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APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR IN BEHAVIOUR CHANGE INTERVENTIONS: A SYSTEMATIC REVIEW

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This paper reviews studies explicitly applying the Theory of Planned Behaviour (TPB) to behaviour change interventions. A systematic and multiple search strategy identified 30 papers, describing 24 distinct interventions. Studies were rarely explicit about use of the TPB. The TPB was mainly used to measure process and outcome variables and to predict intention and behaviour, and less commonly to develop the intervention. Behaviour change methods were mostly persuasion and information, with increasing skills, goal setting, and rehearsal of skills used less often. When reported, half of the interventions were effective in changing intention, and two-thirds in changing behaviour, with generally small effect sizes, where calculable. Effectiveness was unrelated to use of the theory to develop interventions. Evidence about mediation of effects by TPB components was sparse. The TPB may have potential for developing behaviour change interventions, but more comprehensive studies are needed that compare the utility of the TPB with other social cognition models and behavioural techniques.

Keywords: Planned behaviour; Intervention; Behaviour change; Review

INTRODUCTION

The literature about methods of health-related behaviour change is vast and describes a wide range of approaches, including operant conditioning, modelling, self-management methods, and cognitive-behavioural approaches (Kanfer and Goldstein, 1986). The main methods used are designed to facilitate behaviour change among people who are already intending to change. For instance, behaviour change methods derived

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from Social Cognitive Theory (Bandura, 1986) have been widely and successfully applied, primarily among people seeking help. However, it might be equally important to establish a strong intention to change behaviour among those who may lack it, as is common in disease prevention. An accepted methodology to establish and strengthen intention is currently lacking. Theories that focus on the determinants of intention might provide insight into this process. We focus on the potential of the Theory of Planned Behaviour (TPB) for behaviour change. It is the most extensively studied social cognition theory, and is relevant to both intention and behaviour change. A review of evidence that the TPB can underpin effective behaviour change interventions constitutes a first step towards assessing the relative effectiveness of social cognition models in this area.

The TPB (Ajzen, 1991) is an extension of the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980). It states that the proximal determinant of behaviour is the intention to act. The intention, in turn, is influenced by the attitude towards the behaviour, subjective norm, and perceived behavioural control. Perceived behavioural control can also predict behaviour directly to the extent that the measure matches actual control. The theory has been applied mainly to predict and explain a wide range of behaviours, including health-relevant behaviours such as smoking, sexual behaviour, exercise and food choice (Godin, 1993; Sparks, 1994; Blue, 1995; Manstead and Parker, 1995; Conner and Sparks, 1996; Godin and Kok, 1996; Conner and Armitage, 1998). Many prediction studies aim at identifying beliefs that could subsequently be targeted by a persuasive message. This process typically follows three steps. Firstly, modal salient beliefs are elicited from a sample of the target group. Secondly, a questionnaire is constructed to assess beliefs that distinguish intenders from non-intenders, and to identify the relative contribution of the attitudinal or normative component. Finally, an intervention is designed to change the key beliefs identified (see Sutton, 2000, for implicit assumptions and problems arising).

Identified reviews (e.g., Godin, 1993; Sparks, 1994; Blue, 1995; Manstead and Parker, 1995; Conner and Sparks, 1996; Godin and Kok, 1996; Conner and Armitage, 1998; Notani, 1998; Sutton, 1998; Armitage and Conner, 2001; Albarracin *et al.*, 2001) of the TPB have mainly focused on the predictive ability of the theory and possible extensions. The theory explained 41% of variance in intention and 34% in health-related behaviour (Godin and Kok, 1996). Several reviewers (e.g. Sparks, 1994; Blue, 1995; Manstead and Parker, 1995; Conner and Armitage, 1998) argue that more research is needed to test whether changes in beliefs lead to behaviour change, and that the TPB could be more widely used to develop and evaluate interventions. To our knowledge this is a largely unexplored area. This is the first attempt to systematically review the literature on the application of the TPB to the development and/or evaluation of behaviour change interventions. We specified studies where authors stated that they had used the TPB in relation to recruiting individuals to an intervention and maintaining adherence, or in relation to changing cognitions and/or behaviour in the intervention. We addressed four main questions: (1) How often and in what way has the TPB been applied to interventions aimed at behaviour change and/or their evaluation? (2) What methods have been used to alter components of the model? (3) How many interventions have been effective in changing targeted TPB components, intention and behaviour? (4) Were any changes in intention and behaviour mediated by TPB components?

METHOD

A systematic review methodology was followed (Sutton *et al.*, 1998). As the literature had not been described previously and the studies were quite heterogeneous, a descriptive review was conducted.

Inclusion and Exclusion Criteria

We included published studies with an explicit application of the TPB or revised TRA to an intervention and/or its evaluation. By intervention we mean the use of specific behaviour change methods to support change in behaviour and/or its underlying cognitions. These methods are not confined to persuasion, the main method suggested by Fishbein and Ajzen.

Explicit application implies that the authors mentioned in the introduction, methods or abstract that they had used the TPB or revised TRA (addition of perceived behavioural control to TRA). We included studies in which the TPB was used alongside other theories or models, provided that the TPB was explicitly mentioned. Studies that only used other models were excluded (e.g. Clarke *et al.*, 1991; Bell *et al.*, 1993; Orpinas *et al.*, 1995; Bryan *et al.*, 1996). We also excluded studies that measured a mix of components of the TPB and other theories, without explicit mention of the TPB (Lechner and de Vries, 1995; Brug *et al.*, 1996). Finally, studies in which self-efficacy was measured alongside the TRA were excluded if the authors did not report that they used self-efficacy as a proxy measure of perceived behavioural control (PBC) (Apodaca *et al.*, 1997). This was done because these studies could not be distinguished from studies that applied both the TRA and Social Cognitive Theory.

We defined application of the TPB to an intervention and/or its evaluation as including (1) use of the TPB to develop the intervention; (2) measurement of its components as process and outcome variables; (3) use in explaining (change in) intention and behaviour; and (4) tests of the TPB. Studies that used the TPB in any of the four ways were included, with a sole exception. We excluded studies if the TPB was *only* used to predict behaviour among participants of an intervention, as such studies could have been done without the intervention (e.g. Theodorakis, 1994; Craig *et al.*, 1996; Courneya and Friedenreich, 1997). We included studies in which the TPB was exclusively used to predict participation/interest in the intervention, and adherence/dropout, as this would provide valuable information about the potential of the TPB for recruitment and retention of participants. In recording which TPB components were measured, we based our decisions on the authors' report, and not on whether the measure corresponded to the guidelines given by Fishbein and Ajzen (Ajzen and Fishbein, 1980).

Inclusion and exclusion of papers was judged by the first author, and validated by the second author, although not blindly. A third blind reviewer (DB) checked a random sample of 15 papers, comprising 8 included papers and 7 excluded papers. Questions about 4 papers were resolved by discussion. No additional papers were included.

Identification and Data Extraction of Papers

The combined search strategy was not limited to health-related behaviour change, to strengthen our ability to answer the general question of the TPB's potential for underpinning behaviour change interventions. Medline (1966–May 1999), Psyclit

(1887–March 1999), Embase (1980–February 1999), Cochrane Library, and Current Contents (Life Sciences; 13/4/1998–5/4/1999) were searched. Strategies are at Appendix 1. They were limited to English and comprised two main steps. First we identified studies that used the TPB or revised TRA, using four combinations of keywords: (1) Theory of Planned Behaviour, (2) revised Theory of Reasoned Action, (3) Theory of Reasoned Action combined with keywords related to PBC, and (4) keywords referring to individual TRA components combined with keywords related to PBC. Second, each of these four was combined with keywords referring to intervention and behaviour change. In addition, reference lists of all included papers and the bibliography on Ajzen's website were checked manually. Experts in the field and participants of the British Psychological Society, Division of Health Psychology conference in 1998 were also consulted. Relevant papers were downloaded onto Reference Manager Version 9 (1999), and the following data extracted onto standardised data collection forms by the first author: target behaviour, characteristics of participants, study design, use of the TPB, intervention package, targeted TPB components, change in targeted components, change in intention and behaviour, and mediation of change by TPB components.

Two blind and independent reviewers (DB, MJ) validated the data extraction of included papers, following detailed instructions, and any disagreements were resolved by discussion.

Classification of the Use of the Theory of Planned Behaviour

A taxonomy was developed to classify use of the TPB (see Appendix 2). The first author used the taxonomy to classify use of the TPB, and the classification was validated blindly by DB.

Classification of Behaviour Change Methods

A clinical and health psychologist (MJ) developed a preliminary taxonomy of behaviour change methods (Hardeman *et al.*, 2000), using textbooks (Bootzin, 1975; Kanfer and Goldstein, 1986) and consulting experts in the field. The behaviour change methods used in the interventions were then classified (MJ), using the taxonomy. The classification was validated blindly by a second clinical and health psychologist (DJ) and any disagreements were resolved by discussion (MJ, DJ).

Calculation of Effect Sizes

Effect sizes were calculated, using mean scores in experimental and control groups at follow-up, divided by the standard deviation in the control group (Hedges and Olkin, 1985). If baseline and follow-up data were provided for both groups, the mean change in each group and the standard deviation of change in the control group was used. The standard deviation of score at baseline was used in the case that baseline and follow-up data were reported for one group only (Jenkinson and McGee, 1998). If *F*-statistics or *t*-statistics were reported, the pooled standard deviation was calculated, using information reported on group sample sizes and group means. Finally, for proportions reported at follow-up the effect size, expressed as a percentage, was calculated as the absolute difference in proportions between groups (Campbell and

Machin, 1999). As reported outcomes and interventions varied widely, an average effect size was not calculated.

RESULTS

Search Results

Thirty papers were identified, describing 24 distinct interventions (studies 1–30, of which 4 studies were published in 2 papers and one study in 3 papers; see Appendix 3 for study number, authors and publication year, and Table I for study details). Ten papers were published between 1989 and 1994, and 14 between 1995 and 1999. Fifteen interventions (2,4–9,12,14–16,19,21,24–30) were based in the USA, five (1,3,11,17,18,23) in the UK, two (10,20) in Canada, one (22) in Australia, and one study (13) in the Netherlands. Fourteen interventions were community-based, of which eleven (6–8,12,16,17,21–23,29,30) took place at schools or universities, two (3,18) in the wider community, and one (13) at the worksite. Seven interventions (1,5,9,11,15,19,20,24–28) were targeting groups at higher risk of adverse outcomes of their behaviour. One study (2,4) explored the intention to participate in an intervention, and two (10,14) studied adherence among participants.

Before answering the main questions of the review, we briefly describe the context of target behaviours, characteristics of participants, the interventions, and study design.

Target Behaviours

Twenty-one interventions (1–8,10,11,14–26,29,30) targeted health-related behaviours, including limiting infants' sugar intake, smoking cessation, exercise, testicular self-examination, and drink driving (see Table I). The remaining interventions involved signing up for a chemistry course (12), working in projects (13), and job seeking (9,27,28).

Characteristics of Participants

Most interventions targeted school and university students (see Table I). Participants were mixed-sex, unless the intervention focused on a sex-specific health issue. The worksite intervention (13) involved male managers of a multinational corporation. Interventions in the broader community targeted mothers of 5–7 month old babies (3) and drivers recruited from the general public of a city (18). Groups selected by risk of adverse outcomes of their behaviour included adults with a low fruit and vegetable consumption (1,11), intravenous drug users and crack smokers (5), inner-city African-American adolescents (15), participants of a weight loss programme (19,20,24), adults with gingivitis (25,26), and unemployed people (9,27,28).

Short Description of Interventions

The interventions, including the package for experimental and control groups, are described in Table II. Nine interventions were short and consisted of an audiotaped (7), audiotaped/printed (12), printed (8), audiovisual (16), or videotaped (16,18,29,30)

TABLE I Studies applying the Theory of Planned Behaviour

Study (number)	Target Behaviour	Target group		Use of Theory of Planned Behaviour ^b
		Entry criteria	Gender and baseline age ^a	
Anderson <i>et al.</i> , 1998 (1); Cox <i>et al.</i> , 1998 (11); UK	To increase vegetable and fruit consumption to more than five (80 g) portions (> 400 g) daily.	Adults with a low consumption of fruit and vegetables who contemplated to increase consumption.	I: 26% male; mean age 35.1 yrs C: 45% male; mean age 30.2 yrs	Mentioned in abstract and methods. Used for the measurement of BB, OE, (PBC), B.
Babrow <i>et al.</i> , 1990 (2); Black and Babrow, 1991(4); USA	Participation in a stepped programme of smoking cessation.	Undergraduate and graduate students enrolled at main campuses of a Midwestern university who smoked more than once a month.	Not reported	Mentioned in abstract and introduction. Used for the measurement of BB, OE, PLO, ATT, SN, BI. Used to predict BI (intention to participate).
Beale and Mansfield, 1991 (3); UK	Letting my baby eat or drink anything which contains sugar between meals.	Mothers of 5–7 months old babies attending a sample of baby clinics in Shropshire Health District.	100% female; age not reported	Mentioned in abstract, introduction and methods. Used for development of intervention. Used for measurement of BB, OE, NB, MC, (PP), ATT, SN, PBC, BI. Used to explain change in BI. Test of TPB: prediction of BI.
Bowen, 1996 (5); USA	Condom use with main partner.	Intravenous drug users or crack smokers, sexually active, not in drug treatment for > 30 days, participating in rural AIDS prevention project, reported to have a "main partner", condom use < 100% of time.	54% male; 38% 18–24 yrs, 38% 25–34 yrs; 24% > 34 yrs	Mentioned in abstract and introduction. Used for measurement of BB, (PBC), (BI), B. Used to explain change in B. Test of nearly whole theory.
Bower <i>et al.</i> , 1997 (6); USA	To provide maternity care on entering practice; to manage emergencies in maternity care.	Family practice residents.	Gender not reported; 24% 1st yr resident, 38% 2nd yr, 35% 3rd yr, 4% unknown	Mentioned in abstract, introduction and methods. Used for measurement of ATT, NB, (PBC), BI.

Brubaker and Fowler, 1990 (7); USA	To perform testicular self-examination.	Male college students enrolled in undergraduate psychology and health education classes.	100% male; mean age 19.5 yrs	Mentioned in abstract, introduction and methods. Used for development of intervention.
Brubaker and Wickersham, 1990 (8); USA	To perform testicular self-examination.	Students attending health classes, living on campus.	100% male; age not reported	Used for measurement of BB, OE, NB, MC, ATT, SN, (PBC), BI, B. Used to predict BI and B. Test of the whole theory.
Caplan <i>et al.</i> , 1989 (9); Van Ryn and Vinokur, 1992 (27), Vinokur <i>et al.</i> , 1991 (28); USA	Job seeking.	No preference for seminar or self-administered programme, more than 2 yrs from retirement, no expectation to be recalled to former job, no obvious signs of mental illness, unemployed for 4 months or less.	46% male; mean age 35.9 yrs	Mentioned in abstract, introduction and methods. Used for development of intervention.
Counneya and McAuley, 1995 (10); Canada	Exercise in a structured programme.	Volunteers from an aerobics programme administered by the recreation department of a large university.	23% male; mean age 38.8 years	Used for measurement of ATT, SN, PBC, BI, B. Used to predict B (adherence). Test of nearly whole theory.

(Continued)

TABLE I Continued

Study (number)	Target Behaviour	Target group		Use of Theory of Planned Behaviour ^b
		Entry criteria	Gender and baseline age ^a	
Crawley and Koballa, 1992 (12); USA	Signing up in March on the course-choice form to take in biology; 93% Hispanic-American.	High school students enrolled in biology; 93% Hispanic-American.	48% male; 82% in 10th grade	Mentioned in abstract, introduction and methods. Used for development of intervention. Used for measurement of BB, OE, NB, MC, PLO, (PP), ATT, SN, PBC, BI, B. Used to predict BI and B. Test of the whole theory.
Den Ouden, 1995 (13); The Netherlands	Participants of course on project management.		100% male, mean age 36.6 yrs	Mentioned in abstract and introduction. Used for measurement of (SN), (PBC), BI, B. Used to predict B. Test of the theory (prediction of B).
Estabrooks and Carron, 1998 (14); USA	Attendance in an exercise programme.	Elderly volunteers from 14 different exercise classes.	26% male, mean age 68 yrs	Mentioned in abstract, introduction and methods. Used for the measurement of ATT, SN, PBC, BI, B. Used to predict B (adherence). Test of whole theory.
Jemmott <i>et al.</i> , 1998 (15); USA	Abstinence/condom use.	Inner-city African-American adolescents.	47% male, mean age 11.8 yrs	Mentioned in methods. Used for development of intervention. Used for measurement of BB, ATT, (PLO), (PBC), BI, B.

Murphy and Brubaker, 1990 (16); USA	Practicing testicular self-examination (TSE).	High school males in 9th and 10th grade enrolled in family planning and health classes.	100% male; 9th–10th graders	Mentioned in abstract and introduction. Used for development of intervention.
Orbell <i>et al.</i> , 1997 (17); UK	Performance of breast self-examination (BSE).	Female students and female administrative staff of university.	100% female; mean age 21 yrs	Used for measurement of BB, OE, NB, MC, ATT, SN, PBC, BI, B. Used to predict BI. Test of the theory.
Parker <i>et al.</i> , 1996 (18); UK	To drive down a 30-mph residential street at less than 40-mph.	Drivers recruited from general public in downtown Manchester.	48% male; 34% 17–24 yrs, 33% 25–32 yrs, 32% 33–40 yrs	Mentioned in abstract and introduction. Used for development of intervention.
Porzelius <i>et al.</i> , 1995 (19); Smith <i>et al.</i> , 1995 (24); USA	Weight loss and binge eating.	Obese female adults, 21–65 yrs, 20–100% over ideal body weight, no purging through vomiting or laxative use, no participation in other weight programmes.	100% female; mean age 37.9 yrs	Used for measurement of BB, NB, PBC, BI, B. Used for measurement of ATT, SN, PBC, BI, B. Used to predict B. Test of part of the theory.
Rodgers and Brawley, 1993 (20); Canada	Regulation of eating behaviour and nutritional aspects of eating; exercise/physical activity.	Participants of a weight loss programme in a hospital setting.	Not reported	Mentioned in introduction. Used for development of intervention. Used for measurement of BB, OE, ATT, SN, (PBC), BI, B. Used to predict BI and B. Test of the theory.

(Continued)

TABLE I Continued

Study (number)	Target Behaviour	Target group		Use of Theory of Planned Behaviour ^b
		Entry criteria	Gender and baseline age ^a	
Sanderson and Jemmott, 1996 (21); USA	College students.	36% male; mean age 19.8 yrs		Mentioned in introduction and methods. Used for development of intervention. Used for measurement of ATT, (PBC), BI, B. Used to predict B. Test of part of theory.
Sheehan <i>et al.</i> , 1996 Australia	Drink driving or being a passenger of a driver who has been drinking.	High school students in 10th grade.	41% male; 58% was 17 yrs, rest older	Mentioned in abstract and introduction. Used for development of intervention. Used for measurement of ATT, SN, PBC, BI, B.
Sheehan and Orbell, 1999 (23); UK	Taking vitamin C tablets every day for three weeks.	Study 1: students of two university halls of residence. Study 2: undergraduate students.	Study 1: 44% male; mean age 18.8 yrs Study 2: 49% male; age not reported	Mentioned in abstract and introduction. Used for measurement of ATT, SN, PBC, BI, B.
Tedesco <i>et al.</i> , 1992 (25), 1993 (26) USA	To improve protective oral health behaviours.	Adults between 21–65 yrs with mild-moderate gingivitis, 10 teeth per dental arch, no previous periodontal therapy, good health, not pregnant, no medication, attendance of screening visit, periodontal attachment loss lower than 1.5 mm, radiographic evidence of bone loss lower than 25%.		Mentioned in abstract, introduction and methods. Used for measurement of BB, OE, NB, MC, ATT, SN, (PBC), BI, B. Used to predict BI and B. Test of whole theory with (PBC) only directly predicting B.

Warden, 1991 (29); USA	Becoming a laboratory partner of a classmate who has AIDS.	7th grade life science students from three middle schools representing two school districts in the central Texas area.	Gender not reported; 7th grade	Mentioned in abstract. Used for development of intervention.
Warden and Koballa, 1995 (30); USA	Volunteering to become the laboratory partner of a student who has AIDS during the current school year.	Middle school students from classes where teacher participated in National Science Foundation funded teacher-enhancement programme.	Gender not reported; 7th grade	Mentioned in introduction and methods. Used for development of intervention.

Notes: ^aI: intervention group; C: control group.

^bAbbreviations refer to TPB components. BB: behavioural beliefs; OE: outcome evaluations; NB: normative beliefs; MC: motivation to comply; PLO: perceived likelihood of occurrence; PP: perceived power; ATT: attitude; SN: subjective norm; PBC: perceived behavioural control; BI: behaviour. If a proxy measure of the component is used, it is mentioned between parentheses.

TABLE II Description of interventions and behaviour change methods

<i>Study (number)</i>	<i>Intervention and control package^a</i>	<i>Behaviour change methods</i>
Anderson <i>et al.</i> , 1998 (1); Cox <i>et al.</i> , 1998 (11)	Intervention group 1: 8-week intervention with lecture, question and answering sessions, reminder boards, magnets, lunch boxes, recipes, tasting sessions. Included weighed total dietary inventories and estimated portion intakes. Intervention group 2: same as group 1, but without weighed total dietary inventories. Control group: provided weighed total dietary inventories.	Goal or target specified; self-monitoring; increasing skills; prompts, triggers, cues; information; experiential
Babrow <i>et al.</i> , 1990 (2); Black and Babrow, 1991 (4)	Recruitment phase: measurement of interest in potential intervention. Intervention group: short talk by dental health educator, "care pack" with toothbrush, toothpaste, leaflets. Control group: no intervention.	Environmental changes; persuasion; information
Beale and Mansfield, 1991 (3)		
Bowen, 1996 (5)	Intervention group: four educational sessions. Standard intervention (2 sessions) included demonstration of correct condom use and cleaning injection equipment, HIV testing. Enhanced intervention (2 sessions) focused on personal risks, specific goals to reduce risk, group intervention with subject's network. Control group: only standard intervention.	Goal or target specified; increasing skills; rehearsal of skills; persuasion; information; personalising message; modelling by others
Bower <i>et al.</i> , 1997 (6)		
Brubaker and Fowler, 1990 (7)	Theory-based message group: audiotaped message to alter beliefs about outcomes of performing TSE, printed summary of main issues, diagram illustrating TSE procedure. Informational message group: audiotaped message with information about TSE, printed summary of main issues, diagram illustrating TSE procedure. Control group: no message.	Persuasion; information

Brubaker and Wickersham, 1990 (8)	Intervention group: poster placed in student dormitories with brief description of testicular cancer, statement on importance of early detection, and brief description of testicular self-examination. No control group.	Information
Caplan <i>et al.</i> , 1989 (9), Van Ryn and Vinokur, 1992 (27), Vinokur <i>et al.</i> , 1991 (28)	Intervention group: two-week seminar with eight 3-hour sessions; financial incentives for transport costs and participation; printed materials. Delivered by male-female pair of trainers (profession not reported). Control group: self-administered job-search materials, booklet with job-searching tips, pamphlet on coping with unemployment.	Contingencies/incentives; goal/target specified; graded task starting with easy tasks; increasing skills; rehearsal of skills; stress management; social encouragement/support; planning/implementation; persuasion; information; modelling by others; group involvement
Courneyea and McAuley, 1995 (10)	Intervention group: exercise classes requiring fees, two or three times a week for a minimum of 12 weeks. No control group.	Insufficient information
Crawley and Koballa, 1992 (12)	Student-only group: listened to audiotape recording played by biology teacher as they read the printed message. Message addressed salient beliefs about signing up for chemistry in the Fall of 1990. Student-and-parent/guardian: same as group above, plus took home a copy of the printed message in English and Spanish. Questionnaire-as-message group: completed questionnaire. Control group: did not get anything.	Social encouragement/support; persuasion; information; homework
Den Ouden, 1995 (13)	Intervention group: course in project management at the Dutch branch of large multinational corporation, including lectures, simulations, and group discussions. No control group.	Insufficient information
Estabrooks and Carron, 1998 (14)	Intervention group: exercise classes (Center for Activity and Aging) held 2–3 times a week for 16 weeks. Classes include power walking, strength training, cardiovascular training, and tai chi. No control group.	Increasing skills

(Continued)

TABLE II Continued

<i>Study (number)</i>	<i>Intervention and control package^a</i>	<i>Behaviour change methods</i>
Jennnott <i>et al.</i> , 1998 (15)	Intervention group 1: Abstinence HIV intervention. Intervention group 2: Safer-sex intervention. Delivered by adult or peer facilitator. Both groups had eight one-hour modules, divided over two consecutive Saturdays, involving group discussions, videos, games, brainstorming, experiential activities, and skill building activities. Control group: Health promotion intervention, focused on risk behaviours associated with cardiovascular disease, stroke, and certain cancers.	Goal/target specified; increasing skills; rehearsal of skills; social encouragement/support; persuasion; information; group involvement; personal experiments
Murphy and Brubaker, 1990 (16)	Theory-based message group: videotaped presentation based on TPB. Informational message group: audio-visual presentation (slides accompanied by sound track) focused on information provision. Control group: pamphlet with general health information.	Increasing skills, persuasion, information, modelling by others
Orbell <i>et al.</i> , 1997 (17)	Intervention group: specification of when and where BSE would be performed during following month. Control group: no specification of BSE performance.	Goal or target specified; planning/implementation
Parker <i>et al.</i> , 1996 (18)	Four intervention groups: watched one of four videos (targeting behavioural beliefs (BB), normative beliefs (NB), perceived behavioural control (PBC), and anticipated regret (AR), respectively). Control group: watched video aimed at employees of water company, encouraging safety-mindedness.	Persuasion, information, modelling by others
Porzelius <i>et al.</i> , 1995 (19); Smith <i>et al.</i> , 1995 (24)	Two weight loss programmes for obese women of 15, 90-min. sessions over 17 weeks. Designed to give participants more control over eating habits. Delivered by trained health care professionals, dietitian, and psychologist. 1. Obese Binge Eating Treatment: helping participants learn to identify and control emotional sources of eating, by assertiveness training, coping, problem solving, self-monitoring of negative thoughts and hunger, and peer support through small groups.	Goal/target specified; (self-)monitoring; increasing skills; stress management/coping skills; planning/implementation; social encouragement/support; information; group involvement; homework

<p>Rodgers and Brawley, 1993 (20)</p> <p>Sanderson and Jemmott, 1996 (21)</p> <p>Sheehan <i>et al.</i>, 1996 (22)</p> <p>Sheeran and Orbell, 1999 (23)</p>	<p>2. Standard Behavioural Treatment (control group): strict control over eating and binge eating by focusing on cognitions directly related to eating and weight, calorie-counting, meal planning, and group discussion with leader-directed format.</p> <p>Intervention group: Self-help weight control programme with weekly 1.5-hour meetings about nutrition and eating behaviour. Volunteers watched videotape aimed at changes in cognitive determinants of physical activity, followed by half-hour discussion about issues in video.</p> <p>No control group.</p>	<p>Two intervention groups: two group sessions for total of 3 hours, videos, games, exercises, group discussions. Delivered by trained undergraduate peer facilitators.</p> <ol style="list-style-type: none"> 1. Technical skills condition: to increase beliefs that students could use condoms correctly, with facility, and without ruining mood. 2. Communication skills condition: to increase students' belief that they could communicate with and negotiate safer sex with partner. <p>Control group: received education at 3 months.</p>	<p>Intervention group: 12 lessons aimed at changing cognitive determinants of drink driving and passenger behaviour, using role-play and interactional activities. Educational video for principals, parents and school support groups. Delivered by trained teachers.</p> <p>Control group: no lessons and video.</p>	<p>Study 1: Intervention group: supply of Vitamin C tablets, specification about where and when they would take the vitamin C tablet every day for the next 3 weeks.</p> <p>Control group: supply of Vitamin C tablets, no specification of where and when to take tablets.</p> <p>Study 2: Intervention group: supply of 50 Vitamin C tablets (2-weeks baseline, without instruction). Asked to try taking a vitamin C pill every day for next three weeks, specifying where and when they would take tablets.</p> <p>Control group: same as intervention group, but asked to try for three weeks without specifying where and when.</p>
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(Continued)

TABLE II Continued

<i>Study (number)</i>	<i>Intervention and control package^a</i>	<i>Behaviour change methods</i>
Tedesco <i>et al.</i> , 1992 (25), 1993 (26)	Intervention group: four visits with oral hygiene instructions by hygienist; watching of phase contrast slides on videomonitor taken before and after prophylaxis, plus video of previous visit (excluding 1st visit). Description of oral pathogens and association to periodontal disease. Emphasis on control of patient over health of mouth, accomplishments, and links between slides and clinical scores. Control group: four visits with traditional oral hygiene instruction, involving brushing and flossing techniques from a hygienist, and feedback on present state of oral hygiene, areas for improvement, and progress.	Goal/target specified; baseline data on outcome; information personalising message; interactive
Warden, 1991 (29)	Three manipulations: 1) Message: videotaped message based on salient beliefs versus message based on traditional content-related facts versus placebo message. 2) Ability: presence versus absence of mental focusing task. 3) Motivation: degree of prior knowledge about transmission and prevention of AIDS.	Persuasion; information
Warden and Koballa, 1995 (30)	Six steps to construct message: 1) identify target audience and behaviour for message; 2) elicit salient beliefs from subset of audience; 3) identify modal salient beliefs; 4) select modal beliefs to be targeted; 5) message construction; 6) message validation.	Persuasion; information

Note: ^aIf profession delivering intervention is not recorded in the table, the authors did not report it.

message, or single instruction (17,23). All but one (18) of these interventions were applied among students. The 15 longer interventions comprised exercise classes (10,14), an educational session (3), and a series of educational sessions (1,5,6,9,11,13, 15,19–22,24–28). The duration was less than a month in 5 studies (6,9,15,21,23(Study 1),27,28) and between one and six months in 9 studies (1,5,10,11,13,14,19,20,23 (Study 2),24–26). The longest intervention (22) took place over two school years.

Study Design

Evaluation studies of 14 interventions (1,3,5,7,9,11,12,15,16,19,21–29) had a randomised controlled design, and seven (6,8,13,14,17,18,20) were non-randomised trials (see Table III). One study (10) was longitudinal, and two (2,4,30) were surveys. Eighteen studies had sample sizes of less than 200 subjects. Follow-up was often quite short, with less than a week in 5 studies (6,12,18,20,29,30), less than a month in 2 studies (3,23 (Study 1)), one to six months in 9 studies (7,8,10,13,14,16,17,21,23 (Study 2)), and more than six months in 7 studies (1,5,9,11,15,19,22,24–28). One study (29) did not report on duration of the total follow-up.

Use of the TPB

The way that the TPB was used is shown in Table I. In all interventions TPB components were measured, but only Crawley and Koballa (1992) measured the full range of TPB components, including all behavioural, normative and control beliefs and their evaluations. In 11 interventions (7–10,14,16,17,20,22,23,25–28) the full range of TPB components was measured but not (all) the beliefs. The components were measured to assess changes between or within groups in 13 interventions (1,7,9,11–13,15–17,19, 21–28). The TPB was used to develop 12 interventions (3,7,9,12,15,16,18,20–22, 27–30). However, interventions were often based on selected TPB components only. In 2 interventions (3,5) the TPB was used to explain resulting change in intention or behaviour. The capacity of the TPB to predict intention or behaviour was tested in 12 interventions (7–9,12,13,16,17,19–21,24–28,30).

In short, the TPB was used for measurement in all interventions. The theory was used to develop half of the interventions, and to assess changes within or between groups in a similar proportion.

Methods used to Change Behaviour and Underlying Cognitions

The descriptions of the interventions were limited. As a result, some behaviour change methods were either not described, or not classifiable (see Table II for further detail). Two interventions (10,13) supplied insufficient information on behaviour change methods. Among the other interventions, nineteen (1–9,11,12,15,16,18–22,24–30) used information, and thirteen (3,5–7,9,12,15,16,18,20,22,27–30) used persuasion. Otherwise, the most commonly used methods were increasing skills (9 interventions; 1,5,6,9,11,14–16,19,21,24,27,28), goal setting (7 interventions; 1,5,9,11,15,17,19,24–28), rehearsal of skills (6 interventions; 5,6,9,15,21,22,27,28), modelling (6 interventions; 5,6,9,16,18,21,27,28), planning/implementation (5 interventions; 9,17,19,22–24,27,28), and social encouragement/support (5 interventions; 6,9,12,15,19,24,27,28). More specifically, studies that used the TPB to develop the intervention also used information

TABLE III Research design and effectiveness of interventions

Study (number)	Research design			Change in intention ^b	Change in behavior ^b
	Design	Sample size	Duration of intervention/follow-up ^a		
Anderson <i>et al.</i> , 1998 (1); Cox <i>et al.</i> , 1998 (11)	RCT	N=170 randomised	I: 8 weeks F: at 6 and 12 months	Not reported.	+ compared to C; $d=1.02$ (based on post-intervention comparisons).
Babrow <i>et al.</i> , 1990 (2); Black and Babrow, 1991 (4)	Survey	N=191	No intervention	Not reported.	Not reported.
Beale and Manstead, 1991 (3)	RCT	N=162	I: one meeting F: at 3-4 weeks	0 compared to C; $d=0.23$.	Not reported.
Bowen, 1996 (5)	RCT	N=78	I: standard 2 weeks; enhanced 3 weeks to 4.5 months F: 5-10 months and < 30 days after last session	Not reported.	Not reported.
Bower <i>et al.</i> , 1997 (6)	Non-randomised trial	N=55	I: 2 days F: at 2 days	0 within-group; $d=0.18$ (based on change in intervention group).	Not reported.
Brubaker and Fowler, 1990 (7)	RCT	N=114	I: 10 minutes F: at 1 week and 4 weeks	+ compared to C; $d=-1.72$ (theory-based versus information), $d=9.05$ (theory-based versus control) (based on pooled within-group standard deviations).	+ compared to C. Post-intervention: $d=3.7\%$ (theory-based versus information), $d=18.52\%$ (theory-based versus control). At 4 weeks: $d=7.69\%$ (theory-based versus information), $d=25\%$ (theory-based versus control).
Brubaker and Wickersham, 1990 (8)	Non-randomised trial	N=232	I: poster F: 6 weeks	Not reported.	Not reported.

Caplan <i>et al.</i> , 1989 (9); Van Ryn and Vinokur, 1992 (27); Vinokur <i>et al.</i> , 1991 (28)	RCT N=1122 randomised	I: 2 weeks F: at 1, 4, and 32 months	1 month: 0 compared to C. 4 months: 0 compared to C. 32 months: not reported. Not possible to calculate effect sizes.	At 1 month: + compared to C, $d=7\%$ (re-employment); + compared to C, $d=0.31$ (monthly earnings (\$)). At 4 months: + compared to C, $d=8\%$ (re-employment); + compared to C, $d=0.13$ (monthly earnings (\$)). At 32 months: 0 compared to C, $d=2.9\%$ (re-employment among all adults); + compared to C, $d=5.9\%$ (re-employment among adults who earn money (> 30 h per week)); 0 compared to C, $d=0.07$ (monthly earnings (\$)).
Courneyea and McAuley, 1995 (10)	Longitudinal study	N=62	I: minimum of 12 weeks F: at 1, 4, 8, and 12 weeks	Not reported.
Crawley and Koballa, 1992 (12)	RCT	Pilot: N=69 N=598	I: message F: after attending message	+ student-only and control groups, compared to student-and-parent and questionnaire-as-message group, $d=-0.03$ (student-and-parent versus questionnaire-as-message); $d=-0.33$ (student-and-parent versus control); $d=0.33$ (student versus questionnaire-as-message); $d=0.03$ (student versus control).
Den Ouden, 1995 (13)	Non-randomised trial	N=243	I: 1 month F: 6 months	0 within-group; not possible to calculate effect size.
Estabrooks and Carron, 1998 (14)	Non-randomised trial	N=157	I: 16 weeks F: at weeks 5 until 12	Not reported. Not reported.

(Continued)

TABLE III Continued

Study (number)	Research design		Change in intention ^b		Change in behaviour ^b
	Design	Sample size	Duration of intervention/follow-up ^a	Change in intention ^b	
Jennett <i>et al.</i> , 1998 (15)	RCT	N=659	I: 2 weeks F: at 2 weeks, and at 3, 6, and 12 months	0 compared to C; $d=0.01$ (abstinence versus control; $d=0.06$ (safe sex versus control).	Abstinence: + at 3 months, 0 at 6 and 12 months (% sexual intercourse, 0 at 3, 6, and 12 months (frequency of intercourse) compared to C. (a) % sexual intercourse: $d=-14.5\%$ (3 months); $d=-5.5\%$ (6 months); $d=-3.1\%$ (12 months). (b) Adjusted frequency of intercourse: $d=-0.04$ (3 months); $d=-0.06$ (6 months); $d=-0.11$ (12 months). (c) % consistent condom use: $d=2\%$ (3 months); $d=6.9\%$ (6 months); $d=-10\%$ (12 months). (d) Frequency of condom use: $d=0.33$ (3 months); $d=0.33$ (6 months); $d=0.46$ (12 months). Safer sex: + at 3 months (consistent use), + at 3, 6 and 12 months (frequency of use) compared to C. (a) % sexual intercourse: $d=-4.9\%$ (3 months); $d=-7.7\%$ (6 months); $d=-6.6\%$ (12 months). (b) Adjusted frequency of intercourse: $d=-0.11$ (3 months); $d=-0.19$ (6 months); $d=-0.19$ (12 months). (c) % consistent condom use: $d=29.5\%$ (3 months); $d=12.5\%$ (6 months); $d=11.3\%$ (12 months). (d) Frequency of condom use: $d=0.40$ (3 months); $d=0.46$ (6 months); $d=0.59$ (12 months).

Murphy and Brubaker, 1990 (16)	RCT	N=99	I: 12 minutes F: at 1 month	+ theory-based group compared to informational message group and C; $d=19\%$ (theory-based versus information), $d=36\%$ (theory-based versus control).
Orbell <i>et al.</i> , 1997 (17)	Non-randomised trial	N=188	I: message F: at 1 month	Not reported. + compared to C; $d=50\%$.
Parker <i>et al.</i> , 1996 (18)	Non-randomised trial	N=238	I: video F: after viewing video	0 compared to C; $d=-0.11$ (NB versus C); $d=-0.23$ (BB versus C); $d=-0.08$ (PBC versus C); $d=-0.07$ (AR versus C).
Porzelius <i>et al.</i> , 1995 (19); Smith <i>et al.</i> , 1995 (24)	RCT	N=70 randomised	I: 17 weeks F: posttreatment, at 6 and 12 months	Not reported. Weight loss: <i>Post-treatment</i> 0 among severe binge and no binge eaters compared to C; + among moderate binge eaters compared to C.
Rodgers and Brawley, 1993 (20)	Non-randomised trial	Not reported	I: 10 weeks F: 10 weeks	Exercise: - among dropouts compared to adherents. Eating: not reported. Not possible to calculate effect size. Not reported. <i>Follow-up</i> 0 among and no and moderate binge eaters compared to C; + among severe binge eaters compared to C. Binge eating: 0 between-groups; + within- groups. Not possible to calculate effect sizes.

(Continued)

TABLE III Continued

<i>Study (number)</i>	<i>Research design</i>	<i>Sample size</i>	<i>Duration of intervention/follow-up^a</i>	<i>Change in intention^b</i>	<i>Change in behaviour^b</i>
Sanderson and Jemmott, 1996 (21)	RCT with waiting list control group	N = 141	I: 1 week F: 3 months	+ both I groups compared to C; not possible to calculate effect size.	0 sexually active in both I groups compared to C. + students in casual relationship compared to students in steady relationship (at 3 months). Not possible to calculate effect sizes.
Sheehan <i>et al.</i> , 1996 (22)	RCT	N = 4,545; follow-up study with N = 2,833	I: over two school years F: at 3 months and 3 years	Not reported.	0 drink driving (within-group); + passenger behaviour (within-group); not possible to calculate effect size.
Sheeran and Orbell, 1999 (23)	RCT	Study 1: N = 136 Study 2: N = 40	I: 3 weeks in Study 1; 5 weeks in Study 2 F: at 10 days and 3 weeks in Study 1; at 2 and 5 weeks in Study 2	Not reported.	+ compared to C. Study 1: $d = -0.17$ (10 days); $d = -0.35$ (3 weeks). Study 2: $d = -0.47$ (5 weeks).

Tedesco <i>et al.</i> , 1992 (25), 1993 (26)	RCT	<i>N</i> =167 randomised	I: 4 months F: at 7 and 13 months	Brushing: 0 for I group, 0 for C group; $d=0.27$ (I versus C). Flossing: + for I group, 0 for C group; $d=0.25$ (I versus C).	<i>Self-reported behaviour:</i> Brushing: + for I and 0 for C (both within group), 0 between groups; $d=0.54$ (I versus C). Flossing: + for I and C (both within group), 0 between groups; $d=0.20$ (I versus C). <i>Objective behaviour:</i> Plaque index: + for I and C (within group), 0 between groups. Gingival index: + for I and C (within group), 0 between groups. Not possible to calculate effect sizes.
Warden, 1991 (29)	RCT	<i>N</i> =312	I: video F: post-intervention, remaining follow-up not reported	+ students with prior knowledge compared to C; not possible to calculate effect size.	Not reported.
Warden and Koballa, 1995 (30)	Surveys	<i>n</i> =70 to generate beliefs, <i>n</i> =90 to field test questionnaire, <i>n</i> =16 to validate message	I: 15 min F: post-message (validation of message)	Not reported.	Not reported.

Notes: ^aI: intervention; F: follow-up ^b+: significant change in desired direction ($p < 0.05$); -: significant change in undesired direction ($p < 0.05$); 0: no change; *d*: effect size.

and persuasion most commonly, followed by increasing skills, rehearsal of skills and modelling.

Effectiveness of Interventions in Changing Targeted Components

The targeted components of the TPB in the intervention were rarely explicitly reported. Two extractors who knew the TPB well attempted to classify the targeted components, but could not reach agreement, even for studies that used the theory to develop the intervention. Thus, we were not able to assess how many interventions had been effective in changing targeted components.

Effectiveness of Interventions in Changing Intention

Evaluation studies of 13 interventions reported on change in behavioural intention, with 6 studies showing some positive effect (see Table III). Four evaluation studies (7,16,21,25,26) reported at least one change in the desired direction in the intervention group compared to the control group, and two (12,29) reported a positive change only in intervention subgroups, compared to controls. Of these 6 studies, effect sizes could be calculated for 4 studies, and they were small to moderate (d between 0.2 and 0.5) in 2 studies (12,25,26), and large ($d > 0.8$) in 2 studies (7,16). Four studies (3,9,15,18,27,28) reported no change in the intervention group compared to the control group, and effect sizes could be calculated for 3 of these studies. They were very small ($d < 0.2$) in 2 studies (15,18), and small to moderate in one study (3). Two studies (6,13) reported no change within the intervention group over time (pre- and post-intervention), of which one (6) had a very small effect size. Finally, in a weight loss programme (20) a negative change was found among dropouts; an effect size could not be calculated.

Among the studies that used the TPB to develop the intervention, five (42%) (7,12,16,21,29) found positive changes in intention. For 3 of these studies effect sizes could be calculated, and they were small to moderate in one study (12), and large in 2 studies (7,16). Four studies (33%) (3,9,15,18,27,28) found no changes in intention. Effect sizes could be calculated for 3 studies, and were very small in 2 studies (15,18), and small to moderate in one study (3). Finally, three studies (25%) (20,22,30) did not report results. Use of the TPB to develop the intervention was unrelated to the direction of effect in intention (Chi-square analysis, $p > 0.05$).

In short, in about half of the interventions the evaluation study reported on change in intention, and half of those found some change in the desired direction. Effect sizes, where calculable, were generally small.

Effectiveness of Interventions in Changing Behaviour

Evaluation studies of 13 interventions reported on change in behaviour (see Table III). Seven (1,7,9,11,15,16,17,23,27,28) reported at least one positive change in the intervention group compared to the control group. Effect sizes were very small in one study (15, abstinence group), small to moderate in two (9,23,27,28), moderate to large in one (15, safer sex group), and large in one study (1,11). Effect sizes based on proportions, calculable for 3 studies (7,16,17), ranged from 3.7% (7) to 50% (17). Den Ouden (1995) reported behaviour change in the intervention group over time, and Crawley and

Koballa (1992) found positive changes in behaviour over time only in one of the intervention groups. A study on drink driving (22) reported a positive change in the intervention group over time for passenger behaviour, but no change for the driver. Immediately after a weight loss programme (19,24), intervention subgroups had equal or less weight loss compared with controls, and at 12-month follow-up they had equal or more weight loss. For binge eating no difference was found between intervention and control groups. Effect sizes could not be calculated for any of the above studies. A study into oral health (25,26) reported no significant behaviour change in the intervention group compared to controls, with effect sizes small to moderate for flossing and moderate to large for brushing. Finally, Sanderson and Jemmott (1996) reported no change in condom use in intervention groups compared to the control group among sexually active students. However, at 3 months students in either intervention group who were not in a steady relationship reported more consistent condom use than the control group, whereas students in a relationship in either intervention group reported somewhat less consistent condom use than controls. Effect sizes could not be calculated.

Among the studies that used the TPB to develop the intervention, four (33%) (7,9,15,16,27,28) found positive changes in behaviour, with effect sizes very small in one study (15, abstinence group), small to moderate in one (9,27,28), and moderate to large in one study (15, safer sex group). Effect sizes based on proportions ranged from 2.9% (9,27,28) to 36% (16). Three studies (25%) (12,21,22) found mixed results, of which effect sizes could not be calculated. Finally, five studies (42%) (3,18,20,29,30) did not report results. Use of the TPB to develop the intervention was unrelated to the direction of effect in behaviour (Chi-square analysis, $p > 0.05$).

Thus, in about two-thirds of the studies that reported on behaviour change, the intervention resulted in some change in the desired direction. Effect sizes, where calculable, were generally small to moderate.

Mediation of Change in Intention and Behaviour

Only two studies (3,5) reported on the mediation of intention and/or behaviour *change* by TPB components; all other studies reported on behaviour after the intervention only. Beale and Manstead (1991) found that change in mothers' intention not to give their infants sugary drinks or foods between meals was correlated with change in attitude ($r = 0.16$; $p < 0.03$). This, in turn, reflected a change in a specific behavioural belief that was targeted in the intervention. They found no significant correlation with a change in subjective norm or PBC. Bowen (1996) found that change in condom use was mediated by intention ($\beta = 0.44$) and PBC ($\beta = 0.34$) measured at baseline, but not by behavioural beliefs. They did not report measurement of subjective norms.

Use of Other Theories/Models

In several studies other theories or models were explicitly applied to the development and/or evaluation of the intervention alongside the TPB. Eight studies (5,6,9,14,15, 20,21,25–28) used Social Learning/Cognitive Theory, in particular self-efficacy. Other models reported were the Transtheoretical Model (1,5,11), Elaboration Likelihood Model (12,29), AIDS Reduction Model (5), and Stepped Approach Model (2,4).

Study Quality: Recruitment/Dropout Rates and Quality of Measurements

Seventeen studies did not report recruitment rates. Recruitment rates were between 50% and 75% in one intervention (8), and higher than 75% in six (2–4,9,13,15,19, 24,27,28). Intervention dropout was not reported in 14 interventions. Dropout was lower than 25% in 8 interventions (6,15–18,21,23,25,26), between 25% and 50% in one intervention (5), and between 50% and 75% in another (9,27,28). Loss to follow-up (study dropout) was not reported in the evaluation studies of 6 interventions, and inconsistently reported in one study (1,11). It was lower than 25% in ten studies (3,6,7,9,12,15,17,18,21,23(Study 2),27,28), between 25% and 50% in five (8,10,13, 23(Study 1),25,26), and between 50% and 75% in three studies (5,19,22,24). In sum, for many interventions recruitment rates and intervention and study dropout were not reported.

The reliability of the TPB components, measured by Cronbach's alpha, was reported in 16 studies (2–4,6–10,13–17,20,21,23,25–28). Fourteen (1,5,7–11,13,15–18,19(binge eating),21,22,24,27,28) out of 18 studies reporting on behaviour used self-report. Five studies (12,14,19(weight loss),23–26) measured behaviour more objectively, counting class enrolment, attendance, or pills. Intention and subjective norm were commonly measured with one item. The operationalisation of components was inconsistent across studies, in particular for PBC and its underlying beliefs. Eleven studies (1,3,5,7–9,11,13, 15,20,21,25–28) used a proxy measure for PBC, often self-efficacy.

In summary, about one-third of the studies did not report on the reliability of the measured components, and more than half measured behaviour by self-report.

DISCUSSION

This review is a first step in collating previously unreviewed literature into the application of the TPB to behaviour change interventions. Using as an inclusion criterion the authors' statement that they used the TPB, we identified a diverse literature with few coherent studies that were explicit about how the theory had been applied. Addressing our first question, the TPB has rarely been applied to the development and/or evaluation of interventions. The taxonomy about use of the TPB was helpful in assessing more specifically that the theory was most frequently used to measure process and outcome variables and to predict intention or behaviour (change), and less often to develop the intervention. To allow judgment of the effectiveness of using the TPB to develop interventions, as compared to other social cognition models, studies would need to apply the TPB more comprehensively and be more explicit about how it has been applied, specifying targeted components and measuring them. We found few studies that used the TPB to predict intention to take part in an intervention. Such an application could provide valuable information about how best to recruit participants.

Our second question was what behaviour change methods have been used to alter TPB components. The most common methods were information, persuasion, increasing skills, goal setting, rehearsal of skills, modelling, planning/implementation and social encouragement/support. The TPB is primarily a cognitive theory and, since all of the components that predict intention and behaviour are cognitive, one might have expected the methods used to change them to be cognitive. Some directly cognitive

methods were used, which we characterized as information and persuasion. Virtually all interventions involved the transmission of information about risks, behaviour, and the connections between behaviour and outcomes. They used a wide variety of methods. Persuasive communications were those that were explicitly designed to encourage the desired behaviour, including written messages and involvement in discussion or argument. However, the majority of methods was more behavioural and not directly derived from or related to the TPB. These methods were more closely related to those of cognitive behaviour therapy, using a range of behavioural and cognitive techniques to change behaviour, with cognitive changes mediating these effects. Thus, even when authors use the TPB to develop parts of the intervention, they seem to see the theory as more useful in identifying cognitive targets for change than in offering suggestions on how these cognitions might be changed. We recommend in future research comparisons of the utility of the TPB in development and evaluation of behaviour change interventions, to establish its contribution over and above behavioural approaches alone.

The third question focused on the effectiveness of interventions in changing targeted TPB components, intention and behaviour. We were not able to classify which components were targeted, as it appears that the interventions were seldom explicitly developed to target specific components of the model, or this was not reported. We were able to extract how many interventions resulted in change in intention and two-thirds a behaviour change in the desired direction. As effect sizes could be calculated for change in intention for only 33% of interventions, and effect sizes for behaviour change for 38%, they should be interpreted with great caution. In addition, effect sizes are difficult to compare across studies, as they were calculated differently, depending on study design and results reported, and as they refer to a wide range of outcomes and interventions. They were generally of small to moderate magnitude. Data from the small number of studies available provides little evidence that use of the TPB to develop the intervention is associated with change in intention and behaviour in the desired direction. However, it is difficult to assess the true effectiveness of using the TPB, as interventions were rarely designed on the basis of the theory, and often also other theories and models were used to develop the intervention. Future studies should report which TPB components are targeted, and measure the effects in these components to identify whether particular behaviour change methods are effective in changing specific TPB components.

The last question was whether any change in intentions or behaviour was mediated by TPB components. Half of the studies reported on change in intention or behaviour, of which only two tested mediation of change. They found results in accordance with the theory. At present there is thus insufficient evidence to judge whether TPB components mediate changes in intention and behaviour within evaluated interventions. Future studies should explore these mediational effects further so that the assumptions underlying the theory can be tested in more depth (see Sutton, 2000 for a detailed discussion). Few studies in this review tested factors that affect effectiveness of interventions, and future studies might profitably explore the effects of moderating variables such as behaviour change methods, type of behaviour, quality of measurement, and dropout rates.

Studies were often of poor design. More precise estimations of effectiveness of interventions could be made if studies had a randomised controlled design, longer follow-up period, intention to treat analysis, and used standardised, reliable measures of

constructs and more objective measures of behaviour. It would aid interpretation if authors reported recruitment and dropout rates, to provide insight into the feasibility and acceptability of the intervention, and the generalisability of findings.

The review has limitations. We did not search the grey literature or include unpublished interventions, which might have introduced a bias towards more effective interventions. It sometimes proved difficult to judge whether the TPB was applied to an intervention. Particularly when self-efficacy was used, we had to rely on the authors' report about using it as a proxy measure of PBC, or applying both SCT and TRA to the intervention. At times it was difficult to judge whether the TPB was truly applied to an intervention, or whether a convenient sample of participants of an intervention was used to test the predictive power of the theory only. The validation of inclusion and exclusion criteria by a blind reviewer should have reduced the likelihood of excluding relevant studies or including irrelevant ones. Misclassification of methods used to change behaviour may have occurred, due to lack of detail in the papers. Validation of data extraction by a blind reviewer will have diminished the likelihood of misclassification.

Fishbein and Ajzen appear to focus on persuasive messages as the main method of changing key beliefs that discriminate intenders from non-intenders, or those who perform the behaviour from those who do not. However there is ample evidence that a wide range of techniques can be successfully used to change cognitions, and the studies we identified used that range rather than being restricted to persuasion. For instance, in Social Cognitive Theory (SCT) (Bandura, 1986), where self-efficacy is considered the critical mediating construct, four specific methods for changing self-efficacy and thereby behaviour have been proposed: (1) persuasive communication, (2) experience of successfully enacting the behaviour, (3) vicarious experience i.e. observing others perform the behaviour, and (4) physiological feedback compatible with successful performance. Since PBC and self-efficacy are agreed to be more or less similar constructs (Ajzen, 1998), one could reasonably expect that the same methods would be useful in enhancing PBC, and that one is not restricted to using direct persuasive methods.

One might then ask what the TPB might add to what has been achieved using SCT. The main differences are the additional proximal predictor of behaviour in the TPB, i.e. intention, and the specification of the cognitions predicting intention. These differences are potentially critical in two ways. First, SCT has primarily been used with people that already wish to change their behaviour. Thus intention may either have reached a threshold value beyond which it has no predictive value, or there may be little variance in intention. By contrast, the TPB has been used in contexts where people's intention is either not established or may be low. So while the SCT has frequently been used with people seeking help, the TPB and other social cognition models have been used to target preventive health behaviours in community-based samples where intention to change cannot be assumed. Second, the TPB suggests which cognitions may be valuable to change in order to enhance intention. For attitudes and subjective norm, these cognitions may refer to expectancy or value, while for PBC they relate to power and likelihood. Thus we would argue that while SCT is an effective cognitive-behavioural model for designing interventions with motivated individuals, the TPB is a more purely cognitive model, which may be valuable where motivation has not been established.

Although focusing here on the comparison of the TPB with SCT, the wider issue of whether different social cognition models lead to different interventions in terms of

targets for change, effectiveness, and efficiency for assessing outcomes would be important to address for theoretical and practical purposes. This review may be a first step towards more robust and unifying methods for intervention development and evaluation. Future comparisons of social cognition models in this area may provide more insight in overlaps and connections between different social cognitive approaches, and factors affecting the effectiveness of interventions.

The Theory of Planned Behaviour may have a valuable contribution to make to developing effective interventions aimed at behaviour change, especially among individuals where motivation to act cannot be taken for granted. However current evidence is lacking. Well-designed studies that evaluate carefully developed interventions, specifically targeting TPB components and measuring the effect on cognitions as well as behaviour, are needed to provide evidence about the utility of the TPB in this area.

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APPENDIX 1

Search strategies

<i>Psyclit</i>	<i>Medline</i>	<i>Cochrane Library</i>
1 theory of planned behav?r 2 revised theory of reasoned action 3 theory of reasoned action and (perceived behav?r control) 4 theory of reasoned action and (perceived control)	1 theory of planned behav?r 2 revised theory of reasoned action 3 theory of reasoned action and (perceived behav?r control) 4 theory of reasoned action and (perceived control)	1 theory and (planned and behav*) 2 revised and (theory and reasoned and action) 3 (theory and reasoned and action) and (perceived behav* and control) 4 (theory and reasoned and action) and (perceived and control)
5 theory of reasoned action and control 6 theory of reasoned action and self-efficacy	5 theory of reasoned action and control 6 theory of reasoned action and self-efficacy	5 (theory and reasoned and action) and control 6 (theory and reasoned and action) and self-efficacy
7 (Ajzen not Fishbein) in ab 8 (perceived behav?r control) or (perceived control) or (self-efficacy)	7 (Ajzen not Fishbein) in ab 8 (perceived behav?r control) or (perceived control) or (self-efficacy)	7 (Ajzen: AB not Fishbein: AB) 8 (perceived and behav* and control) or (perceived and control) or self-efficacy
9 explode "Behavior" 10 explode "Planned-Behavior" 11 explode "Behavior-Change"	9 explode "Self-Efficacy" / all subheadings 10 #8 or #9 11 explode "Behavior"/methods, nursing, prevention-and-control, psychology, rehabilitation, therapy behav?r	9 behavior*:ME ^a 10 behav* 11 #8 and (#9 or #10) 12 behav?r 13 #10 and (#11 or #12)
12 behav?r 13 (#9 or #10 or #11 or #12) and (perceived behav?r control or perceived control)	14 explode "Motivation"/all subheadings 15 intention	12 motivation*:ME 13 intention 14 #8 and (#12 or #13) 15 attitude*:ME
14 explode "Intention" 15 intention	14 intention	14 #8 and (#12 or #13) 15 attitude
16 #8 and (#14 or #15) 17 explode "Attitudes" 18 explode "Attitude-Change" 19 attitude 20 #8 and (#17 or #18 or #19) 21 subjective norm 22 social norm 23 #8 and (#21 or #22) 24 belief? 25 cognition*	16 #10 and (#14 and #15) 17 explode "Attitude"/all subheadings 18 explode "Attitude-to-Health"/all subheadings 19 attitude 20 #10 and (#17 or #18 or #19) 21 subjective norm 22 social norm 23 #10 and (#21 or #22) 24 belief? 25 cognition*	16 attitude 17 #8 and (#15 or #16) 18 subjective and norm 19 social and norm 20 #8 and (#18 or #19) 21 belief* 22 cognition* 23 #8 and (#21 or #22) 24 intervention-studies*:ME 25 program-evaluation*:ME

	<i>Current Contents (Life Sciences)</i>	<i>Embase</i>
26 (#24 or #25) and (perceived behavio?ral control or perceived control)	26 #10 and (#24 or #25)	26 behavior-therapy*:ME
27 explode “Program-Evaluation”	27 explode “Intervention-Studies”/all subheadings	27 randomized-controlled-trials*:ME
28 explode “Treatment”	28 explode “Program-Evaluation”/all subheadings	28 clinical-trials*:ME
29 explode “Persuasive-Communication”	29 explode “Behavior-Therapy”/all subheadings	29 controlled-clinical-trials*:ME
30 explode “Messages”	30 explode “Randomized-Controlled-Trials”/all subheadings	30 evaluation-studies*:ME
31 explode “Learning-Strategies”	31 explode “Clinical-Trials”/ all subheadings	31 follow-up-studies*:ME
32 explode “Behavior-Change”	32 explode “Controlled-Clinical-Trials”/all subheadings	32 longitudinal-studies*:ME
33 explode “Behavior-Modification”	33 explode “Evaluation-Studies”/all subheadings	33 multicenter-studies*:ME
34 explode “Behavior-Therapy”	34 explode “Follow-Up-Studies”/all subheadings	34 feasibility-studies*:ME
35 intervention* or program* or recruitment or persuasion or message or activit* or strateg* or behavio?r change or clinical trial or controlled clinical trial or randomi?ed controlled trial	35 explode “Longitudinal-Studies”/all subheadings	35 intervention* or program* or recruitment or persuasion or message* or activit* or strateg* or behav* and change)
36 #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35	36 explode “Multicenter-Studies”/all subheadings	36 #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35
37 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #13 or #16 or #20 or #23 or #26) and #36	37 explode “Feasibility-Studies”/all subheadings	37 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #11 or #14 or #17 or #20 or #23
	38 intervention* or program* or recruitment or persuasion or message or activit* or strateg* or behavio?r or change or behavio?r change	38 #36 and #37
	39 #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38	
	40 (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #13 or #16 or #20 or #23 or #26) and #39	

(Appendix continued)

Search Strategies (Continued)

<i>Current Contents (Life Sciences)</i>	<i>Embase</i>
8 behavio?r.mp.	8 exp Behavior/
9 #7 and #8	9 behavio?r.mp.
10 motivation.mp.	10 (#8 or #9) and perceived control.mp.
11 intention.mp.	11 intention.mp.
12 #7 and (#10 or #11)	12 exp Motivation/
13 attitude.mp.	13 #7 and (#11 or #12)
14 #7 and #13	14 exp Attitude/
15 subjective norm.mp.	15 exp Patient attitude/
16 social norm.mp.	16 attitude.mp.
17 norm.mp.	17 #7 and (#14 or #15 or #16)
18 #7 and (#15 or #16 or #17)	18 subjective norm.mp.
19 belief\$mp.	19 social norm.mp.
20 cognition\$mp.	20 #7 and (#18 or #9)
21 #7 and (#19 or #20)	21 belief\$mp.
22 (randomized controlled trial) or (clinical trial) or (controlled clinical trial) or (evaluation) or (behavior therapy).mp.	22 cognition\$mp.
23 (intervention\$ or programs or recruitment or persuasion or message or activit\$ or strateg\$ or behavio?r change)	23 #7 and (#21or #22)
24 #22 or #23	24 exp types of study/
25 #1 or #2 or #3 or #4 or #5 or #6 or #9 or #12 or #14 or #18 or #21	25 exp Health care quality/
26 #24 and #25	26 exp Behavior therapy/
	27 exp Behavior modification/
	28 exp Clinical trial/
	29 exp Controlled study/
	30 exp "evaluation and follow up"/
	31 exp Follow up/
	32 exp Longitudinal study/
	33 exp multicenter study/
	34 exp feasibility study/
	35 (intervention\$ or program\$ or recruitment or persuasion or message or activit\$ or strateg\$ or behavio?r change).mp.
	36 #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35
	37 #1 or #2 or #3 or #4 or #5 or #6 or #10 or #13 or #17 or #20 or #23 or #25
	38 #36 and #37

Notes: *ME = MESH heading.

APPENDIX 2

Taxonomy for use of Theory of Planned Behaviour

-
- 1 Mentioned in:
 - a abstract
 - b introduction
 - c methods
 - 2 Used for measurement of (mentioned between brackets if assessed in a different way)
 - a behavioural beliefs
 - b outcome evaluations
 - c normative beliefs
 - d motivation to comply
 - e perceived likelihood of occurrence
 - f perceived power
 - g attitude
 - h subjective norm
 - i perceived behavioural control
 - j intention
 - 3 Used to develop the intervention; components targeted:
 - a behavioural beliefs
 - b outcome evaluations
 - c normative beliefs
 - d motivation to comply
 - e perceived likelihood of occurrence
 - f perceived power
 - g attitude
 - h subjective norm
 - i perceived behavioural control
 - j intention
 - 4 Used to predict or explain:
 - a intention
 - b behaviour
 - c change in intention
 - d behaviour change
 - 5 Test of the TPB:
 - a Prediction of intention and its antecedents
 - b Prediction of behaviour from intention and PBC
 - c Test of (nearly) whole theory
-

APPENDIX 3

Studies Included in the Review (Study Number, Author and Year of Publication)

-
- 1. Anderson, Cox, McKellar, Reynolds, Lean and Mela (1998)
 - 2. Babrow, Black and Tiffany (1990)
 - 3. Beale and Manstead (1991)
 - 4. Black and Babrow (1991)
 - 5. Bowen (1996)
 - 6. Bower, Wolkomir and Schubot (1997)
 - 7. Brubaker and Fowler (1990)
 - 8. Brubaker and Wickersham (1990)
 - 9. Caplan, Vinokur, Price and Van Ryn (1989)
 - 10. Courneya and McAuley (1995)
 - 11. Cox, Anderson, Reynolds, McKellar, Lean and Mela (1998)
 - 12. Crawley and Koballa (1992)
 - 13. Den Ouden (1995)
 - 14. Estabrooks and Carron (1998)
-

(Continued)

Studies Included in the Review (Study Number, Author and Year of Publication) (*Continued*)

-
- 15. Jemmott, Jemmott and Fong (1998)
 - 16. Murphy and Brubaker (1990)
 - 17. Orbell, Hodgkins and Sheeran (1997)
 - 18. Parker, Stradling and Manstead (1996)
 - 19. Porzelius, Houston, Smith and Arfken (1995)
 - 20. Rodgers and Brawley (1993)
 - 21. Sanderson and Jemmott (1996)
 - 22. Sheehan, Schonfeld, Ballard, Schofield, Najman and Siskind (1996)
 - 23. Sheeran and Orbell (1999)
 - 24. Smith, Sondhaus and Porzelius (1995)
 - 25. Tedesco, Keffer, Davis and Christersson (1992)
 - 26. Tedesco, Keffer, Davis and Christersson (1993)
 - 27. Van Ryn and Vinokur (1992)
 - 28. Vinokur, van Ryn, Gramlich and Price (1991)
 - 29. Warden (1991)
 - 30. Warden and Koballa (1995)
-