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Abstract

The theory of planned behaviour (TPB, Ajzen, 1991) has been used extensively to predict social and health behaviours. However, a critical test of the TPB is whether interventions that increased scores on the theory's predictors would engender behaviour change. The present research deployed a novel technique in order to provide this test. Statistical simulations were conducted on data for 30 behaviours ($N = 211$) that estimated the impact of interventions that generated maximum positive changes in attitudes, subjective norms, and perceived behavioural control on subsequent intentions and behaviour. Findings indicated that interventions that maximized TPB variables had a substantial impact on behavioural intentions. Although TPB maximization increased the proportion of the sample that performed respective behaviours by 28% compared to baseline, the behaviour of a substantial minority of the sample (26%) did not change. The research also identified several interactions among TPB variables in predicting simulated intention and behaviour scores and investigated the mediating role of intentions in predicting behaviour.

Key words: Theory of Planned Behaviour, Intention, Behaviour Change, Simulation, Interventions

Simulating Behaviour Change Interventions Based on the Theory of Planned Behaviour:

Impacts on Intention and Action

The theory of reasoned action (TRA; Fishbein, 1980; Fishbein & Ajzen, 1975) and its extension, the theory of planned behaviour (TPB; Ajzen, 1991), have been used extensively to predict and understand social and health behaviours. The predictive validity of these theories is supported by numerous meta-analyses of correlational research (e.g., Armitage & Conner, 2001; Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002; Sheeran, 2002; Sheeran & Taylor, 1999; Sheppard, Hartwick, & Warshaw, 1988; Trafimow, Sheeran, Conner, & Finlay, 2002). Although these correlational tests are important, Fishbein (1993, p. xix) argued that: “[t]he ultimate test of the theory...lies in its capacity to guide behaviour change interventions.” However, intervention studies that have attempted to change TRA/TPB variables do not yet indicate whether the theories provide a useful basis for behaviour change efforts. This is because these experiments often have non-significant or small impacts on relevant predictors (see Hardeman, Johnston, Johnston, Bonetti, Wareham, & Kinmouth, 2002 for a review), and thus demonstrate only that it can be hard to change people’s cognitions. An alternative, potentially informative test of the theoretical structure of the TPB and its capacity to guide behaviour change interventions would be afforded by estimating how much change in intention and behaviour would be generated if participants’ scores on the theory’s predictors were maximized. The present research aims to provide such a test, by deploying statistical simulations on a dataset involving 30 behaviours.

The Theories of Reasoned Action and Planned Behaviour

The TRA and TPB both assume that the most immediate and important predictor of behaviour is the person’s decision or *intention* to act (e.g., “I intend to exercise in the next week”). The theories also assume that people’s evaluations of the behaviour (*attitude*; e.g., “For me to exercise in the next week would be good/bad”) and their perceptions of social pressure to perform the behaviour (*subjective norm*; e.g., “Most people who are important to me think that I

should exercise in the next week”) are key determinants of intention. The TPB postulates an additional predictor of intention and behaviour, namely, *perceived behavioural control* (PBC). PBC refers to people’s appraisals of their ability to perform a behaviour (e.g., “For me to exercise in the next week would be easy/difficult”) and is closely related to the Bandura’s (1997) concept of self-efficacy. Thus, the TPB proposes that the more positive people’s attitudes and subjective norms, and the greater their PBC, the stronger are their intentions to perform the behaviour. Similarly, the stronger people’s intentions, the more likely they are to perform the behaviour. The TPB suggests that PBC may also predict behaviour (after intention has been taken account) when perceptions of control accurately reflect the amount of actual control over the behaviour (Ajzen & Madden, 1986; Sheeran, Trafimow, & Armitage, 2003).

The TPB has an expectancy-value structure and supposes that attitudes, subjective norms, and PBC are each derived from the summation of particular sets of beliefs weighted by relevant value components. Thus, attitudes are determined by beliefs about the likely outcomes of performing the behaviour (*behavioural beliefs*; e.g., “It is likely/unlikely that I will feel tired if I exercise in the next week”) multiplied by evaluations of those outcomes (*outcome evaluations*; e.g., “Feeling tired is good/bad”). Subjective norms are determined by beliefs about the extent to which important others want the person to perform a behaviour (*normative beliefs*; e.g., “My friends think that I should/should not exercise in the next week”) multiplied by *motivation to comply* with those people’s views (e.g., “I generally want to do what my friends think I should do”). Finally, PBC is determined by beliefs concerning the factors that may inhibit or facilitate performance of the behaviour multiplied by the perceived power of these factors (*control beliefs*; e.g., “For me to exercise in the next week requires time”, and *power*, e.g., “Having time increases my likelihood of exercising in the next week”). According to the TPB, efforts to change behaviour need to target behavioural, normative, and control beliefs and/or their respective value components. Belief and value changes should be reflected in more positive attitudes, subjective norm, and PBC that in turn enhance behavioural intentions, and thereby increase the likelihood of

behaviour. According to Ajzen (1991), the TPB is a “sufficient” account of behaviour; that is, variables not specified by the theory should only affect behaviour through their impact on the theory’s key predictors (attitude, subjective norm, and PBC).¹

The TPB as a Basis for Behaviour Change Interventions

Meta-analyses of correlational tests indicate that attitude, subjective norm, and PBC typically account for 30-50% of the variance in intentions, and that intentions and PBC account for 20-30% of the variance in behaviour (e.g., Armitage & Conner, 2001; Hagger et al., 2002; Sheeran, 2002; Sheeran & Taylor, 1999; Sheppard et al., 1988; Trafimow et al., 2002). Attitude typically has the strongest beta weight in predicting intention, followed by PBC and then subjective norm. Intention is a much stronger predictor of behaviour compared to PBC. Although examination of standardized regression weights (betas) and R^2 values can prove helpful in identifying what variables should be targeted by interventions (see Sutton, 2002, for a discussion of limitations to this approach), these values say relatively little about how much impact an intervention is likely to have in changing either intentions or behaviours. Regression weights have little intuitive meaning, and coupled with the fact that regression models generally account for moderate proportions of variance in outcomes, it is difficult to anticipate the likely effectiveness of interventions on the basis of these values.

An alternative approach to estimating the potential impact of interventions that target TPB variables would be to conduct controlled experiments where variables are carefully manipulated and their impact on outcomes is assessed. This approach has been advocated by Sutton (2002) and has the virtue of permitting direct tests of the TPB’s causal assumptions. Experimental tests are, of course, the optimal strategy. However, there are two problems with the kinds of experiments that have been conducted to date. The first relates to the consideration that the TPB is a model of behavioural prediction, and not a model of how specified predictors should be changed. That is, the TPB stipulates what variables should be manipulated in order to engender intention and behaviour change (i.e., attitude, subjective norm, and PBC) but the theory

is mute about what strategies should be used to change these predictors (e.g., persuasive communications vs. behavioural modeling vs. goal setting). This consideration is important because most interventions designed to change TPB variables are better construed as tests of cognition change strategies than as tests of the capacity of TPB variables to promote behaviour change. Second, “TPB-based” interventions rarely generate significant changes in attitude, subjective norm, and PBC (Hardeman et al., 2002), and thus do not permit inferences about potential impacts on intentions or behaviour that would accrue from generating *substantial* changes in the respective predictors (either individually or in combination).

One approach to these issues that has not (to our knowledge) been used in previous research is to deploy statistical simulations to estimate the likely impact on intentions or behaviour of maximum changes in each of the predictor variables specified by the TPB. Statistical simulations permit precise answers to questions about the anticipated effect of, e.g., increasing participants’ mean attitude toward a behaviour from 0.02 to 3.00 (on a -3 to +3 scale), on subsequent intention strength and the likelihood of performing the behaviour. Simulation approaches to attitudinal data were pioneered in the field of political science (e.g., Althaus, 1998; Bartels, 1996; Delli Carpini & Keeter, 1996; Gilens, 2001) where researchers wanted to assess the impact of political knowledge (or rather lack of knowledge) on attitudes and voting choices. Using regression-based procedures, respondents’ preferences (expressed in a public opinion survey) are adjusted to match the predicted preferences of a respondent who shares the same background characteristics but possesses the highest level of political information (usually assessed by a test). Comparing the sample’s observed scores on key outcome variables with the imputed values of a ‘fully informed’ but otherwise identical sample assesses the importance of political knowledge.

For instance, Althaus (1998) modeled the effect of having ‘full’ political information on 45 policy preferences covered in the 1988 and 1992 US National Election Studies surveys. On foreign policy issues the modelled ‘fully informed’ sample was, on average, 6.1% more “dovish”

and interventionist than was the real sample. They were less in favour of using military force to protect oil supplies and were less supportive of isolationist US foreign policies. On fiscal issues they were, on average, 11.6% more in favour of paying for services and deficit reduction, and on operative issues they were 9.2% on average more in favour of free market approaches and less government intervention. As can be imagined, where the imputed and observed percentages straddle the 50% mark, these effects imply a potentially important bias in referenda brought about by a lack of political sophistication among the electorate.

The Present Research

In the present research we use statistical simulations to estimate the impact of changing scores on TPB predictors (attitude, subjective norm, and PBC) on the strength of behavioural intentions and the likelihood of subsequent behavioural performance. Regression-based simulations are tested on data for 30 behaviours from a relatively large sample of participants ($N = 211$). For present purposes, we assume that the TPB specifies causal relations and that regression weights indicate the degree of causation (McClendon, 1994). The key question addressed by the present research is whether the TPB provides a sound theoretical basis for behaviour change interventions, i.e., how much change in intention and behaviour is engendered by maximum changes in participants' evaluations of the behaviour, perceptions of social pressure to perform it, and appraisals of control over the performance? In addition, we conduct a sensitivity analysis to assess the range of likely impacts arising out of changes of various magnitudes (i.e. conventionally 'small', 'medium' and 'large' effects) in each of the key constructs in the TPB.

The present research also affords an opportunity to test the structure of the TPB in three ways. First, the extent to which the theory is a "sufficient" account of intentions and behaviour — or requires extension or modification - can be determined by the extent to which maximizing TPB predictors generates the maximum possible values in intentions and behaviour. Second, the TPB assumes that intentions mediate the impact of attitude and subjective norm on behaviour,

whereas perceived behavioural control may have direct and/or indirect effects (Ajzen, 1988). The present research tests the mediation hypothesis by examining whether maximizing attitude, subjective norm, and PBC scores increases behavioural performance after intention scores have been maximised.

The third aspect of testing the structure of the TPB concerns the possibility that attitude, subjective norm, and PBC may have interactive rather than additive effects on intention and behaviour change. Eagly and Chaiken (1993) pointed out that tests of interactions between TPB variables are rare (see Conner & McMillan, 1999, for a notable exception). Three particular interactions that have been proposed in the literature (but rarely tested) will be examined here. The first is the contingent consistency hypothesis (e.g., Acock & deFleur, 1972; DeFleur & Westie, 1958; Grube & Morgan, 1990; Rabow, Neuman, & Hernandez, 1987). Briefly, this hypothesis proposes that the effect of attitudes on intentions depends upon the extent of normative support for the behaviour. Attitudes should have greater impact on intention when subjective norms favor the performance, and have less impact when there is social pressure not to perform the behaviour. Previous findings concerning the contingent consistency hypothesis have been equivocal, and further tests are warranted (see Grube and Morgan, 1990, for discussion).

The second interaction hypothesis comes from Eagly and Chaiken (1993), and suggests that PBC may interact with attitudes in predicting intentions. Eagly and Chaiken questioned the causal link between PBC and intention in the case of behaviours that are negatively evaluated, on the grounds that it is implausible that the mere controllability of behaviour would enhance people's motivation to perform a negatively evaluated behaviour, e.g., to shout out loudly in libraries (p. 189). According to this idea, simulating maximum values of PBC should have less impact on behavioural intentions when attitudes toward the behaviour are negative and greater impact when attitudes are positive. The evidence for this interaction is mixed. For example, some studies have found no evidence that attitudes moderate the PBC-intention relationship for alcohol-related behaviours (Conner, Warren, Close & Sparks, 1999; Norman & Conner, in press).

In contrast, other studies have reported significant attitude x PBC interactions in relation to drug use intentions (Conner & McMillan, 1999; McMillan & Conner, in press).

The final interaction tested here concerns the potential synergy between PBC and intention in predicting behaviour. Ajzen's (1991) rationale for introducing the concept of PBC was that an intention can only find expression in behaviour when the person possesses the relevant resources, ability, or opportunity to act. This idea implies that greater perceived control over behaviour should be associated with improved consistency between intentions and behaviour. However, support for this hypothesis has been mixed in studies to date (e.g., Armitage and Conner, 2001), because people's perceptions of control may not accurately reflect the amount of actual control over the behaviour (Sheeran et al., 2003). One way of indexing the accuracy of PBC might be to use the level of consensus about control judgments among a sample (i.e., the variability in PBC scores); the idea is that consensual control perceptions are likely to be more accurate than are control perceptions characterized by disagreement. Thus, the prediction tested here is that PBC affects how well simulated intentions predict behaviour predominantly when there is considerable agreement about the extent of control over the behaviour.

In sum, the present research aims to evaluate the TPB's structure and its capacity to guide behaviour change interventions. Simulated changes in intention and behaviour scores, moderation of attitude-intention, PBC-intention, and PBC-behaviour relations, and mediation of predictor-behaviour relations by intention are each examined. In particular, we estimate

- (a) How much change in intention is engendered by maximizing scores on attitude, subjective norm, and PBC (both individually and in theoretically-specified combinations); we also conduct a sensitivity analysis that assesses the impact of small, medium, and large changes in the predictors on intention scores,
- (b) To what extent does the impact on intention of maximizing attitude scores depend on supportive norms (the contingent consistency hypothesis), and to what extent does the impact on intention of maximizing PBC scores depend on supportive attitudes,

- (c) How much change in behaviour is engendered by maximizing scores on attitude, subjective norm, and PBC, and by generating small, medium, and large changes in these predictors,
- (d) To what extent does the simulated impact of intention scores on behaviour depend on both perceived control over the behaviour and consensual perceptions of control, and
- (e) Whether maximising attitude, subjective norm, and PBC augments behavioural performance after intention scores have been maximised.

METHOD

Participants and procedure

Students at a UK university ($N = 211$) voluntarily completed a questionnaire assessing TPB constructs for 30 behaviours (see Table 1 for the list of behaviours). The focus of the questions was on performing each of the behaviours in the “next two weeks”; a second questionnaire administered two weeks later requested self-reports about performance of the behaviours. Because the present study forms part of a larger research project, only relevant questionnaire items are described here.

Questionnaires

The TPB constructs were measured using 7-point scales (-3 to $+3$). *Intentions* (INT) were measured by two items (e.g., “I intend to [perform the behaviour] over the next two weeks”, *definitely do-definitely do not*). *Attitude* (ATT) items had the form “(Performing the behaviour) over the next two weeks would be...” with responses on three semantic differential scales (*good-bad*, *enjoyable-unenjoyable*, *pleasant-unpleasant*). *Subjective norms* (SN) were measured by two items (e.g., “Most people who are important to me think that I should [perform the behaviour] over the next two weeks”, *definitely yes-definitely no*). *Perceived behavioural control* (PBC) was measured by four items: “For me to (perform the behaviour) over the next two weeks would be...” (*easy-difficult*), “If I wanted to I could easily (perform the behaviour) over the next two weeks” (*strongly agree-strongly disagree*), “How much control do you have over (performing the

behaviour) over the next two weeks?” (*complete control-no control*), and “I feel in complete control over whether or not I (perform the behaviour) over the next two weeks” (*strongly agree-strongly disagree*). Reliabilities proved satisfactory for TPB variables across behaviours (median alphas were .97, and .83 for ATT and PBC, respectively, and the median correlations for the two-item INT and SN measures were .94 and .87, respectively).

Measures of TPB variables all specified particular levels of performance for the target behaviours (e.g., “exercise at least 6 times in the next two weeks”, “attend all of my lectures”). To maximize scale correspondence (Courneya, 1994), the behaviour measures at follow-up asked participants to indicate whether or not they had performed the behaviour at the specified frequency (*yes/no*). At least 201 students completed measures on both testing occasions for each behaviour (see Table 1).

RESULTS

Descriptive Findings

Table 1 presents descriptive statistics (*M*, *SD*) for the TPB constructs for each of the 30 behaviours. It is notable that mean SN scores vary considerably across the behaviours; some behaviours, like deciding to buy a magazine or rent a video, are seen as involving little social pressure whereas others like avoiding smoking and attending lectures are behaviours that referents definitely want the person to undertake. Perceived behavioural control is high for behaviours like magazine purchase, eating fruit, and taking vitamin pills. However, while mean PBC scores do not drop below the mid-point of the scale, behaviours like visiting a bottle bank, going to the countryside and getting 7 hours of sleep are perceived as less under individual control. There is a range of ATT scores though the means reflect positive evaluations of the majority of behaviours. The percentage of participants who reported performing the 30 behaviours at follow-up ranged from 6% to 79%; across behaviours, the median proportion who acted at the specified frequency was 47%. Thus, there is a good deal of scope for improving rates of behavioural performance among the present sample.

Simulations

Two sets of simulations were conducted that reflected the ordering of processes within the TPB. First, the impact of simulated maximum values of attitude, subjective norms and control beliefs on intentions was assessed for each variable separately, and for combinations of these variables as specified by the TRA (ATT + SN) and TPB (ATT + SN + PBC). The second set of simulations modelled the separate and combined impact of intentions and PBC on behaviour. Consistent with the TRA and TPB, it was assumed that interventions engender changes in ATT, SN or PBC first, that these changes are then reflected in changes in intentions, and that intention change then generates behaviour change. Thus, we modelled the impact on behaviour of simulated values of intentions accruing from maximum values of ATT, SN, and PBC (rather than maximum values of intention) to respect the assumption that interventions affect intentions through their effects on the theory's predictors.

Simulations for Behavioural Intentions. The process of simulating intention scores proceeded in stages as follows: First, INT was regressed on ATT, SN and PBC. Second, a simulated data set was generated where participants' scores on all variables remained unchanged except for the to-be-maximized variable where the maximum possible value was substituted for the observed value (e.g., all respondents' ATT scores were set to +3). Third, predicted INT scores were calculated using the regression weights obtained in the first stage. This process was repeated for each predictor separately and for combinations of predictors for all 30 behaviours.

Table 2 summarizes the regressions of intentions on TPB variables. Findings indicate that the TPB generally provides very good prediction of intention. The median variance explained in intentions across behaviours was 41%. This value is virtually identical to the R^2 value obtained in Armitage and Conner's (2001) meta-analysis of 185 TPB studies ($R^2 = .39$), and suggests that the present dataset is suitable for simulating impacts of interventions based on the TPB. For 26 out of the 30 behaviours, all three TPB variables were significant predictors of intention. ATT

contributed the largest beta weight to the regression equations followed by PBC and SN (median betas = .32, .28, and .25, respectively).

Table 3 presents the simulated intention scores under maximized ATT, SN and PBC separately, under the TRA (i.e., maximized ATT +SN) and under the TPB (i.e., maximized ATT+SN+PBC). Differences between intention values under the various maximization scenarios and observed intention scores are also presented. As expected, the beta weights for predictors were strongly positively correlated with the impact of maximizing values for those predictors. The correlations across the 30 behaviours between the beta weights and changes in intention strength were .75, .75, and .70 for ATT, SN and PBC, respectively (all $ps < .001$).

In order to examine the impact of maximizing individual variables, maximizing TRA variables, and maximizing TPB variables, we conducted a Friedman test that compared the simulated values of intention with the observed values for intention. This test proved highly significant, $\chi^2(5, N = 30) = 132.00, p < .001$, so Wilcoxon tests were used to compare pair-wise differences. Findings indicated that maximizing ATT, SN, and PBC each engendered significantly stronger intentions ($Mdns = 1.50, 1.48, \text{ and } 1.03$, respectively) compared to the intention scores originally observed ($Mdn = .59$; all $ps < .001$). The simulated values of intention for maximized ATT and SN were both significantly higher than the simulated values for maximized PBC (both $ps < .05$); simulated intentions for maximized ATT versus maximized SN did not differ significantly from one another.

Intention scores from the TRA simulations ($Mdn = 2.35$) indicated that maximizing ATT and SN simultaneously generated significantly stronger intentions compared to maximizing ATT, SN, or PBC on their own (all $ps < .001$). Not surprisingly, the same was true for TPB simulations (simultaneous maximization of ATT, SN, and PBC). Moreover, the TPB generated significantly stronger intentions than did the TRA ($z = 4.78, p < .001$). The median intention score across the 30 behaviours for the TPB simulation was 2.81 (out of a maximum score of +3). This finding suggests that maximizing ATT, SN, and PBC scores is sufficient to generate virtually the

maximum possible intention scores. In sum, the simulations indicate that maximizing TPB predictors has a substantial impact on intention strength.

Sensitivity Analyses: Simulations for Behavioural Intentions. We also assessed the impact of ‘small’ (.2 SD), ‘medium’ (.5 SD), and ‘large’ (.8 SD) changes on the three TPB predictors on simulated intention scores (Cohen, 1992). Figure 1 shows the impact of increasing ATT, SN, and PBC by these effect sizes as well as the impact of equivalent changes on ATT and SN simultaneously (TRA) and ATT, SN, and PBC simultaneously (TPB). The findings indicate that small, medium, and large increases in the individual TPB predictors generated linear changes in intention scores. Small changes in attitude, SN, and PBC were associated with median intention scores of .75, .60, and .67, respectively, whereas for large changes in these predictors, the respective intention scores were 1.20, 1.05, and .90. Compared to the baseline observed intention scores, increments in ATT, SN, and PBC all produced significant increases in intentions across the 30 behaviours (all z s > 4.73 , $p < .001$). Generating change in all three TPB variables simultaneously produced greater change intention scores compared to generating change in TRA variables or the individual predictors, and this was true at each level of change (small, medium, and large). For instance, a large change in TPB and TRA variables engendered intention scores of 1.93 and 1.73, respectively. Thus, the findings from the sensitivity analyses are consistent those obtained for the maximisation analyses. However, the virtue of the former analyses is that they are likely to offer a more realistic portrayal of the changes in intention that would accrue from real-world interventions designed to increase scores on TPB predictors.

Interaction Effects in Intention Simulations. The simulations for behavioural intentions provide a valuable opportunity to test potential interactions that have been proposed in the literature. The first, the contingent consistency hypothesis, states that the impact of attitudes on intention (or behaviour) depends upon the presence of relevant normative support. To test this hypothesis, we computed the correlation between the means for SN and the simulated increment in the values of intention accruing from maximizing ATT. This correlation was positive and

significant ($r = .60, p < .001$), and indicates that maximizing ATT has greater impact on intention scores when subjective norms are supportive. Conversely, of course, less change in intention would be anticipated by increasing attitudes towards the behaviour when subjective norms do not favour the behaviour.

Of interest, however, is the fact that the impact of maximizing attitude scores was also positively correlated with mean PBC scores ($r = .63, p < .001$) and was negatively correlated with the standard deviations of PBC scores ($r = -.57, p < .001$). These findings indicate that enhancing attitudes towards behaviours has greater impact on respective intentions when people perceive greater control over the behaviours and when there is a good deal of consensus about the extent of control. In order to examine the relative importance of the mean SN, mean PBC, and variability in PBC scores in predicting the impact of maximizing ATT scores on intentions, hierarchical regression analysis was undertaken. The three predictors were entered on the first step of the equation, followed by the two-way interactions at the second step, and the three-way interaction at the third step. Findings indicated that the only significant predictors were mean SN (beta = .60, $p < .01$) and variability in PBC (beta = -.63, $p < .03$, $F(7, 22) = 8.74, p < .001, R^2 = .74$). These findings suggest that the contingent consistency hypothesis should be extended to take into account not only the extent to which social norms support attitudes but also how much agreement there is about the controllability of the behaviour.

The second potential interaction tested here concerned Eagly and Chaiken's (1993) proposal that PBC has greater impact on intention when the behaviour is positively evaluated. Consistent with this idea, the correlation between mean ATT and the simulated increment in intention scores associated with maximizing PBC was $r = .41$ ($p < .03$) - increasing PBC has less impact on intentions, the less favourable are attitudes towards the behaviour. It was also the case, however, that mean SN was highly correlated with the impact of maximizing PBC ($r = .82, p < .001$) indicating that maximizing PBC has greater impact on intentions when subjective norms favour performance of the behaviour. Simultaneous regression of mean ATT, mean SN, and their

interaction indicated that ATT and SN had additive impacts on simulated intention scores for PBC (betas = .27 and .78, respectively, $ps < .02$; beta for interaction term = -.04, ns , $F(3, 26) = 26.09$, $p < .001$, $R^2 = .75$). Thus, maximizing PBC has greater impact on intentions when attitude and subjective norm both are positive.

Simulations for Behaviour. The process of simulating behaviour scores proceeded in the following stages: First, using logistic regression analyses, behaviour was regressed on INT and PBC. Second, a simulated data set was generated in which the INT scores were set to the simulated values derived from maximizing the individual predictors and their combinations. In the case of simulating the impact of maximized PBC, PBC scores are set to a maximum value of +3. The third stage involved calculating predicted probabilities of having performed the behaviour using the coefficients derived from the first stage. These mean predicted probabilities are an estimate of the proportion of the simulated sample that would have performed the behaviour when focal variables are maximized.

The first two columns in Table 4 show the odds ratios (OR) for the logistic regression of behaviour on intention and PBC. Findings indicate that, for all of the behaviours, positive intentions were associated with significantly greater likelihood of action compared to negative intentions (OR range = 1.28 to 2.65, $Mdn = 1.83$). Interestingly, PBC significantly predicted behaviour in only 11 out of 30 cases after intention had been taken into account (OR range = .67 to 3.12, $Mdn = 1.24$). Nagelkerke R^2 values ranged from .09 (Avoid lying in past 9am) to .74 (Avoiding eating meat) with a median value of .35.

Table 5 presents the predicted probabilities of behavioural performance under maximized ATT, SN and PBC, under maximized TRA, and under maximized TPB. A Friedman test comparing these simulated values of behaviour with the observed frequency of performance was highly significant, $\chi^2(5, N = 30) = 112.05$, $p < .001$. Wilcoxon tests indicated that maximizing ATT, SN, and PBC each increased the likelihood of action ($Mdns = .59$, $.56$, and $.55$, respectively) compared to the level of performance originally observed ($Mdn = .47$; all $ps <$

.001). However, there were no significant differences in predicted probabilities engendered by maximizing ATT vs. SN vs. PBC ($.09 < z_s < 0.83$, *ns*). Maximizing TRA variables or TPB variables both produced significantly greater rates of performance compared to maximizing ATT, SN, or PBC on their own (all $p_s < .001$). Whereas the median proportion of the sample who performed the behaviour under TRA maximization was .69, this proportion increased to .79 under TPB maximization ($z = 4.78$, $p < .001$). Thus, the TPB provides significantly better simulated values for both intentions and behaviour compared to the TRA.

Overall, maximizing TPB variables generated a substantial increase in the likelihood of performing the behaviour ($Mdn = .29$). Nonetheless, it is notable that the predicted probabilities indicate that, on average, more than one-quarter of the sample would not act even if they had maximum scores on ATT, SN, and PBC (and for certain behaviours like recycling bottles, renting a video, and visiting parents, the predicted probabilities are much lower; values = .19, .35, and .60, respectively). In sum, the TPB appears to provide a better account of the antecedents of intention change than the antecedents of behaviour change.

Sensitivity Analyses: Simulations for Behaviours. In a similar manner to the sensitivity analyses conducted for intentions, we modelled the impact of ‘small’ (.2 *SD*), ‘medium’ (.5 *SD*), and ‘large’ (.8 *SD*) increments in ATT, SN, PBC, ATT+SN (TRA) and ATT+SN+PBC (TPB) on intentions and then simulated the behaviour change that would result from these increments. Findings from these simulations are presented in Figure 2.

For ‘small’ (mean plus 0.2 *SD*) increments of ATT, SN, and PBC, the proportion of participants performing the behaviour are .46, .45, and .45, respectively; these values rose to .52, .50, and .50, respectively, when ‘large’ increments were generated. Increments in attitude and subjective norm had to be ‘large’ before they engendered significant increases in the proportion of participants performing the behaviour. However, in the case of PBC, a ‘medium’ size increment sufficed to produce a significant increase in the proportion of the sample who acted ($z = -2.20$, $p < .05$). Again, the TPB out performed the TRA when changes in the respective

predictors were both ‘small’ (.49 and .48, respectively) and ‘large’ effects (.66 and .61). In sum, the sensitivity analyses serve to underline the importance of generating substantial changes in multiple TPB predictors in order to produce statistically significant increases in the likelihood of behavioural performance.

Interaction Effects in Behaviour Simulations. The third interaction hypothesis tested here concerned the possibility that the behavioural impact of simulated intentions would be greater the more control participants perceived over the behaviour, and the more consensus there was about the extent of control. To test this idea, first, we computed correlations between the predicted probabilities associated with maximizing TRA variables and both mean PBC and the standard deviations for PBC. Both correlations were significant ($r_s = .69$ and $-.59$, respectively, $p_s < .001$) Second, we regressed the simulated behaviour scores associated with maximizing ATT and SN on mean PBC scores, *SD* for PBC scores, and the interaction between the two terms. Findings indicated that the only significant predictor of the predicted probabilities was the interaction term ($\beta = .33$, $p = .05$, $F(3, 26) = 10.99$, $p < .001$, $R^2 = .56$). The interaction was decomposed using procedures recommended by Aiken and West (1991). We computed simple slopes for PBC at two levels of PBC variability; one standard deviation below the mean (low variability) and one standard deviation above the mean (high variability) (see Figure 3). Findings indicated that when there was little agreement about the extent of control over the behaviour, PBC did not predict how much impact simulated intentions had on behaviour ($B = -.01$, ns). However, when there was a good deal of consensus about control perceptions, then PBC was significantly associated with predicted probabilities for maximized TRA scores ($B = 12$, $p < .01$). This finding supports the idea that PBC is important determinant of the predictive validity of behavioural intentions - when there is consensus about the extent of control².

The Mediating Role of Intentions in Predicting Behaviour. The final set of analysis examined the causal ordering implied by the TPB and, in particular, the role of intention in mediating attitude-behaviour, subjective norm-behaviour, and PBC-behaviour relations. We

adopted a different simulation approach than that used heretofore in order to test this hypothesis. First, we regressed behaviour on to intentions, and then estimated the behaviour scores with INT maximized to a value of 3. Next, we simulated the impact of adding maximized ATT, SN and PBC scores to these regressions and examined to whether doing so produced significant increases in the proportion of participants performing each behaviour. If maximising ATT, SN, and PBC scores increases the likelihood of behavioural performance after INT scores have been maximised, did then this would imply that intentions do not entirely mediate the relationship between respective predictors and behaviour.

Findings showed that the median proportion of the sample that performed the 30 behaviours was .79 when intention scores were maximised. Wilcoxon's tests were then conducted to see whether the addition of maximized ATT, SN and PBC scores significantly increased the proportions of the sample who performed the behaviours above that engendered by maximized INT scores alone. In the case of ATT and PBC, there were significant increases ($z = -2.62$ and -3.82 , respectively) but not in the case of SN ($z = -1.35$, *ns*). However, even though the increases in the probability of performing the behaviour were statistically significant, these effects were small in substantive terms. The median increments in the proportion of the sample performing the behaviours after intention was set to the highest possible value were 1%, 1%, and 2% for maximization of attitude, subjective norm, and PBC, respectively.

DISCUSSION

The present research examined an important but neglected question about the dominant model of behavioural prediction in social and health psychology - does the theory of planned behaviour provide a sound theoretical basis for interventions designed to promote behaviour change? We adopted a novel technique to answer this question. Statistical simulations were undertaken on data from a large sample of participants and behaviours that accurately reflected the TPB's predictive validity according to previous meta-analytic reviews (e.g., Armitage & Conner, 2001). Regression-based simulations modelled the impact of an "ideal intervention" that

maximized attitude, subjective norm, and PBC scores on intentions to perform, and subsequent performance of respective behaviours. Findings indicated that maximizing each of the predictors on their own engendered significantly stronger intentions compared to the intention scores originally observed; however, consistent with the structure of the TPB, simultaneous maximization of all three variables generated the largest increase in intentions. The median intention score across the 30 behaviours that accrued from maximization was +2.81. Since the highest possible value of intention was +3, this finding indicates that the TPB provides an extremely good basis for efforts to change behavioural intentions.

Although the simulations indicate that generating maximum changes attitude, subjective norm, and PBC is likely to engender strong intentions as the TPB proposes, the evidence concerning how well intentions mediate the impact of changes in TPB predictors on behaviour was more equivocal. The TPB predicts that intention mediates the influence of attitude and subjective norm on behaviour; PBC, on the other hand, is thought to directly predict behaviour (after intention has been taken into account) when perceptions of control accurately reflect the extent of actual control over behaviour (see Sheeran, Trafimow, & Armitage, 2003, for an empirical demonstration). Consistent with TPB predictions, maximising PBC scores increased behavioural performance after intention scores had been maximized, whereas maximising subjective norms did not increase performance. Contrary to expectations, however, maximizing attitude scores also increased performance in the wake of intention maximization. In fact, several correlational studies have found residual effects of attitude on behaviour even after intention was taken into account (e.g., Abraham, Clift, & Grabowski, 1999; Bagozzi, Baumgartner, & Yi, 1989; Norman & Smith, 1995), and the present findings suggest that such direct effects may be likely in intervention studies designed to increase attitudes. Finally, it is important to acknowledge that the direct effect of attitude on behaviour was much smaller than was the indirect effect (mediated by intention). The predicted increases in the median proportion of the sample who perform the behaviours were 1% and 8% for the direct and indirect routes, respectively). Thus, intention is an

important mediator of the attitude-behaviour relation in the present simulations, but does not entirely mediate this association.

The present study also examined interactions between TPB variables as determinants of simulated intention scores. In particular, we tested the contingent consistency hypothesis (e.g., Grube & Morgan, 1990) that maximizing attitude scores would have greater impact on behavioural intention when subjective norm favoured performance of the behaviour. This hypothesis was supported; more supportive norms meant that stronger intentions accrued from attitude maximization. However, the findings also supported an extension of the hypothesis. Variability in PBC scores was associated with the outcomes of maximizing attitude scores, alongside subjective norm. This finding is novel, and suggests that attitude change is most likely to alter people's behavioural decisions if the behaviour is socially sanctioned, and if people are clear about how controllable is the behavioural performance. This finding also is consistent with the concept of contingent consistency because it serves to underline the importance of the social context as a determinant of attitudinal processes. The present results indicate that the impact of one's personal evaluations of a behaviour on one's intentions to perform that behaviour depends both on approval from others and on consensus among others about perceived controllability.

Eagly and Chaiken (1993) proposed the second interaction hypothesis that the impact of PBC on intention depends upon favourability of attitude towards the behaviour. Again, we found both support for the hypothesis, and evidence that the hypothesis should be extended. Findings supported the idea that maximizing PBC scores engenders stronger intentions when people positively evaluate the respective behaviour. This is consistent with Eagly and Chaiken's analysis: perceived controllability has less motivational impact when attitudes are opposed to performance of the behaviour. In addition, however, maximizing perceptions of control has less impact on intention if subjective norms also are opposed to performance of the behaviour. Thus, it appears that favourable evaluations and social approval of a behavioural performance both need to be in place to obtain greatest benefit from maximizing PBC on intentions. These are important

caveats regarding the predictive validity of PBC. Future studies might do well to test interactions between PBC and attitude and subjective norm in order to corroborate the findings obtained here, and also examine whether other variables such as moral norm (e.g., Manstead, 2000) or anticipated affect (e.g., Richard, van der Pligt, & de Vries, 1995) also attenuate the PBC-intention relation.

The key test of the TPB is whether maximum possible changes in attitude, subjective norm, and PBC engender substantial improvements, not only in the strength of intentions to perform behaviours, but also in the likelihood of performing respective behaviours (Fishbein, 1993). Findings supported the structure of the TPB in predicting behaviour; simultaneous maximization of all three TPB predictors produced greater probabilities of performance compared maximizing each variable on its own or maximizing only TRA variables. Moreover, it seems fair to characterize the extent of behaviour change that accrued from maximizing TPB variables as ‘substantial.’ The mean proportion of participants who performed the behaviours increased from 46% at baseline to 74% under TPB maximization. This capacity to generate a potential 28% increase in the likelihood of behavioural performance would seem to suggest that the TPB offers a useful basis for behaviour change efforts.

Although the improvement in the probability of performance is substantial, it is apparent that the TPB provides a better account of the determinants of intention than it does of the determinants of behaviour. Whereas TPB maximization increased intention scores to 95% of their highest possible value (+2.81 on a -3 to +3 scale), respective behaviour scores only increased to 74% of their highest possible value. A substantial minority of the sample (26%) did not perform the behaviours even when their intentions and perceptions of control were at the maximum possible values that could be anticipated by an ideal TPB-based intervention. Thus, although the TPB provides a useful basis for interventions to promote behaviour change, it is also clear that changing intentions and PBC does not guarantee action - there remains a substantial “gap” between intentions and behaviour (Sheeran, 2002)

Several factors have been proposed to explain why intentions are not always translated into action (reviews by Sheeran, 2002; Sheeran, Milne, Webb, & Gollwitzer, 2005). One important factor is *intention viability* which refers to the idea that realisation of intentions is likely to occur only if the person possesses actual control over the behaviour (see also Ajzen, 1991). Findings from our test of the interaction between the level of perceived control and the extent of consensus about control in predicting the impact of simulated intentions on behaviour were consistent with this idea. We hypothesized that maximizing attitude and subjective norm scores would have stronger effects on behaviour when participants both believe they have control over the behaviour *and* there is a good deal of agreement about the extent of control. This hypothesis was based on the idea that consensual control perceptions are likely to be more accurate (i.e., better reflect the extent of actual control) than are control perceptions characterized by disagreement. Because greater actual control moderates the intention-behaviour relation (Sheeran et al., 2003), we predicted that the behavioural impact of simulated intentions would be greatest when perceived control was high and participants agreed that it was high. Findings supported this prediction. We acknowledge that greater consensus about PBC may not always reflect more accurate perceptions of control (e.g., participants all could have inflated estimates of control; e.g., Langer, 1975), and that further research is needed to specify the relations between consensus and accuracy of control perceptions. Nonetheless, the present findings are compatible with the idea that (lack of) intention viability may help to explain why more participants did not perform respective behaviours under TPB maximization.

Limitations of the Simulation Approach. The present study assessed the impact of maximizing all three TPB constructs in order assess the adequacy of the TPB as a basis for behaviour change interventions. However, it is important to acknowledge limitations of this approach. First, the simulations presented here do not address either the feasibility of behaviour change or the strategies that might engender such change. Experimental studies are needed for these purposes (e.g., Webb & Sheeran, in press). Instead, the present simulations were designed

to serve a ‘what if’ purpose that enabled us to explore theoretical implications for the TPB in terms of the model’s sufficiency assumption and the specified relationships between the predictors (mediator and moderator effects), and applied implications in terms of the ‘in principle’ utility of model’s predictors as cognitive targets for interventions. In practice, it may prove difficult to develop interventions that simultaneously maximize all three components, as Hardeman et al.’s (2002) review would seem to indicate. Findings from the sensitivity analyses suggest that relatively large changes in the TPB predictors are required to produce even modest increases in the likelihood of behavioural performance, and small changes in attitudes are likely to produce negligible changes in behaviour. Substantial changes in behaviour only occur when combinations of the TPB variables are manipulated simultaneously. Thus, while acknowledging the limitations of simulated data, the present review suggests caution in manipulating TPB variables in isolation from one another, and in using manipulations that are likely to have only small effects on respective cognitions.

Second, the present analyses also raise important conceptual issues. The simulation procedures employed here make assumptions about the nature of models and interventions that are worth considering. First, the simulations assume that maximisation of an individual predictor has no impact on the other predictor variables. Thus, an intervention that influences attitudes is presumed not to influence control beliefs or normative beliefs in relation to the same behaviour. Although, mean attitude, subjective norm, and PBC scores were not significantly intercorrelated across the behaviours studied here (all $r_s < .25$, *ns*), the possibility that changing perceptions of control, for example, might change attitudes and subjective norms cannot be ruled out. Consistent with this idea, Leach, Hennessy, and Fishbein (2001) have argued that appraisals of the ease/difficulty of performing a behaviour should be construed as a component of attitude rather than PBC. Whether such “cross-over” effects among TPB predictors occur in interventions cannot be addressed using the present data; however, the potential for such effects has clear implications for our understanding of the causal structure of the TPB which considers attitude,

subjective norm and perceived behavioural control as independent predictors of intention and behaviour.

Third, the use of regression models implicitly assumes that the regression weights apply to all individuals in the sample even though this is not necessarily the case (Sutton, 2002). The simulation procedures presented here rely on this 'equal applicability' assumption and, from the viewpoint of estimating the maximum potential impact of an intervention aimed at a group, is a reasonable one to make. It is likely, however, that the impact of changing TPB predictors on intentions and behaviour will vary between individuals (e.g., for attitudinally- versus normatively versus PBC-controlled participants; Sheeran, Norman, & Orbell, 1999; Sheeran, Trafimow, Finlay, & Norman, 2002; Trafimow & Finlay, 1996), and indeed may even vary over time. In principle, these variations could be modelled though it would be necessary to collect data from the same individuals on multiple occasions to permit such analyses. Analysing the role of individual differences and temporal factors constitutes a useful avenue for future research.

Conclusions

The present simulations offer an informative alternative test of the adequacy of the TPB as a model of behavioural prediction. Three key questions concerning the structure of the model were examined here: Do the specified predictors combine in additive versus interactive fashion?; Do intentions mediate relations between behaviour and attitude, subjective norm, and PBC?; and, Is the TPB a sufficient account of intentions and behaviour? Traditional regression analyses rarely have been used to test interactions among TPB predictors (Eagly & Chaiken, 1993). The present results, on the other hand, obtained evidence that the predictors combine synergistically rather than additively. The attitude-intention relation was moderated by subjective norm and PBC variability, the PBC-intention relation was moderated by attitude and subjective norm, and the intention-behaviour relation was moderated by the interaction between level and variability of PBC. These findings suggest that tests of interactions among TPB variables should become

routine in future studies to capture more accurately how the model's predictors combine in determining intentions and behaviour. In addition, the present simulations serve to underline the potential for direct effects of attitude on behaviour (i.e., effects that are not mediated by intention) in interventions designed to promote behaviour change.

Traditional regression analyses also have failed to resolve questions about the sufficiency of the model. The present simulations offered more clear-cut answers, however. First, the TPB has greater sufficiency as an account of intentions and behaviour compared to attitude, subjective norm, and PBC on their own, and the TRA. Second, maximizing TPB variables engendered virtually the maximum possible intention scores across behaviours. We acknowledge that modifications of the TPB such as the Model of Goal-Directed Behaviour and the Extended Model of Goal-Directed Behaviour have introduced additional constructs that permit more accurate prediction of behaviour in traditional regression analyses compared to the TPB (see Perugini & Bagozzi, 2004). It would be worthwhile simulating intention and behaviour change using these models in future studies for comparison with the present findings. Finally, although there was a substantial increase in the proportion of the sample that would perform the behaviours when TPB variables were maximized, almost the same proportion was predicted to fail to perform the behaviours under maximization. The TPB is not therefore a sufficient account of behaviour according to the present analyses, and better explains intention formation than behavioural performance.

These findings imply that the TPB provides a useful starting point for interventions to promote behaviour change. Persuasive communications and other strategies designed to promote more favourable attitudes, subjective norms, and PBC regarding a behaviour can be expected to engender greater likelihood of behavioural performance—if the intervention targets multiple predictors and generates large effects. However, even the most efficacious TPB intervention is likely to be characterised by substantial discrepancies between intentions and behaviour. Strategies that increase people's actual control over the behaviour (cf. Bandura, 1997), that

generate temporally stable as well as strong intentions (Cooke & Sheeran, 2004; Sheeran, Orbell, & Trafimow, 1999), and prompt people to form implementation intentions that spell out the when, where, and how of behavioural striving in advance (Gollwitzer, 1993; Gollwitzer & Sheeran, in press) may be vital in ensuring that people bridge the intention-behaviour “gap”, and thus be important complements to the TPB intervention studies.

Author Notes

The first and second authors contributed equally to writing the manuscript.

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Footnotes

¹ We acknowledge that the TPB's claim that intentions are the immediate prior cause of behaviour is contested (e.g., Greve, 2001). Greve's critique is an extensive philosophical work that can be countered by arguing that 'behaviour' rather than 'action' is the dependent variable in TPB studies unlike 'action', the concept of 'behaviour' does not presuppose intention is the cause. Norman and Conner (2005) discuss this issue in depth, and so we do not pursue this issue further in the present paper for the sake of brevity.

² Because the present dataset measured cognitions and performance for 30 behaviours, it is possible to conduct within-participants analyses to replicate the between-participants analyses reported in the text. We chose not to conduct these analyses for two reasons. First, there was the practical difficulty of conducting separate regressions for 211 participants with five combinations of predictors and two dependent variables, and then conducting the same regression analyses again using simulated values (a total of 4220 regression analyses). Second, when we compared the between-participants correlations with the median within-participants correlation for respective associations, the differences in the strength of these correlations was not substantial. Thus, there are no grounds for thinking that within-participants analyses would engender different conclusions compared to the between-participant analyses.

Figure Captions

Figure 1

Sensitivity Analyses: Median Intention Scores for Small, Medium, and Large Changes in Predictor Variables across 30 Behaviours.

Figure 2

Sensitivity Analyses: Median Behaviour Probabilities for Small, Medium, and Large Changes in Predictor Variables across 30 Behaviours.

Figure 3

Interaction between PBC Scores and Variability in Control Perceptions in Predicting the Impact of Maximizing TRA Variables on Simulated Probabilities of Behaviour

Table 1

Means and Standard Deviations for TPB Variables and Proportion of the Sample Performing the Behaviours

Behaviour	Mean INT	SD	Mean ATT	SD	Mean SN	SD	Mean PBC	SD	% reporting behaviour	N
Engage in exercise	0.14	2.08	1.39	1.30	-0.10	1.75	1.36	1.28	39.42	208
Buy a magazine	0.09	2.11	1.33	1.20	-1.18	1.70	2.25	0.84	37.14	210
Go to the pub	0.78	2.03	1.86	1.25	0.22	1.85	2.11	1.08	61.14	211
Buy a newspaper	0.39	2.15	1.08	1.30	-0.29	1.85	2.71	0.65	46.45	211
Read for pleasure	1.04	1.97	2.17	1.07	0.38	1.77	1.90	1.30	56.04	207
Take vitamin pills	-0.07	2.50	0.38	1.05	0.37	1.95	2.41	0.85	43.27	208
Go to a friend's house	1.65	1.59	2.49	0.78	1.04	1.69	2.13	1.22	71.09	211
Go to a sports centre	0.61	2.18	1.50	1.31	0.65	1.64	2.08	1.04	44.23	208
Go out for a meal	0.72	1.87	2.42	0.93	-0.16	1.60	1.72	1.29	64.73	207
Attend all of your lectures	2.23	1.50	1.27	1.15	2.09	1.24	2.21	1.06	49.76	211
Get at least 7 hours sleep	1.32	1.71	2.54	0.77	1.54	1.45	1.22	1.49	38.05	205
Buy new clothes	-0.64	1.97	1.89	1.13	-0.44	1.53	1.43	1.56	38.76	209
Avoid lying in past 9am	0.71	2.28	-0.41	1.71	0.25	1.61	1.33	1.48	51.69	207
Go to the cinema	0.60	1.81	2.21	0.96	-0.12	1.46	2.09	1.02	46.63	208
Avoid getting drunk	0.53	2.20	0.88	1.59	0.59	1.80	2.08	1.35	53.85	208
Walk for pleasure	0.30	1.89	1.82	1.24	0.29	1.53	1.97	1.00	40.87	208
Do 20hrs of indep. study	1.02	1.99	0.36	1.45	1.39	1.55	1.34	1.35	51.47	204
Write letters to family/friends	0.96	1.99	1.64	1.23	0.78	1.58	2.02	1.08	53.37	208
Take bottles to bottle bank	-1.35	1.83	0.38	1.17	-0.08	1.45	0.67	1.63	6.25	208
Visit the countryside	-0.42	1.97	2.13	1.07	0.01	1.63	1.00	1.50	21.53	209
Go to the library	0.47	2.13	0.44	1.29	0.58	1.64	2.23	0.92	37.98	208
Avoid eating meat	-1.17	2.30	-0.35	1.94	-1.00	1.73	1.51	1.44	20.19	208
Eat fruit	1.90	1.55	2.31	0.98	1.39	1.53	2.47	0.87	62.02	208
Rent a video	-0.37	2.01	1.79	1.36	-0.53	1.42	1.79	1.57	20.00	210
Avoid smoking	2.14	1.84	1.82	1.80	2.16	1.49	2.67	1.55	79.23	207
Go shopping with a friend	1.33	1.55	2.05	1.05	0.29	1.42	2.19	1.10	70.33	209
Go home (e.g. visit parents)	-0.60	2.41	1.82	1.25	0.11	1.70	1.39	1.69	26.00	200
Avoid fast-food	0.14	1.96	0.44	1.33	0.34	1.46	2.00	1.17	34.95	206
Visit nightclub	0.59	2.05	1.76	1.48	0.25	1.58	2.02	1.15	48.33	206
Tidy your room	0.91	2.06	0.41	1.29	0.44	1.69	2.27	0.96	57.69	208
Medians	0.59		1.70		0.29		2.02		46.54	

Note: INT = intention, ATT = attitude, SN = subjective norm and PBC = perceived behavioural control

Table 2
Regressions of intentions on TPB Predictors

Behaviour	β ATT	β SN	β PBC	Adj R ² (1)	n
Engage in exercise	0.36	0.30	0.36	0.52	208
Buy a magazine	0.44	0.24	0.12	0.36	210
Go to the pub	0.32	0.38	0.34	0.52	211
Buy a newspaper	0.45	0.26	0.15	0.38	211
Read for pleasure	0.35	0.16	0.48	0.51	207
Take vitamin pills	0.26	0.45	0.14	0.42	208
Go to a friend's house	0.19	0.40	0.33	0.43	211
Go to a sports centre	0.50	0.17	0.18	0.44	208
Go out for a meal	0.17	0.37	0.21	0.30	207
Attend all of your lectures	0.13	0.23	0.44	0.32	211
Get at least 7 hours sleep	<i>0.09</i>	0.30	0.50	0.35	205
Buy new clothes	0.21	0.28	0.28	0.25	209
Avoid lying in past 9am	0.26	0.21	0.23	0.22	207
Go to the cinema	<i>0.10</i>	0.38	0.34	0.33	208
Avoid getting drunk	0.42	0.17	0.15	0.34	208
Walk for pleasure	0.49	0.22	0.22	0.51	208
Do 20hrs of indep. study	0.35	0.25	0.37	0.51	204
Write letters to family/friends	0.45	0.33	0.14	0.54	208
Take bottles to bottle bank	0.30	0.24	0.27	0.33	208
Visit the countryside	0.29	0.31	0.38	0.45	209
Go to the library	0.42	0.32	0.19	0.48	208
Avoid eating meat	0.58	0.11	0.17	0.55	208
Eat fruit	0.31	<i>0.09</i>	0.44	0.44	208
Rent a video	0.26	0.19	0.33	0.30	210
Avoid smoking	0.13	0.24	0.46	0.40	207
Go shopping with a friend	0.33	0.18	0.30	0.35	209
Go home (e.g. visit parents)	<i>0.12</i>	0.38	0.31	0.35	200
Avoid fast-food	0.33	0.13	0.20	0.21	206
Visit nightclub	0.48	0.30	0.18	0.54	206
Tidy your room	0.40	0.20	0.28	0.41	208
Medians	0.32	0.25	0.28	0.41	

Note.

1 = Adj R-Sq for original data regression of intention on ATT, SN and PBC

Figs underlined and in italics are not significantly different from zero

Table 3

Simulated Intention Values under Maximised ATT, SN, PBC, TRA, and TPB

Behaviour	Observed Intention	INT mean under max ATT	Diff	INT mean under max SN	Diff	INT mean under max PBC	Diff	INT mean under TRA	INT mean under TPB	TRA-TPB Difference
Engage in exercise	0.14	1.08	0.93	1.25	1.11	1.10	0.96	2.186	3.145	0.959
Buy a magazine	0.09	1.39	1.30	1.34	1.25	0.26	<u>0.17</u>	2.640	2.808	0.168
Go to the pub	0.78	1.36	0.59	1.95	1.17	1.34	0.56	2.532	3.093	0.561
Buy a newspaper	0.39	1.81	1.42	1.37	0.98	0.54	<u>0.14</u>	2.788	2.930	0.142
Read for pleasure	1.04	1.57	0.53	1.49	0.45	1.84	0.80	2.022	2.818	0.796
Take vitamin pills	-0.07	1.57	1.64	1.45	1.52	0.16	<u>0.24</u>	3.091	3.328	0.237
Go to a friend's house	1.65	1.85	0.20	2.39	0.74	2.03	0.38	2.588	2.964	0.376
Go to a sports centre	0.61	1.86	1.26	1.14	0.53	0.95	0.34	2.398	2.737	0.339
Go out for a meal	0.72	0.92	0.20	2.07	1.35	1.11	0.39	2.272	2.667	0.395
Attend all of your lectures	2.23	2.51	0.28	2.47	0.25	2.71	0.49	2.752	3.242	0.490
Get at least 7 hours sleep	1.32	1.41	<u>0.09</u>	1.84	0.52	2.33	1.01	1.923	2.943	1.020
Buy new clothes	-0.64	-0.24	0.41	0.59	1.24	-0.09	0.55	1.001	1.555	0.554
Avoid lying in past 9am	0.71	1.91	1.20	1.52	0.81	1.31	0.60	2.718	3.314	0.596
Go to the cinema	0.60	0.75	<u>0.15</u>	2.05	1.46	1.15	0.56	2.205	2.762	0.557
Avoid getting drunk	0.53	1.75	1.22	1.03	0.50	0.76	<u>0.23</u>	2.246	2.476	0.230
Walk for pleasure	0.30	1.19	0.89	1.02	0.73	0.73	0.43	1.914	2.349	0.435
Do 20hrs of indep. study	1.02	2.28	1.25	1.55	0.52	1.92	0.90	2.800	3.697	0.897
Write letters to family/friends	0.96	1.96	1.00	1.88	0.92	1.21	<u>0.25</u>	2.879	3.130	0.251
Take bottles to bottle bank	-1.35	-0.13	1.23	-0.43	0.93	-0.64	0.71	0.800	1.513	0.713
Visit the countryside	-0.42	0.05	0.47	0.72	1.14	0.58	0.99	1.188	2.183	0.995
Go to the library	0.47	2.26	1.79	1.46	0.99	0.80	0.33	3.248	3.581	0.333
Avoid eating meat	-1.17	1.14	2.30	-0.56	0.61	-0.77	0.40	1.742	2.142	0.400
Eat fruit	1.90	2.23	0.33	2.05	<u>0.15</u>	2.31	0.41	2.381	2.796	0.415
Rent a video	-0.37	0.10	0.47	0.55	0.92	0.15	0.52	1.022	1.542	0.520
Avoid smoking	2.14	2.30	<u>0.16</u>	2.39	0.25	2.55	0.40	2.549	2.954	0.405
Go shopping with a friend	1.33	1.79	0.46	1.85	0.52	1.67	0.34	2.312	2.652	0.340
Go home (e.g. visit parents)	-0.60	-0.33	<u>0.26</u>	0.94	1.54	0.12	0.72	1.204	1.923	0.719
Avoid fast-food	0.14	1.37	1.24	0.60	0.47	0.47	0.33	1.841	2.173	0.332
Visit nightclub	0.59	1.43	0.84	1.67	1.08	0.90	0.31	2.504	2.814	0.310
Tidy your room	0.91	2.57	1.66	1.55	0.64	1.35	0.44	3.211	3.649	0.438
Median column score	0.59	1.50		1.48		1.03		2.35	2.81	0.43
Mean difference (simulated-observed)			0.86		0.84		0.50			0.43

Note. Values underlined and in italics are not significantly different from zero

Table 4
Logistic Regressions of Behaviour on Intention and PBC

Behaviour	OR Int	OR PBC	Observed Behaviour 1	Nagelkerke R ²
Engage in exercise	1.760	<u>1.280</u>	0.394	0.369
Buy a magazine	1.677	<u>0.991</u>	0.371	0.262
Go to the pub	2.144	<u>1.466</u>	0.611	0.493
Buy a newspaper	2.251	<u>0.673</u>	0.464	0.468
Read for pleasure	1.591	1.496	0.560	0.337
Take vitamin pills	2.654	<u>1.608</u>	0.433	0.707
Go to a friend's house	1.816	1.373	0.711	0.302
Go to a sports centre	1.884	<u>1.176</u>	0.442	0.390
Go out for a meal	1.406	<u>1.204</u>	0.647	0.158
Attend all of your lectures	1.810	2.032	0.498	0.267
Get at least 7 hours sleep	1.988	<u>1.181</u>	0.380	0.268
Buy new clothes	1.335	<u>1.151</u>	0.388	0.125
Avoid lying in past 9am	1.282	<u>0.898</u>	0.517	0.086
Go to the cinema	1.317	1.508	0.466	0.146
Avoid getting drunk	1.456	1.743	0.538	0.319
Walk for pleasure	2.433	<u>0.876</u>	0.409	0.419
Do 20hrs of indep. study	1.709	1.686	0.515	0.422
Write letters to family/friends	2.259	<u>0.907</u>	0.534	0.425
Take bottles to bottle bank	2.391	<u>0.984</u>	0.063	0.372
Visit the countryside	1.846	<u>1.187</u>	0.215	0.314
Go to the library	1.779	<u>1.198</u>	0.380	0.320
Avoid eating meat	2.433	3.118	0.202	0.735
Eat fruit	3.134	<u>0.866</u>	0.620	0.423
Rent a video	1.449	<u>1.286</u>	0.200	0.168
Avoid smoking	1.433	1.872	0.792	0.411
Go shopping with a friend	1.957	<u>1.127</u>	0.703	0.277
Go home (e.g. visit parents)	1.920	1.732	0.260	0.540
Avoid fast-food	1.761	<u>1.058</u>	0.350	0.278
Visit nightclub	2.038	1.492	0.483	0.445
Tidy your room	1.867	1.886	0.577	0.441
Average	1.893	1.369	0.457	0.356
Medians	1.831	1.242	0.465	0.353

Notes:

1 = Predicted prob is the proportion of the sample doing the behaviour
 All odds ratios deviate significantly from 1 except those underlined and in italics. All difference scores deviate significantly from 0 except those underlined and in italics

Table 5

Logistic Regressions of Behaviour on Intention and PBC, and Simulated Intention Values under Maximised ATT, SN, PBC, TRA, and TPB

Behaviour	Sim Behaviour Max Att	% change	Sim Behaviour Max SN	% change	Sim Mean Max PBC	% change	Sim Behaviour Max TRA	% change	Sim Behaviour Max TPB	
Engage in exercise	0.476	8.21	0.501	10.69	0.580	18.59	0.667	27.280	0.814	4
Buy a magazine	0.498	12.65	0.491	11.93	0.354	<u>-1.73</u>	0.654	28.260	0.672	3
Go to the pub	0.724	11.28	0.801	18.95	0.789	17.72	0.884	27.263	0.934	3
Buy a newspaper	0.693	22.89	0.613	14.83	0.420	-4.42	0.824	35.955	0.835	3
Read for pleasure	0.611	5.07	0.603	4.25	0.737	17.69	0.694	13.361	0.816	2
Take vitamin pills	0.715	28.26	0.691	25.87	0.465	<u>3.19</u>	0.925	49.231	0.950	5
Go to a friend's house	0.758	4.72	0.811	9.97	0.826	11.50	0.843	13.210	0.893	1
Go to a sports centre	0.592	14.97	0.479	<u>3.69</u>	0.486	4.33	0.623	18.069	0.746	3
Go out for a meal	0.676	2.86	0.754	10.70	0.740	9.28	0.781	13.366	0.829	1
Attend all of your lectures	0.500	<u>0.28</u>	0.496	<u>-0.17</u>	0.655	15.76	0.564	6.636	0.722	2
Get at least 7 hours sleep	0.337	-4.33	0.406	<u>2.53</u>	0.561	18.05	0.428	4.751	0.660	2
Buy new clothes	0.406	<u>1.82</u>	0.464	7.64	0.469	8.16	0.507	11.944	0.587	1
Avoid lying in past 9am	0.589	7.24	0.566	4.90	0.509	<u>-0.80</u>	0.626	10.909	0.630	1
Go to the cinema	0.470	<u>0.36</u>	0.556	8.97	0.587	12.08	0.601	13.465	0.689	2
Avoid getting drunk	0.635	9.70	0.578	<u>3.93</u>	0.671	13.28	0.720	18.154	0.812	2
Walk for pleasure	0.536	12.69	0.499	9.05	0.402	<u>-0.71</u>	0.676	26.734	0.738	3
Do 20hrs of indep. study	0.642	12.72	0.558	4.33	0.714	19.94	0.772	25.729	0.905	3
Write letters to family/friends	0.702	16.80	0.688	15.43	0.538	<u>0.45</u>	0.827	29.335	0.847	3
Take bottles to bottle bank	0.055	<u>-0.79</u>	0.043	-1.99	0.034	-2.82	0.113	5.050	0.189	1
Visit the countryside	0.189	<u>-2.59</u>	0.260	4.43	0.308	9.28	0.339	12.367	0.544	3
Go to the library	0.576	19.57	0.463	8.29	0.403	<u>2.34</u>	0.725	34.520	0.770	3
Avoid eating meat	0.299	9.71	0.107	-9.45	0.207	<u>0.52</u>	0.565	36.307	0.776	5
Eat fruit	0.693	7.27	0.647	<u>2.71</u>	0.698	7.73	0.725	10.481	0.800	1
Rent a video	0.192	<u>-0.76</u>	0.219	1.94	0.240	3.97	0.269	6.900	0.345	1
Avoid smoking	0.810	<u>1.80</u>	0.814	<u>2.17</u>	0.901	10.84	0.854	6.173	0.913	1
Go shopping with a friend	0.791	8.73	0.797	9.34	0.794	9.04	0.848	14.470	0.882	1
Go home (e.g. visit parents)	0.177	-8.34	0.315	5.47	0.355	9.45	0.404	14.400	0.640	3
Avoid fast-food	0.474	12.48	0.368	<u>1.90</u>	0.364	<u>1.41</u>	0.350	0.049	0.600	2
Visit nightclub	0.584	10.06	0.623	13.95	0.589	10.61	0.778	29.471	0.848	3
Tidy your room	0.778	20.07	0.660	8.28	0.737	15.97	0.875	29.808	0.922	3
Average	0.539	8.180	0.529	7.151	0.538	8.024	0.649	19.122	0.744	2
Medians	0.587	8.469	0.557	6.554	0.550	9.164	0.685	14.435	0.788	2

Notes:

1 = Average predicted prob is the proportion of the sample doing the behaviour

All odds ratios deviate significantly from 1 except those underlined and in italics

All difference scores deviate significantly from 0 except those underlined and in italics