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Predicting long-term healthy eating behaviour:

Understanding the role of cognitive and affective attitudes

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The data that support the findings of this study are available from the corresponding author, [MC], upon reasonable request.

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Predicting long-term healthy eating behaviour: Understanding the role of cognitive and affective attitudes

Abstract

Objectives: There are few tests of the ability of cognitive and affective attitudes to predict long-term performance of health behaviours. We assessed relationships between cognitive and affective attitudes and health eating behaviour over periods of 4, 6 and 10 years. **Design**: A prospective survey measuring cognitive and affective attitudes at baseline (T1) and 6 years (T2), and self-report healthy eating behaviour at baseline (T1), 6 (T2) and 10 (T3) years later in a sample of UK adults recruited through General Practice (N = 285). **Results**: When considered simultaneously, affective attitude (T1 and T2) predicted health eating behaviour cross-sectionally (at T1 and T2) and prospectively (over 4 [T2-T3], 6 [T1-T2] and 10 [T1-T3] years) whereas cognitive attitude did not. Stability of affective attitude (T1-T2) moderated the effect of affective attitude-behaviour relationship in some (T1-T2, T1-T3), but not all (T2-T3), prospective analyses. Change in affective attitude, but not cognitive attitude (T1-T2), predicted change in behaviour over 6 (T1-T2) and 10 (T1-T3) years. **Conclusions**: The findings indicate that affective attitudes can be significant predictors of healthy eating behaviour over prolonged time periods suggesting they may be useful targets for interventions designed to produce long-term change in eating behaviour.

Key words: cognitive attitude, affective attitude, healthy eating, attitude stability.

Cognitive and affective attitudes are identified as important determinants of behaviour in the Reasoned Action Approach (RAA; Fishbeing & Ajzen, 2010). Reviews of the RAA (e.g., McEachan et al., 2016) suggest that while cognitive attitude may indirectly influence behaviour via intention, affective attitude may both directly and indirectly (via intention) influence behaviour. However, the long-term effects of cognitive and affective attitudes on health behaviour has been little explored. This is particularly important for behaviours such as healthy eating (the focus here) because the health benefits of following a particular diet only occur after repeatedly performing the behaviour over prolonged periods of time (de Ridder et al., 2017). The present research focused on the relative power of cognitive and affective attitudes to predict engagement with health eating cross-sectionally and prospectively over periods of 4, 6 and 10 years and on how stability and change in cognitive and affective attitudes over time were associated with healthy eating behaviour and changes in healthy eating behaviour over time.

There is a long established distinction between instrumental/cognitive and experiential/affective attitudes (e.g., Abelson, Kinder, Peters, & Fiske, 1982; Trafimow & Sheeran, 1998). Cognitive attitude can be defined as the evaluation implied by cognitions about the attitude object (Chaiken & Baldwin, 1981), and is commonly assessed by semantic differentials items such as 'harmful-beneficial' or 'worthless-valuable' (Crites, Fabrigar, & Petty, 1982). Affective attitude can be defined as the evaluation implied by feelings (or emotions) about the attitude object (Chaiken, Pomerantz, & Giner-Sorolla, 1995), and is commonly assessed by items such as 'unpleasant-pleasant' or 'unenjoyable-enjoyable' (Crites et al., 1982). Fishbein and Ajzen (2010) include both types of attitude in their RAA (also see Ajzen & Fishbein, 2005; Conner & Sparks, 2005) as components of an overall attitude. In contrast, an increasing number of studies have explored cognitive and affective attitudes as independent predictors of behaviour (for review see Conner, 2018). For example,

Lawton, Conner, and McEachan (2009) looked at how single-item semantic differential measures of cognitive (harmful-beneficial) and affective (not enjoyable-enjoyable) attitudes predicted health behaviours assessed one month later. The study examined 14 health behaviours including both eating fruit and vegetables and a low fat diet. Comparisons of the simple correlations showed that compared to cognitive attitude, affective attitude was a stronger predictor of 13 out of 14 behaviours. Importantly, when both types of attitude were simultaneously entered into regression analyses, the beta weight for affective attitude was significant for all behaviours and significantly stronger than the beta weight for cognitive attitude for 9 out of 14 behaviours. A similar pattern of results was reported by Lawton, Conner, and Parker (2007) using multiple-item measures of cognitive and affective attitudes (based on behavioural beliefs), controlling for other TPB components (subjective norm and perceived behavioural control), and utlising objective measures of behaviour for exceeding the posted speed limit in a sample of adult drivers and smoking initiation in a sample of adolescents.

Meta-analyses of correlational studies have confirmed the importance of affective compared to cognitive attitudes in predicting health behaviours (Conner et al., 2015; McEachan et al., 2016). Conner et al. (2015) reviewed 16 studies and reported that affective compared to cognitive attitude was more strongly related to behaviour (affective attitude: r_+ = .27, k = 16; cognitive attitude: r_+ = .18, k = 16). However, only six of the reviewed studies examined effects over prolonged intervals ($\geq$ six months) and only one study looked at eating behaviours, reporting effects over a limited period of time (Richetin et al., 2010, Study 1, one week interval). McEachan et al. (2016), in a meta-analysis of RAA studies, reported the most comprehensive review to date. They reported that affective compared to cognitive attitude was more strongly related to behaviour (affective attitude: r_+ = .30, k = 47; cognitive attitude: r_+ = .20, k = 47). However, only six of the studies looked at dietary behaviours and none of

these studies looked at effects over periods greater than one month.

What is clear from the above review is that few, if any, studies have examined the impacts of cognitive and affective attitudes on eating behaviours across prolonged periods of time. As noted above, the principal effects of eating on health outcomes requires that the behaviour be performed repeatedly over considerable periods of time For example, the health benefits of eating plenty of fruit and vegetables or fibre rich foods, following a low fat diet, or even following the Mediterranean diet are only likely following long-term adherence (de Ridder et al., 2017). In order to produce positive health outcomes, the implication is that the most important variables are those that predict eating behaviours over prolonged periods of time. Moreover, these variables might then also be appropriate targets for interventions designed to produce long-term behaviour change and consequent improvement in health outcomes.

There are a number of reasons why affective compared to cognitive attitudes might be expected to be stronger predictors of behaviours such as healthy eating. First, frequently performed behaviours, such as healthy eating, may be more strongly influenced by implicit (or reflexive) influences and affective attitude may better capture such influences on behaviour. A number of influential dual process models contrast explicit versus implicit influences on behaviours. For example, the reflective-impulsive model (Strack & Deutsch, 2004) distinguishes between reflective or explicit influences on behaviour captured by models such as the RAA and impulsive or automatic influences on behaviour captured by measures such as the Implicit Associations Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Studies with eating behaviours (between meal snacking) have shown IAT measures to have incremental validity in predicting behaviour after controlling for explicit measures of cognitive attitude, but not after controlling for explicit measures of affective attitude (Ayres et al., 2012). Second, it may also be that affective attitude better takes account of habit as

another powerful influence on behaviours such as healthy eating that are frequently performed in stable contexts (Ouellette & Wood, 1998). In recent a multi-behaviour study, Conner (in preparation) showed that affective attitude mediated the impact of habit (tapped by a measure of frequency x stability of context) on behaviour (and cognitive attitude did not). Third, a cognitive attitude (e.g., harmful-beneficial) about healthy eating is more likely based on knowledge, while an affective attitude about healthy eating (e.g., not enjoyable-enjoyable) is more likely based on direct experience. Various classic studies in the attitude domain show attitudes based on direct experience to be more predictive of behaviour (e.g., Fazio & Zanna, 1978). Fourth, engaging in behaviour for an intrinsic value, such as the enjoyment of performing the behaviour (an affective reason), versus a more extrinsic value, such as gaining approval from others (a cognitive reason), may be key to long-term engagement. For example, self-determination theory (Hagger & Chatzisarantis, 2015) holds that intrinsic motivation (i.e., experienced as emanating from one's self *and* strongly linked to the intrinsic satisfaction or pleasure of performing the behaviour) may be key to long-term performance of behaviour. In line with this proposition, more autonomous/intrinsic motivations have been found to be predictive of long-term mainentance of physical activity (Teixeira et al., 2012), diabetic dietary self-care (Senécal et al., 2000), medication adherence (Williams et al., 1998), weight loss (Elsborg & Elbe, 2018), and smoking cessation (Williams et al., 2002). The meta-analysis of Ng et al. (2012) also found that intrinsic motivation was strongly related to engaging in healthy eating ($r_+ = .41$).

The primary focus of the current research was to explore the power of cognitive and affective attitudes to predict behaviour over prolonged time delays. An additional focus was to examine stability and change in cognitive and affective attitudes over time due to their links to the potential mechanisms underlying the impact of attitudes on behaviour. Two mechanisms are assumed to determine how attitude influences behaviour: prediction and

influence (Fabrigar, MacDonald, & Wegener, 2005). The prediction mechanism refers to the idea that an attitude assessed at one time point is only likely to predict behaviour at a later time point if it persists over the intervening time interval (Ajzen & Fishbein, 1980; Schwartz, 1978), i.e., the attitude remains the same up to the point at which a decision to perform the behaviour or not is formed. Strong attitudes are assumed to be more stable over time and, partly as a consequence, more predictive of behaviour (Krosnick & Petty, 1995). In contrast, the influence mechanism refers to the idea that attitudes influence our behaviour in part by shaping our perceptions of the world (Fazio, 1986, 1995). That is, the capacity of an attitude to predict behaviour is partly dependent on the attitude's ability to consistently bias perceptions of the attitude object and the context in which the behaviour is performed when deciding whether to perform a behaviour. The influence mechanism suggests that strong attitudes may be perceived as more relevant when deciding whether to perform a behaviour (Fabrigar et al., 2005). As a result, strong attitudes may be more readily accessible at the point of decision and therefore more predictive of behaviour

In relation to the prediction mechanism, the current research tested whether the temporal stability of cognitive and affective attitude moderated the relationship between cognitive and affective attitudes and subsequent behaviour. Measures of cognitive and affective attitude were taken at two time points (T1 and T2) and behaviour at three time points (T1, T2, and T3). This enabled us to test three versions of this moderation effect for the stability of cognitive and affective attitude over time (T1 to T2; 6 year interval); that is, did stability moderate the impact of cognitive and affective attitudes at T1 on (i) behaviour at T2 (i.e., over a 6 year interval) and (ii) behaviour at T3 (i.e., over a 10 year interval), and (iii) the impact of cognitive and affective attitudes at T2 on behaviour at T3 (i.e., over a 4 year interval)? The first test is most directly consistent with the prediction mechanism (i.e., attitude is more predictive to the extent that it stays the same up until the time at which

behaviour is measured, T1-T2), but might be more open to methodological consistency biases attributable to measuring attitude and behaviour at the same time (T2). The second and third tests are less directly consistent with the prediction mechanism, but partly remove this potential source of bias given that behaviour is assessed at a later time point to the attitude measures; however, to be consistent with the prediction mechanism, these tests assume that attitude stability (assessed between T1-T2) remains constant when predicting behaviour over the extended time peiods (T1-T3 and T2-T3). In the health domain, a number of studies have examined the temporal stability of intentions as a moderator of the intention-behaviour relationship using designs similar to our first (e.g., Conner & Godin, 2007) and particularly third (e.g., Conner, Norman, & Bell, 2002; Conner, Sheeran, Norman, & Armitage, 2000; Sheeran & Abraham, 2003) tests. Two published studies have reported temporal stability to moderate the overall attitude-behaviour relationship for oral contraception use (Davidson & Jaccard, 1979) and volunteering (Schwartz, 1978).

More related to the influence mechanism, the current research also tested whether changes in cognitive or affective attitudes over time covaried with changes in healthy eating behaviour over time (i.e., as attitude becomes more positive then does healthy eating become more likely?). Change in attitude and behaviour over time might be expected to show stronger covariation when the attitude is consistently biasing perceptions of the behaviour or perceived to be relevant to the behaviour over time. Given our arguments about why affective compared to cognitive attitudes may be stronger predictors of healthy eating behaviour, we also predicted that *changes* in affective compared to cognitive attitudes over time would be more predictive of *changes* of healthy eating over the same time period. In the current study, our measures of cognitive and affective attitude (at T1 and T2) and behaviour (at T1, T2, and T3) enabled us to test two versions of this prediction. First, did change in cognitive and affective attitude over time (T1 to T2) predict change in behaviour over exactly

the same time period (T1 to T2)? This would represent a test of the fully concurrent change in predictors with change in outcome. Second, did change in cognitive and affective attitude over time (T1 to T2) predict change in behaviour over an overlapping, but longer time period (T1 to T3)? This would represent a test of the partially concurrent change in predictors with change in outcome.

To summarise, the present research tested whether cognitive and affective attitudes were predictive of healthy eating both cross-sectionally and prospectively for periods up to 10 years and so might be useful targets for interventions to produce long-term change in healthy eating that might have health consequences. In line with the prediction and influence mechanisms for how attitude influences behaviour, the present research also examined whether stability moderated relationships between cognitive and affective attitude and later healthy eating behaviour and whether change in cognitive and affective attitude over time was predictive of change in healthy eating behaviour over time. These tests were achieved by using data from a previously published study (Conner et al., 2002), whch focused on predicting healthy eating behaviour over a six year period using theory of planned behaviour (Ajzen, 1991) variables but without distinguishing between affective and cognitive attitudes. The present study used these data (T1 and T2) plus additional behaviour data collected from the same sample at ten year follow-up (T3). The study therefore includes measures of cognitive and affective attitude taken at baseline (T1) and then six years later (T2) plus measures of healthy eating taken at baseline (T1) and then six (T2) and ten (3) years later. Based on the arguments presented earlier it was hypothesised that affective compared to cognitive attitude would be stronger predictors of behaviour both cross-sectionally and prospectively. It was also hypothesised that stability of cognitive and affective attitude would moderate the impact of these attitudes on later behaviour (in all comparisons) and that changes in affective compared to cognitive attitude would be stronger predictors of changes

in behaviour over fully and partially overlapping time periods.

Method

Respondents

Patients attending health promotion clinics at their General Practice were recruited into the study by practice staff. The clinics focused on a range of health-related behaviours (e.g., exercise, alcohol, smoking) including eating behaviours. Those identified as needing to eat a more healthy diet and not experiencing any diet-related illnesses were given information on the benefits of healthy eating and advised to attempt to change their diet. Healthy eating was defined in terms of low dietary fat consumption, high dietary fibre consumption, and high fruit and vegetable consumption. Recommendations on each of these three aspects of healthy eating were provided to patients. The health promotion clinics were brief, low technology, interventions typically lasting 30 minutes. The majority of the clinics were run by practice nurses, although a few were run by general practitioners. At the end of the clinic, patients were given a questionnaire (T1) by the practice nurse or general practitioner to complete after their clinic appointment. Pre-paid return envelopes were included so that patients could post their questionnaires directly to the researchers. T1 questionnaires were received from 285 patients (out of approximately 350 distributed). Six years (T2) and ten years (T3) later these patients were sent further questionnaires to complete and return using a pre-paid envelope. Questionnaires were received from 135 T2 and 67 T3 patients. T1 data was collected in 1994.

The T1 sample had a mean age of 46.8 years (SD = 13.7). However, the sample was biased in terms of the number of women (N = 222) compared to men (N = 59) (4 missing values). In order to test for attrition biases, we compared responses on T1 and T2 measures of cognitive and affective attitude, and behaviour. For T1 measures we compared those completing only T1 measures versus those completing both T1 and T2 measures or both T1

and T3 measures. For T2 measures we compared those completing only T2 measures versus those completing both T2 and T3 measures. Analyses revealed no significant differences for cognitive attitude at T1 (T1 only versus T1 and T2: $F(1,254) = 0.46$, $p = .50$; T1 only versus T1 and T3: $F(1,254) = 0.41$, $p = .53$) or at T2 (T2 only versus T2 and T3: $F(1,138) = 2.63$, $p = .11$); affective attitude at T1 (T1 only versus T1 and T2: $F(1,251) = 0.15$, $p = .70$; T1 only versus T1 and T3: $F(1,251) = 1.28$, $p = .26$) or at T2 (T2 only versus T2 and T3: $F(1,136) = 0.88$, $p = .35$); or behaviour at T1 (T1 only versus T1 and T2: $F(1,279) = 0.65$, $p = .42$; T1 only versus T1 and T3: $F(1,279) = 0.3.54$, $p = .06$) or Time 2 (T2 only versus T2 and T3: $F(1,144) = 0.68$, $p = .41$). There were also no significant differences by age (T1 only versus T1 and T2: $F(1,277) = 0.33$, $p = .57$; T1 only versus T1 and T3: $F(1,277) = 1.09$, $p = .30$). For gender there was no effect for T1 only versus T1 and T2 ($\chi^2(1) = 3.65$, $p = .06$) but a significant effect for T1 only versus T1 and T3 ($\chi^2(1) = 6.75$, $p = .009$). This latter difference was attributable to more women than men being retained.

Measures

Gender was assessed as male or female. *Age* was assessed in years.

Cognitive attitude was assessed as the mean of two semantic differential scales at T1 and T2 ('My eating a healthy diet would be/is...', harmful-beneficial, foolish-wise; scored 1-7). The correlation between items was .71 and .71 for T1 and T2 respectively. *Affective attitude* was assessed as the mean of two semantic differential scales at T1 and T2 ('My eating a healthy diet would be/is...', unpleasant-pleasant, unenjoyable-enjoyable; scored 1-7). The correlation between items was .81 and .67 for T1 and T2 respectively.

Stability of cognitive attitude (T1-T2) was assessed as the absolute difference between cognitive attitude scores at T1 and T2 (scored as stability of cognitive attitude = 6 – absolute [cognitive attitude T1 – cognitive attitude T2]; higher scores indicate greater cognitive attitude stability, range 0-6). *Stability of affective attitude* (T1-T2) was assessed as the absolute

difference between affective attitude scores at T1 and T2 (scored as stability of affective attitude = 6 – absolute [affective attitude T1 – affective attitude T2]; higher scores indicate greater affective attitude stability, range 0-6).

Change of cognitive attitude (T1-T2) was computed as the unstandardized residual from regressing cognitive attitude at T2 onto cognitive attitude at T1. *Change of affective attitude* (T1-T2) was computed as the unstandardized residual from regressing affective attitude at T2 onto affective attitude at T1. See Lowe et al. (2008) for a similar approach using difference scores based on measures of the same construct taken at different time points to explore concurrent change in variables.

Behaviour at each time point (T1, T2, T3) was assessed using a 33-item food frequency questionnaire (FFQ). The items of food were commonly consumed food categories that were arranged in terms of food groups. These were: dairy products; meats and fish; bread and cereals; fruit and vegetables; desserts and snacks. Each food was rated on the frequency it was eaten, on a scale with six categories: '2 or more times a day'; 'every day'; '3-5 times a week'; '1-2 times a week'; '1-3 times a month'; and 'rarely/never'. This measure was a slightly adapted version of the FFQ developed by Cade and Margetts (1988). Margetts, Cade, and Osmond (1989) demonstrated the FFQ to be valid against 24-hour dietary records in a UK sample of 433 men and women: the two measures gave similar estimates of fat (Spearman's *rho* = .36, $p < .001$) and fibre (Spearman's *rho* = .26, $p < .001$; no value for fruit and vegetables reported) intake. Using the FFQ measure, standard portion size data and nutritional data we were able to compute measures of *percentage fat intake* (i.e., percentage of calories derived from all fat in the diet; T1: $M = 34.9$, $SD = 6.45$), *fibre intake* (i.e., grams of fibre consumed per day; T1: $M = 9.65$, $SD = 3.40$), and *fruit/vegetable intake* (i.e., portions of fruit and vegetables consumed per day; T1: $M = 4.23$, $SD = .96$). To compute an overall measure of *healthy eating behaviour*, each of the three measures was standardized and a

mean computed (after multiplying the percentage calories from fat measure by –1). The mean score was significantly correlated with each of the standardised variables used to compute it (*r*s = .89, .61, .53 [T1]; *r*s = .69, .78, .82 [T2]; *r*s = .75, .85, .77 [T3]; all *p*s < .01 for fat, fibre, and fruit and vegetable measures respectively).

Change of behaviour (T1-T2) was computed as the unstandardized residual from regressing behaviour at T2 onto behaviour at T1. *Change of behaviour* (T1-T3) was computed as the unstandardized residual from regressing behaviour at T3 onto behaviour at T1.

Analyses

We used multiple imputation in SPSS to replace individual missing values for cognitive attitude and affective attitude at T1 and T2 and for behaviour at T1, T2 and T3. A total of 10 imputed datasets were generated using available measures of cognitive and affective attitude, behaviour, age and gender. All analyses used the pooled function in SPSS to report average effects across the 10 imputed datasets. First, we computed descriptives (*M* and *SD*) on the measured variables and examined change over time in cognitive and affective attitude using repeated measures ANOVA. Second, we examined the correlations between cognitive and affective attitudes (T1 and T2) and behaviour (T1, T2, and T3) to give two cross-sectional comparisons (at T1 and T2) and three prospective comparisons (T1 to T2, a 6 year interval; T2 to T3, a four year interval; T1 to T3, a ten year interval). Third, we used multiple regression analysis to explore the simultaneous impact of cognitive and affective attitudes on behaviour measured cross-sectionally (at T1 and T2) and prospectively (T1 to T2; T2 to T3; T1 to T3). Fourth, we examined the stability of cognitive and affective attitude as moderators of the relationship between cognitive and affective attitude and behaviour. Moderated regression analysis used cognitive and affective attitude and stability plus the interaction between the attitude and stability measures to predict behaviour. Three analyses were conducted each using the cognitive and affective stability measures computed based on using T1 and T2 measures:

predicting behaviour at T2 from cognitive and affective attitude at T1 plus stability; predicting behaviour at T3 from cognitive and affective attitude at T1 plus stability; predicting behaviour at T3 from cognitive and affective attitude at T2 plus stability. This analysis used mean-centred variables to avoid problems of multi-collinearity and simple slope analyses to explore any significant interactions between attitude and stability measures (Aiken & West, 1991). Fifth, and finally, we used multiple regression analyses to examine how changes in cognitive and affective attitude between T1 and T2 were related to changes in behaviour between T1 and T2 and changes in behaviour between T1 and T3.

Results

Table 1 reports means and standard deviations for the measured variables at each time point. All variables had reasonable variance and were not be unduly skewed. Both cognitive and affective attitude became less positive towards healthy eating between T1 and T2. Repeated measures t-tests indicated this change to be significant for cognitive attitude ($t(284) = 7.62$, $p < .001$) but not for affective attitude ($t(284) = 1.55$, $p = .12$). Cognitive and affective attitudes were generally moderately to strongly inter-correlated at Time 1 ($r = .46$, $p < .001$) and Time 2 ($r = .61$, $p < .001$).

Table 1 also reports the correlations between cognitive and affective attitudes and behaviour at all time points. All correlations were positive. However, in both cross-sectional comparisons (at T1 and T2) and longitudinal comparisons (T1 to T2, T1 to T3, T2 to T3) affective attitudes were stronger correlates of behaviour than cognitive attitudes. T1 cognitive attitudes were not significantly correlated with behaviour at any time point, while T2 cognitive attitudes were significantly correlated with behaviour at T2 and T3. Affective attitudes (T1 and T2) were significantly correlated with behaviour at all time points (T1, T2, T3) (Table 1).

Table 2 (first two panels) reports the results of the regressions to predict healthy eating behaviour from cognitive and affective attitudes plus the model fit statistics (adjusted R^2 and F test). The regression results reflect the pattern of findings observed in the zero order correlations (Table 1), that is, cognitive attitude was a non-significant predictor whereas affective attitude was a significant positive predictor of behaviour for each cross-sectional (T1 and T2) and longitudinal (T1 to T2: six years; T2 to T3: four years; T1 to T3: ten years) set of analyses (Table 2). The significant negative effect for cognitive attitude on behaviour in the cross-sectional analyses at T1 (Table 2, panel one) was likely to be a suppressor effect given that the simple correlation (Table 1) between the two variables was non-significant and positive.

Stability of cognitive (M = 4.48, SD = 1.47) and affective (M = 4.58, SD = 1.20) attitude between T1 and T2 (6 year period) was similar ($t(284) = 0.96$, $p = .34$). Table 2 (panels three and four) reports the tests of stability of cognitive and affect attitude as moderators of attitude-behaviour relationships using moderated regression analyses. In the analyses predicting behaviour at T2 and T3 from attitudes at T1 the effects of both cognitive and affective attitude on behaviour were significantly moderated by stability, in addition to affective attitude being a significant predictor (Table 2, panel three). This was not the case in the analyses predicting behaviour at T3 from attitudes at T2, although affective attitude was significant in this regression (Table 2, panel four). Simple slopes analyses was used to explore the significant interactions and controlled for the effects of other predictors in each analysis (e.g., controlling for affective attitude, stability of affective attiude and the interaction between affective attitude and stability when exploring the effects of cognitive attitude). These analyses revealed similar patterns in relation to predicting behaviour at T2 and T3 from attitude measures at T1 (Table 2, panel three). As the stability of cognitive attitude increased so the power of cognitive attitude to predict behaviour increased from low

(*M* – 1*SD*: predicting behaviour at T2, *B* = -.050, *SE* = .062, *p* = .424; predicting behaviour at T3, *B* = -.052, *SE* = .097, *p* = .599), medium (*M*: predicting behaviour at T2, *B* = .053, *SE* = .069, *p* = .444; predicting behaviour at T3, *B* = .073, *SE* = .093, *p* = .436) to high (*M* + 1*SD*: predicting behaviour at T2, *B* = .163, *SE* = .096, *p* = .088; predicting behaviour at T3, *B* = .203, *SE* = .108, *p* = .063) levels of stability, although cognitive attitude was not a significant predictor of behaviour in any of these simple slope analyses. Similarly, as the stability of affective attitude increased so the power of affective attitude to predict behaviour increased. It was a non-significant predictor at low (*M* – 1*SD*: predicting behaviour at T2, *B* = .079, *SE* = .053, *p* = .139; predicting behaviour at T3, *B* = .024, *SE* = .071, *p* = .739), but a significant predictor at medium (*M*: predicting behaviour at T2, *B* = .172, *SE* = .051, *p* = .001; predicting behaviour at T3, *B* = .157, *SE* = .055, *p* = .005) and high (*M* + 1*SD*: predicting behaviour at T2, *B* = .272, *SE* = .072, *p* < .001; predicting behaviour at T3, *B* = .294, *SE* = .077, *p* < .001) levels of stability.

Table 3 reports the tests of how changes in cognitive and affective attitude related to changes in behaviour plus the model fit statistics (adjusted R^2 and *F* test). This revealed that changes in affective attitude (T1 to T2) was a significant predictor, while changes in cognitive attitude (T1 to T2) was not a significant predictor, of changes in behaviour for the same time period (T1 to T2 change) and for a longer and partially overlapping time period (T1 to T3 change) (Table 3).

Discussion

The current findings add to previous research that has highlighted the importance of affective compared to cognitive attitudes in predicting health behaviour (Conner et al., 2015; McEachan et al., 2016), in line with predictions. Importantly the findings demonstrate that affective attitude predicted healthy eating behaviour both cross-sectionally and longitudinally for time periods of four, six and ten years. Previous research (see Conner et al., 2015;

McEachan et al., 2016) had only shown such effects for affective attitude on eating behaviours for intervals up to one month. The present research showed that such effects extend to four, six and even ten years. This is consistent with effects for affective attitudes on behaviour over prolonged time intervals ($\geq$ six months) for other health behaviours such as smoking initiation (Conner et al., 2006), speeding (Elliot & Thompson, 2010), breast self-examination (Lechner, de Nooijer, & de Vries, 2004), and condom use (Schutz et al., 2011) and also to less frequently performed behaviours such as blood donation (Conner et al., 2013), and organ donation consent (Godin et al., 2008).

These findings highlight the potential of affective over cognitive attitudes as targets for interventions to change health behaviours such as healthy eating. A number of experimental studies have shown the value of targeting affective attitude as a means to change physical activity (e.g., Conner et al., 2011; Parrott et al., 2008; Sirriyeh, Lawton, & ward, 2010). A more limited number of studies have targeted affective attitude in relation to changing eating behaviours. For example, Carfora et al. (2016) showed that daily affective text messages significantly increased self-reported fruit and vegetable consumption in a sample of adolescents. Mediation analyses indicated the effects to be explained by changes in affective attitude. In addition, the affective text messages were found to be more effective than similar cognitive text messages. However, these effects need to be replicated using objectively measured behaviour. For example, Walsh and Kiviniemi (2014) manipulated affective reactions to fruit using an implicit priming task and showed that it resulted in significantly more choices of fruit in an objective task, although behaviour was assessed very soon after the priming task.

It may be the case that affective attitude is particularly important in relation to eating behaviours because of the widely recognized affective component to eating. Lawton et al. (2009) used Russell's (2003) theory of emotion to argue that the influence of affective

attitude will be strongest for those behaviours like eating that have a more immediate impact on the senses or physiological state and weakest amongst behaviours where the impact is less immediate (e.g., screening). Russell (2003) proposed that affective qualities are attributed to behaviours as a result of experiencing the emotion when enacting the behaviour and that this guides action. In relation to eating, this would suggest that the positive or negative emotions experienced during eating may drive the formation of an affective attitude that subsequently drive behaviour. In the introduction we also suggested that affective compared to cognitive attitudes may better reflect the automatic influences on frequently performed behaviours such as eating, including the role of habit. However, the effects of affective attitude on the long-term performance of less frequently performed behaviours (blood donation: Conner et al., 2013; organ donation consent: Godin et al., 2008) suggest this may not be the only explanation.

The current work also confirmed predictions that the stability of cognitive and affective attitudes moderates their impact on subsequent behaviour, i.e., more stable attitudes were more predictive of behaviour. This is consistent with the prediction mechanism through which attitudes are assumed to determine behaviour (Fabrigar et al., 2005). However, in the current research, when controlling for other predictors, cognitive attitude was not a significant predictor of behaviour at any level of stability examined, while affective attitude was a stronger and significant predictor only at moderate and high levels of stability. In addition, significant moderation effects were only found when the period over which stability was assessed (T1-T2) corresponded to the full (T1-T2) or partial (T1-T3) time period over which the attitude-behaviour relationship was assessed. No moderation effects were found when stability was assessed over a time period (T1-T2) different from that over which the attitude-behaviour relationship was assessed (T2-T3). Although it might be argued that the latter test is less consistent with the prediction mechanism, it has been the preferred test of

stability as a moderator in relation to the intention-behaviour relationship (Sheeran & Abraham, 2003) because it reduces consistency biases between the predictor and the dependent variable. Future research might usefully further assess the moderating effects of attitude stability, either for cognitive and affective attitude as explored here or in relation to overall attitude as explored in other studies (Davidson & Jaccard, 1979; Schwartz, 1978), when assessed over time periods (e.g., T1 to T2) completely distinct from those over which the attitude-behaviour relationsip is assessed (e.g., T3 to T4).

Finally, in line with predictions, it was also found that change in affective attitude but not cognitive attitude was predictive of change in health eating behaviour, i.e., affective attitude and behaviour track one another over time more than cognitive attitude and behaviour. This effect was apparent when both attitudes and behaviour change were assessed over the same time period (T1 to T2) and when they were assessed over a partially overlapping time period (T1 to T2 for attitude change, T1 to T3 for behaviour change). This overlap in change of affective attitude and change in healthy eating over time could partially explain the long-term effects of one on the other. It does not definitively address the direction of causation, although the fact that change in affective attitude over one time period was predictive of behaviour change of an overlapping but longer time period is supportive of the idea that it is affective attitude determining behaviour. This would be consistent with the influence mechanism through which attitudes are assumed to determine behaviour (Fabrigar et al., 2005).

There are a number of strengths and weaknesses to the present research. In relation to strengths, the study focused on a general population sample, examined behaviour at various time intervals up to ten years (an unusually long period of time for research of this nature), used measures of temporal stability as well as change values (i.e., residuals) to examine the impact of temporal variation on attitude-behavour relations, and used an intention-to-treat

approach to the main analyses predicting behaviour. There are also a number of weaknesses. First, the sample studied was self-selective in terms of respondents only being those who had agreed to attend a health promotion clinic and had received an intervention. This may have resulted in a sample with an overall higher degree of motivation and less overall variability in motivation to engage in healthy eating. However, this might have been expected to simply weaken the observed relationships. In addition, the sample over-represented women. Previous research has found women to place greater value on their health and to be more likely to engage in health-protective behaviours compared to men (e.g., Liang, et al., 1999). Caution is, therefore, warranted in making generalizations. Second, the focus on self-reported behaviour may have opened the research to consistency biases, although the food frequency questionaire employed was well validated. Nonetheless, the findings would be strengthened by more objective behavioural measures such as observation of eating behaviour, validation by significant others, bodily composition data or physiological data. Third, there was no strong logic to assessing effects at 6 and 10 years post baseline allowing tests of effects over 4, 6 and 10 years. Maintaining healthy eating over periods as long as 10 years might be expected to have some impacts on health outcomes, although even longer time periods may be necessary for effects that translate into increases in longevity. Fourth, it is worth noting that we examined the effects of cognitive and affective attitudes on behaviour in isolation from other key predictors. We did not examine the impact of various other known predictors of health behaviour including individual (e.g., social norms and self-efficacy) and contextual (e.g., physical and social environment, family composition) factors. It may be that controlling these factors reduces the effects of affective attitude on behaviours such as healthy eating.

The present research also suggests that there may be value in further research examining affective attitudes both as a determinant of health behaviours and as a means to

change such behaviours. In relation to the former, studies attempting to replicate the current findings and exploring other effects of affective attitude appear waranted. For example, recent research has highlighted the inconsistency between cognitive and affective attitudes as a moderator of the overall attitude-behaviour relationship (Conner, Wilding, van Harreveld, & Dalege, in press). In relation to the latter, testing further interventions that target affective attitudes (e.g., helping individuals to enjoy healthy behaviours) either on their own or as part of broader interventions appear waranted.

Conclusions

In conclusion, the present research demonstrates that affective compared to cognitive attitudes have significant effects on long-term performance of healthy eating behaviours. In addition, stability of cognitive and affective attitude was shown to moderate their relationships with behaviour in some analyses and change in affective but not cognitive attitude was shown to map on to change in healthy eating behaviour. The present findings therefore suggest that affective attitude might represent a useful target for interventions designed to change eating behaviours in order to promote positive health outcomes. In contrast, cognitive attitude was not predictive of healthy eating behaviour suggesting lower potential efficacy as a target for interventions designed to change behaviour.

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Table 1.

Descriptives (Mean and SD) and zero-order correlations for cognitive attitude, affective attitude and behaviour (N = 285).

	Behaviour (T1)	Behaviour (T2)	Behaviour (T3)	Mean (SD)
Cognitive Attitude (T1)	0.01	0.05	0.06	2.30 (1.29)
Affective Attitude (T1)	0.24***	0.20**	0.18*	1.08 (1.59)
Cognitive Attitude (T2)	-	0.31***	0.44**	1.73 (1.60)
Affective Attitude (T2)	-	0.40***	0.51***	0.95 (1.59)
Mean (SD)	-0.10 (1.00)	-0.35 (0.94)	-0.53 (1.17)	

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2.

Regressions of behaviour onto cognitive attitude and affective attitude plus stability measures and interactions (N = 285).

	Behaviour (T1)			Behaviour (T2)			Behaviour (T3)		
	B	SE	Beta	B	SE	Beta	B	SE	Beta
T1 Predictors									
Cognitive Attitude (T1)	-0.103	0.052	-0.135*	-0.041	0.056	-0.056	-0.025	0.088	-0.028
Affective Attitude (T1)	0.193	0.045	0.311***	0.150	0.046	0.254***	0.136	0.059	0.185*
T2 Predictors									
Cognitive Attitude (T2)	-	-	-	0.071	0.075	0.121	0.153	0.101	0.209
Affective Attitude (T2)	-	-	-	0.235	0.063	0.398***	0.278	0.087	0.378**
T1 Predictors Plus T1-T2 Stability									
Cognitive Attitude (T1)	-	-	-	0.053	0.069	0.073	0.073	0.093	0.080
Affective Attitude (T1)	-	-	-	0.172	0.051	0.291***	0.157	0.055	0.213**
Stability of Cognitive Attitude (T1-T2)	-	-	-	-0.068	0.089	-0.107	-0.033	0.091	-0.041
Stability of Affective Attitude (T1-T2)	-	-	-	-0.067	0.077	-0.086	-0.045	0.088	-0.046
Cognitive Attitude (T1) x Stability	-	-	-	0.067	0.030	0.294*	0.083	0.032	0.292*
Affective Attitude (T1) x Stability	-	-	-	0.076	0.030	0.227*	0.110	0.040	0.262**
T2 Predictors Plus T1-T2 Stability									
Cognitive Attitude (T2)	-	-	-	-	-	-	0.262	0.128	0.358
Affective Attitude (T2)	-	-	-	-	-	-	0.264	0.086	0.359**
Stability of Cognitive Attitude (T1-T2)	-	-	-	-	-	-	-0.077	0.080	-0.097
Stability of Affective Attitude (T1-T2)	-	-	-	-	-	-	-0.029	0.079	-0.030
Cognitive Attitude (T2) x Stability	-	-	-	-	-	-	0.045	0.038	0.131
Affective Attitude (T2) x Stability	-	-	-	-	-	-	0.023	0.043	0.044

Note. For predictions of Behaviour (T1): from T1 Predictors, *adjusted* R^2 = .067, $F(2,282) = 11.33$, $p < .001$. For predictions of Behaviour (T2): from T1 predictors, *adjusted* R^2 = .038, $F(2,282) = 6.54$, $p = .005$; from T2 predictors, *adjusted* R^2 = .167, $F(2,282) = 29.84$, $p < .001$; from T1 predictors plus T1-T2 Stability, Δ*adjusted* R^2 = .092, $\Delta F(4,278) = 7.49$, $p < .001$. For predictions of Behaviour (T3): from T1 predictors, *adjusted* R^2 = .031, $F(2,282) = 5.60$, $p = .004$; from T2 predictors, *adjusted* R^2 = .290, $F(2,282) = 66.27$, $p < .001$; from T1 predictors plus T1-T2 Stability, Δ*adjusted* R^2 = .173, $\Delta F(4,278) = 15.50$, $p < .001$; from T2 predictors plus T1-T2 Stability, Δ*adjusted* R^2 = .023, $\Delta F(4,278) = 2.28$, $p = .061$. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3.

Regressions of change of behaviour(T1-T2 and T1-T3) onto change of cognitive attitude and affective attitude (T1-T2; N = 285).

	Change of Behaviour (T1-T2)			Change of Behaviour (T1-T3)		
	B	SE	Beta	B	SE	Beta
Change of Cognitive Attitude (T1-T2)	0.093	0.069	0.107	0.164	0.101	0.330
Change of Affective Attitude (T1-T2)	0.162	0.063	0.256*	0.222	0.095	0.444*

Note. For predictions of Change of Behaviour (T1-T2): from T1-T2 Predictors, *adjusted* R^2 = .108, $F(2,282) = 18.40$, $p < .001$. For predictions of Change of Behaviour (T1-T3): from T1-T2 Predictors, *adjusted* R^2 = .239, $F(2,282) = 47.15$, $p < .001$. * $p < .05$, ** $p < .01$, *** $p < .001$.