

Can theory-based messages in combination with cognitive prompts promote exercise in classroom settings?

Chloe Hill, Charles Abraham*, Daniel B. Wright

Department of Psychology, University of Sussex, Falmer, Brighton BN1 9QG, UK

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Abstract

A randomised control trial evaluated the effectiveness of a theory-based persuasive leaflet designed to encourage students to undertake at least one additional physical exercise session a week. Participants were 503 secondary school students attending a school in South-East England. The leaflet was written to target potentially modifiable cognitive antecedents of exercise specified by the Theory of Planned Behaviour. It was separately augmented with two cognitive change techniques, resulting in three intervention conditions, leaflet alone; leaflet plus motivational quiz, and leaflet plus implementation intention prompt, as well as a no-leaflet control condition. Cognitions and behaviour were measured immediately before and 3 weeks after intervention. The results showed that all three-leaflet interventions significantly increased reported exercise, intention to exercise and related cognitions, compared to the control condition, but did not differ in their impact. Mediation analysis showed that intervention effects on exercise were partially mediated by intentions and perceived behavioural control.

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Introduction

Regular exercise is associated with lower levels of cardiovascular damage throughout the lifespan (Bouchard & Depres, 1995; Kohl, 2001). Consequently, guidelines for young people recommend 1 h of moderate exercise each day (Biddle, Sallis, & Cavill, 1998; Clarkson, Munuck, & Kaplan, 1986). However, in the UK, for example, 40% of young men and 60% of young women fail to meet this

standard (Department of Health, [DOH] 2004). The greatest decrease in exercise occurs during late adolescence making this a prime age for exercise enhancement interventions (Stephens, Jacobs, & White, 1985). Brief cost-effective interventions that could be widely administered, such as the provision of effective exercise promotion materials in schools, could make a particularly important contribution.

Identifying cognitive antecedents of exercise

A variety of social cognitive models specify potentially modifiable cognitive antecedents of health behaviour change (Conner & Norman, 2005; Glanz, Rimer, & Lewis, 2002). Of these, the

*Corresponding author. Tel.: +44 1273 678885.

E-mail addresses: c.hill@sussex.ac.uk (C. Hill),
s.c.s.abraham@sussex.ac.uk (C. Abraham),
danw@central.susx.ac.uk (D.B. Wright).

Theory of Planned Behaviour (TPB; Ajzen, 1991, 2001) proposes that intention is the most proximal determinant of action and is, in turn, predicted by attitude, subjective norm and perceived behavioural control. Attitude represents a person's evaluation of the behaviour (e.g., will it lead to valued outcomes?). Subjective norm is the perception of others' approval of the proposed behaviour, especially those whose opinions are valued. Perceived behavioural control (PBC) refers to a person's perception of whether or not they can control performance and is closely related to Bandura's construct of self-efficacy (Bandura, 1998). Both PBC and self-efficacy are expected to bolster intentions and sustain action because people are more likely to attempt actions that are controllable and easy to perform (Armitage & Conner, 2001; Bandura, 1997).

Meta-analyses suggest that on average the theory accounts for 27% of the variance in exercise behaviour (Hagger, Chatzisarantis, & Biddle, 2002; Hausenblas, Carron, & Mack, 1997). Yet few experimental tests of the theory have been reported. A systematic review found that only 12 studies had used TPB constructs to develop behaviour change intervention components (Hardeman et al., 2002). Even these were often based on selected TPB components and did not usually tests for mediation of intervention effectiveness by predicted cognition change. Three exercise interventions were identified (Courneya & McAuley, 1995; Estabrooks & Carron, 1998; Rodgers & Brawley, 1993), but behaviour change was not a measured outcome. Consequently few studies have examined behaviour change mediated by cognitions related to the TPB.

Motivation, cognitive response and persuasion

Studies of belief and attitude change have tested a variety of persuasive techniques. For example, the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986) proposes that elaborated or systematic processing is more likely when people have sufficient time and motivation to consider persuasive messages. Strong arguments presented under these conditions are likely to elicit favourable cognitive responses and attitude change (e.g., Chatzisarantis & Hagger, 2005; Jones, Sinclair, & Courneya, 2003).

To date however, few studies have examined the impact of extrinsic motivational incentives on attitude or behaviour change. In a three-condition

experiment, Krahé, Abraham, and Scheinberger-Olwig (2004) compared a no-leaflet control condition with (1) a publicly available leaflet found to target cognitions associated with condom use (including self-efficacy and attitudes) and (2) the same leaflet supplemented by a quiz on leaflet contents with a prize draw for correctly completed quiz entries. Krahé et al. found that the leaflet alone was no more effective than the no-leaflet control condition but, in combination with the quiz and incentive to win a prize, the leaflet generated significantly higher pro-condom cognitions at follow up.

Implementation intentions

Intention does not always lead to action but the formation of implementation intentions (Gollwitzer, 1993, 1999) has been found to make enactment of intentions more likely. By specifying the context in which a behaviour will be performed implementation, intentions create a link between cues from a particular context and action. For example, whereas an intention might take the form 'I intend to exercise for one hour a week,' the corresponding implementation intention might be 'Every Monday I will stay after school and play football for at least an hour.' Milne, Orbell, and Sheeran (2002) found that a text-based intervention based on Protection Motivation Theory (PMT) prompted positive pro-exercise cognition change but did not increase exercise. However, when this intervention was combined with an implementation intention prompt, greater behaviour change was observed (see Gollwitzer & Sheeran, 2006 for a meta-analysis of such studies).

The present study

The present study evaluated a leaflet designed to encourage increased exercise amongst a youth sample using persuasive text to change attitudes, norms and behaviour control. The leaflet (L) was assessed in relation to self-reported change in the number of 30-min exercise sessions undertaken over 3 weeks and in relation to changes in cognitive mediators of behaviour change. The leaflet was presented on its own and in combination with one of two cognitive prompts. First, based on the Elaboration Likelihood Model, an incentive to read the leaflet and complete a quiz was added (LQ condition). Second, an implementation intention

prompt was added (LII). This design allowed examination of whether the leaflet was effective and whether effectiveness was enhanced by these two additional techniques. The study also examined the extent to which cognitive changes mediated changes in self-reported exercise.

Thus three hypotheses were tested:

- (1) Participants receiving the leaflet (in the leaflet only [L], leaflet plus motivational incentive and quiz [LQ] and leaflet plus implementation intention prompt [LII] conditions) will report stronger intentions, perceived behavioural control, attitudes and normative beliefs as well as more exercise sessions, compared to the participants in the control condition.
- (2) Participants receiving augmented interventions (LQ and LII) will report stronger intentions, perceived behavioural control, attitudes and normative beliefs as well as more exercise sessions, compared to the leaflet-only condition (L).
- (3) Observed increases in exercise sessions between the leaflet conditions (L, LQ and LII) and the control condition will be mediated by increases in intentions, perceived behavioural control, attitudes and normative beliefs.

Method

Pilot and elicitation research

Three months prior to the study, the questionnaire was piloted in the target college with 63 students. The pilot confirmed that the terms and items used were easily understood. Results also indicated that in a normal week 16% of students engaged in no exercise or did one session of 30 min or more, 11% undertook two sessions and 22% did three exercise sessions, that is, nearly 50% were exercising three times or fewer a week, despite guidelines recommending 5–7 sessions a week.¹

Elicitation research (Fisher & Fisher, 1992) was undertaken to identify role models to promote pro-exercise normative beliefs. Students were asked to

state in order of preference three male and three female sporting celebrities they admired, and who were admired by their college friends. Nineteen percent of students most admired Paula Radcliffe (Olympic marathon runner) and 12% most admired David Beckham (England footballer). Students thought their friends most admired David Beckham (44%) and Paula Radcliffe (9%).

Participants

The study sample comprised 620 students in the last 2 years of secondary school, attending a school in south-east England. Of these, 519 (84%) were available at 3-week follow up. Absences accounted for the majority of those lost to follow up. A few questionnaires could not be matched due to missing or inaccurate identifier information and 16 participants were excluded because of missing data on the pre or post exercise measure. This resulted in a final sample of 503. Of these, 94% were British, 51% were female and age ranged from 16 to 21 years ($M = 16.97$, $S.D = 1.4$). All were fluent English speakers.

A random number generator was used to allocate pre-existing registration classes (created by the college on the basis of surnames) to condition. This resulted in 6 classes in the control condition ($n = 128$), 5 classes in the leaflet only condition ($n = 127$), 6 classes in the leaflet plus quiz and prize condition ($n = 131$), and 5 classes in the leaflet plus implementation intention prompt condition ($n = 117$).

The intervention leaflet

The leaflet was designed to target intentions, behavioural control, attitudes and normative beliefs in relation to energetic exercise outside of Physical Education classes. Two pages of persuasive script aimed to: (1) raise awareness of different types of exercise (i.e., swimming, gym-based activities, team sports); (2) promote positive attitudes towards exercise (e.g., ‘you too can enjoy exercise,’ ‘exercise will enhance your self-esteem and confidence,’ ‘exercise can stop you putting on weight,’ ‘exercise reduces your risk of developing chronic diseases, such as coronary heart disease and diabetes in later life’); (3) target normative beliefs by highlighting others’ exercising and approval of exercise (e.g., ‘people are impressed by others who look fit and healthy’; ‘It’s cool to be fit and healthy’) and by

¹The Department of Health (2004) recommends that young people should do 1 h of moderate activity (i.e., the equivalent of brisk walking) each day, and the American College of Sports Medicine (1998) guidelines are that individuals should accumulate a minimum of 30 min of at least moderate intensity exercise on most (i.e., 5), and preferably all days of the week (i.e., 150 min of moderate/strenuous intensity exercise per week).

profiling two of students' most admired sports personalities (Paula Radcliffe and David Beckham) including their sport achievements, age, weight, and height; (4) enhance behavioural control (e.g., 'It's easy to do one more session of exercise than you do at the moment,' 'exercise such as jogging is free'); and (5) prompt exercise intentions (e.g., 'build exercise into your daily routine'). The leaflet listed different sports activities and encouraged participants to increase their exercise programme by one session each week. Thus a participant reporting no exercise in the last week was encouraged to set the goal of one exercise session the following week and two exercise sessions the week after, and a participant who reported two sessions of exercise in the last week was encouraged to do three in the following week and four the week after, and so on.

Adding an incentive and quiz (LQ)

Participants in this condition received the leaflet together with a 9-question quiz about the leaflet content. They were informed that those who completed the quiz would be entered into a prize draw and could win £50 of music vouchers (see Krahé et al., 2004). They were then asked to read the leaflet and answer the quiz questions. The quiz included questions taken directly from persuasive scripts in the leaflet (see above) with specific words missing (e.g. "most people are [missing word = impressed] by people who are fit and healthy"). Participants were asked to insert missing words and could refer to the leaflet whilst completing the quiz.

Adding an implementation intention prompt (LII)

Participants in this condition received the leaflet with an implementation intention prompt. They were encouraged to formulate "*clear ideas about what you want to do*" (e.g. "people who have realistic plans are more successful in changing the way they behave in their lives"). Participants were asked to record a new additional exercise goal for the coming week, stating *what* they intended to do, *when* they would do it and how they may achieve this, i.e., what *specific aids* they may need (i.e., sports clothes, etc.).

The control condition (C)

An exercise word search was provided for participants in the control condition to control for

the time and cognitive effort spent in the leaflet conditions.

Procedure

Tutors read an instruction sheet to the class stating that the study was designed to find out what participants thought about exercise and how much exercise they were currently doing each. Participants were asked to complete all parts of the study in silence. Instructions included a definition of "a session of exercise" which was also printed on the front of the questionnaire i.e.

After a session of energetic exercise you may feel sweaty, tired, or out of breath. There are many ways we can exercise energetically... skipping, skating, riding a bicycle, dancing, or running all count. Any active play during school breaks, physical education activity classes during school (except P.E. lessons²) or after-school, or playing games like football can also be counted".

After receiving instructions, each participant was given a two-page questionnaire including an identifier to allow matching of pre- and post-intervention data for each participant. The questionnaire asked participants if they could improve on the amount of exercise they currently do, and that they answer the questions in relation to the next 3 weeks.

Immediately after completing the pre-intervention questionnaire Participants had 20 min for one of the four experimental conditions: (1) an exercise word search (C); (2) reading the leaflet (LQ); (3) reading the leaflet and completing the quiz (LQ); (4) reading the leaflet and completing the implementation intention prompt (LII).

Three weeks after the intervention, participants read the same instructions and were asked to complete a similar post-intervention questionnaire. Participants were then de-briefed. They were informed about all conditions and given the chance to read the leaflet and/or complete the quiz and/or implementation intention prompt if they had not already done so.

Measures

Questionnaire items were based on previous measures of constructs (e.g., Ajzen, 1991; Conner

²PE lessons were excluded from the study as they were not deemed to be under students' volitional control.

& Sparks, 2005) and were informed by findings from the pilot study. Constructs were measured on 7-point bipolar response scales labelled strongly agree (+3) to strongly disagree (−3), unless otherwise stated. Mean scores were used to index multi-item scales. Identical measures were administered pre- and post-intervention.

Exercise was measured using one item: (“On average over the last three weeks, I have exercised energetically for at least 30 minutes _____ times per week”).

Intention was measured by two items: (“I am going to do at least one extra session of energetic exercise for 30 minutes or more each week”; & “I will definitely do at least one extra session of energetic exercise for 30 minutes or more each week”; pre-intervention $r = .64$, post-intervention $r = .60$).

Behaviour control (PBC) was assessed using four items (e.g., “I could easily do at least one extra session of energetic exercise for 30 minutes or more each week”; “I have everything I need to do at least one extra session of energetic exercise for 30 minutes or more each week”; Cronbach’s α s pre-intervention .72; post-intervention .76).

Attitude was measured by two items (“Doing at least one extra session of energetic exercise for 30 minutes or more each week would be....” [Pleasant = +3–Unpleasant = −3] & “If I do at least one extra session of energetic exercise for 30 minutes or more each week, I will feel:” [Good+3–Bad = −3]; pre-intervention $r = .59$, post-intervention $r = .56$).

Normative beliefs were assessed using one item: “My friends at college think I should do at least one extra session of energetic exercise for 30 minutes or more each week.”

Analyses

There were few missing values and these were imputed using adjusted mean substitution. Our measure of exercise was skewed and, therefore, transformed prior to assessment of whether registration class membership affected exercise within conditions. ANCOVAs were used to test for differences in exercise and cognitions across conditions, controlling for baseline measures. Membership of registration classes was associated with exercise within conditions necessitating use of multilevel ANCOVAs, controlling for registration class membership as well as pre-intervention exercise/cognition scores.

Results

Missing data

Five participants had missing data only on the normative beliefs measure, either pre- or post-intervention. Mean pre-intervention scores on this measure were 0.35 units higher than post-intervention scores. Consequently, 0.35 was added to pre-intervention scores to impute post-intervention scores for 1 participant and 0.35 was subtracted from post-intervention scores to impute pre-intervention scores for four participants missing pre-intervention scores. There were no other missing values.

Representativeness

There were no significant differences in age, gender, cognition or exercise scores between the 117 participants who dropped out and the 503 (81%) who remained in the study, suggesting that the post-intervention sample did not differ substantially from the original pre-intervention sample on these variables.

Descriptive findings

Table 1 shows comparisons between pre- and post-intervention means and difference between the means for each condition. The number of reported exercise sessions increased in all three-intervention conditions and significantly so in the L-Quiz and L-Implementation-Intention conditions. By contrast, there was a small non-significant decrease in the number of exercise sessions reported in the control group. At pre-intervention, intentions, behavioural control and attitude were significantly associated with reported levels of exercise (r s = .17–.23), while normative beliefs were not ($r = .03$); and behavioural control, attitude and normative beliefs were all significantly associated with intentions (r s = .29–.58).

Measures of exercise pre- and post-intervention generated skewed distributions (skewness 1.00 and .83, respectively) because most participants were inactive. These measures were transformed by adding .5 to the value and then taking its square root (Turkey, 1977). This reduced skewness considerably (.07. and .11, respectively). All other measures were more approximately normally distributed and entered as originally scored.

Table 1
Pre-intervention and post-intervention means (sd) on study measures

Measure	No. of items (range)	Time point	Conditions			
			Control	Leaflet	L + Quiz	L + II
Exercise	1 (free response)	Post-intervention	2.52 (1.8)	3.17 (2.0)	2.96 ^a (1.9)	3.46 ^a (2.3)
		Pre-intervention	2.66 (2.0)	2.94 (2.4)	2.27 ^b (1.6)	2.92 ^b (2.3)
		Pre-Post difference	−0.14	0.23	0.69	0.54
Intention	2 (1–7)	Post-intervention	3.64 ^a (1.5)	4.37 (1.5)	4.68 (1.4)	4.25 (1.1)
		Pre-intervention	4.20 ^b (1.7)	4.08 (1.7)	4.36 (1.6)	4.08 (1.6)
		Pre-Post difference	−0.56	0.29	0.32	0.17
PBC	4 (1–7)	Post-intervention	4.06 ^a (1.4)	4.42 ^a (1.2)	4.46 (1.1)	4.74 (1.0)
		Pre-intervention	4.52 ^b (1.5)	4.68 ^b (1.3)	4.48 (1.5)	4.61 (1.6)
		Pre-Post difference	−0.46	−0.26	−0.02	0.13
Attitude	2 (1–7)	Post-intervention	4.57 ^a (1.6)	4.86 ^a (1.2)	4.96 (1.1)	4.99 (1.1)
		Pre-intervention	5.18 ^b (1.4)	5.02 ^b (1.4)	5.10 (1.5)	4.83 (1.5)
		Pre-Post difference	−0.61	−0.16	−0.14	0.16
Normative beliefs	1 (1–7)	Post-intervention	2.66 (1.3)	3.41 ^a (1.8)	3.57 ^a (1.6)	3.13 ^a (1.3)
		Pre-intervention	3.04 (1.8)	2.76 ^b (1.7)	2.95 ^b (1.5)	2.63 ^b (1.7)
		Pre-Post difference	−0.38	0.65	0.62	0.50

Notes: C = control, L = leaflet-only, L + Quiz = leaflet plus quiz, L + II = leaflet plus implementation intention prompt.

Differing subscripts ^{a,b} indicate significant differences between pre-intervention and post-intervention scores in each condition. All $ps < .01$.

Multilevel modelling and randomisation checks

We used a hierarchical sampling method, first sampling classes and then participants. Consequently, we tested whether participants were more similar with respect to exercise and cognition measures to the others in their class than they were to participants in other classes, within conditions. Second, we checked for pre-intervention differences among intervention conditions.

Within each condition we used ANOVAs to compare classes on pre- and post-intervention exercise. Six of these eight comparisons were statistically significant ($F_s = 2.10$ – 6.21 ; $ps = .001$ – $.08$) with only the Leaflet-Quiz condition showing similar-sized means across classes. Consequently, it would have been inappropriate to treat the data from each participant as independent. Thus multilevel modelling, controlling for class membership was used to examine differences between conditions (Goldstein, 2003).

We checked whether random allocation had generated conditions with no apparent systematic differences between participants on cognition and exercise measures at pre-intervention. Multilevel ANOVAs were run for each of the pre-intervention measures using the NLME package (Pinheiro & Bates, 2000) in the statistics language *R*. Controlling

for between-class variation within conditions, there were no systematic differences at pre-intervention between the leaflet conditions and the control condition for exercise ($F(3, 479) = .10$, $p = .96$, $R^2 = .00$)³, intention ($F(3, 479) = .84$, $p = .47$, $R^2 = .00$), PBC ($F(3, 479) = .16$, $p = .92$, $R^2 = .00$), attitude ($F(3, 479) = .87$, $p = .45$, $R^2 = .01$), and normative beliefs ($F(3, 479) = 1.52$, $p = .21$, $R^2 = .01$). Thus, randomisation appeared to be successful.

Differences between experimental conditions

To test hypotheses 1 and 2 multilevel ANCOVAs were used to compare post-intervention exercise and cognitions across conditions, co-varying pre-intervention levels. We conducted ANCOVAs, first for exercise and then for each cognition measure (i.e., intention, PBC, attitude, normative beliefs). In each case we estimated an ANCOVA assuming the slopes of the regression lines are parallel (the standard ANCOVA approach) and then assessed whether this assumption is plausible. Using multilevel ANCOVAs requires a different method of estimation to ordinary least squares ANCOVAs, hence χ^2 statistics are reported rather than F_s . Statistical details are provided in Chapter 4 of Pinheiro and Bates (2000).

The analysis of self-reported exercise revealed a strong positive relationship between exercise at the 2 points in time ($R^2 = .59$)³ and a main effect of condition, $\chi^2(3) = 15.65$, $R^2 = .61$. Each of the leaflet conditions produced a greater increase in exercise than the control condition (maximum non-corrected pairwise $p = .002$ between each leaflet condition and the control condition). None of the leaflet conditions differed significantly from one another (all $p > .25$). When the parallel slope assumption was relaxed, this did not significantly improve the model, $\chi^2(3) = 7.04$, $p = .07$; $R^2 = .62$.

We repeated these analyses for cognition measures. In each case the ANCOVA was statistically significant with the leaflet increasing: intention (from $R^2 = .22$ including pre-intervention intention as a covariate to $R^2 = .29$ when condition added, $\chi^2(3) = 16.53$, $p < .001$), behavioural control (from $R^2 = .27$ including pre-intervention level as a covariate to $R^2 = .30$ when condition was added, $\chi^2(3) = 14.22$, $p = .003$), attitude (from $R^2 = .26$ including pre-intervention attitude as a covariate to $R^2 = .29$ when condition was added, $\chi^2(3) = 7.96$, $p = .05$), and normative beliefs (from $R^2 = .02$ including pre-intervention beliefs as a covariate to $R^2 = .07$ when condition was added, $\chi^2(3) = 14.00$, $p < .001$). In all cases these greater increases were observed for the leaflet conditions compared to the control condition (all p values .06 or less) while none of the 12 comparisons among the three leaflet conditions showed any significant differences. Thus, the results clearly support hypothesis 1 but reject hypothesis 2.

Interestingly, the parallel slope assumption was rejected for intention ($\chi^2(3) = 14.48$, $p = .002$), PBC ($\chi^2(3) = 8.02$, $p = .05$), and attitude ($\chi^2(3) = 13.53$, $p = .004$). All had the same pattern of results: significant negative interaction parameters. Thus the effect of the leaflet conditions was largest for those who began with low intention, low PBC and low attitude scores. However, the parallel slope model did fit the normative beliefs analysis, $\chi^2(3) = 1.62$, $p = .66$.

To investigate the role of cognitions in mediating the effect of the intervention on exercise behaviour, we collapsed across the three leaflet conditions and

examined whether addition of cognitions reduced the effect of the intervention on exercise behaviour, controlling for pre-intervention exercise. These analyses followed the logic of Baron and Kenny (1986; see also Preacher & Hayes, 2004) and also accounted for differences in registration classes within (see Bryk & Raudenbush, 1992). Adding post-intervention intention resulted in a reduced effect of condition (F reduced from 19.61 to 13.77; Sobel test, $z = 3.31$, $p = .001$) indicating a small but significant indirect effect of condition through intention, consistent with partial mediation. A smaller but significant reduction in the condition-exercise effect was also observed when behavioural control was entered (F reduced from 19.61 to 17.00; Sobel test, $z = 2.26$, $p = .02$). Thus, as is shown in Fig. 1, receiving the intervention leaflet (L, LQ, LII versus C) affected exercise, and this was partially mediated by Intention and Perceived Behavioural Control. However, the larger unexplained effect of leaflet means that cognitions did not adequately explain the effectiveness of the interventions. Overall then, hypothesis 3 was only partially supported.

We repeated the mediation analyses described above to examine whether the effect of the intervention on intention was mediated by the effect on Perceived Behavioural Control, attitude and normative beliefs. Once again, all leaflet conditions were combined because they did not differentially affect intentions. Including pre-intervention intention as a covariate, the effect of the intervention conditions on intention was significant, $F(1, 19) = 21.58$; $p < .001$. This effect was reduced when behavioural control was entered (F reduced to 12.54, $p = .002$; Sobel test, $z = 2.99$, $p = .003$) suggesting that the effect of the interventions on intention was partly mediated by perceived behavioural control. Smaller but significant reductions were observed when normative beliefs and attitudes were entered separately (F reduced to 16.60,

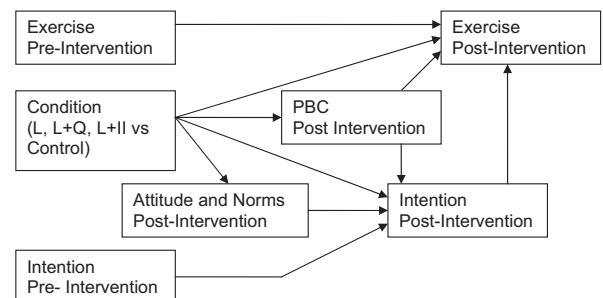


Fig. 1. Model tested concerning exercise change.

³There are different, and no agreed upon, methods for estimating effect sizes in multilevel models. Here the conceptually simplest approach, namely, the proportion reduction in variance from the baseline model, is used and denoted as R^2 (Hox, 2002). Caution is necessary when interpreting this statistic.

$p < .001$; Sobel test, $z = 3.33$, $p = .001$, and F reduced to 17.37, $p < .001$; Sobel test, $z = 2.08$, $p = .04$, respectively). These findings suggest that the effect of the intervention on intentions was partially mediated by all three cognitions.

Discussion

The study provides an experimental test of the effectiveness of an exercise-promotion leaflet based on the TPB. We also tested whether two additional cognitive prompts derived from the Elaboration Likelihood Model (Leaflet-Quiz condition) and from theory describing implementation intention formation (Leaflet-Implementation Intention condition) could improve the effectiveness of the leaflet. Finally, we tested whether intervention-induced behaviour change was mediated by TPB-specified cognitions. The results show that all three leaflet conditions significantly increased reported exercise, intention, behavioural control, attitudes and normative beliefs compared to the control condition, but that the leaflet was no more effective when combined with additional prompts. The impact of the leaflet on intention and to a lesser extent behavioural control partially accounted for its effect on exercise, and the effect of the leaflet on intention in turn was partly mediated by effects on behavioural control, attitude, and normative beliefs. These results suggest that intention change facilitates exercise change and that enhanced perceptions of behavioural control, attitude, and normative beliefs mediate intention change. However, these cognitions did not fully account for the changes in exercise generated by our leaflet-based interventions.

Descriptive analyses revealed post-intervention decreases in the three cognitions amongst control participants. It is possible that reflecting on increasing exercise while completing the pre-intervention questionnaire in the absence of encouragement or advice may undermine pro-exercise cognitions. Alternatively this reduction may have been genuine, reflecting a real background decrease in attitudes, norms and perceived control among these college students over the duration of the study. A fifth, no-questionnaire condition, which only measured exercise pre- and post-intervention, could have clarified which of these explanations is most likely. In either case, the effectiveness of any intervention must be assessed against this background.

Multilevel modelling (Goldstein, 2003) was used to control for significant within-condition class differences. All the leaflet conditions positively increased reported exercise and cognitions compared to the control. Thus, the leaflet was successful in generating the cognitive and behaviour changes for which it was designed.

Increased intentions to exercise and to a lesser extent perceived behavioural control partially mediated increases in self-reported exercise. At the same time, the unmediated effect of the interventions on exercise implies that change other than that specified by the theory is occurring as a result of students reading the leaflet. Further research is needed to identify variables beyond those specified by the theory, which could capture these changes. For example, [Luszczynska, Sobczyk, and Abraham \(in review\)](#) found that the effects of an implementation intention intervention on physical activity was mediated by changes in frequency of planning. Planning and other volitional processes such as goal prioritisation in the face of goal conflict may be initiated by the leaflets but were not measured here. Thus, the TPB provides a limited theoretical framework on which to base behaviour change intervention design and explain their effectiveness.

In a revised version of the TPB, [Fishbein et al. \(2001\)](#) have emphasised the importance of environmental barriers/facilitators and behavioural skills when promoting behaviour change (see [Fishbein & Cappella, 2006](#) for guidance on how to apply this revised model). Targeting a wider set of determinants of exercise and exercise change may necessitate more than persuasive communication. Feedback on performance, provision of social support and relapse prevention may all enhance the effectiveness of exercise promotion programmes (see e.g., [Nichols et al., 2000](#); [Peterson & Aldana, 1999](#)). Nonetheless, our leaflet increased reported exercise and this effect was greatest for students who (1) had weaker pre-intervention intentions to increase exercise, (2) reported less control over being able to do so and (3) had a less positive attitude towards doing additional exercise. This is encouraging from a public health perspective because it suggests that this theory based, low cost intervention had most impact on youth who most need pro-exercise interventions.

The lack of any difference between the three leaflet conditions was unexpected. We expected stronger effects on exercise with the addition of a motivational incentive and quiz, and an

implementation intention prompt. In a similar classroom-based study, Krahé et al. (2004) found that a leaflet designed to increase condom use was effective compared to a no-leaflet control only when combined with a motivational incentive and quiz. It is possible that our sample of older college students needed less motivational incentive than younger students reading about safer sex. Alternatively, it is possible that the limited time available curtailed the effect of the motivational incentive. We controlled for time spent on the interventions so that participants who only read the leaflet and those who read the leaflet and completed the quiz both had 20 min. Further research on the use of motivational incentives and post-leaflet quizzes in classrooms could clarify the conditions under which this additional intervention technique can augment the effects of a persuasive text.

Previous work suggests that implementation intention formation (Gollwitzer, 1999) can help promote exercise (Prestwich, Lawton, & Conner, 2003) and augment the impact of a persuasive text (Milne et al., 2002). Yet our implementation intention prompt did not lead to greater exercise increases than the leaflet alone. Two possible explanations warrant further research. The prompt we used asked students to specify what exercise they would undertake, when they would do it and what equipment or clothes they might need. This corresponds to previous definitions of implementation intention formation. (Sheeran, Milne, Webb, & Gollwitzer, 2005). More research is needed to identify for each behaviour which implementation intentions and prompts are most effective. Environmental barriers and facilitators of implementation intentions may also be critical in certain contexts.

Caution should be exercised in interpretation of our findings because of some methodological limitations. As is the case in many field trials we were limited in the measures we could take and had to rely on brief self-report measures. While our single self-report measure of exercise is very similar to those used in other exercise studies, we would ideally have also included a longer, potentially more reliable self-report measure (e.g., Godin & Shephard, 1986) and a measure of physical fitness change. However, similar self-report measures have been found to correlate with objective measures (Sallis et al., 1996). Intervention effects were assessed 3-week post intervention but there was no longer-term follow-up.

From a practical perspective, the leaflet can be recommended as a cost-effective means for promoting exercise among youth in college settings. As in other interventions, formative research is needed to elicit admired sports personalities and other issues related to the persuasiveness of messages (Elaboration Likelihood model). In conclusion, we have demonstrated how the Theory of Planned Behaviour can be combined with the Elaboration Likelihood model to change exercise behaviour among youth.

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