedness, nausea, anxiety), 'appetite' (hunger, thirst, full, desire to eat), 'negative emotions' (sad, happy, withdrawn), where happy was reverse coded to reflect a negative state, and 'alertness' (alert, drowsy).

Covariate analysis

The following theoretical covariates were correlated (Pearson's *r*) with the outcome measures to determine whether they should be entered as covariates in the regression models: mood and appetite measures (VAS PCA items); eating style (TFEQ-R21 subscales); time spent on social media; and affiliation with Facebook users (Facebook PCA items). Measures were included as covariates if they significantly correlated with the outcome measure ($p < .05$).

Results

Participant characteristics

The final sample consisted of 369 participants. The mean age for the sample was 22.1 years of age, 87% (n = 320) were women and 13% (n =49) were men. Ethnic background; 48% White, 34% Asian, 9% Black, 5% mixed ethnicities and 4% 'Other'. Participants average BMI was within a healthy range (mean = 23.7, standard deviation = 5.10), 8% had an underweight BMI (BMI <18.5), 63% had a healthy BMI (BMI of 18.5-24.9), 21% had an overweight BMI (BMI of 25.0-29.9) and 8% had an obese BMI (BMI =>30.0). Eight percent were smokers and 62% drank alcohol. For food frequency (SFFFQ), on average, participants consumed fruit and vegetables 2-3 times a week, salad once a week, crisps and sweet snacks

2-3 times a week and SSBs once a week. Measures from the SFFFQ were positively and significantly correlated with measures from the UFDIQ; i.e. frequency measures for fruit, vegetables, SSB and junk food intake (all *r*s => 0.5; all *p*s < 0.001), and measures of amount consumed for fruit and vegetables (both *r*s => 0.8; all *p*s < 0.001). Hence, UFDIQ measures were used in all subsequent analyses. For further information regarding social media use, and other measures, see Tables 1, 2 and 3.

Table 1. Frequencies and percentages for social media use

Measure	N (= 369)	Percentage (%)
Facebook Account - Yes	299	81
Facebook Account - No	70	19
*Time spent on Facebook**		
No time	22	6
Less than 10 min	85	23
10-30 mins	86	23
30-60 mins	62	17
Over an hour	44	12
*Use of other social media accounts**		
Yes	286	76
No	13	81

* Responses to both measures were for participants who said 'yes' to having a Facebook account

Table 2. Participants' consumption, perceptions, mood and eating style (mean and standard deviation)

Measure	Mean (SD)
Participants daily consumption (servings)	
Fruit and vegetables combined	3.7 (2.0)
HED snacks and SSBs combined	2.9 (1.9)
Perceived consumption by others (servings)	
Fruit and vegetables combined	3.8 (1.7)
HED snack and SSBs combined	6.9 (2.9)
Facebook Perceptions and Affiliation	
Positive aspects of Facebook	3.2 (1.2)
Affiliation to Facebook users	2.3 (1.1)

Perceptions of Facebook users	2.9 (1.4)
VAS	
Feeling unwell	20.2 (19.0)
Appetite	51.3 (25.1)
Negative emotions	31.2 (20.7)
TFEQ-R21	
Uncontrolled eating	2.3 (0.6)
Cognitive restraint	2.6 (0.7)
Emotional eating	2.1 (0.8)

SSBs = Sugar Sweetened Beverages; HED = High energy Dense; VAS = Visual Analogue Scales; TFEQ = Three-Factor Eating Questionnaire.

Key: *Facebook Perceptions and Affiliation* (whether participants identify and affiliate with Facebook users) rated from Strongly agree (1) to Strongly Disagree (7); *VAS* (mood and appetite) rated from 0 (Not at all) to 100 (Very much); *TFEQ-R21* (eating style) rated Definitely false (1) to Definitely true (4).

Table 3. Participant characteristics for perceived consumption and participants own consumption (mean and standard deviation)

Measure	**Type of norm**			
	Descriptive Mean (SD)	Injunctive Mean (SD)	Liking Mean (SD)	Frequency Mean (SD)
Participants perceived consumption by others (servings)				
Vegetables	1.9 (1.1)	4.1 (2.4)	40.9 (18.5)	3.3 (0.8)
Fruit	1.9 (0.9)	3.8 (1.4)	59.5 (17.6)	3.5 (0.7)
HED snacks	3.8 (1.7)	1.4 (1.0)	86.6 (13.8)	3.9 (0.5)
SSBs	3.1 (1.7)	1.2 (1.1)	82.9 (14.8)	3.7 (0.6)
Participants own consumption (servings)				
Vegetables	2.0 (1.4)	-	68.4 (24.2)	4.6 (0.8)
Fruit	1.7 (1.1)	-	76.4 (21.9)	4.5 (0.8)
HED snacks	1.8 (1.3)	-	78.4 (21.7)	4.4 (0.8)
SSBs	1.1 (1.2)	-	61.1 (30.1)	3.7 (1.3)

SSBs = Sugar Sweetened Beverages; HED = High energy Dense

Key: Descriptive: how much is actually consumed; Injunctive: how much should be consumed; Liking; how much a food is liked; Frequency: how often a food is consumed

Associations between covariates, consumption and BMI

Pearson's correlations for theoretical covariates revealed that the three types of eating style (uncontrolled eating, cognitively restrained eating and emotional eating, as defined by the TFEQ) were significantly positively correlated with fruit and vegetable consumption and HED snack and SSB consumption (with the exception of cognitively restrained eating, which was negatively associated with HED snack and SSB consumption), as well as BMI (all *p*s <.01). and were therefore controlled for. None of the other measures correlated with the outcomes and were not included as covariates.

Predictors of participants' food consumption

Multiple linear regression revealed that the final models with perceived descriptive, injunctive, liking and frequency norms, as well as the three eating styles (uncontrolled, cognitive restraint and emotional eating) significantly predicted participants consumption of fruit and vegetables, ($F(7) = 6.90$, $p = <.001$, $r = .35$), and HED snack and SSBs ($F(7) = 18.97$, $p = <.001$, $r = .54$). Perceptions of how many servings of fruit and vegetables Facebook users eat (perceived descriptive norms), as well as perceptions about how often Facebook users eat fruit and vegetables (perceived frequency norms) both significantly predicted participants own fruit and vegetable consumption. Uncontrolled, as well as cognitive restrained eating styles, also significantly predicted participants' self-reported fruit and vegetable consumption. See Table 4.

However, for participants HED snack and SSB consumption, in the final model, only perceptions of how many servings of HED snacks and SSBs Facebook users *should* eat (perceived injunctive norms) was a significant predictor. Again, an uncontrolled eating style also significantly predicted participants own HED snack and SSB consumption, as well as cognitive restrained eating style. See Table 4.

Predictors of participants' BMI

The regression model with the four perceived norms about Facebook users' fruit and vegetable consumption and the three eating styles significantly predicted BMI, $F(7) = 3.64$, $p = .001$, $r = .26$. However only emotional eating was a significant predictor of participants' BMI. The model with perceived norms about Facebook users' HED snack and SSB consumption and the eating styles also significantly predicted BMI, $F(7) = 3.82$, $p = .001$, $r = .27$, however, as above, only emotional eating was a significant predictor.

V2

331 **Table 4.** Predictors of food and drink consumption, and BMI

Predictor	Outcome																			
Perception of norm / Covariate	**Participants fruit and vegetable consumption**					**Participants HED snack and SSB consumption**					**Participants BMI (fruit and veg norms as predictors)**					**Participants BMI (HED snack and SSB norms as predictors)**				
	β	**SE**	**Sβ**	**95% CI**		**β**	**SE**	**Sβ**	**95% CI**		**β**	**SE**	**Sβ**	**95% CI**		**β**	**SE**	**Sβ**	**95% CI**	
				Lower	**Upper**				**Lower**	**Upper**				**Lower**	**Upper**				**Lower**	**Upper**
Perception of norm corresponding to outcome variable																				
Descriptive	.22	.08	.19**	.07	.37	.06	.04	.09	-.02	.13	-.07	.19	.19	-.45	.31	-.06	.16	.12	-.28	.17
Injunctive	.05	.04	.07	-.03	.13	.35	.06	.35***	.24	.46	.04	.10	.10	-.16	.23	-.03	.17	.17	-.37	.31
Liking	-.004	.003	-.06	-.01	.003	.006	.004	.08	-.002	.01	-.001	.01	.01	-.09	.02	-.002	.01	.01	-.03	.02
Frequency/ often	.21	.08	.14**	.04	.37	.003	.12	.001	-.24	.25	.01	.22	.22	-.43	.44	.26	.37	.40	-.46	.99
TFEQ-R21 (covariates)																				
Uncontrolled eating	-.43	.20	-.14*	-.82	-.05	.39	.18	.12*	.03	.75	.34	.52	.52	-.68	1.36	.24	.55	.55	-.84	1.31
Cognitive restrained	.44	.14	.16**	.16	.72	-.69	.13	-.26***	-.95	-.44	.65	.38	.38	-.10	1.39	.70	.39	.39	-.08	1.47
Emotional eating	.23	.15	.10	-.06	.52	.23	.13	.10	-.12	.41	1.37	.39	.39***	.60	2.14	1.46	.40	.40***	.68	2.24

V2

HED = high energy-dense; SSB = sugar sweetened beverages; *p <.05, **p <.01, *** p<.001

Post-hoc Mediation analysis

Given that there was no direct effect of the perceived norms on BMI in the regression models, exploratory mediation analysis was carried out to investigate if there was an indirect effect of each of the perceived norms, about Facebook users' consumption of fruit and vegetables, and HED snack and SSB consumption, on participants BMI, through participants own consumption of these foods (see Figure 1 below for model).

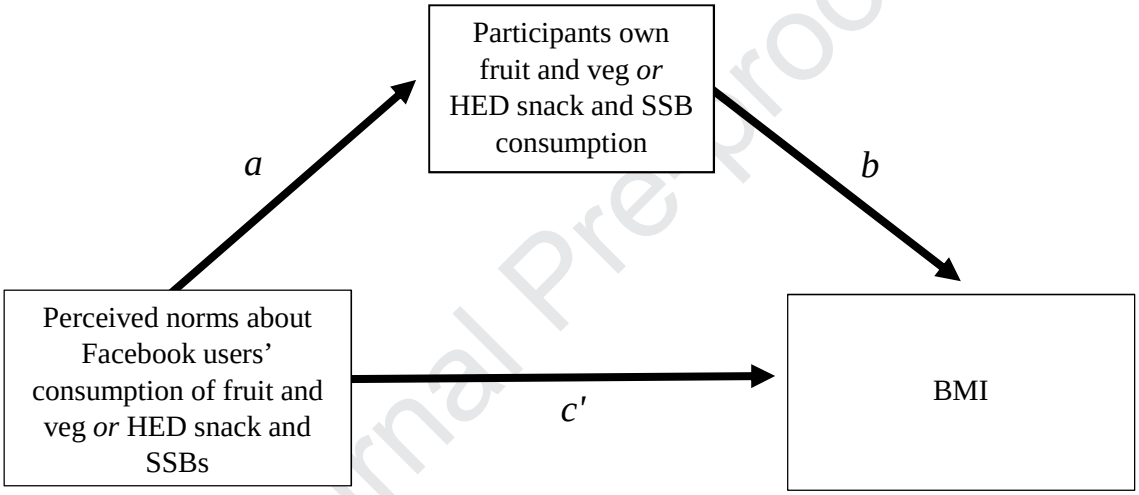

Figure 1: Mediation model of effect of perceived norms on BMI, via participants' food/drink consumption.

All analyses revealed that there was no significant mediation. To be precise, there was no significant indirect effect of the four perceived norms about Facebook users' fruit and vegetable consumption or HED snack and SSB consumption, on BMI, via participants' consumption of fruit and vegetables or HED snack and SSBs, respectively (all *p*s >.05).

Discussion

We examined whether four different perceived norms about Facebook users' consumption of fruit, vegetables, HED snack foods and SSBs predicted participants own consumption of these foods. Our results revealed that descriptive and frequency norms about how much and how frequently participants perceived Facebook users to consume fruit and vegetables positively predicted participants own consumption of fruit and vegetables, whereas, perceived injunctive norms about what others should eat positively predicted participants' consumption of HED snack foods and SSBs. Thus, the more participants perceived Facebook users to consume fruit and vegetables, the more participants consumed themselves. Whilst the more HED snacks and SSBs they perceived Facebook users should consume, the more they consumed themselves. However, there were no associations between perceived liking norms and participants food or drink consumption. Similarly, the four perceived norms did not predict BMI, suggesting that social media and our social networks may communicate norms about others eating habits, which implicitly influence our own eating habits, but may not necessarily influence BMI.

As demonstrated by previous work (e.g. Lally et al., 2011; Robinson et al., 2016; Thomas et al. 2017), participants' perceptions of others' eating habits predicted their own self-reported food consumption, with participants matching their consumption to their perception of the norm. Moreover, these results suggest that norms communicating what others actually do (i.e. descriptive/frequency norms) may guide consumption of low energy-dense foods, as in previous work (e.g. Robinson et al., 2014; Thomas et al. 2017; Stok et al., 2012), whereas perceived norms relating to social approval (i.e. injunctive norms) may guide consumption of HED snack foods and beverages (e.g. Schüz et al, 2018). One possible explanation for perceived descriptive and frequency norms predicting consumption of LED foods could be that, due to the high frequency of HED food related posts (Barre et al., 2016), social media

may provide less or no information about others' consumption of fruit and vegetables. This may make social media an unusual context in which to gauge eating norms for fruit and vegetable consumption (i.e. participants are less certain of *how much* and *how frequently* people are consuming fruit and vegetables, as they receive less information about this). As Higgs (2015) suggests, in unfamiliar contexts, participants tend to use descriptive norms about what others *actually* eat to guide their own consumption, because norms about what others actually do provides information that we can base our own behaviour on. Therefore, perceptions of how much and how frequently social media users consume fruit and vegetables, even if this based on very little information, may have been most influential in predicting participants' consumption, because it is the *most useful* norm for guiding consumption of these foods in this context.

In contrast, consumption of HED snack foods and SSBs, which are typically perceived as 'unhealthy', may be more related to social endorsement and approval. Or in other words, matching consumption to the perceived injunctive norm for HED snacks and SSBs may have occurred because the act of doing so is less likely to incur a negative judgement, within a social media context, where desire for social acceptance is likely to be high (Clark, Algoe & Green, 2018). Therefore, normative information about what others *approve* of may be more useful in guiding consumption of HED snack foods and SSBs, which may have more (negative) social connotations attached to them. It is also important to note that Facebook, like many other social platforms, allow users to signal their approval with various tools (e.g. the like button). Thus, it is possible that these digital social environments are uniquely conveying approval, in a way that is different from everyday perceptions of norms among our peers. An emergent question is whether the norms we perceive in our digital social circles are more salient, or exert a greater influence, than the norms we perceive in the physical world

around us? This is an important question, as the answer may also indicate whether certain environments and norms are more amenable and useful for social norm interventions to enhance healthy eating.

Taken together, these findings add to the literature to suggest that there may be variability in how norms influence food consumption. Measuring these concurrently within a single study, for the first time, provides evidence that different types of norms may selectively predict the consumption of different types of food, expanding previous evidence considering the effect of norms or types of food in isolation, or compared to other types of messages (e.g. Robinson et al. 2013; Stok et al., 2012; Lally et al., 2011). This knowledge could be used to develop and test social norm-based interventions, to specifically target the consumption of high or low energy-dense foods, through exposure to different norms via experimentally manipulated social media posts or encouraging people to follow highly liked healthy eating social media accounts. Further this evidence suggests that exposure to descriptive norms concerning fruit and vegetable consumption may present the optimum social norm intervention to enhance consumption of these foods. Similarly, exposure to injunctive norms regarding the consumption of HED snacks and beverages may be particularly effective in blunting their consumption.

Interestingly, while our hypothesis that perceived norms would positively predict participants' food and drink consumption was partially supported, perceived liking norms did not significantly predict participants' food and beverage consumption. At first glance, this seems at odds with previous research showing that manipulation of liking norms can produce an increase in vegetable consumption (Thomas et al., 2016). However, actively exposing participants to a liking norm that has been selected on the basis of appearing positive and

persuasive, is clearly different to assessing passive perceptions of liking. Also, as noted in Thomas and colleagues' previous work (2016), there is often a disparity between liking and consumption. For example, in Thomas et al.'s study, participants ate more of the broccoli even though they liked it less, reminding us that we may eat foods that we do not like because of health reasons, and vice versa, we may not consume a food, although we like it, for health or other reasons. Thus, here, the lack of association between participants' perceptions of how much others like a given food or drink, and their own consumption, may reflect the fact that other factors such as health and liking predict consumption of a food. For instance, we may accurately perceive that most people like HED snacks, but liking may not be the most important factor in determining whether we consume them ourselves. It may also be that social approval is valued over and above perceptions of liking or enjoyment of a food, in certain contexts or with certain norm referent groups.

Unexpectedly, the four different perceived norms about Facebook users' consumption of foods and beverages did not predict participants BMI. Further, there was no indirect effect of perceived norms on BMI via consumption (the mediator). Participants perceived their peers to consume more HED foods and drinks than they themselves did, and based on previous research (e.g. Leahey et al., 2012), it would be expected that these perceived norms might predict body weight. However, unlike this sample, who on average had a healthy BMI weight, Leahey and colleagues research was focussed on individuals who were overweight/obese, which may account for the null result here. Another explanation is that participants match their behaviour to the norm, even if these norms are momentary or within specific contexts (Schüz et al. 2018). As perceptions about Facebook users' consumption are likely to be based on posts which are constantly changing, it follows that norms on Facebook could also be momentary, if they are dependent on these posts. Therefore, while participants

458 may shift their short-term food consumption to match these norms (explaining how these
459 norms predict intake), BMI, which is a long-term reflection of food consumption and energy
460 balance, may not be predicted by momentary norms. If BMI is indeed partly a long-term
461 consequence of norms in networks (e.g. Leahey et al. 2015), then it would be useful to study
462 whether perceptions about social media users' eating habits affect participants' dietary
463 behaviour and BMI over time; this would provide a more robust test of whether perceived
464 norms actually predict BMI.
465
466 Although this study used a large sample, including both men and women, and represented a
467 variety of ethnicities, there are some limitations to consider. Firstly, the use of self-report
468 measures means that participants' perceptions of the norm, consumption and BMI may be
469 inaccurate or biased, though these measures are typical of this field (e.g. Lally et al., 2011;
470 Robinson et al., 2016). Secondly, when using BMI, there are many notable caveats with this
471 measure, such as the inability to consider percentage of body fat (Nuttal, 2015), though again,
472 it is a widely used metric. Thirdly, as with much of the cross-sectional social norms research,
473 it is possible that a so-called false-consensus effect may have occurred (Robinson, 2015),
474 with the cross-sectional design of the research making it difficult to determine whether
475 participants own perceptions of what they consume informed their perceptions of what
476 Facebook users consume or vice-versa. However, in this study, due to our a-priori predictions
477 that perceptions about Facebook users' consumption would predict participants'
478 consumption, this was the only direction that was tested, but we note the inherent limitation
479 of this approach. One way to address the three limitations above would be to follow on from
480 this work with experimental laboratory studies, measuring actual food consumption, using
481 additional physiological measures such as waist circumference or body composition, and
482 directly manipulating norms within social media settings to examine causality.

Additionally, in this study it was not a requirement for participants to be Facebook users to take part, though the vast majority were (81%). Although we do not have the capacity to meaningfully examine users versus non-users with this data set, future work might further explore whether the perception of norms in a social circle that one does not reside within (i.e. an out-group), does not influence or predict consumption, or whether the unique properties of social media and digital social circles circumvents this, such that the norms of an out-group are influential. Despite these limitations, this study is one of the first to consider whether different types of norms predict participants eating habits and BMI, in a social media context. To our knowledge, this study provides the first evidence to suggest that our wider online social circles may be implicitly influencing our eating habits via normative perceptions. Moreover, the influence of norms on intake appears to be nuanced, with theoretical implications of how and why these norms have selective predictive ability.

Conclusions

This study has demonstrated that perceived descriptive and frequency norms about what Facebook users *actually* eat predicted participants' own fruit and vegetable consumption, whereas norms relating to social approval predicted their own consumption of HED foods and SSBs. This suggests that certain social norms may be more or less influential in determining the types of food that we choose to consume, and that the norms we perceive in our social media circles predict our food choices, though further work is required to explore causality. Perceived norms about Facebook users eating habits did not predict BMI in this cross-sectional study, however, future work will consider the long-term effects that perceived norms may have on eating habits and BMI.

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References

Ball, K., Jeffery, R.W., Abbot, G., McNaughton, S.A. & Crawford, D. (2010). Is healthy behavior contagious: associations of social norms with physical activity and healthy eating. *International Journal of Behavioral Nutrition and Physical Activity, 7* **(**86). https://doi.org/10.1186/1479-5868-7-86

Barre, L., Cronin, A., &Thompson, B.S. (2016). What people post about food on social media (Poster Abstracts). *Journal of Nutrition Education and Behavior, 48,* S52.

Burger, J. M., Bell, H., Harvey, K., Johnson, J., Stewart, C., Dorian, K., & Swedroe, M. (2010). Nutritious or delicious? The effect of descriptive norm information on food choice. *Journal of Social and Clinical Psychology*, *29*(2), 228-242.

Cappelleri, J., Bushmakin, A., Gerber, R., Leidy, N., Sexton, C., Lowe, M., & Karlsson, J. (2009). Psychometric analysis of the Three-Factor Eating Questionnaire-R21: results from a large diverse sample of obese and non-obese participants. *International Journal of Obesity,* 33(6), 611-620. http://dx.doi.org/10.1038/ijo.2009.74

Cialdini, R.B. & Goldstein, N.J. (2004). Social influence: Compliance and conformity *Annu. Rev. of Psychol., 55*, 591-621. https://doi.org/10.1146/annurev.psych.55.090902.142015

Cialdini, R., &, Trost, M. (1998). Social influence: Social norms, conformity and compliance

(4th ed.) In Gilbert, G.L.D.T., & Fiske, S.T. (Eds.), The handbook of social psychology, Vol. 2, McGraw-Hill: New York, pp. 151-192.

Clark, J. L., Algoe, S. B., & Green, M. C. (2018). Social network sites and well-being: the role of social connection. *Current Directions in Psychological Science*, *27*(1), 32-37. https://doi.org/10.1177%2F0963721417730833

Cleghorn, C. L., Harrison, R. A., Ransley, J. K., Wilkinson, S., Thomas, J., & Cade, J. E. (2016). Can a dietary quality score derived from a short-form FFQ assess dietary quality in UK adult population surveys? *Public Health Nutrition, 19*(16), 2915-2923.

De Noia, J., & Cullen, K.W. (2015). Fruit and vegetable attitudes, norms and intake in low-income youth. *Health Education and Behavior, 42*(6), 775-782.

Deutsch, M. & Gerard, H.B. (1955). A study of normative and informational social influences upon individual judgement. *Journal of Abnormal Psychology, 51* (3) (1955), 629-636. https://doi.org/10.1037/h0046408

Higgs, S. (2015). Social norms and their influence on eating behaviours. *Appetite, 86,* 38-44. http://dx.doi.org/10.1016/j.appet.2014.10.021

Higgs, S., & Thomas, J. (2016). Social influences on eating. *Current Opinion in Behavioral Sciences, 9,* 1-6.

Kopelman, P. G. (2000). Obesity as a medical problem. *Nature, 404*(6778), 635-643.

Lally, P., Bartle, N., & Wardle, J. (2011). Social norms and diet in adolescents. *Appetite, 57*(3), 623 – 627. https://doi.org/10.1016/j.appet.2011.07.015

Leach, C. W., Van Zomeren, M., Zebel, S., Vliek, M. L., Pennekamp, S. F., Doosje, B., ... & Spears, R. (2008). Group-level self-definition and self-investment: a hierarchical (multicomponent) model of in-group identification. *Journal of personality and social psychology*, *95*(1), 144 – 165.

Leahey, T. M., Kumar, R., Weinberg, B. M., & Wing, R. R. (2012). Teammates and social influence affect weight loss outcomes in a team□based weight loss competition. *Obesity, 20(7)*, 1413-1418. https://doi.org/10.1038/oby.2012.18

Leahey, T. M., Doyle, C. Y., Xu, X., Bihuniak, J., & Wing, R. R. (2015). Social networks and social norms are associated with obesity treatment outcomes. *Obesity*, *23*(8), 1550-1554. https://doi.org/10.1002/oby.21074

Mollen, S., Rimal, R., Ruiter, R., & Kok, G. (2013). Healthy and unhealthy social norms and food selection. Findings from a field-experiment. *Appetite*, *65*, 83-89. http://dx.doi.org/10.1016/j.appet.2013.01.020

Neighbors, C., Larimer, M. E., & Lewis, M. A. (2004). Targeting misperceptions of descriptive drinking norms: efficacy of a computer-delivered personalized normative feedback intervention. *Journal of consulting and clinical psychology*, *72*(3), 434.

Nuttall, F.Q. (2015). Body Mass Index: Obesity, BMI, and Health: A Critical Review. *Nutrition Today, 50*(3), 117-128. https://dx.doi.org/10.1097%2FNT.0000000000000092

Office for National Statistics. (2017). *Internet access –households and individuals: 2017*. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2017

Pelletier, J. E., Graham, D. J., & Laska, M. N. (2014). Social norms and dietary behaviors among young adults. *American journal of health behavior*, *38*(1), 144-152.

Perkins, H. W., Linkenbach, J. W., Lewis, M. A., & Neighbors, C. (2010). Effectiveness of social norms media marketing in reducing drinking and driving: A statewide campaign. *Addictive behaviors*, *35*(10), 866-874.

Rekhy, R., & McConchie, R. (2014). Promoting consumption of fruit and vegetables for better health. Have campaigns delivered on the goals?. *Appetite*, *79*, 113-123. https://doi.org/10.1016/j.appet.2014.04.012

Robinson, E. (2015). Perceived social norms and eating behaviour: An evaluation of studies and future directions. *Physiology & behavior*, *152*, 397-401.

Robinson, E., Harris, E., Thomas, J., Aveyard, P., & Higgs, S. (2013). Reducing high calorie snack food in young adults: a role for social norms and health

based messages. *International Journal of Behavioral Nutrition And Physical Activity*, *10*(1), 73. http://dx.doi.org/10.1186/1479-5868-10-73

Robinson, E., Fleming, A., & Higgs, S. (2014). Prompting healthier eating: Testing the use of health and social norm based messages. *Health Psychology*, *33*(9), 1057-1064. http://dx.doi.org/10.1037/a0034213

Robinson, E., Otten, R., & Hermans, R. C. (2016). Descriptive peer norms, self-control and dietary behaviour in young adults. *Psychology & health*, *31*(1), 9-20. https://doi.org/10.1080/08870446.2015.1067705

Schüz, B., Papadakis, T., & Ferguson, S. G. (2018). Situation-specific social norms as mediators of social influence on snacking. *Health Psychology*, *37*(2), 153-159. http://psycnet.apa.org/doi/10.1037/hea0000568

Slater, A., Varsani, N., & Diedrichs, P. C. (2017). # fitspo or# loveyourself? The impact of fitspiration and self-compassion Instagram images on women's body image, self-compassion, and mood. *Body image*, *22*, 87-96. https://doi.org/10.1016/j.bodyim.2017.06.004

SmartInsights (2019). *Global social media research summary 2019.* Available at: https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/

Stok, F., de Ridder, D., de Vet, E., & de Wit, J. (2012). Minority talks: The influence of descriptive social norms on fruit intake. *Psychology & Health*, *27*(8), 956-970. http://dx.doi.org/10.1080/08870446.2011.635303

Stok, F., de Ridder, D., de Vet, E., & de Wit, J. (2014). Don't tell me what I should do, but what others do: The influence of descriptive and injunctive peer norms on fruit consumption in adolescents. *British Journal Of Health Psychology*, *19*(1), 52-64. http://dx.doi.org/10.1111/bjhp.12030

Thomas J.M., Dourish C.T., & Higgs S. (2015). Effects of awareness that food intake is being measured by a universal eating monitor on the consumption of a pasta lunch and a cookie snack in healthy female volunteers. *Appetite, 92,* 247–251. https://doi.org/10.1016/j.appet.2015.05.034

Thomas, J., Liu, J., Robinson, E., Aveyard, P., Herman, C., & Higgs, S. (2016). The Effects of Liking Norms and Descriptive Norms on Vegetable Consumption: A Randomized Experiment. *Frontiers In Psychology*, *7*. http://dx.doi.org/10.3389/fpsyg.2016.00442

Thomas, J., Ursell, A., Robinson, E., Aveyard, P., Jebb, S., Herman, C., & Higgs, S. (2017). Using a descriptive social norm to increase vegetable selection in workplace restaurant settings. *Health Psychology*, *36*(11), 1026-1033. http://dx.doi.org/10.1037/hea0000478