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Young Driver Safety: A review of behaviour change techniques for future interventions

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Cranfield University
March 2017

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Acknowledgements

The author would like to thank the RAC Foundation for supporting this project. In particular the author would like to thank Elizabeth Box and Steve Gooding for funding the project, as well as for their patience and helpful comments during the report preparation. The author and the RAC Foundation would also like to thank the peer reviewers for their helpful comments on drafts of the report.

Disclaimer

This report has been prepared for the RAC Foundation by Dr Mark Sullman (Cranfield University). Any errors or omissions are the author's sole responsibility. The report content reflects the views of the author and not necessarily those of the RAC Foundation.

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Foreword

Road collisions are a leading cause of death amongst young people and the number of young drivers killed and seriously injured on the nation's roads remains stubbornly high, despite decades of public intervention programmes.

This report finds that the vast majority of today's road safety interventions, for young drivers and other age groups, are based on ideas of what might work rather than on the available theory or research evidence. Few interventions are adequately evaluated and of those that are, the vast majority have not led to demonstrably improved road safety amongst attendees.

Given the limited resources available for road safety interventions, it is vital that the initiatives adopted reduce loss of life and prevent serious injuries to the greatest possible extent.

This report therefore provides some vitally important pointers for practitioners working in road safety, exploring what lessons can be learned from other sectors. In particular it shows what can be learnt from the effectiveness and use of behaviour change techniques in other areas of public health and which techniques have improved intervention success.

Following this report, the RAC Foundation will be developing a practical guide for road safety professionals covering how to develop effective interventions. This guidance will build on the evidence presented in this report with the aim of providing a range of materials to help practitioners develop the most effective interventions.

The aim for all working in road safety – be they policymakers, researchers or practitioners – must be to develop robust, effective and efficient public health interventions. The Foundation looks to play its part, working in partnership with others across this field, to help give young people the best – safest – start to their motoring lives.

Steve Gooding

A handwritten signature in black ink that reads "Steve Gooding". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Director, RAC Foundation

Executive Summary

Introduction

The number of young people killed and injured on UK roads remains high, despite the implementation of many different road safety interventions aimed at pre-drivers and young novice drivers. Several recent reviews have reported that few of these interventions have been adequately evaluated, and that this is the case not just in the UK but also worldwide (Sullman & Dorn, 2015). Furthermore, of those that had been properly evaluated, the vast majority have not led to a significant positive effect on the safety of attendees. Therefore, one of the most important questions is: why have these interventions not improved novice driver safety?

One likely explanation relates to the development of the interventions themselves. Most road safety interventions do not appear to be based upon any theory or research-based evidence, but are instead based upon previous interventions and the designers' opinion of what should work.

In other areas of human health, an extensive body of research has defined and tested different approaches to changing behaviour – otherwise known as 'behaviour change techniques' (BCTs). However, BCTs appear to have been largely ignored in road safety, with only one article on young drivers explicitly mentioning them (Fylan & Stradling, 2014). That article reviewed six UK road safety interventions, and reported that very few BCTs were used in each programme, and moreover that they collectively relied on a very narrow range of BCTs. Therefore, the present review was commissioned to evaluate the evidence to support the different types of BCTs in other areas of health, in order to inform the development of road safety interventions aimed at young novice drivers and pre-drivers.

Method

A literature review was undertaken using three electronic databases (PsychINFO, Scopus and Medline); which identified tens of thousands of articles in the health domain which included BCTs (or a derivative) in the title, keywords or abstract. Due to the extremely large quantity of research in this area, this was not an exhaustive review, but instead focused on identifying relatively recent studies that had been used to change behaviour with regard to obesity, physical exercise, diet and nutrition, as well as drug use (i.e. smoking tobacco and alcohol). The original intention was to focus solely on studies attempting to change the behaviour of adolescents, but in order to increase the evidence base the review was extended to include both adults and children.

Findings

There is a paucity of data on BCTs in the field of driving behaviour. This makes understanding what is likely to be successful and what does not work very difficult. Although this problem is not confined solely to the area of driving, momentum towards defining and noting BCTs in other areas of psychology have improved greatly since 2010.

Using a 26-item taxonomy of BCTs (Abraham & Michie, 2008), it appears that there are several BCTs for which there is substantial evidence that they improve intervention success, many of which were similar in efficacy across the age groups.

For adolescents (13–18 years old), the BCTs most frequently identified in successful interventions were:

- 12 ('Prompt self-monitoring of behaviour');
- 13 ('Provide feedback on performance');
- 8 ('Provide instruction');
- 10 ('Prompt specific goal-setting');
- 1 ('Provide information about behaviour-health link');
- 2 ('Provide information on consequences');
- 11 ('Prompt review of behavioural goals'); and
- 20 ('Plan social support or social change').

Although in adults (18+ years old) the success rates were relatively low, the BCTs most frequently appearing in successful interventions were (in order):

- 12 ('Prompt self-monitoring of behaviour');
- 2 ('Provide information on consequences');
- 5 ('Prompt barrier identification');
- 10 ('Prompt specific goal-setting');
- 13 ('Provide feedback on performance'); and
- 20 ('Plan social support or social change').

In contrast, intervention success rates were found to be much higher among children (4–12 years old), with the following BCTs being identified most often in successful interventions:

- 10 ('Prompt specific goal-setting');
- 12 ('Prompt self-monitoring of behaviour');
- 2 ('Provide information on consequences');
- 8 ('Provide instruction');
- 20 ('Plan social support or social change'); and
- 17 ('Prompt practice').

Across all age groups, the BCTs most commonly identified in successful interventions were (in order):

- 10 ('Prompt specific goal-setting');
- 12 ('Prompt self-monitoring of behaviour');
- 2 ('Provide information on consequences');

- 20 ('Plan social support or social change');
- 8 ('Provide instruction'); and
- 13 ('Provide feedback on performance').

There was a considerable degree of commonality between the three age groups, as four of these BCTs appeared in the lists of successful interventions for all three age groups (2, 10, 12 & 20), while the other two (8 & 13) appeared in the lists for two of the three age groups.

Conclusions

The present review found strong evidence regarding the efficacy of BCTs 10 ('Prompt specific goal-setting'), 12 ('Prompt self-monitoring of behaviour'), 2 ('Provide information on consequences'), 20 ('Plan social support or social change'), 8 ('Provide instruction') and 13 ('Provide feedback on performance'). Intervention designers, and others involved in the safety of young drivers, should weave these BCTs into interventions in order to improve the chances of successfully achieving behaviour change.

There is clearly an urgent need for primary research to develop a body of knowledge regarding BCT effectiveness for improving young driver safety. The present review provides a starting point with regard to the types of BCTs most associated with intervention effectiveness among adolescents, as well as children and adults. It must also be acknowledged that this is only a cross section of the research, rather than an exhaustive review. A broader and more inclusive review of the literature should be undertaken at a later date, when sufficient time has passed for the utilisation of the common terminology proposed by Michie et al. (2015) in their 93-item taxonomy and the request for more complete reporting to have both become common practice.

1. Introduction



1.1 Background

Although there are a number of road safety interventions in operation in the UK, there is no robust evidence that any of these are having the desired effect (Sullman & Dorn, 2015). One of the reasons for this is likely to be that the design of most road safety interventions is not based on any behaviour change theory or research evidence. Furthermore, at the time of this review there was only one peer-reviewed study which looked at behaviour change techniques (BCTs) in relation to young driver safety (Fylan & Stradling, 2014). In Fylan and Stradling's review of road safety interventions, they reported that very few BCTs were used by these individual programmes, and that they collectively relied on a very narrow range of BCTs. However, as Fylan and Stradling did not measure intervention effectiveness, knowledge in this area is currently extremely limited. Although there is little or no information regarding BCTs in relation to improving young novice driver safety, there is a vast body of research pertaining to BCTs for motivating behaviour change in other health-related behaviours. Therefore, in order to more clearly understand the potential of the different types of BCTs to improve road safety amongst young novice drivers, it would be helpful to learn from other areas of psychology, where the accumulated knowledge is considerably larger and more advanced. Consequently, the RAC Foundation has commissioned Cranfield University's Driving Research Group to review the evidence surrounding the use of BCTs to improve health in other areas of life in order to assess which BCTs might be most likely to be effective in the sphere of road safety.

This knowledge will benefit the field by identifying the ‘active ingredients’ that need to be present for behaviour change to be successful, and also highlight those BCTs less likely to be effective. Until researchers and practitioners understand which active ingredients are more likely to be successful, interventions will continue to be based on “common sense” or educated guesses rather than fact. Furthermore, more innovative intervention designers will not know which BCTs to include in their interventions in order to increase the chances of success. Therefore, the main aim of this review is to identify which types of BCTs have been shown to work in other areas of health, and are thus more likely to be effective with pre-drivers and/or young novice drivers. The present review is a small first step in moving young driver interventions from being opinion-based to being evidence-based.

1.2 Organisation of this report

The present review will start by defining BCTs and presenting a taxonomy for classifying them. The second section of the report briefly outlines the methodology used to identify interventions for the review, and the inclusion criteria. Following the method section, the findings are reported according to the health issue addressed. This was divided into four subsections: obesity, physical activity, nutrition, and lastly alcohol and smoking. At the end of the results section, the findings are collated in order to draw overall conclusions from the review. The final sections are made up of the conclusions, recommendations and practical examples of the six most successful BCTs.

1.3 What are behaviour change techniques?

In other areas of public health, practitioners use a wide variety of interventions which are designed to improve health and well-being, with each intervention including one or more BCT(s). BCTs are observable, non-reducible components of an intervention which are designed to change behaviour. Furthermore, for an individual to improve their health in the medium-to-long term, behaviour change must be sustained. Maintaining changes to behaviour can involve both helping to prevent relapses, and ensuring that new behaviours become habitual.

Decades of research have gone into defining and testing various BCTs, but the progress of knowledge in this area has been held back by differences in the definitions and terms used by researchers across the globe. Until recently there was no agreed taxonomy for categorising the different approaches to behaviour change, a situation which naturally resulted in a high degree of confusion regarding the meaning of intervention descriptions. However, in 2008 an attempt was made to provide a more rigorous methodology for characterising intervention content (Abraham & Michie, 2008). This was followed by the CALO-RE taxonomy (the ‘Coventry, Aberdeen and LONDON REfined’ taxonomy), which defined 40 discrete BCTs designed for smoking cessation (Michie et al., 2011a: Appendix A). Most recently, Michie and her colleagues proposed a taxonomy containing 93 non-overlapping BCTs, which were arranged into 16 groupings (Behaviour Change Technique

Taxonomy version 1 – BCTTv1; Michie et al., 2015). There have been several other attempts to develop a taxonomy that is universally agreed upon, but these are amongst the most commonly accepted.

The Abraham and Michie (2008) taxonomy of 26 BCTs will be used to classify BCTs in the current literature review for a number of reasons, which are outlined below. Firstly, this taxonomy has previously been related to road safety, and thus comparisons can be made with those findings (Fylan & Stradling, 2014). Furthermore, as the Abraham and Michie (2008) taxonomy has been around longer than the other taxonomies, many of the more recent interventions have used this taxonomy when reporting the BCTs they used. This is demonstrated by the fact that the 26-item taxonomy has been cited almost 1,200 times, while the 93-item version has been cited 388 times. A further reason for using the 26-item taxonomy is that using the 93-item taxonomy would result in the evidence being spread more thinly across the different BCTs, making it more difficult to identify patterns. Finally, the 26-item taxonomy was easier to use when reviewing the literature, and will also be easier for the target audience to understand. In contrast, it was also thought that the 93-item taxonomy was too unwieldy for this review. The 26 BCTs are labelled and briefly described in Table 1.1.

Table 1.1: Definitions of the 26 behaviour change techniques

Technique	Definition
1. Provide information about behaviour-health link	General information about behavioural risk, for example, susceptibility to poor health outcomes or mortality risk in relation to the behaviour
2. Provide information on consequences	Information about the benefits and costs of action or inaction, focusing on what will happen if the person does or does not perform the behaviour
3. Provide information about others' approval	Information about what others think about the person's behaviour and whether others will approve or disapprove of any proposed behaviour change
4. Prompt intention formation	Encouraging the person to decide to act or set a general goal, for example, to make a behavioural resolution such as "I will take more exercise next week"
5. Prompt barrier identification	Identify barriers to performing the behaviour and plan ways of overcoming them
6. Provide general encouragement	Praising or rewarding the person for effort or performance without this being contingent on specified behaviours or standards of performance
7. Set graded tasks	Set easy tasks, and increase difficulty until target behaviour is performed
8. Provide instruction	Telling the person how to perform a behaviour and/or preparatory behaviours
9. Model or demonstrate the behaviour	An expert shows the person how to correctly perform a behaviour, for example, in class or on video
10. Prompt specific goal-setting	Involves detailed planning of what the person will do, including a definition of the behaviour specifying frequency, intensity, or duration and specification of at least one context, that is, where, when, how, or with whom
11. Prompt review of behavioural goals	Review and/or reconsideration of previously set goals or intentions

Technique	Definition
12. Prompt self-monitoring of behaviour	The person is asked to keep a record of specified behaviour(s) (e.g. in a diary)
13. Provide feedback on performance	Providing data about recorded behaviour or evaluating performance in relation to a set standard or others' performance, i.e. the person received feedback on their behaviour
14. Provide contingent rewards	Praise, encouragement, or material rewards that are explicitly linked to the achievement of specified behaviours
15. Teach to use prompts or cues	Teach the person to identify environmental cues that can be used to remind them to perform a behaviour, including times of day or elements of contexts
16. Agree on behavioural contract	Agreement (e.g. signing) of a contract specifying behaviour to be performed so that there is a written record of the person's resolution witnessed by another
17. Prompt practice	Prompt the person to rehearse and repeat the behaviour or preparatory behaviours
18. Use follow-up prompts	Contacting the person again after the main part of the intervention is complete
19. Provide opportunities for social comparison	Facilitate observation of non-expert others' performance for example, in a group class or using video or case study
20. Plan social support or social change	Prompting consideration of how others could change their behaviour to offer the person help or (instrumental) social support, including 'buddy' systems and/or providing social support
21. Prompt identification as a role model	Indicating how the person may be an example to others and influence their behaviour or provide an opportunity for the person to set a good example
22. Prompt self-talk	Encourage use of self-instruction and self-encouragement (aloud or silently) to support action
23. Relapse prevention	Following initial change, help identify situations likely to result in readopting risk behaviours or failure to maintain new behaviours, and help the person plan to avoid or manage these situations
24. Stress management	May involve a variety of specific techniques (e.g. progressive relaxation) that do not target the behaviour but seek to reduce anxiety and stress
25. Motivational interviewing	Prompting the person to provide self-motivating statements and evaluations of their own behaviour to minimise resistance to change
26. Time management	Helping the person make time for the behaviour (e.g. to fit it into a daily schedule)

Source: Abraham & Michie (2008: 382)

2. Methodology



2.1 Overview of method

This section outlines the methodology that was used to undertake the literature review. Previous literature reviews of young driver interventions (e.g. Sullman & Dorn, 2015) have highlighted the fact that the proportion of road safety interventions which developed their interventions by using behaviour change principles and techniques was very low. Therefore, to get a better understanding of what might work, this review looked beyond the driving behaviour literature into behaviour change research in other areas of health, which have a more developed pool of literature. However, owing to the volume of research involved and the difficulty in identifying BCTs, the aim was not to undertake an exhaustive search, but rather to provide a representative view of the current state of knowledge and evidence regarding BCTs in those other areas

2.2 Procedure

Firstly, the researcher developed a list of search terms which were used to search the following databases: PsychINFO, Medline and Scopus. The search involved paired search terms, starting with the term 'behaviour change techniques' or 'BCT' (including the US spelling), which were individually paired with the following terms: 'obesity', 'diet', 'nutrition', 'driving', 'sex', 'physical activity', 'physical exercise', 'alcohol', 'drugs', 'smoking' and related terms. These search pairs resulted in tens of thousands of articles.

This large pool of articles was further refined by focusing on the following selection criteria:

- age of evaluation: ten or fewer years old (although several interventions were included outside this time frame);
- soundness of evaluation methodology (preferably a randomised controlled trial¹);
- presence of a control group;
- use of non-clinical samples (i.e. those who were not undergoing clinical treatment for a debilitating health condition);
- reliance (preferably) not solely on self-reported data;
- targeting of the appropriate age group (interventions targeting younger participants and adults were included because of difficulties in identifying a sufficient number of adolescent interventions);
- language: interventions were chosen that were written in English; and
- source and reputation: articles in reputable journals with impact factors were included.

The inclusion criteria greatly reduced the number of articles included. However, the main purpose for which the selection criteria were used was to ensure that the evidence reviewed was methodologically sound. Nevertheless, owing to the characteristics of the evaluations and programmes assessed, some degree of flexibility in the inclusion criteria was required – for example, random controlled studies were sought, but in a number of occasions less methodologically sound quasi-experimental studies² were included to broaden the evidence base to be considered.

The method and results sections of all included articles were scrutinised and it was also noted whether the intervention resulted in a statistically significant change in the outcome of interest (i.e. was successful) or did not (i.e. was unsuccessful). The length of time between intervention exposure and the measurement of change was not recorded or used in any way (due to a lack of consistency). The BCTs which were identified in each of the articles were then recorded as being associated with a successful or unsuccessful intervention and the results compiled by health behaviour and age group.

¹ In randomised controlled trials (RCTs) participants are allocated at random (i.e. by chance alone) to receive one of several interventions. One of these interventions is the standard of comparison, normally called the control group. The other is the intervention group which receives the treatment of interest. Random group allocation aims to minimise selection bias, thus enabling us to be more confident that any observed changes were really due to the intervention, rather than arising from existing inter-group differences.

² Quasi-experiments do not use randomisation to allocate participants to the different groups, increasing the risk that the groups differed in some important way before any type of treatment. This experimental design is considered inferior to RCTs.

3. Results



The following section outlines the findings with regard to the BCTs identified in each intervention according to whether they were successful (or not) at changing the behaviour under examination. The most common interventions using BCTs in the arena of health were aimed at reducing or managing obesity. There have been many studies that have attempted to address obesity specifically, while others have attempted to improve aspects of lifestyle that lead to obesity, such as poor diet, lack of physical exercise, insufficient walking, and sedentary activities. Although this review attempted to separate these and to present the evidence individually, many of these studies have attempted to influence behaviour in two of these lifestyle factors. It was also originally planned to review the literature concerning interventions in relation to drug use and sexual health. However, there were too few interventions in the sexual health area that had clear BCTs, and the literature concerning drugs (ranging from smoking tobacco to using Class A drugs) also suffers from this problem, and was further complicated by the necessity for medical interventions in many cases. Therefore, sexual health was excluded from this review and there is only a very small section on smoking and use of alcohol.

The smoking section presents the findings from two reviews, an audit of stop-smoking interventions in the UK (West et al., 2010) and an extensive review of the research evidence (Lorenatto et al., 2016), while the section on alcohol interventions also includes two reviews of the literature on this topic (Michie et al., 2012; Tanner-Smith & Lipsey, 2015). The four reviews in this section did not simply rely on information contained within journal articles or reports, but involved also contacting authors and obtaining intervention manuals, along with other supplementary materials, activities which were outside the scope of the present review.

The findings from the present review are presented across five sections, based upon the health issue being addressed: driving, obesity, physical exercise, diet & nutrition, and drugs. Where possible an attempt has been made to separately report the interventions that were aimed at children, adolescents and adults.

3.1 Young driver interventions

Firstly, there was only one journal article on young drivers or pre-drivers which also included 'behaviour change techniques' in the title, keywords or abstract. This article was the previously mentioned work by Fylan and Stradling (2014), which, as stated, did not evaluate intervention success and thus will not be included in the results section.

3.2 Obesity

This section presents the BCTs identified in the interventions reviewed on this topic using the 26-item taxonomy (Abraham & Michie, 2008). It was also noted whether the intervention successfully changed behaviour, in order to separate BCTs which appeared more often in successful interventions and those which appeared more often in unsuccessful interventions.

Table 3.1: Behaviour change techniques identified in interventions aimed at managing or preventing obesity

Behaviour change technique	Children			Adults		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
1. Provide information about behaviour-health link	0	2	0%	–	–	N/A
2. Provide information on consequences	8	2	80%	5	1	83.3%
3. Provide information about others' approval	0	1	0%	–	–	N/A
4. Prompt intention formation	0	1	0%	–	–	N/A
5. Prompt barrier identification	3	4	43%	3	0	100%
6. Provide general encouragement	1	0	100%	–	–	N/A
7. Set graded tasks	2	0	100%	–	–	N/A
8. Provide instruction	4	4	50%	3	1	75%
9. Model or demonstrate the behaviour	3	1	75%	–	–	N/A

Behaviour change technique	Children			Adults		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
10. Prompt specific goal-setting	6	6	50%	5	1	83.3%
11. Prompt review of behavioural goals	3	1	75%	1	0	100%
12. Prompt self-monitoring of behaviour	7	4	64%	4	1	80%
13. Provide feedback on performance	1	1	50%	5	1	83.3%
14. Provide contingent rewards	4	6	40%	–	–	N/A
15. Teach to use prompts or cues	0	1	0%	–	–	N/A
16. Agree on behavioural contract	2	3	40%	–	–	N/A
17. Prompt practice	5	1	83%	–	–	N/A
18. Use follow-up prompts	–	–	–	1	0	100%
19. Provide opportunities for social comparison	0	2	0%	–	–	N/A
20. Plan social support or social change	4	4	50%	3	0	100%
21. Prompt identification as a role model	4	0	100%	–	–	N/A
22. Prompt self-talk	1	0	100%	–	–	N/A
23. Relapse prevention (relapse prevention therapy)	3	1	75%	–	–	N/A
24. Stress management	3	0	100%	–	–	N/A
25. Motivational interviewing	0	1	0%	–	–	N/A
26. Time management	–	–	–	–	–	N/A

Note: N/A – not applicable

Source: Author's own

In total, 14 randomised controlled trials which attempted to manage or prevent childhood obesity were reviewed (Chen et al., 2010; Fitzgibbon et al., 2005, 2006; Gentile et al., 2009; Golley et al., 2007; Janicke et al., 2008; Johnson et al., 1997; Kalavainen et al., 2007; Nader et al., 1999; Nemet et al., 2005; Reilly et al., 2006; Salmon et al., 2005; Singh et al., 2009; Tanofsky-Kraff et al., 2010). In total, ten of the interventions reviewed were successful

in reducing BMI (body mass index), while four were not successful. All studies included used an objective measure (BMI) as the outcome measure. The studies were categorised according to whether the study explicitly mentioned any of the BCTs included in the Abraham and Michie (2008) taxonomy. These were then divided into the interventions which resulted in a significant change in the outcome of interest (BMI) and those that did not.

Table 3.1 presents the 26 BCTs and the frequency with which they occurred in interventions that were successful in reducing BMI among children and those which were not. There were an average of 7.5 (range 3–15) BCTs identified across these interventions, with no obvious difference in the mean number of BCTs coded between effective and non-effective interventions. The most commonly identified BCTs, in successful interventions, were ‘Provide information on consequences’ (BCT 2), ‘Prompt self-monitoring of behaviour’ (BCT 12), ‘Prompt specific goal-setting’ (BCT 10) and ‘Prompt practice’ (BCT 17). The success rates (effective vs non-effective interventions) of these four BCT types, in order from most to least successful, were: ‘Prompt practice’ (83%), ‘Provide information on consequences’ (80%), ‘Prompt self-monitoring of behaviour’ (64%) and ‘Prompt specific goal-setting’ (50%). However, there also appears to be evidence that ‘Prompt identification as a role model’ (BCT 21) is another successful approach, with 100% success in the four interventions using this BCT. An additional four BCTs achieved 100% success, but these were only found in 1 to 3 interventions each, meaning that there is not enough evidence to be sure that this was not simply due to the low number identified.

The effectiveness ratios also highlighted the BCTs that were components of non-effective trials. Six BCTs were shown to be 100% non-effective (‘Provide information about behaviour-health link’, ‘Provide information about others’ approval’, ‘Prompt intention formation’, ‘Teach to use prompts or cues’, ‘Provide opportunities for social comparison’ and ‘Motivational interviewing’).

There were six randomised controlled trial (RCT) interventions which aimed to reduce BMI among obese or overweight adults (Allman-Farinelli et al., 2016; Appel et al., 2011; Chambliss et al., 2011; Collins et al., 2012; Hunter et al., 2008; Kraschnewski et al., 2011). Five interventions successfully reduced participant BMI and one did not. An average of five BCTs were identified per intervention (range 3–8), but only nine different BCTs were identified in total. The most commonly identified successful interventions were BCTs 2 (Provide information on consequences), 10 (Prompt specific goal-setting), 13 (‘Provide feedback on performance’) and 12 (‘Prompt self-monitoring of behaviour’). As there was only one intervention which was not successful, the success rates for these four BCTs ranged from 75% to 100%. Surprisingly only one study could be found which focused on reducing obesity among adolescents (Brownell, Kelman & Stunkard, 1983), but as this was only a single very old study it was not included in this review.

3.3 Physical activity

The third section of this report summarises the literature regarding interventions aimed at increasing physical activity. Unsurprisingly, most of the literature involved interventions aimed

at overweight and obese adults. Although there were not enough interventions identified which aimed to increase physical activity in overweight/obese children and adolescents, there were enough studies which aimed to increase walking in children, adolescents and adults. Therefore, this section includes two sets of summaries, the first of which is focused on interventions which aimed to increase walking in all three groups and the second of which aimed to increase physical activity in overweight/obese adults as well as non-obese adolescents.

3.3.1 Walking interventions

This section reviews the literature regarding interventions aimed at increasing walking among children, adolescents and adults. There were nine interventions identified among children (Bungum, Clark & Aguilar, 2014; Ford, Perkins & Swaine, 2013; McKee et al., 2007; McMinn et al., 2012; Mendoza, Levinger & Johnston, 2009; Mendoza et al., 2011; Morrison et al., 2013; Sirard et al., 2008; Wen et al., 2008), three among adolescents (Lee et al., 2012; Schofield, Mummery & Schofield, 2005; Shimon & Petlichkoff, 2009) and six among adults (Butler et al., 2009; Calfas et al., 1996; Gilson et al., 2007; Halbert et al., 2000; Hemmingsson et al., 2009; Norris et al., 2000).

Six of the nine interventions among children were successful, and all three of the interventions among adolescents were successful. Four of the six interventions which aimed to increase walking among adults were successful, with the remaining two being unsuccessful. All of the interventions involving adults were RCTs and used an objective method of determining walking behaviour (a pedometer). Although all of the adolescent interventions also used a pedometer, only one of the three was an RCT. Of the interventions among children, five were RCTs, with the remainder (four) being quasi-experimental. Five of the nine recorded walking behaviour using an objective method (an accelerometer) and the remainder (four) used various types of self-reporting. Therefore, the results among children may be viewed with some degree of caution as three of the six successful interventions used self-reported data (e.g. asking for a show of hands in class, or asking them to complete a travel behaviour survey). Of the five using objective methods to collect walking behaviour, three significantly increased walking behaviour and two resulted in no significant increase in walking. The majority of the studies involving children or adolescents were delivered in an educational setting (school), while those involving adults were delivered at a community level.

There were several BCTs that were not identified in any of the interventions reviewed among children (1, 3, 4, 5, 6, 11, 15, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26), similarly for adolescents (1, 3, 4, 5, 6, 7, 9, 11, 15, 16, 18, 19, 21, 22, 23, 24, 25, 26), and somewhat less so for adults (3, 9, 14, 17, 21, 22, 24, 25, 26). This is most likely due to a lack of detail in the articles, as many of these interventions were conducted and published before the Abraham and Michie (2008) taxonomy was published – or at least before it became well known. For example, it is unlikely that any of the authors of the studies published before 2010 would have seen this taxonomy before submitting their papers for publication (this applies to 12 of the 18 studies) or read the plea for adequate reporting of behavioural interventions (Michie & Abraham, 2008).

Table 3.2: Behaviour change techniques in interventions to increase walking in children, adolescents and adults

Behaviour change technique	Children			Adolescents			Adults			Overall
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective	
1. Provide information about behaviour-health link	-	-	-	-	-	-	1	1	50%	50% n=2
2. Provide information on consequences	1	0	100%	1	0	100%	3	1	75%	83.3% n=6
3. Provide information about others' approval	-	-	N/A	-	-	N/A	-	-	N/A	N/A
4. Prompt intention formation	-	-	N/A	-	-	N/A	2	1	66.7%	66.7% n=3
5. Prompt barrier identification	-	-	N/A	-	-	N/A	3	2	60%	60.0% n=5
6. Provide general encouragement	-	-	N/A	-	-	N/A	3	1	75%	75.0% n=4
7. Set graded tasks	3	1	75%	2	0	100%	1	0	100%	85.7% n=7
8. Provide instruction	2	1	66.7%	-	-	N/A	1	0	100%	75.0% n=4
9. Model or demonstrate the behaviour	0	1	0%	-	-	N/A	-	-	N/A	0% n=1
10. Prompt specific goal-setting	1	2	33.3%	3	0	100%	4	0	100%	80.0% n=10
11. Prompt review of behavioural goals	-	-	N/A	-	-	N/A	1	0	100%	100% n=1
12. Prompt self-monitoring of behaviour	2	2	50%	3	0	100%	3	2	60%	66.7% n=12
13. Provide feedback on performance	2	2	50%	3	0	100%	3	1	75%	72.7% n=11

Behaviour change technique	Children			Adolescents			Adults			Overall	
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective	% Effective	% Effective
	14. Provide contingent rewards	0	1	0%	1	0	100%	-	-	N/A	N/A
15. Teach to use prompts or cues	-	-	N/A	-	-	N/A	-	1	0%	0%	0% n=1
16. Agree on behavioural contract	-	-	N/A	-	-	N/A	1	1	50%	50%	50% n=2
17. Prompt practice	-	-	N/A	0	2	0%	-	-	N/A	N/A	0% n=2
18. Use follow-up prompts	-	-	N/A	-	-	N/A	2	0	100%	100%	100% n=2
19. Provide opportunities for social comparison	-	-	N/A	-	-	N/A	2	1	66.7	66.7%	66.7% n=3
20. Plan social support or social change	4	1	80%	2	0	100%	2	2	50%	50%	72.7% n=11
21. Prompt identification as a role model	-	-	N/A	-	-	N/A	-	-	N/A	N/A	N/A
22. Prompt self-talk	-	-	N/A	-	-	N/A	-	-	N/A	N/A	N/A
23. Relapse prevention	-	-	N/A	-	-	N/A	1	1	50%	50%	50% n=2
24. Stress management	-	-	N/A	-	-	N/A	-	-	N/A	N/A	N/A
25. Motivational interviewing	-	-	N/A	-	-	N/A	-	-	N/A	N/A	N/A
26. Time management	-	-	N/A	-	-	N/A	-	-	N/A	N/A	N/A

Note: N/A – not applicable
Source: Author's own

Table 3.2 shows that the BCT most commonly found in successful interventions among children was 'Plan social support or social change' (BCT 20), followed by 'Set graded tasks' (BCT 7). These two were successful in 80% and 75% respectively of the interventions in which they appeared, although it should be mentioned that there were very small numbers of BCTs identified overall. This, as mentioned above, was perhaps due to a lack of detail included in the articles. The most common BCTs used in adolescent interventions were: 'Prompt specific goal-setting' (BCT 10), 'Prompt self-monitoring of behaviour' (BCT 12) and 'Provide feedback on performance' (BCT 13). These three BCTs were effective in 100% of the interventions that included them (n=3), but this is due to the fact that only three interventions were identified, and all three were successful.

In adults, the most common BCTs were 'Prompt barrier identification' (BCT 5) and 'Prompt self-monitoring of behaviour' (BCT 12), which were found in five of the six interventions. These were followed by: 'Provide information on consequences' (BCT 2), 'Provide general encouragement' (BCT 6), 'Prompt specific goal-setting' (BCT 10), 'Provide feedback on performance' (BCT 13) and 'Plan social support or social change' (BCT 20). The two BCTs that were identified in five different interventions (BCTs 5 and 12) were both successful in 60% of the interventions, with those identified four times being successful in 83.3%, 75%, 100% and 50% of the interventions respectively. This would appear to show strong support for 'Prompt specific goal-setting', 'Provide information on consequences' and 'Provide general encouragement'.

Due to the relatively small number of studies considered in this section, particularly with regard to adolescents, the findings were combined from these three age groups to try and develop a clearer picture of BCT effectiveness. This showed that the most common BCT overall was 'Prompt self-monitoring of behaviour', which was identified in 12 interventions (66.7% successful), this was followed by 'Provide feedback on performance' (n=11, 72.7% successful), 'Plan social support or social change' (also n=11, 72.7% successful), and after these 'Prompt specific goal-setting' (N=10, 80% successful). Therefore, there is reasonable support for these four BCTs being able to increase walking among children and adolescents drawn from the general population.

3.3.2 Interventions to increase general physical activity

Table 3.3: Behaviour change techniques in interventions to increase physical activity in overweight/obese adults and non-obese adolescents

Behaviour change technique	Adolescents			Adults		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
1. Provide information about behaviour-health link	1	7	12.5%	–	–	N/A
2. Provide information on consequences	1	2	33.3%	2	0	100%
3. Provide information about others' approval	–	–	N/A	–	–	N/A
4. Prompt intention formation	3	6	33.3%	–	–	N/A
5. Prompt barrier identification	3	3	50%	–	–	N/A
6. Provide general encouragement	1	5	16.7%	–	–	N/A
7. Set graded tasks	2	5	28.6%	2	0	100%
8. Provide instruction	3	10	40%	1	0	100%
9. Model or demonstrate the behaviour	2	3	40%	1	0	100%
10. Prompt specific goal-setting	–	–	N/A	3	0	100%
11. Prompt review of behavioural goals	0	1	0%	3	0	100%
12. Prompt self-monitoring of behaviour	3	10	23.1%	3	0	100%
13. Provide feedback on performance	1	5	16.7%	3	0	100%
14. Provide contingent rewards	0	3	0%	–	–	N/A
15. Teach to use prompts or cues	1	0	100%	3	0	100%
16. Agree on behavioural contract	1	1	50%	–	–	N/A
17. Prompt practice	3	6	33.3%	–	–	N/A
18. Use follow-up prompts	1	4	20%	–	–	N/A
19. Provide opportunities for social comparison	4	12	25%	1	0	100%

Behaviour change technique	Adolescents			Adults		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
20. Plan social support or social change	3	6	33.3%	2	0	100%
21. Prompt identification as a role model	–	–	N/A	–	–	N/A
22. Prompt self-talk	1	0	100%	–	–	N/A
23. Relapse prevention	3	5	37.5%	–	–	N/A
24. Stress management	2	3	40%	–	–	N/A
25. Motivational interviewing	0	1	0%	–	–	N/A
26. Time management	1	1	50%	–	–	N/A

Note: N/A – not applicable

Source: Author's own

There were three interventions which aimed to increase physical activity amongst adolescents (Lee et al., 2012; Lubans & Sylva, 2006; Sloopmaker et al., 2010), one of which used self-reported behaviour measures (Lubans & Sylva, 2006), while the other two used objective outcomes. All three interventions made significant improvements to behaviour and included very similar BCTs, with all three including BCTs 8 ('Provide instruction'), 10 ('Prompt specific goal-setting'), 11 ('Prompt review of behavioural goals'), 12 ('Prompt self-monitoring of behaviour'), 13 ('Provide feedback on performance') & 15 ('Teach to use prompts or cues'). As all three interventions were successful, there were no BCTs that were unsuccessful.

There were 17 RCTs reviewed which aimed to increase physical activity among adults, including: Berry et al., 2007; Burke et al., 2005, 2007, 2008; Carels et al., 2004; Craighead & Blum, 1989; Dallow & Anderson, 2003; Dubbert & Wilson, 1984; James & May Hampton, 1982; Kreuter et al., 2000; Leermakers et al., 1999; Rapoport, Clark & Wardle, 2000; Riebe et al., 2003; 2005; Sbrocco et al., 1999; Tudor-Locke et al., 2004; Wing et al., 1985. About half of the studies measured physical exercise using an objective measure (e.g. a pedometer), while the remainder relied on self-reported activity. The studies were categorised according to whether they explicitly mentioned any of the BCTs included in the Abraham and Michie (2008) taxonomy, which were again divided into effective and non-effective interventions.

Surprisingly, only four of the 17 interventions were successful at increasing physical activity. There were between 4 and 12 BCTs identified across these interventions, with no clear difference between effective and non-effective interventions. However, many of these studies had control groups which were also clearly exposed to BCTs, making it difficult for the treatment group to perform significantly better than the control group. For example, Riebe

et al. (2005) included almost exactly the same 11 interventions in the treatment group as those included in the control group. Although this was the most extreme example, most of the other studies clearly included several different BCTs in their control groups, making it less likely that the intervention group would display a significantly larger behaviour change than the control group.

The most common BCT found in successful interventions was 'Provide opportunities for social comparison' (Table 3.3). However, although this BCT was successful in four interventions this BCT was also included in 12 unsuccessful interventions. The next most common BCTs (found in successful interventions) were 'Prompt intention formation' (BCT 4), 'Prompt barrier identification' (BCT 5), 'Provide instruction' (BCT 8), 'Prompt self-monitoring of behaviour' (BCT 12), 'Prompt practice' (BCT 17), 'Plan social support or social change' (BCT 20) and 'Relapse prevention' (BCT 23), which were all successful on three occasions. However, the number of ineffective interventions which also included these BCTs were at least as high as the number which successfully increased physical activity amongst overweight and obese adults. Among the 26 techniques identified by Abraham and Michie (2008), 'Providing information on others' approval', 'Prompt specific goal-setting' and 'Prompt identification as a role model' were not identified in any of the studies reviewed.

In conclusion, there is relatively weak evidence to support several of the BCTs for increasing physical activity in overweight/obese adults. This might simply be because this particular group is unusually challenging, or that this behaviour (physical activity) is very difficult to change among this group. However, the most likely explanation is that using control groups which were also exposed to BCTs contributed substantially to the low number of successful interventions. Unfortunately there is relatively little evidence to consider interventions among adolescents, and two of these studies relied solely on self-reported behaviour. However, of the studies that were reviewed, all were successful.

3.4 Nutrition

The fourth section presents the research using BCTs to influence diet. As mentioned earlier, there were many different studies which attempted to address or prevent obesity by a number of different methods, including increasing physical activity, reducing sedentary activities, improving diet or a combination of these. Therefore, in order to reduce crossover between these interventions, this section deals with interventions that aimed to increase intake of dairy foods or calcium among children and adolescents. These were less frequently paired with other types of outcomes (i.e. increasing physical activity or reducing sedentary behaviour). This section included 31 interventions, which were composed of 14 interventions among children and 17 interventions among adolescents. In total, 10 of the 14 interventions among children successfully increased dairy or calcium intake and 12 of the 17 interventions were successful among adolescents.

Table 3.4 presents the individual BCTs used in successful and unsuccessful interventions to increase calcium intake among children and adolescents. Among children the most common were 'Prompt intention formation' (BCT 4), 'Provide general encouragement'

(BCT 6), 'Provide instruction' (BCT 8), 'Prompt specific goal-setting' (BCT 10) and 'Prompt practice' (BCT 17). 'Prompt practice' was successful in 100% of the six interventions which included this technique, while the other four BCTs were successful in 75% of the interventions in which they were used, providing strong evidence that these five BCTs are effective for increasing calcium or dairy intake among children. There was also reasonable evidence that BCTs 9 ('Model or demonstrate the behaviour') and 19 ('Provide opportunities for social comparison') were more common in effective interventions. However, there were no interventions identified that used BCTs 16, 22, 23, 24 or 26.

The evidence concerning adolescents was less clear, with generally a lower proportion of successful interventions. However, the BCT used most commonly by successful interventions was BCT 1 ('Provide information about behaviour-health link'), which was used seven times, but only had a success rate of 58.3%. This was followed by BCT 8 ('Provide instruction', 83% success rate), which was identified in five successful interventions. The next most common BCTs were all found in four successful interventions and included BCT 11 ('Prompt review of behavioural goals', 100% success), BCT 4 ('Prompt intention formation', 66.7% success rate) and BCT 2 ('Provide information on consequences'), which had a success rate of 57.1%. As with the interventions aimed at children, there were several BCTs that were not identified in any of the interventions reviewed here (3, 7, 15, 16, 22, 23, 26). In both groups there were also clearly a number of other BCTs that were not included in the Abraham and Michie (2008) taxonomy, such as lessons from a dietician and taste exposure. There was some degree of commonality between the two age groups (children and adolescents), with BCTs 4 ('Prompt intention formation') and 8 ('Provide instruction') being among the most successful BCTs in both age groups.

Table 3.4: Behaviour change techniques in interventions to increase dairy or calcium intake among children and adolescents

Behaviour change technique	Children			Adolescents		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
1. Provide information about behaviour-health link	3	1	75%	7	5	58.3%
2. Provide information on consequences	3	2	60%	4	3	57.1%
3. Provide information about others' approval	2	0	100%	–	–	N/A
4. Prompt intention formation	6	2	75%	4	2	66.7%
5. Prompt barrier identification	2	1	66.7%	3	2	60%
6. Provide general encouragement	6	2	75%	3	1	75%
7. Set graded tasks	0	2	0%	–	–	N/A

Behaviour change technique	Children			Adolescents		
	Effective	Non-effective	% Effective	Effective	Non-effective	% Effective
8. Provide instruction	6	2	75%	5	1	83.3%
9. Model or demonstrate the behaviour	5	2	71.4%	3	3	50%
10. Prompt specific goal-setting	6	2	75%	2	3	40%
11. Prompt review of behavioural goals	2	2	50%	4	0	100%
12. Prompt self-monitoring of behaviour	4	3	57.1%	3	0	100%
13. Provide feedback on performance	0	2	0%	3	0	100%
14. Provide contingent rewards	1	1	50%	2	2	50%
15. Teach to use prompts or cues	2	2	50%	–	–	N/A
16. Agree on behavioural contract	–	–	N/A	–	–	N/A
17. Prompt practice	6	0	100%	3	0	100%
18. Use follow-up prompts	2	0	100%	2	0	100%
19. Provide opportunities for social comparison	5	1	83.3%	3	0	100%
20. Plan social support or social change	4	1	80%	3	1	75%
21. Prompt identification as a role model	3	1	75%	0	2	0%
22. Prompt self-talk	–	–	N/A	–	–	N/A
23. Relapse prevention	–	–	N/A	–	–	N/A
24. Stress management	–	–	N/A	2	0	100%
25. Motivational interviewing	1	0	100%	2	0	100%
26. Time management	–	–	N/A	–	–	N/A

Note: N/A – not applicable

Source: Author's own

3.5 Alcohol and smoking

This section summarises the research which attempted to improve behaviour in relation to alcohol consumption and smoking. This section was particularly challenging, as treating addictions often involves going beyond the use of BCTs (e.g. use of medication and/or long-term counselling). This is particularly the case for illegal drugs, which were not included in this review. It was not possible to obtain many of the individual articles within this area, and those which could be obtained did not contain enough information to determine the types of BCTs used. However, this section briefly outlines the findings of four reviews (Lorenzatto et al., 2016; Michie et al., 2012; Tanner-Smith & Lipsey, 2015; West et al., 2010) which sourced information additional to the published journal articles, including treatment protocols and communication with the authors to identify the BCTs used, which was beyond the scope of the present review.

3.5.1 Alcohol

This section briefly covers two reviews of interventions designed to reduce excessive alcohol consumption. Brief alcohol interventions are interventions which have a relatively brief contact time (1 to 5 sessions) and can be undertaken by a wide range of health professionals (e.g. a GP, nurse, psychologist or counsellor). The first of these is a review of 18 RCT brief alcohol interventions (Michie et al., 2012) and the second is a more inclusive systematic review of the research in the area (Tanner-Smith & Lipsey, 2015).

Firstly, Michie et al. examined the relationship between the BCTs specified in the treatment protocols of different brief alcohol interventions and the success or otherwise of the interventions, using the taxonomy proposed by Michie, Churchill and West (2011). This taxonomy was designed specifically for smoking cessation, and although many of its BCTs clearly map onto the Abraham and Michie (2008) taxonomy, several do not. They found that the 18 studies used 19 different types of BCTs, but rather than examining their effectiveness individually they investigated the effectiveness of BCT 'clusters'. The first cluster included BCTs that aimed to maximise motivation to abstain from alcohol or reduce excessive consumption ('Provide information on the consequences of drinking and drinking cessation', 'Boost motivation and self-efficacy', 'Provide normative information about others' behaviour and experiences', 'Prompt commitment from the client there and then', 'Provide rewards contingent on effort or progress' and 'Motivational interviewing').

The second cluster included BCTs that aimed to maximise self-regulatory capacity and skills. These were 'Facilitate action planning / know-how to help identify relapse triggers', 'Facilitate goal-setting', 'Prompt review of goals' and 'Prompt self-recording'. The third cluster included BCTs that did not clearly form part of the other two clusters and included 'Assess current and past drinking behaviour' and 'Offer / direct towards appropriate written materials', none of which appear in the Abraham and Michie (2008) taxonomy.

This study found that the motivational cluster was the most commonly used approach (with 83% of trials used at least one BCT from this cluster), followed by the self-regulation cluster (78%). They also reported that the BCT 'prompting self-recording' was the only BCT

that was reliably associated with greater effect sizes (i.e., a stronger influence on the target behaviour). This BCT appears to be extremely similar, if not exactly the same, as the BCT 'Prompt self-monitoring of behaviour' (BCT 12) in the Abraham and Michie (2008) taxonomy. However, it should also be noted that many of the techniques were only reported by a very small number of interventions, making these comparisons a little difficult to interpret.

The second study conducted a much broader meta-analysis of 185 studies which evaluated brief alcohol interventions among adolescents and young adults. These were divided into interventions which aimed to reduce alcohol consumption and those which attempted to reduce alcohol-related problems. This review included such a large number of studies because, unlike most reviews, it also included quasi-experimental studies (i.e. those which did not randomly allocate participants to the various groups, creating the risk that the groups inherently differed in some important way). Although this creates a risk of bias, as there were not large numbers of RCTs the inclusion of quasi-experimental studies allowed a larger pool of evidence from which to draw conclusions. The study concluded that overall brief alcohol interventions did lead to significant reductions in alcohol consumption and alcohol-related problems, in both adolescents and young adults. Unfortunately, however, this study did not use a specific taxonomy for identifying BCTs, but instead classified them according to what appears to be their own system (i.e. blood alcohol concentration information, alcohol calorie content, decisional balance exercises, general education/information, personalised feedback, goal-setting, provision of cost information, or norm referencing). Owing to the large number of studies reviewed, they were able to statistically analyse the effectiveness of the BCTs.

Two BCTs had significantly larger effects than the others when it came to reducing alcohol consumption amongst adolescents: goal-setting and including decisional balance exercises. The decisional balance approach is not included in the Abraham and Michie (2008) taxonomy, but is from the Transtheoretical Model for Behaviour Change (Prochaska & DiClemente, 1983; Prochaska, DiClemente & Norcross, 1992) and involves principally identifying the cons associated with engaging in the problem behaviour and the pros associated with not engaging in that behaviour. Furthermore, personalised feedback and norm referencing were most effective for reducing alcohol-related problems. It is unfortunate that this research did not use any recognised taxonomy, but clearly there is substantial support for both goal-setting and feedback (these are normally combined, as they are important aspects of goal-setting theory), as well as the use of norms to change behaviour. The effectiveness of norms, and identifying pros and cons, are each framed as BCTs within the 93-item taxonomy, created by Michie et al. (2013), although it is unclear whether these map directly onto the BCTs of the same name in this taxonomy.

It is a great pity that neither of these reviews used a valid taxonomy to classify the BCTs, but it is interesting to note, in the combined findings of these two studies, that goal-setting, feedback and prompting self-monitoring all received support.

3.5.2 Smoking

The use of BCTs to encourage individuals to stop smoking is another relatively complex area, due in part to the addictive nature of smoking, the necessity to treat the addiction in

some way (e.g. nicotine replacement therapy) and the use of BCTs specific to this area. Michie et al. (2011b) developed a 43-item BCT taxonomy to categorise BCTs specifically for smoking cessation, although most of these individual BCTs also appear in the larger and smaller versions of the BCT taxonomies. This section describes the findings of two studies which reviewed the evidence surrounding the effectiveness of BCTs in supporting, or initiating smoking cessation.

The first study investigated the BCTs from 56 RCTs, with only seven of these interventions being successful (West et al., 2010). In this case an intervention was classified as successful if the intervention increased the odds of cessation by at least 50%. These were classified according to the 43-item taxonomy designed specifically for smoking cessation. They found that 37 different BCTs were used in these interventions, with an average of eight BCTs per intervention (range 6–34). The criterion for a successful BCT was that the BCT appeared in two or more successful RCTs, which is not a difficult criterion, even given the fact that there were only seven successful interventions. The BCTs which met this criterion were: 'Provide information on the consequences of smoking and smoking cessation' (n=7), 'Give rewards contingent upon stopping smoking' (n=4), 'Give normative information about others' behaviour and experiences' (n=2), 'Measure CO [Carbon Monoxide]' (n=6), 'Facilitate barrier identification and problem-solving' (n=2), 'Facilitate relapse prevention and coping' (n=3), 'Facilitate action planning / develop treatment plan' (n=5), 'Facilitate goal-setting' (n=6), 'Advise / facilitate use of social support' (n=2), 'Assess current and past smoking behaviour' (n=7), 'Assess current readiness and ability to quit' (n=5) and 'Offer / direct towards appropriate written materials' (n=7). Clearly several of these are specific to smoking, but there are a number of more general BCTs that appear in the Abraham and Michie (2008) taxonomy (i.e. 'Provide information on the consequences', 'Give contingent rewards', 'Give normative information about others' behaviour', 'Facilitate barrier identification', 'Facilitate relapse prevention', 'Facilitate action planning', 'Facilitate goal-setting'). However, it should be noted that the participants in these interventions were all pregnant and thus had a greater motivation to stop smoking.

The second study investigated whether the quality of goal-setting was associated with increased likelihood that the individual will attempt to stop smoking (Lorenzatto et al., 2016). The researchers analysed the transcripts of practitioners who delivered stop-smoking advice (n=85) and then their clients self-reported attempts to quit smoking at follow-up. This found that only 21% of the 85 smokers reported initiating an attempt to quit smoking, with the remainder continuing to smoke. However, interestingly the researchers found wide variations in the quality of the goal-setting process, which translated into clear and significant differences in self-reported attempts to quit smoking. The issue of BCT fidelity is an important one, encompassing all BCTs and having important implications for the success or failure of the attempt to change behaviour. This clearly also highlights the importance of having knowledgeable and highly skilled individuals delivering the intervention, as without high-quality delivery the BCTs cannot be expected to change behaviour.

Across these two reviews it appears that interventions more often than not failed to motivate smoking cessation. However, these two reviews on the BCTs also appear to provide some support for high-quality goal-setting (BCT 10), BCT 2 ('Provide information

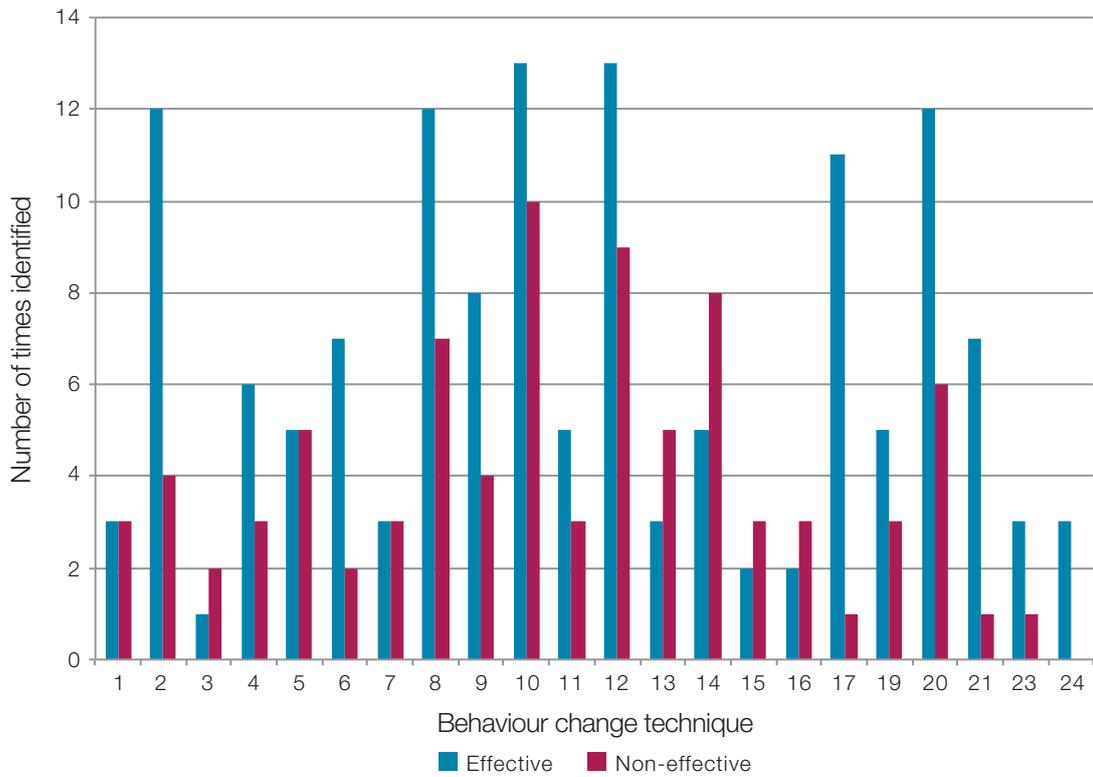
on consequences'), BCT 5 ('Prompt barrier identification'), BCT 14 ('Provide contingent rewards'), BCT 20 ('Plan social support or social change') & BCT 23 ('Relapse prevention (relapse prevention therapy)'). Goal-setting is the only one of these BCTs which is also supported in the reviews of brief alcohol interventions.

3.6 Summary of results

In order to provide more clarity regarding which BCTs were more likely to facilitate behaviour change, by age group, the information on successful and unsuccessful BCTs (excluding those on smoking and alcohol) were combined and are summarised in the following section.

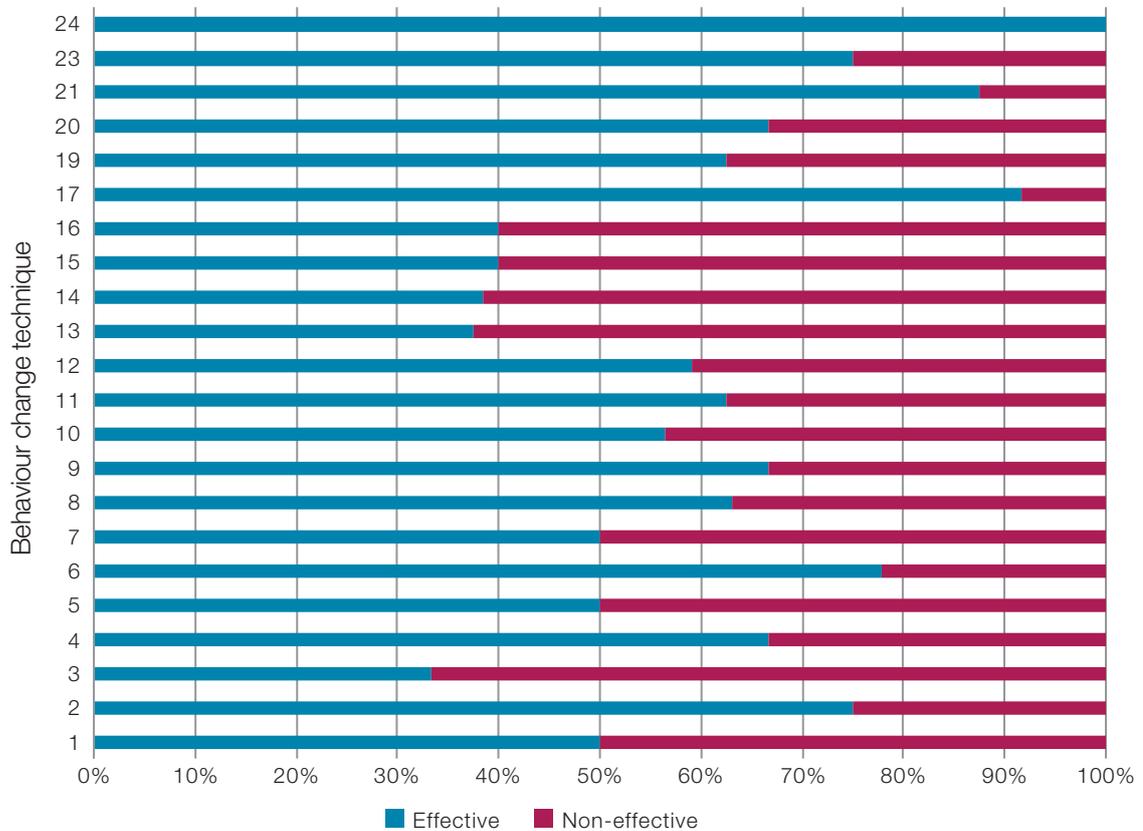
Figure 3.1 provides an overall summary of which BCTs were associated with successful vs unsuccessful interventions across all health problems for children. This shows that BCTs 10 ('Prompt specific goal-setting') and 12 ('Prompt self-monitoring of behaviour') were most often identified in successful interventions, followed by BCTs 2 ('Provide information on consequences'), 8 ('Provide instruction'), 20 ('Plan social support or social change') and 17 ('Prompt practice'). As intervention success is only part of the story, it is also important to consider BCT presence in intervention failure. The BCTs most commonly identified in unsuccessful interventions were BCTs 10 ('Prompt specific goal-setting'), 12 ('Prompt self-monitoring of behaviour'), 14 ('Provide contingent rewards'), 8 ('Provide instruction') and 20 ('Plan social support or social change'). Interestingly, four of the five BCTs most commonly identified in unsuccessful interventions were also commonly identified in successful interventions. The one 'unsuccessful' BCT which was not in the list of most successful BCTs was BCT 14, which shows that this BCT is more clearly associated with unsuccessful interventions. BCTs 18, 22, 25 and 26 were excluded from this figure, owing to very low numbers (i.e. they were identified in two or fewer interventions).

Figure 3.1: The number of times each behaviour change technique was identified in successful vs unsuccessful interventions targeting children (behaviour change techniques 18, 22, 25 & 26 excluded)



Source: Author's own

Figure 3.2: Success vs failure for each behaviour change technique identified amongst interventions targeting children (behaviour change techniques 18, 22, 25 & 26 excluded)

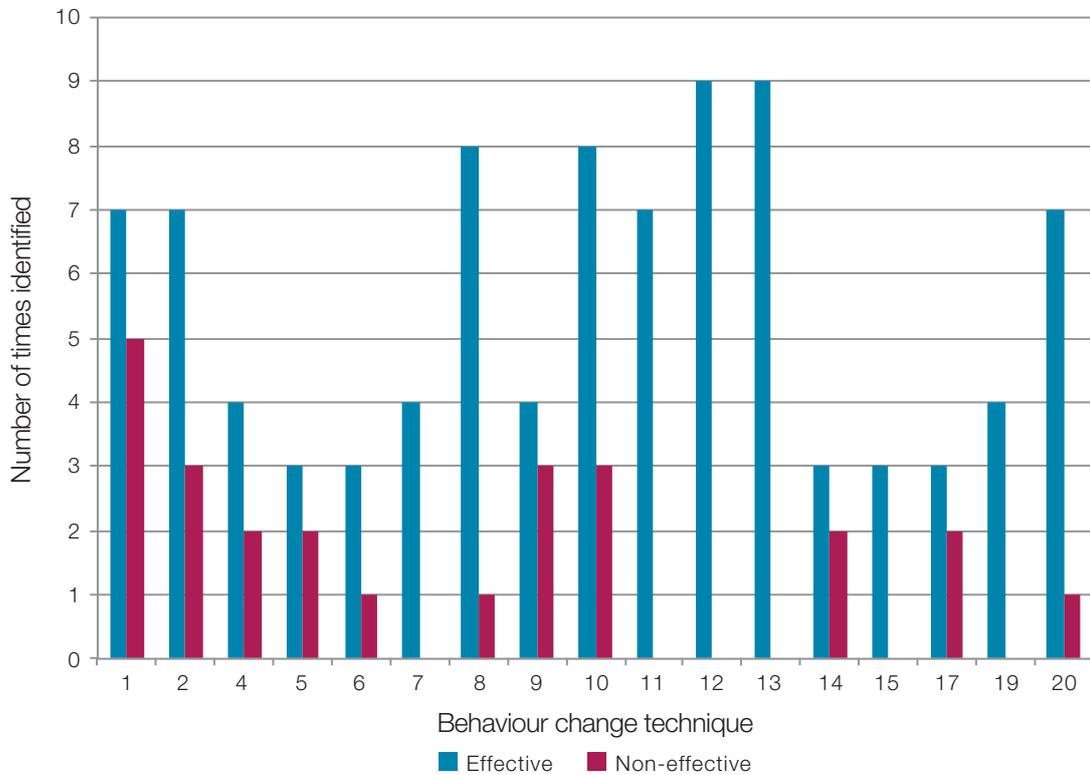


Source: Author's own

Figure 3.2 shows (still across all health behaviours for children) the proportion at which each BCT appeared in a successful intervention compared with an unsuccessful intervention. Only one BCT was 100% successful (BCT 24, 'Stress management'), although this BCT was only identified three times, meaning that the evidence supporting this BCT was weak. There were, however, many BCTs which had success rates of 70% or above: BCTs 2, 6, 17, 21 and 23 (the number of times they were identified in successful interventions being 16, 9, 12, 8 and 4 respectively).

There were also several BCTs which were unsuccessful in more than half of the interventions they were identified in: BCTs 3, 13, 14, 15 and 16, indicating that these BCTs were more clearly associated with interventions that were unsuccessful (n=2, 5, 8, 3 and 3 respectively).

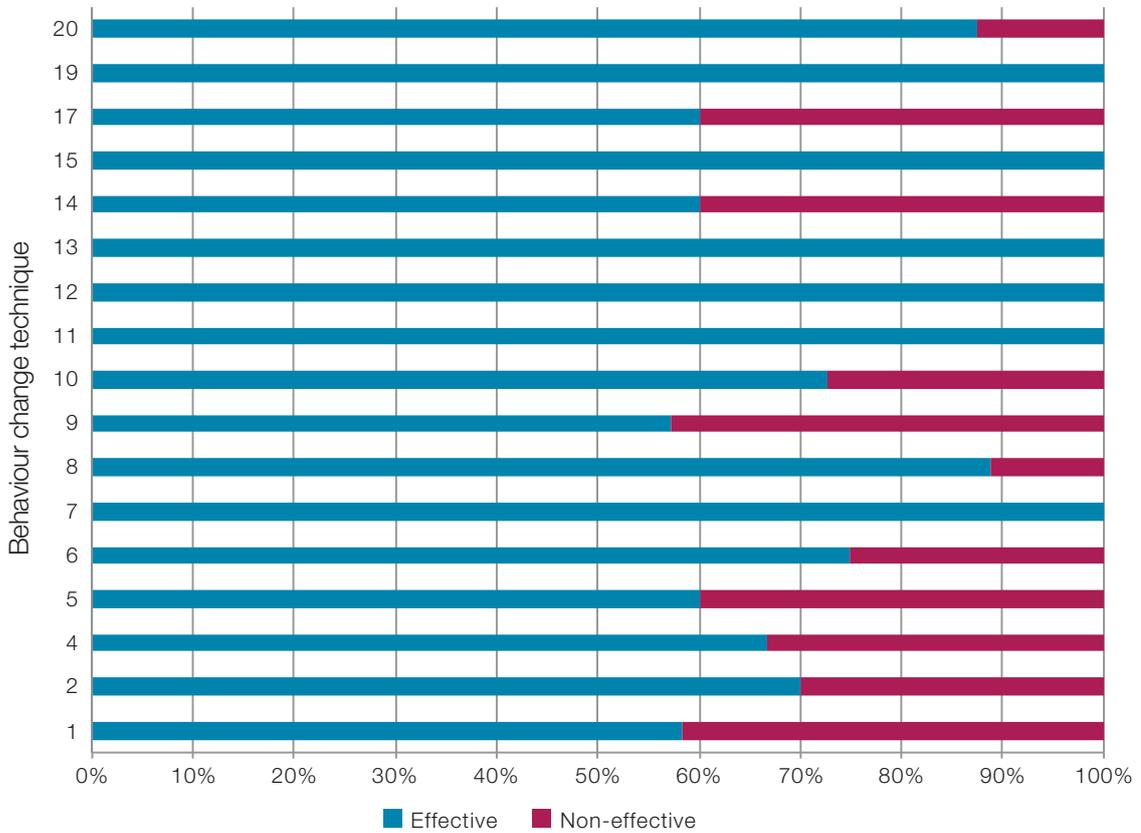
Figure 3.3: The number of times each behaviour change technique was identified in successful vs unsuccessful interventions targeting adolescents (behaviour change techniques 3, 16, 18 and 21–26 excluded)



Source: Author's own

Figure 3.3 provides an overall summary of which BCTs were associated with successful vs unsuccessful interventions across all health problems for adolescents (3, 16, 18, 21, 22, 23, 24, 25 and 26 excluded). The BCTs most commonly associated with successful interventions were: 12 (n=9), 13 (n=9), 8 (n=8), 10 (n=8), 1 (n=7), 2 (n=7), 11 (n=7) & 20 (n=7). Several of the BCTs found in adolescent interventions were associated only with success (i.e. 7, 11, 12, 13 & 19). Many of the BCTs were not included in the graph, as these were identified in too few interventions (two or fewer).

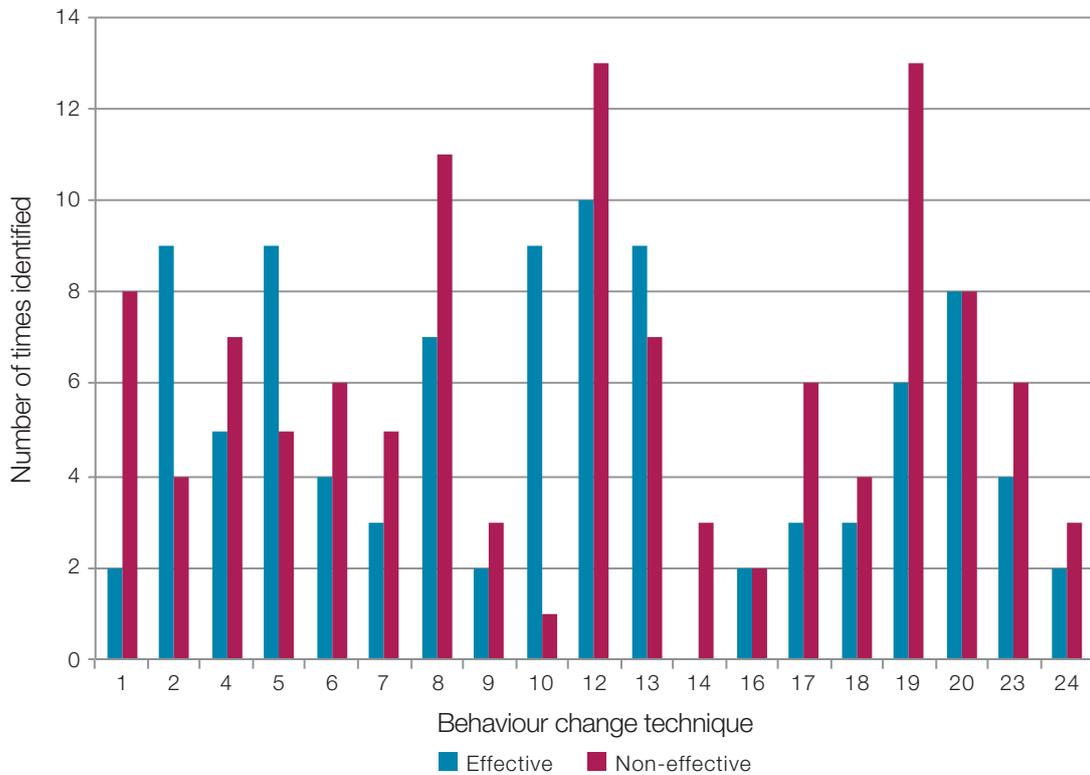
Figure 3.4: Success vs failure for each behaviour change technique identified amongst interventions targeting adolescents (behaviour change techniques 3, 16, 18 and 21–26 excluded)



Source: Author's own

Figure 3.4 shows that BCTs 12 (n=9), 13(n=9), 11 (n=7), 19 (n=4), 7 (n=4) and 15 (n=3) were 100% successful when included in an intervention. However, these only appeared in 4 to 9 interventions, meaning that the evidence for them was not extremely strong. There were also a number of BCTs that were successful in more than 70% of interventions in which they were identified: BCTs 2 (n=7), 6 (n=3), 10 (n=8), 8 (n=7) and 20 (n=7). In contrast, the least successful was BCT 9 (n=4) which was only successful in 57% (i.e. four successful and three unsuccessful) of the interventions in which it was identified.

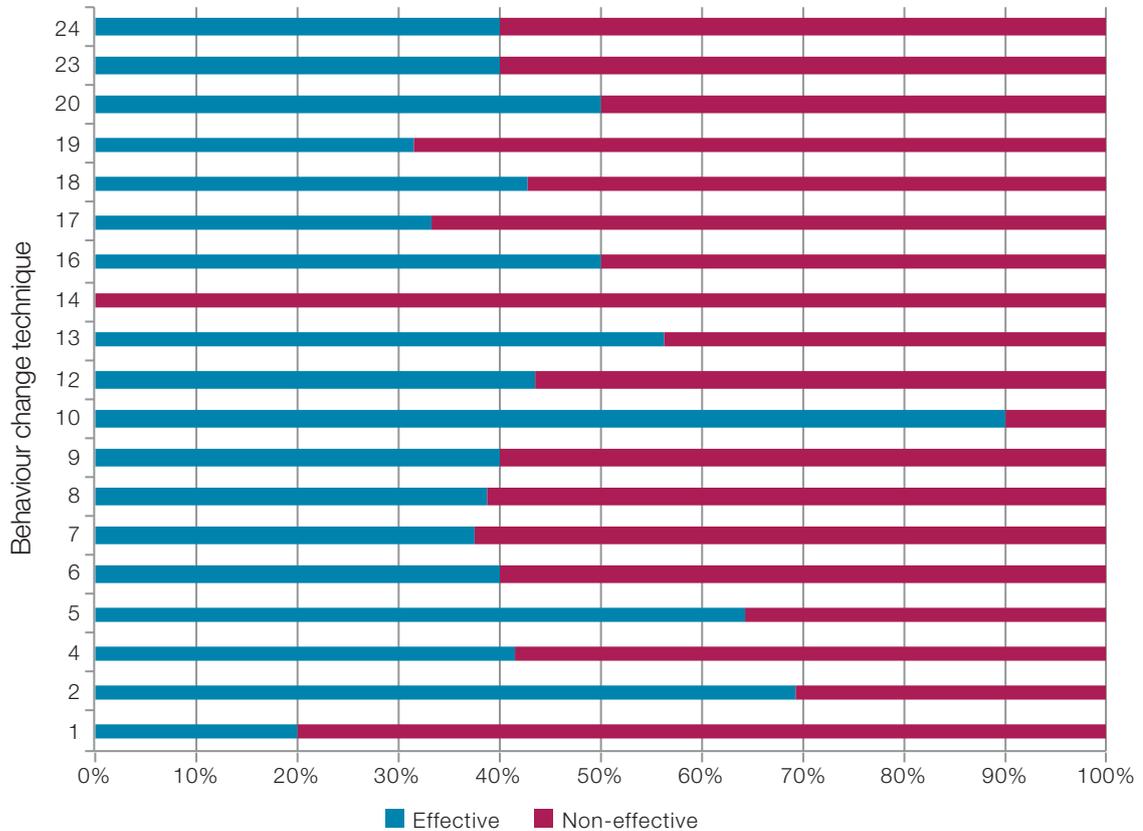
Figure 3.5: The number of times each behaviour change technique was identified in successful vs unsuccessful interventions among adults (behaviour change techniques 3, 11, 15, 21, 22, 25, 26 excluded)



Source: Author's own

Figure 3.5, moving on to all health problems for adults, shows that the most successful interventions included BCTs 12 (n=10), 2 (n=9), 5 (n=9), 10 (n=9), 13 (n=9) and 20 (n=8). In contrast, the most unsuccessful BCTs were 19, 12, 8, 1 & 20.

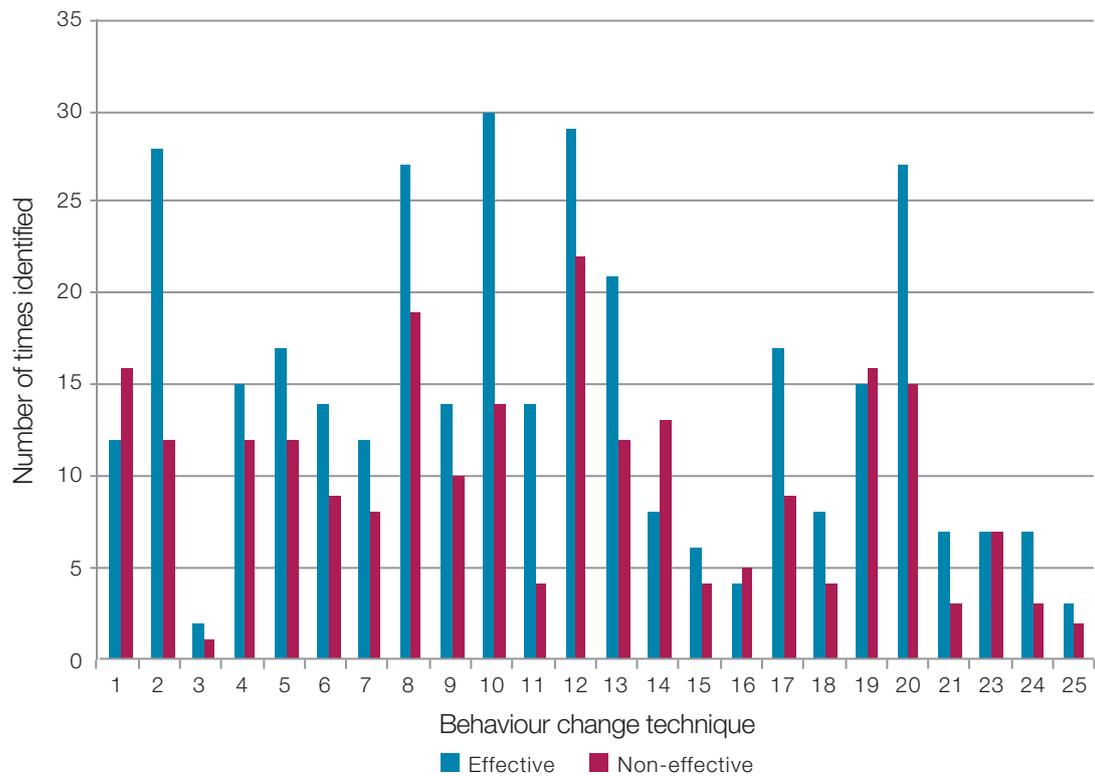
Figure 3.6: Success vs failure for each behaviour change technique identified amongst interventions targeting adults (behaviour change techniques 3, 11, 15, 21, 22, 25, 26 excluded)



Source: Author's own

Figure 3.6 shows (across all health behaviours for adults) that several BCTs were more clearly related to failure than success. However, BCT 10 was successful in all but one intervention which included it (90%), with the next most successful BCTs being BCTs 2 (69.2%), 5 (64.3%) and 13 (56.3%). This figure also shows that BCT 14 was unsuccessful in all cases (n=3) and that BCT 1 was only successful in 20% of the interventions (n=10) in which it was identified.

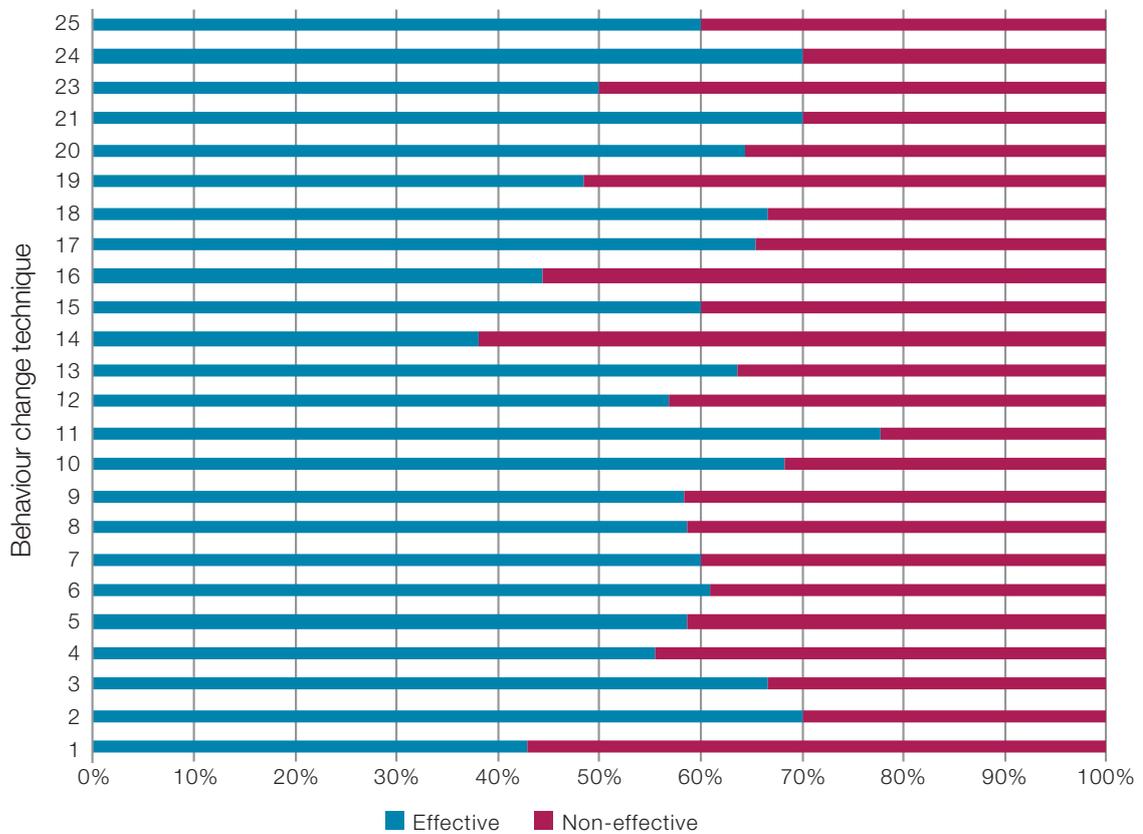
Figure 3.7: Overall behaviour change technique effectiveness (behaviour change techniques 22 & 26 excluded)



Source: Author's own

In order to provide an overview of the BCTs which appeared more commonly in successful than in unsuccessful interventions, the data from the adults, children and adolescents was combined. This clearly shows that across the three age groups the BCTs identified most commonly among successful interventions included (in order of success) BCTs 10, 12, 2, 20, 8 and (some way behind those) 13. Figure 3.7 also shows that the BCTs which were identified more often in unsuccessful interventions, than successful interventions, were BCTs 1, 14, 16 and 19.

Figure 3.8: Overall proportion of effectiveness (behaviour change techniques 22 & 26 excluded)



Source: Author's own

Figure 3.8 presents an overall view of the proportion at which each BCT was identified in successful interventions, compared with unsuccessful interventions. This shows that only four BCTs were associated with success rates of 70% or more, which were BCTs 2 (n=28 successful), 11 (n=14 successful), 21 (n=7 successful) and 24 (n=9 successful). There were also several BCTs which were successful in more than 60% of the interventions they were identified in: BCTs 3, 6, 7, 10, 13, 15, 17, 18, 20 and 25. There were no BCTs which were either completely successful or completely unsuccessful on all occasions. There were, however, several interventions which were successful in less than half of the interventions in which they were identified (i.e. BCTs 1, 14, 16 and 19).

4. Discussion



The total number of successful interventions in which each BCT was present appears to be the best available means upon which to judge that BCT's performance, given the low numbers for many BCTs and the relatively large proportion of interventions which did not make a significant change to the target behaviour (i.e. were unsuccessful). The interventions among children found that the BCTs most commonly identified in successful interventions were BCTs 10, 12, 2, 8, 20 and 17. Similarly, the most successful BCTs in adolescents were BCTs 12, 13, 10, 8, 11, 1, 2, and 20, while for adults these were BCTs 12, 2, 5, 10, 13 and 20. However, it should be noted that more failures than successes were identified for interventions targeting adults.

Comparing the three age groups it is clear that there are substantial similarities regarding which are the most successful BCTs, with BCTs 2, 10, 12 and 20 appearing in all three groups, while 8 and 13 also appear in two of the three groups. However, there may also be some differences in which BCTs work in each age group, as BCTs 1, 5, 11 and 17 each only appeared in one of the three age groups.

Combining all the data from the three age groups together provides a much larger pool from which to examine the evidence supporting each BCT. The combined data shows that the most successful BCTs (in order of success) were: BCTs 10, 12, 2, 20, 8, and 13, meaning that there is relatively strong support for these six BCTs. Furthermore, although the review of the interventions on smoking cessation and brief alcohol interventions were not

included in the combined data, these four previous reviews found support for BCTs 10, 2, 5, 14, 20 and 23, demonstrating an overlap with three of the BCTs (10, 2 and 20). Therefore, there is substantial support for 12 ('Prompt self-monitoring of behaviour'), 10 ('Prompt specific goal-setting'), 2 ('Provide information on consequences'), 20 ('Plan social support or social change'), 8 ('Provide instruction') and 13 ('Provide feedback on performance'), with particularly strong support for 10, 2 and 20. Interestingly, these findings also appear to support guidelines from the National Institute for Health and Care Excellence (NICE, 2014), which advocates the inclusion of goals and planning, along with feedback and monitoring techniques in behaviour change programmes.

Particularly interesting is the comparison between the present findings and those of Fylan and Stradling (2014). Fylan and Stradling reviewed six different UK interventions aimed at school children and young novice drivers (one also being aimed at young adults). They used a different numbering system to the original Abraham and Michie (2008) taxonomy, but the original numbering system will be retained here. They found that all six interventions they evaluated included BCTs 1 ('Provide information about behaviour-health link') and 2 ('Provide information on consequences'), with BCTs 5 ('Prompt barrier identification') and 6 ('Provide general encouragement') appearing in five of the six interventions, and BCT 8 ('Provide instruction') appearing in four. Only two further BCTs were identified, both in the same intervention, which were 15 ('Teach to use prompts or cues') and 21 ('Prompt identification as a role model'). Thus in total only seven of the 26 BCTs (Abraham and Michie, 2008) were used by at least one of the six UK interventions. As noted by Fylan and Stradling, this is a relatively narrow range of BCTs.

Comparing the BCTs identified as most effective in the present review with the BCTs identified as being present in the UK-based interventions (Fylan & Stradling, 2014) highlights some similarities and some differences. Four of the six most effective BCTs identified in this review were not found in any of the six interventions Fylan and Stradling reviewed (i.e. 12 – 'Prompt self-monitoring of behaviour', 10 – 'Prompt specific goal-setting', 20 – 'Plan social support or social change', and 13 – 'Provide feedback on performance'). However, on the positive side, all six of their interventions (Fylan & Stradling, 2014) included BCT 2 ('Provide information on consequences'), which was one of the six BCTs identified most often in effective interventions, and BCT 8 ('Provide instruction') appeared in four of the six interventions. In contrast, the six interventions also commonly included BCTs which were not supported by this review. All six interventions evaluated by Fylan and Stradling (2014) included BCT 1 ('Provide information about behaviour-health link'), which the present study found to be more often ineffective (n=16) than effective (n=12). Although BCTs 5, 6 and 15 were associated more with effective interventions (17, 14, 5, respectively) than ineffective (12, 9, 3, respectively), the evidence is not overwhelmingly positive.

As the interventions that Fylan and Stradling (2014) reviewed were aimed mainly at adolescents, it would also appear appropriate to compare their findings with those specifically from the review of adolescent interventions. Again, there are some similarities and also some obvious differences. The most successful BCTs identified in interventions among adolescents were: 12 (successful, n=9), 13 (n=9), 10 (n=8), 8 (n=8), 11 (n=7), 1 (n=7) 2 (n=7) and 20 (n=7). The Fylan and Stradling review found that two of these BCTs

occurred in all of the interventions they reviewed (BCTs 1 & 2), with BCT 8 appearing in four of the six interventions. However, five of the eight most effective BCTs, found in this review of adolescent interventions (BCTs 12, 13, 10, 11 & 20), were not used by any of the interventions which Fylan and Stradling evaluated. It should also be noted that the present study reviewed a relatively small number of interventions which were aimed specifically at adolescents, and thus the measure of success across all age groups might be a better indication of BCT potency.

One of the interesting problems with this review is disentangling the effectiveness of the different BCTs from the others in which they co-occur. Unfortunately it was not possible in the current review to disentangle the contribution made by each BCT, as it would require statistical analyses beyond the scope of this research. It also seems possible that the presence of one BCT in an intervention has an influence on the effectiveness of another BCT, or that particular BCTs are only successful in tandem. Furthermore, we can speculate about whether BCTs 1 & 2 ('Provide information about behaviour-health link' & 'Provide information on consequences') are actually active ingredients that motivate behaviour change, or whether they are simply necessary preconditions that must exist before the other BCTs can actually work. It seems likely that the majority of those approaching the age of licensing would be aware of the link between risky behaviour and their health, as well as the potential consequences of having a crash. Notwithstanding the possible biases surrounding their individual perceived vulnerability, it is difficult to imagine that interventions which rely predominantly on these BCTs would be successful in motivating change. This has been backed up by a review of interventions aimed at improving safety among pre-drivers and young drivers, which relied mainly on the provision of information about the risk of crashing and resultant consequences. This review found no evidence that those types of interventions had a positive impact on those adolescents that attended (Sullman & Dorn, 2015). Future research is needed to disentangle the individual effectiveness of the different BCTs in relation to road safety.

4.1 Limitations

There were a large number of problems faced while reviewing this literature, including the identification of the types of BCTs used in each intervention. The reasons for this are twofold. Firstly, until recently there were no clear definitions of the different types of BCTs, so terms such as 'goal-setting' may not have meant the same thing to different researchers. Moreover, the identification of the types of BCT used was made more difficult by the fact that the level of detail included in journal articles was typically very low, a complication which has previously been identified by other researchers (e.g. Michie & Abraham, 2008). Recently there have been moves to address both of these problems, with the call to use a single taxonomy of BCTs, and the move by several journals to include supplementary materials online, which contain more detailed information. Thus, recently published research in this area is considerably easier to review than older research.

A further complication in identifying which BCTs work is the fact that most interventions use a combination of BCTs (typically 4 to 12 different techniques), rather than one. As mentioned

in the previous section, this makes disentangling the effects of each impossible, and thus the best that could be done in this work was to identify which of the BCTs occurred more often in successful interventions and which were associated with a lack of behaviour change. Study quality was also variable, meaning that it was not possible to accept only RCTs in all areas of the review – in some cases a number of lower-quality studies, such as case-control studies, had to be included. Clearly the use of RCTs is preferable, as without randomisation group equivalence is more difficult to justify, but it is equally difficult to obtain a sufficiently large pool of interventions upon which to judge the BCTs. In other words, to some degree this was a balancing act, which aimed to increase the pool of evidence, while at the same time attempting to ensure that only high quality evidence was considered.

There were also a number of other additional complications, chief amongst which were the use of many different outcome measures between studies (e.g. BMI, self-reporting, pedometers), variability in the nature of the people delivering the intervention (i.e. their training, knowledge and skills), variability in the target of change (e.g. obesity, physical activity and diet), in the duration of the intervention, in whether or not there was direct contact with the participants (some were conducted via the Internet or by smartphone apps), in the number of participants included, in their country of origin, in the age groups included, in the specification of the control group treatment (several control groups also appeared to be exposed to BCTs), in the combinations of behaviours to change (e.g. obesity was tackled through exercise, diet and reducing sedentary activity in some interventions), in the level of detail in the intervention description, in attrition rates, in the sex of the participants, and in whether they followed up the target behaviour sometime after the intervention had finished – and the length of that follow-up period. However, by far the largest problem was that in many articles it was not clear which, if any, BCTs were included in the intervention described. In such cases the intervention was not included in the review. This led to a substantial number of articles and interventions being excluded from this review, most of which appear in the 'Further Reading' section. The second-largest reason for excluding interventions was that many were focused solely on clinical patients, such as the clinically obese, cancer survivors and those with cardiovascular disease.

It is important to note that aside from the nature of the BCTs included in an intervention, there are a number of reasons why an intervention might be unsuccessful. For example, there are problems surrounding the implementation of each BCT. It may be that the BCT(s) were poorly implemented and thus failed to bring about behaviour change. It could also be that those delivering the intervention were not adequately trained, or perhaps even lacked motivation themselves. Unfortunately, it is not possible to determine whether this was the case in any of the studies included in this review, but as almost all of the studies were published in high-quality journals this is unlikely to be a major source of error.

Another possible limitation may be that different BCTs are more effective for changing different types of health behaviours. Related to this point, although this report has identified the BCTs most commonly found in interventions which were successful in changing these health behaviours, primary research is needed to test the effectiveness of these BCTs for improving young driver safety.

Although beyond the scope of the present research, the strength of the conclusions could have been improved if a systematic review and meta-analysis had been undertaken in compliance with appropriate guidelines (see the Cochrane Collaboration). This approach would have also allowed us to estimate the likelihood that publication bias (the bias towards publishing positive findings) influenced the findings of this study.

4.2 Conclusions

In conclusion, recent research has identified that most pre-driver and young driver interventions do not have the desired impact (Sullman & Dorn, 2015) and that one of the reasons for this could be the absence of appropriate 'active ingredients' in these interventions. As there is little or no literature in the field of driving behaviour, the present review set out to investigate which BCTs are most commonly associated with effective interventions in other areas of health. This is particularly valuable information, as those developing or refining interventions do not currently have scientific evidence regarding which BCTs they should use. Furthermore, the same problem also exists for those commissioning interventions to be run in their school, region or borough. The information contained within this report will provide a basis for informing both those developing interventions and those selecting interventions to fund or implement.

Finally, the present review found strong evidence regarding the efficacy of BCTs 10 ('Prompt specific goal-setting'), 12 ('Prompt self-monitoring of behaviour'), 2 ('Provide information on consequences'), 20 ('Plan social support or social change'), 8 ('Provide instruction') and 13 ('Provide feedback on performance'). Intervention designers, and others involved in the safety of young drivers should weave these BCTs into interventions in order to improve the chances of successfully achieving behaviour change.

5. Recommendations



This report reviewed the evidence regarding the effectiveness BCT in other areas of health. The results of the review provide relatively clear support for several BCTs and led to the following recommendations.

1. Road safety intervention designers should include a broader range of behaviour change techniques (BCTs) in their programmes aimed at pre-drivers and young novice drivers.
2. Designers should include the BCTs which have been found to be effective in other areas of health. In particular, they should include BCTs 10 ('Prompt specific goal-setting'), 12 ('Prompt self-monitoring of behaviour'), 2 ('Provide information on consequences'), 20 ('Plan social support or social change'), 8 ('Provide instruction') and 13 ('Provide feedback on performance').
3. Those responsible for commissioning pre-driver and young driver interventions should require the interventions to include research-proven BCTs (as above).
4. Little as may be known about the efficacy of different BCTs in the road safety arena, it is nevertheless vital that the designers of pre-driver and young driver interventions include an inbuilt evaluation process to allow the collection and analysis of intervention performance.
5. Related to the above, researchers and practitioners across the globe need to start building up the knowledge base regarding which BCTs and interventions are effective in the field of road safety, as currently very little is known.
6. It is recommended that a future review of the literature be undertaken using the 93-item taxonomy devised by Michie et al. (2015), once the literature has had time to build and broaden in the areas of both health psychology and traffic psychology.

6. Examples of the six most successful behaviour change techniques



Section 6 provides practical examples of how the six most successful BCTs could be used in road safety. Although one or two practical examples are provided for each of the six BCTs, there are many other ways in which these BCTs could be used in practice.

BCT 10 – Prompt specific goal-setting

Ask the young driver to develop specific goals regarding safety-related behaviours. This should include detailed planning on how often they will engage in (or abstain from) the behaviour, for how long, in what context and with whom. For example, they could develop a goal of never using a mobile phone to text or talk while driving (either handheld or hands-free) for the first two years and they will achieve this by always turning their mobile phone off before they open the driver's door.

Goals can be used with every aspect of driving, and by using In-Vehicle Data Recorders, objective data can be obtained on many of these behaviours (e.g. seat belt use, harsh braking, harsh acceleration, speeding, harsh cornering), depending on the system used.

BCT 12 – Prompt self-monitoring of behaviour

Ask the young driver to keep a driving log and after each journey to record specific features, such as how often they exceeded the speed limit or other safety-related behaviour.

or

Ask the driver to read the daily reports generated by their In-Vehicle Data Recorder each day, to identify where improvements could be made.

BCT 20 – Plan social support or social change

Prompting consideration of how other people important to them (e.g. friends and family) could change their behaviour to offer the young driver help or social support. For example, they could ask their parents and friends not to phone them while they are driving, and to be understanding when they don't answer their phone or text while driving.

Young drivers could also pledge to support each other in avoiding the temptation to drive dangerously as a result of peer pressure.

BCT 2 – Provide information on consequences

Providing information on the benefits and costs of particular driving behaviours, by focusing on what will happen if they engage in the behaviours (or don't engage in a particular behaviour). For example, the young driver could be told about the consequences of speeding or being distracted by using a mobile phone (e.g. they will miss some hazards, it will take them longer to react).

BCT 13 – Provide feedback on performance

Providing information on their recorded driving behaviour. This can be their self-recorded driving behaviour, what was observed by another person (for example, the driving instructor or parent), or as recorded by an In-Vehicle Data Recorder (IVDR). This can be paired with goal-setting (BCT 10) and used to inform the driver how they are doing in terms of meeting their goals.

For example, the young driver may have developed the goal of staying within the speed limit 100% of the time they are driving the car. They could use the IVDR to provide feedback on how they are doing with meeting this goal. The feedback helps the driver to understand their progress and allows them to adjust the strategy, direction or effort and/or intensity of their efforts, if necessary.

BCT 8 – Provide instruction

Telling the person how to perform a specific behaviour and/or preparatory behaviours.

For example, instruction can be given to the driver as to how to overtake safely, or how they should adjust the distance between them and the vehicle in front when driving in the wet or snow.

Appendix A

CALO-RE taxonomy (Michie et al., 2011a)

1. Provide information on consequences of behaviour in general

Information about the relationship between the behaviour and its possible or likely consequences in the general case, usually based on epidemiological data, and not personalised for the individual (contrast with Technique 2).

2. Provide information on consequences of behaviour to the individual

Information about the benefits and costs of action or inaction to the individual or tailored to a relevant group based on that individual's characteristics (i.e. demographics, clinical, behavioural or psychological information). This can include any costs/benefits and not necessarily those related to health, e.g. feelings.

3. Provide information about others' approval

Involves information about what other people think about the target person's behaviour. It clarifies whether others will like, approve or disapprove of what the person is doing or will do. N.B. Check that any instance does not also involve Techniques 1 (Provide information on consequences of behaviour in general) or 2 (Provide information on consequences of behaviour to the individual) or 4 (Provide normative information about others' behaviour).

4. Provide normative information about others' behaviour

Involves providing information about what other people are doing, i.e. indicates that a particular behaviour or sequence of behaviours is common or uncommon amongst the population or amongst a specified group – presentation of case studies of a few others is not normative information. N.B. This concerns other people's actions and is distinct from the provision of information about others' approval (Technique 3 [Provide information about others' approval]).

5. Goal-setting (behaviour)

The person is encouraged to make a behavioural resolution (e.g. take more exercise next week). This is directed towards encouraging people to decide to change or maintain change. N.B. This is distinguished from Technique 6 (Goal-setting – outcome) and 7 (Action planning) as it does not involve planning exactly how the behaviour will be done and either when or where the behaviour or action sequence will be performed. Where the text only states that goal-setting was used without specifying the detail of action planning involved then this would be an example of this technique (not Technique 7 [Action planning]). If the text states that 'goal-setting' was used if it is not clear from the report if the goal-setting was related to behaviour or to other outcomes, Technique 6 should be coded. This includes sub-goals or preparatory behaviours and/or specific contexts in which the behaviour will be performed. The behaviour in this technique will be directly related to or be a necessary

condition for the target behaviour (e.g. shopping for healthy eating; buying equipment for physical activity). N.B. Check if techniques applied to preparatory behaviours should also be coded as instances of Technique 9 (Set graded tasks).

6. Goal-setting (outcome)

The person is encouraged to set a general goal that can be achieved by behavioural means but is not defined in terms of behaviour (e.g. to reduce blood pressure or lose/maintain weight), as opposed to a goal based on changing behaviour as such. The goal may be an expected consequence of one or more behaviours, but is not a behaviour per se (see also Techniques 5 [Goal-setting – behaviour] and 7 [Action planning]). This technique may co-occur with Technique 5 if goals for both behaviour and other outcomes are set.

7. Action planning

Involves detailed planning of what the person will do including, as a minimum, when, in which situation and/or where to act. 'When' may describe frequency (such as how many times a day/week or duration (e.g. for how long)). The exact content of action plans may or may not be described, in this case code as this technique if it is stated that the behaviour is planned contingent to a specific situation or set of situations even if exact details are not present. N.B. The terms 'goal-setting' or 'action plan' are not enough to ensure inclusion of this technique unless it is clear that plans involve linking behavioural responses to specific situational cues; when only described as 'goal-setting' or 'action plan' without the above detail it should be regarded as applications of Techniques 5 and 6.

8. Barrier identification / Problem-solving

This presumes having formed an initial plan to change behaviour. The person is prompted to think about potential barriers and identify ways of overcoming them. Barriers may include competing goals in specified situations. This may be described as 'problem-solving'. If it is problem-solving in relation to the performance of a behaviour, then it counts as an instance of this technique. Examples of barriers may include behavioural, cognitive, emotional, environmental, social and/or physical barriers. N.B. Closely related to Techniques 7 (Action planning) and 9 (Set graded tasks) but involves a focus on specific obstacles to performance. It contrasts with Technique 35 (Relapse prevention / Coping planning) which is about maintaining behaviour that has already been changed.

9. Set graded tasks

Breaking down the target behaviour into smaller easier to achieve tasks and enabling the person to build on small successes to achieve target behaviour. This may include increments towards a target behaviour, or incremental increases from baseline behaviour.

N.B. The key difference to Technique 7 (Action planning) lies in planning to perform a sequence of preparatory actions (e.g. remembering to take gym kit to work), task components or target behaviours which are in a logical sequence or increase in difficulty over time – as opposed to planning 'if-then' contingencies when/where to perform behaviours. General references to increasing physical activity as intervention goal are not instances of this technique.

10. Prompt review of behavioural goals

Involves a review or analysis of the extent to which previously set behavioural goals (e.g. take more exercise next week) were achieved. In most cases this will follow previous goal-setting (see Technique 5, 'goal-setting-behaviour') and an attempt to act on those goals, followed by a revision or readjustment of goals, and/ or means to attain them. N.B. Check if any instance also involves Techniques 6 (Goal-setting – behaviour), 8 (Barrier identification / Problem-solving), 9 (Set graded tasks) or 11 (Prompt review of outcome goals).

11. Prompt review of outcome goals

Involves a review or analysis of the extent to which previously set outcome goals (e.g. to reduce blood pressure or lose/maintain weight) were achieved. In most cases this will follow previous goal-setting (see Technique 6, Goal-setting – outcome) and an attempt to act on those goals, followed by a revision of goals, and/or means to attain them. N.B. Check that any instance does not also involve Techniques 5 (Goal-setting – outcome), 8 (Barrier identification / Problem-solving), 9 (Set graded tasks) or 10 (Prompt review of behavioural goals).

12. Prompt rewards contingent on effort or progress towards behaviour

Involves the person using praise or rewards for attempts at achieving a behavioural goal. This might include efforts made towards achieving the behaviour, or progress made in preparatory steps towards the behaviour, but not merely participation in intervention. This can include self-reward. N.B. This technique is not reinforcement for performing the target behaviour itself, which is an instance of Technique 13 (Provide rewards contingent on successful behaviour).

13. Provide rewards contingent on successful behaviour

Reinforcing successful performance of the specific target behaviour. This can include praise and encouragement as well as material rewards, but the reward/incentive must be explicitly linked to the achievement of the specific target behaviour, i.e. the person receives the reward if they perform the specified behaviour but not if they do not perform the behaviour. This can include self-reward. Provision of rewards for completing intervention components or materials are not instances of this technique. References to provision of incentives for being more physically active are not instances of this technique unless information about contingency to the performance of the target behaviour is provided. N.B. Check the distinction between this and Techniques 7 (Action planning) and 17 (Prompt self-monitoring of behavioural outcome) and 19 (Provide feedback on performance).

14. Shaping

Contingent rewards are first provided for any approximation to the target behaviour, e.g. for any increase in physical activity. Then, later, only a more demanding performance, e.g. brisk walking for 10 minutes on three days a week, would be rewarded. Thus, this is graded use of contingent rewards over time.

15. Prompting generalisation of a target behaviour

Once a behaviour is performed in a particular situation, the person is encouraged or helped to try it in another situation. The idea is to ensure that the behaviour is not tied to one situation but becomes a more integrated part of the person's life that can be performed at a variety of different times and in a variety of contexts.

16. Prompt self-monitoring of behaviour

The person is asked to keep a record of specified behaviour/s as a method for changing behaviour. This should be an explicitly stated intervention component, as opposed to occurring as part of completing measures for research purposes. This could for example take the form of a diary, or completing a questionnaire about their behaviour, in terms of type, frequency, duration and/or intensity. Check the distinction between this and Technique 17 (Prompt self-monitoring of behavioural outcome).

17. Prompt self-monitoring of behavioural outcome

The person is asked to keep a record of specified measures expected to be influenced by the behaviour change, e.g. blood pressure, blood glucose, weight loss, physical fitness. N.B. It must be reported as part of the intervention, rather than only as an outcome measure. Check the distinction between this and Technique 16 (Prompt self-monitoring of behaviour).

18. Prompting focus on past success

Involves instructing the person to think about or list previous successes in performing the behaviour (or parts of it). N.B. This is not just encouragement but a clear focus on the person's past behaviour. It is also not feedback because it refers to behaviour which preceded the intervention.

19. Provide feedback on performance

This involves providing the participant with data about their own recorded behaviour (e.g. following Technique 16 [Prompt self-monitoring of behaviour]) or commenting on a person's behavioural performance (e.g. identifying a discrepancy between behavioural performance and a set goal – see Techniques 5 [Goal-setting – behaviour] and 7 [Action planning] – or a discrepancy between one's own performance in relation to others' – note this could also involve Technique 28 [Facilitate social comparison]).

20. Provide information on where and when to perform the behaviour

Involves telling the person about when and where they might be able to perform the behaviour this, e.g. tips on places and times participants can access local exercise classes. This can be in either verbal or written form. N.B. Check whether there are also instances of Technique 21 (Provide instruction on how to perform the behaviour).

21. Provide instruction on how to perform the behaviour

Involves telling the person how to perform a behaviour or preparatory behaviours, either verbally or in written form. Examples of instructions include: how to use gym equipment

(without getting on and showing the participant), instruction on suitable clothing, and tips on how to take action. Showing a person how to perform a behaviour without verbal instruction would be an instance of Technique 22 only. N.B. Check whether there are also instances of Techniques 5, 7, 8, 9, 22. Instructions to follow a specific diet or programme of exercise without instructions how to perform the behaviours are not included in this definition. Cooking and exercise classes as well as personal trainers and recipes should always be coded as this technique, but may also be coded as 22 (Model/Demonstrate the behaviour).

22. Model/Demonstrate the behaviour

Involves showing the person how to perform a behaviour, e.g. through physical or visual demonstrations of behavioural performance, in person or remotely. N.B. This is distinct from just providing instruction (Technique 21) because in 'demonstration' the person is able to observe the behaviour being enacted. This technique and Technique 21 (Provide instruction on how to perform the behaviour) may be used separately or together. Instructing parents or peers to perform the target behaviour is not an instance of this technique as fidelity would be uncertain.

23. Teach to use prompts/cues

The person is taught to identify environmental prompts which can be used to remind them to perform the behaviour (or to perform an alternative, incompatible behaviour in the case of behaviours to be reduced). Cues could include times of day, particular contexts or technologies such as mobile phone alerts which prompt them to perform the target behaviour. N.B. This technique could be used independently or in conjunction with Techniques 5 (Goal-setting – behaviour) and 7 (Action planning) (see also 24 [Environmental restructuring]).

24. Environmental restructuring

The person is prompted to alter the environment in ways so that it is more supportive of the target behaviour, e.g. altering cues or reinforcers. For example they might be asked to lock up or throw away or their high-calorie snacks, or take their running shoes to work. Interventions in which the interveners directly modify environmental variables (e.g. the way food is displayed in shops, provision of sports facilities) are not covered by this taxonomy and should be coded independently.

25. Agree behavioural contract

Must involve written agreement on the performance of an explicitly specified behaviour so that there is a written record of the person's resolution witnessed by another.

26. Prompt practice

Prompt the person to rehearse and repeat the behaviour or preparatory behaviours numerous times. Note this will also include parts of the behaviour, e.g. refusal skills in relation to unhealthy snacks. This could be described as 'building habits or routines' but is still practice so long as the person is prompted to try the behaviour (or parts of it) during the intervention or practice between intervention sessions, e.g. as 'homework'.

27. Use of follow-up prompts

Intervention components are gradually reduced in intensity, duration and frequency over time, e.g. letters or telephone calls instead of face-to-face and/or provided at longer time intervals.

28. Facilitate social comparison

Involves explicitly drawing attention to others' performance to elicit comparisons. N.B. The fact the intervention takes place in a group setting, or they have been placed in groups on the basis of shared characteristics, does not necessarily mean social comparison is actually taking place. Social support may also be encouraged in such settings and this would then involve Technique 29 (Plan social support / social change). Group classes may also involve instruction (Technique 21 [Provide instruction on how to perform the behaviour]), demonstration (Technique 22 [Model/Demonstrate the behaviour]) and practice (Technique 26 [Prompt practice]).

29. Plan social support / social change

Involves prompting the person to plan how to elicit social support from other people to help him/her achieve their target behaviour/outcome. This will include support during interventions, e.g. setting up a 'buddy' system or other forms of support and following the intervention including support provided by the individuals delivering the intervention, partner, friends, family.

30. Prompt identification as role model / position advocate

Involves focusing on how the person may be an example to others and affect their behaviour, e.g. being a good example to children. Also includes providing opportunities for participants to persuade others of the importance of adopting/changing the behaviour, for example, giving a talk or running a peer-led session.

31. Prompt anticipated regret

Involves inducing expectations of future regret about the performance or non- performance of a behaviour. This includes focusing on how the person will feel in the future and specifically whether they will feel regret or feel sorry that they did or did not take a different course of action. Do not also code instances of this technique as the more generic providing information on consequences (Techniques 1 [Provide information on consequences of behaviour in general] and 2 [Provide information on consequences of behaviour to the individual]).

32. Fear arousal

Involves presentation of risk and/or mortality information relevant to the behaviour as emotive images designed to evoke a fearful response (e.g. "smoking kills!" or images of the grim reaper). Do not also code instances of this technique as the more generic providing information on consequences (Techniques 1 [Provide information on consequences of behaviour in general] and 2 [Provide information on consequences of behaviour to the individual]).

33. Prompt self-talk

Encourage the person to use talk to themselves (aloud or silently) before and during planned behaviours to encourage, support and maintain action.

34. Prompt use of imagery

Teach the person to imagine successfully performing the behaviour or to imagine finding it easy to perform the behaviour, including component or easy versions of the behaviour. Distinct from recalling instances of previous success without imagery (Technique 18 [Prompting focus on past success]).

35. Relapse prevention / Coping planning

This relates to planning how to maintain behaviour that has been changed. The person is prompted to identify in advance situations in which the changed behaviour may not be maintained, and to develop strategies to avoid or manage those situations. Contrast with Techniques 7 (Action planning) and 8 (Barrier identification / Problem-solving) which are about initiating behaviour change.

36. Stress management / Emotional control training

This is a set of specific techniques (e.g. progressive relaxation) which do not target the behaviour directly but seek to reduce anxiety and stress to facilitate the performance of the behaviour. It might also include techniques designed to reduce negative emotions or control mood or feelings that may interfere with performance of the behaviour, and/or to increase positive emotions that might help with the performance of the behaviour. N.B. Check whether there are any instances of Technique 8 (Barrier identification / Problem-solving), which includes identifying emotional barriers to performance, in contrast to the current technique, which addresses stress and emotions, whether they have been identified as barriers or not.

37. Motivational interviewing

This is a clinical method including a specific set of techniques involving prompting the person to engage in change talk in order to minimise resistance and resolve ambivalence to change (includes motivational counselling). N.B. Only rate this technique if explicitly referred to by name, not if one identifies specific elements of it; this may happen if you have prior experience with this technique.

38. Time management

This includes any technique designed to teach a person how to manage their time in order to make time for the behaviour. These techniques are not directed towards performance of target behaviour but rather seek to facilitate it by freeing up times when it could be performed. N.B. Only rate this technique if explicitly referred to by name, not if one identifies specific elements of it; this may happen if you have prior experience with this technique.

39. General communication skills training

This includes any technique directed at general communication skills but not directed towards a particular behaviour change. Often this may include role play and group work focusing on listening skills or assertive skills. N.B. Practicing a particular behaviour- specific interpersonal negotiation, e.g. refusal skills in relation to cigarettes or alcohol, would not be an instance of this technique.

40. Stimulate anticipation of future rewards

Create anticipation of future rewards without necessarily reinforcing behaviour throughout the active period of the intervention. Code this technique when participants are told at the onset that they will be rewarded based on behavioural achievement.

Appendix B

93-Item Taxonomy (Michie et al., 2015)

Number label	Definition	Examples
1. Goal-setting		
1.1 Goal-setting (behaviour)	<p>Set or agree on a goal defined in terms of the behaviour to be achieved.</p> <p>Note: only code goal-setting if there is sufficient evidence that goal set as part of intervention; if goal unspecified or a behavioural outcome, code 1.3, goal-setting (outcome); if the goal defines a specific context, frequency, duration or intensity for the behaviour, also code 1.4, action planning.</p>	<p>Agree on a daily walking goal (e.g. 3 miles) with the person and reach agreement about the goal. Set the goal of eating five pieces of fruit per day as specified in public health guidelines.</p>
1.2 Problem-solving	<p>Analyse, or prompt the person to analyse, factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators (includes 'relapse prevention' and 'coping planning').</p> <p>Note: barrier identification without solutions is not sufficient. If the BCT does not include analysing the behavioural problem, consider 12.3, avoidance/changing exposure to cues for the behaviour; 12.1, restructuring the physical environment; 12.2, restructuring the social environment; or 11.2, reduce negative emotions.</p>	<p>Identify specific triggers (e.g. being in a pub, feeling anxious) that generate the urge/want/need to drink and develop strategies for avoiding environmental triggers or for managing negative emotions, such as anxiety, that motivate drinking. Prompt the patient.</p>
1.3 Goal-setting (outcome)	<p>Set or agree on a goal defined in terms of a positive outcome of wanted behaviour.</p> <p>Note: only code guidelines if set as a goal in an intervention context; if goal is a behaviour, code 1.1, goal-setting (behaviour); if goal unspecified code 1.3, goal-setting (outcome).</p>	<p>Set a weight-loss goal (e.g. 0.5 kg over 1 week) as an outcome of changed eating patterns.</p>
1.4 Action planning	<p>Prompt detailed planning of performance of the behaviour (must include at least one of context, frequency, duration and intensity). Context may be environmental (physical or social) or internal (physical, emotional or cognitive includes 'implementation intentions').</p> <p>Note: evidence of action planning does not necessarily imply goal-setting, only code latter if sufficient evidence.</p>	<p>Encourage a plan to carry condoms when going out socially at weekends. Prompt planning the performance of a particular physical activity (e.g. running) at a particular time (e.g. before work) on certain days of the week.</p>

Number label	Definition	Examples
1. Goal-setting		
1.5 Review behaviour goal(s)	<p>Review behaviour goal(s) jointly with the person and consider modifying goal(s) or behaviour change strategy in light of achievement. This may lead to resetting the same goal, a small change in that goal or setting a new goal instead of (or in addition to) the first, or no change.</p> <p>Note: if goal specified in terms of behaviour, code 1.5, review behaviour goal(s), if goal unspecified, code 1.7, review outcome goal(s); if discrepancy created consider also 1.6, discrepancy between current behaviour and goal.</p>	<p>Examine how well a person's performance corresponds to agreed goals, e.g. whether or not they consumed less than one unit of alcohol per day, and consider modifying future behavioural goals accordingly, e.g. by increasing or decreasing alcohol target or changing type of alcohol consumed.</p>
1.6 Discrepancy between current behaviour and goal	<p>Draw attention to discrepancies between a person's current behaviour (in terms of the form, frequency, duration or intensity of that behaviour) and the person's previously set outcome goals, behavioural goals or action plans (goes beyond self-monitoring of behaviour).</p> <p>Note: if discomfort is created only code 13.3, incompatible beliefs and not 1.6, discrepancy between current behaviour and goal if goals are modified, also code 1.5, review behaviour goal(s) and/or 1.7, review outcome goal(s); if feedback is provided, also code 2.2, feedback on behaviour.</p>	<p>Point out that the recorded exercise fell short of the goal set.</p>
1.7 Review outcome goal(s)	<p>Review outcome goal(s) jointly with the person and consider modifying goal(s) in light of achievement. This may lead to resetting the same goal, a small change in that goal or setting a new goal instead of, or in addition to the first.</p> <p>Note: if goal specified in terms of behaviour, code 1.5, review behaviour goal(s), if goal unspecified, code 1.7, review outcome goal(s); if discrepancy created consider also 1.6, discrepancy between current behaviour and goal.</p>	<p>Examine how much weight has been lost and consider modifying outcome goal(s) accordingly, e.g. by increasing or decreasing subsequent weight-loss targets.</p>
1.8 Behavioural contract	<p>Create a written specification of the behaviour to be performed, agreed on by the person, and witnessed by another.</p> <p>Note: also code 1.1, goal-setting (behaviour).</p>	<p>Sign a contract with the person, e.g. specifying that they will not drink alcohol for 1 week.</p>
1.9 Commitment	<p>Ask the person to affirm or reaffirm statements indicating commitment to change the behaviour.</p> <p>Note: if defined in terms of the behaviour to be achieved also code 1.1, goal-setting (behaviour).</p>	<p>Ask the person to use an 'I will' statement to affirm or reaffirm a strong commitment (i.e. using the words 'strongly', 'committed' or 'high priority') to start, continue or restart the attempt to take medication as prescribed.</p>

Number label	Definition	Examples
2. Feedback and monitoring		
2.1 Monitoring of behaviour by others without feedback	<p>Observe or record behaviour with the person's knowledge as part of a behaviour change strategy.</p> <p>Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if feedback given, code only 2.2, feedback on behaviour, and not 2.1, monitoring of behaviour by others without feedback; if monitoring outcome(s) code 2.5, monitoring outcome(s) of behaviour by others without feedback; if self-monitoring behaviour, code 2.3, self-monitoring of behaviour.</p>	Watch hand washing behaviours among healthcare staff and make notes on context, frequency and technique used.
2.2 Feedback on behaviour	<p>Monitor and provide informative or evaluative feedback on performance of the behaviour (e.g. form, frequency, duration, intensity).</p> <p>Note: if biofeedback, code only 2.6, biofeedback and not 2.2, feedback on behaviour; if feedback is on outcome(s) of behaviour, code 2.7, feedback on outcome(s) of behaviour; if there is no clear evidence that feedback was given, code 2.1, monitoring of behaviour by others without feedback; if feedback on behaviour is evaluative e.g. praise, also code 10.4, social reward.</p>	Inform the person of how many steps they walked each day (as recorded on a pedometer) or how many calories they ate each day (based on a food consumption questionnaire).
2.3 Self-monitoring of behaviour	<p>Establish a method for the person to monitor and record their behaviour(s) as part of a behaviour change strategy</p> <p>Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if monitoring of outcome of behaviour, code 2.4, self-monitoring of outcome(s) of behaviour; if monitoring is by someone else (without feedback), code 2.1, monitoring of behaviour by others without feedback.</p>	Ask the person to record daily, in a diary, whether or not they have brushed their teeth for at least two minutes before going to bed. Give patient a pedometer and a form for recording daily total number of steps.
2.4 Self-monitoring of outcome(s) of behaviour	<p>Establish a method for the person to monitor and record the outcome(s) of their behaviour as part of a behaviour change strategy.</p> <p>Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if monitoring behaviour, code 2.3, self-monitoring of behaviour; if monitoring is by someone else (without feedback), code 2.5, monitoring outcome(s) of behaviour by others without feedback.</p>	Ask the person to weigh themselves at the end of each day, over a 2 week period, and record their daily weight on a graph to increase exercise behaviours.

Number label	Definition	Examples
2. Feedback and monitoring		
2.5 Monitoring outcome(s) of behaviour by others without feedback	<p>Observe or record outcomes of behaviour with the person's knowledge as part of a behaviour change strategy.</p> <p>Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if feedback given, code only 2.7, feedback on outcome(s) of behaviour; if monitoring behaviour code 2.1, monitoring of behaviour by others without feedback; if self-monitoring outcome(s), code 2.4, self-monitoring of outcome(s) of behaviour.</p>	Record blood pressure, blood glucose, weight loss, or physical fitness.
2.6 Biofeedback	<p>Provide feedback about the body (e.g. physiological or biochemical state) using an external monitoring device as part of a behaviour change strategy.</p> <p>Note: if biofeedback, code only 2.6, biofeedback and not 2.2, feedback on behaviour or 2.7, feedback on outcome(s) of behaviour.</p>	Inform the person of their blood pressure reading to improve adoption of health behaviours.
2.7 Feedback on outcome(s) of behaviour	<p>Monitor and provide feedback on the outcome of performance of the behaviour.</p> <p>Note: if biofeedback, code only 2.6, biofeedback and not 2.7, feedback on outcome(s) of behaviour; if feedback is on behaviour code 2.2, feedback on behaviour; if there is no clear evidence that feedback was given code 2.5, monitoring outcome (s) of behaviour by others without feedback; if feedback on behaviour is evaluative e.g. praise, also code 10.4, social reward.</p>	Inform the person of how much weight they have lost following the implementation of a new exercise regime.
3. Social support		
3.1 Social support (unspecified)	<p>Advise on, arrange or provide social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) or non-contingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour.</p> <p>Note: attending a group class and/or mention of 'follow-up' does not necessarily apply this BCT, support must be explicitly mentioned; if practical, code 3.2, social support (practical); if emotional, code 3.3, social support (emotional) (includes 'motivational interviewing' and 'cognitive-behavioural therapy').</p>	Advise the person to call a 'buddy' when they experience an urge to smoke. Arrange for a housemate to encourage continuation with the behaviour change programme. Give information about a self-help group that offers support for the behaviour.

Number label	Definition	Examples
3. Social support		
3.2 Social support (practical)	<p>Advise on, arrange or provide practical help (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour.</p> <p>Note: if emotional, code 3.3, social support (emotional); if general or unspecified, code 3.1, social support (unspecified). If only restructuring the physical environment or adding objects to the environment, code 12.1, restructuring the physical environment or 12.5, adding objects to the environment; attending a group or class and/or mention of 'follow-up' does not necessarily apply this BCT, support must be explicitly mentioned.</p>	Ask the partner of the patient to put their tablet on the breakfast tray so that the patient remembers to take it.
3.3 Social support (emotional)	<p>Advise on, arrange or provide emotional social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour.</p> <p>Note: if practical, code 3.2, social support (practical); if unspecified, code 3.1, social support (unspecified).</p>	Ask the patient to take a partner or friend with them to their colonoscopy appointment.
4. Shaping knowledge		
4.1 Instruction on how to perform a behaviour	<p>Advise or agree on how to perform the behaviour (includes 'skills training').</p> <p>Note: when the person attends classes such as exercise or cookery, code 4.1, instruction on how to perform the behaviour, 8.1, behavioural practice/rehearsal and 6.1, demonstration of the behaviour.</p>	Advise the person how to put a condom on a model of a penis correctly.
4.2 Information about antecedents	Provide information about antecedents (e.g. social and environmental situations and events, emotions, cognitions) that reliably predict performance of the behaviour.	Advise to keep a record of snacking and of situations or events occurring prior to snacking.
4.3 Re-attribution	Elicit perceived causes of behaviour and suggest alternative explanations (e.g. external or internal and stable or unstable).	If the person attributes their overeating to the frequent presence of delicious food, suggest that the 'real' cause may be the person's inattention to bodily signals of hunger and satiety.
4.4 Behavioural experiments	Advise on how to identify and test hypotheses about the behaviour, its causes and consequences, by collecting and interpreting data.	Ask a family physician to give evidence-based advice rather than prescribe antibiotics and to note whether the patients are grateful or annoyed.

Number label	Definition	Examples
5. Natural consequences		
5.1 Information about health consequences	<p>Provide information (e.g. written, verbal, visual) about health consequences of performing the behaviour.</p> <p>Note: consequences can be for any target, not just the recipient(s) of the intervention; emphasising importance of consequences is not sufficient; if information about emotional consequences, code 5.6, information about emotional consequences; if about social, environmental or unspecified consequences code 5.3, information about social and environmental consequences.</p>	<p>Explain that not finishing a course of antibiotics can increase susceptibility to future infection. Present the likelihood of contracting a sexually transmitted infection following unprotected sexual behaviour.</p>
5.2 Salience of consequences	<p>Use methods specifically designed to emphasise the consequences of performing the behaviour with the aim of making them more memorable (goes beyond informing about consequences).</p> <p>Note: if information about consequences, also code 5.1, information about health consequences, 5.6, information about emotional consequences or 5.3, information about social and environmental consequences.</p>	<p>Produce cigarette packets showing pictures of health consequences, e.g. diseased lungs, to highlight the dangers of continuing to smoke.</p>
5.3 Information about social and environmental consequences	<p>Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behaviour.</p> <p>Note: consequences can be for any target, not just the recipient(s) of the intervention; if information about health or consequences, code 5.1, information about health consequences; if about emotional consequences, code 5.6, information about emotional consequences; if unspecified, code 5.3, information about social and environmental consequences.</p>	<p>Tell family physician about financial remuneration for conducting health screening. Inform a smoker that the majority of people disapprove of smoking in public places.</p>
5.4 Monitoring of emotional consequences	<p>Prompt assessment of feelings after attempts at performing the behaviour.</p>	<p>Agree that the person will record how they feel after taking their daily walk.</p>
5.5 Anticipated regret behaviour	<p>Induce or raise awareness of expectations of future regret about performance of the unwanted.</p> <p>Note: not including 5.6, information about emotional consequences; if suggests adoption of a perspective or new perspective in order to change cognitions also code 13.2, framing/reframing.</p>	<p>Ask the person to assess the degree of regret they will feel if they do not quit smoking.</p>

Number label	Definition	Examples
5. Natural consequences		
5.6 Information about emotional consequences	<p>Provide information (e.g. written, verbal, visual) about emotional consequences of performing the behaviour.</p> <p>Note: consequences can be related to emotional health disorders (e.g. depression, anxiety) and/or states of mind (e.g. low mood, stress); not including 5.5, anticipated regret; consequences can be for any target, not just the recipient(s) of the intervention; if information about health consequences code 5.1, information about health consequences; if about social, environmental or unspecified code 5.3, information about social and environmental consequences.</p>	Explain that quitting smoking increases happiness and life satisfaction.
6. Comparison of behaviour		
6.1 Demonstration of the behaviour	<p>Provide an observable sample of the performance of the behaviour, directly in person or indirectly e.g. via film, pictures, for the person to aspire to or imitate (includes 'modelling').</p> <p>Note: if advised to practice, also code, 8.1, behavioural practice and rehearsal; if provided with instructions on how to perform, also code 4.1, instruction on how to perform the behaviour.</p>	Demonstrate to nurses how to raise the issue of excessive drinking with patients via a role play exercise.
6.2 Social comparison	<p>Draw attention to others' performance to allow comparison with the person's own performance.</p> <p>Note: being in a group setting does not necessarily mean that social comparison is actually taking place.</p>	Show the doctor the proportion of patients who were prescribed antibiotics for a common cold by other doctors and compare with their own data.
6.3 Information about others' approval	Provide information about what other people think about the behaviour. The information clarifies whether others will like, approve or disapprove of what the person is doing or will do.	Tell the staff at the hospital ward that staff at all other wards approve of washing their hands according to the guidelines.
7. Associations		
7.1 Prompts/cues	<p>Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance.</p> <p>Note: when a stimulus is linked to a specific action in an if-then plan including one or more of frequency, duration or intensity also code 1.4, action planning.</p>	Put a sticker on the bathroom mirror to remind people to brush their teeth.

Number label	Definition	Examples
7. Associations		
7.2 Cue signalling reward	Identify an environmental stimulus that reliably predicts that reward will follow the behaviour (includes 'discriminative cue').	Advise that a fee will be paid to dentists for a particular dental treatment of 6- to 8-year-old, but not older, children to encourage delivery of that treatment (the 6- to 8-year-old children are the environmental stimulus).
7.3 Reduce prompts/cues	Withdraw gradually prompts to perform the behaviour (includes 'fading').	Reduce gradually the number of reminders used to take medication.
7.4 Remove access to the reward	Advise or arrange for the person to be separated from situations in which unwanted behaviour can be rewarded in order to reduce the behaviour (includes 'time out').	Arrange for cupboard containing high-calorie snacks to be locked for a specified period to reduce the consumption of sugary foods in between meals.
7.5 Remove aversive stimulus	Advise or arrange for the removal of an aversive stimulus to facilitate behaviour change (includes 'escape learning').	Arrange for a gym buddy to stop nagging the person to do more exercise in order to increase the desired exercise behaviour.
7.6 Satiation	Advise or arrange repeated exposure to a stimulus that reduces or extinguishes a drive for the unwanted behaviour.	Arrange for the person to eat large quantities of chocolate, in order to reduce the person's appetite for sweet foods.
7.7 Exposure	Provide systematic confrontation with a feared stimulus to reduce the response to a later encounter.	Agree a schedule by which the person who is frightened of surgery will visit the hospital where they are scheduled to have surgery.
7.8 Associative learning	Present a neutral stimulus jointly with a stimulus that already elicits the behaviour repeatedly until the neutral stimulus elicits that behaviour (includes 'classical/Pavlovian conditioning'). Note: when a BCT involves reward or punishment, code one or more of: 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward; 10.9, self-reward; 10.10, reward (outcome).	Present repeatedly fatty foods with a disliked sauce to discourage the consumption of fatty foods.
8. Repetition and substitution		
8.1 Behavioural practice/ rehearsal	Prompt practice or rehearsal of the performance of the behaviour one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill. Note: if aiming to associate performance with the context, also code 8.3, habit formation.	Prompt asthma patients to practice measuring their peak flow in the nurse's consulting room.
8.2 Behaviour substitution	Prompt substitution of the unwanted behaviour with a wanted or neutral behaviour Note: if this occurs regularly, also code.	Suggest that the person goes for a walk rather than watches television.

Number label	Definition	Examples
8. Repetition and substitution		
8.3 Habit formation	<p>Prompt rehearsal and repetition of the behaviour in the same context repeatedly so that the context elicits the behaviour</p> <p>Note: also code 8.1, behavioural practice/rehearsal.</p>	Prompt patients to take their statin tablet before brushing their teeth every evening.
8.4 Habit reversal	<p>Prompt rehearsal and repetition of an alternative behaviour to replace an unwanted habitual behaviour.</p> <p>Note: also code 8.2, behaviour substitution.</p>	Ask the person to walk upstairs at work where they previously always took the lift.
8.5 Overcorrection	Ask to repeat the wanted behaviour in an exaggerated way following an unwanted behaviour.	Ask to eat only fruit and vegetables the day after a poor diet.
8.6 Generalisation of target behaviour	Advise to perform the wanted behaviour, which is already performed in a particular situation, in another situation.	Advise to repeat toning exercises learned in the gym when at home
8.7 Graded tasks	Set easy-to-perform tasks, making them increasingly difficult, but achievable, until behaviour is performed.	Ask the person to walk for 100 yards a day for the first week, then half a mile a day after they have successfully achieved 100 yards, then two miles a day after they have successfully achieved one mile.
9. Comparison of outcomes		
9.1 Credible source	<p>Present verbal or visual communication from a credible source in favour of or against the behaviour.</p> <p>Note: code this BCT if source generally agreed on as credible, e.g. health professionals, celebrities or words used to indicate expertise or leader in field and if the communication has the aim of persuading; if information about health consequences, also code 5.1, information about health consequences, if about emotional consequences, also code 5.6, information about emotional consequences; if about social, environmental or unspecified consequences also code 5.3, information about social and environmental consequences.</p>	Present a speech given by a high status professional to emphasise the importance of not exposing patients to unnecessary radiation by ordering radiographs for back pain.

Number label	Definition	Examples
9. Comparison of outcomes		
9.2 Pros and cons	<p>Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behaviour (includes 'decisional balance').</p> <p>Note: if providing information about health consequences, also code 5.1, information about health consequences; if providing information about emotional consequences, also code 5.6, information about emotional consequences; if providing information about social, environmental or unspecified consequences also code 5.3, information about social and environmental consequences.</p>	Advise the person to list and compare the advantages and disadvantages of prescribing antibiotics for upper respiratory tract infections.
9.3 Comparative imagining of future outcomes	Prompt or advise the imagining and comparing of future outcomes of changed vs unchanged behaviour.	Prompt the person to imagine and compare likely or possible outcomes following attending vs not attending a screening appointment.
10. Reward and threat		
10.1 Material incentive (behaviour)	Inform that money, vouchers or other valued objects will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').	Inform that a financial payment will be made each month in pregnancy that the woman has not smoked.
10.2 Material reward	Arrange for the delivery of money, vouchers or other valued objects if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').	Arrange for the person to receive money that would have been spent on cigarettes if and only if the smoker has not smoked for 1 month.
10.3 Non-specific reward	<p>Arrange delivery of a reward if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').</p> <p>Note: if reward is material, code 10.2, material reward (behaviour), if social, code 10.4, social reward, and not 10.3, non-specific reward; if reward is for outcome code 10.10, reward (outcome). If informed of reward in advance of rewarded behaviour, also code one of: 10.1, material incentive (behaviour); 10.5, social incentive; 10.6, non-specific incentive; 10.7, self-incentive; 10.8, incentive (outcome).</p>	Identify something (e.g. an activity such as a visit to the cinema) that the person values and arrange for this to be delivered if and only if they attend for health screening.

Number label	Definition	Examples
10. Reward and threat		
10.4 Social reward	<p>Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').</p> <p>Note: if reward is material, code 10.2, material reward (behaviour), if unspecified code 10.3, non-specific reward, and not 10.4, social reward; if reward is for outcome code 10.10, reward (outcome). If informed of reward in advance of rewarded behaviour, also code one of: 10.1, material incentive (behaviour); 10.5, social incentive; 10.6, non-specific incentive; 10.7, self-incentive; 10.8, incentive (outcome).</p>	Congratulate the person for each day they eat a reduced fat diet.
10.5 Social incentive	<p>Inform that a verbal or non-verbal reward will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').</p> <p>Note: if incentive is material, code 10.1, material incentive (behaviour), if unspecified code 10.6, non-specific incentive, and not 10.5, social incentive; if incentive is for outcome code 10.8, incentive (outcome). If reward is delivered also code one of: 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).</p>	Inform that they will be congratulated for each day they eat a reduced fat diet.
10.6 Non-specific incentive	Inform that a reward will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'positive reinforcement').	Identify an activity that the person values and inform them that this will happen if and only if they attend for health screening.
10.7 Self-incentive	<p>Plan to reward self in future if and only if there has been effort and/or progress in performing the behaviour.</p> <p>Note: if self-reward is material, also code 10.1, material incentive (behaviour), if social, also code 10.5, social incentive, if unspecified, also code 10.6, non-specific incentive; if incentive is for outcome code 10.8, incentive (outcome). If reward is delivered also code one of: 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).</p>	Encourage to reward self with material (e.g. new clothes) or other valued objects if and only if they have adhered to a healthy diet.

Number label	Definition	Examples
10. Reward and threat		
10.8 Incentive (outcome)	<p>Inform that a reward will be delivered if and only if there has been effort and/or progress in achieving the behavioural outcome (includes 'positive reinforcement').</p> <p>Note: this includes social, material, self- and non-specific incentives for outcome; if incentive is for the behaviour code 10.5, social incentive, 10.1, material incentive (behaviour), 10.6, non-specific incentive or 10.7, self-incentive and not 10.8, incentive (outcome). If reward is delivered also code one of: 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).</p>	Inform the person that they will receive money if and only if a certain amount of weight is lost.
10.9 Self-reward	<p>Prompt self-praise or self-reward if and only if there has been effort and/or progress in performing the behaviour</p> <p>Note: if self-reward is material, also code 10.2, material reward (behaviour), if social, also code 10.4, social reward, if unspecified, also code 10.3, non-specific reward; if reward is for outcome code 10.10, reward (outcome). If informed of reward in advance of rewarded behaviour, also code one of: 10.1, material incentive (behaviour); 10.5, social incentive; 10.6, non-specific incentive; 10.7, self-incentive; 10.8, incentive (outcome).</p>	Encourage to reward self with material (e.g. new clothes) or other valued objects if and only if they have adhered to a healthy diet.
10.10 Reward (outcome)	<p>Arrange for the delivery of a reward if and only if there has been effort and/or progress in achieving the behavioural outcome (includes 'positive reinforcement').</p>	Arrange for the person to receive money if and only if a certain amount of weight is lost.
10.11 Future punishment	<p>Inform that future punishment or removal of reward will be a consequence of performance of an unwanted behaviour (may include fear arousal) (includes 'threat').</p>	Inform that continuing to consume 30 units of alcohol per day is likely to result in loss of employment if the person continues.
11. Regulation		
11.1 Pharmacological support	<p>Provide, or encourage the use of or adherence to, drugs to facilitate behaviour change.</p> <p>Note: if pharmacological support to reduce negative emotions (i.e. anxiety) then also code 11.2, reduce negative emotions.</p>	Suggest the patient asks the family physician for nicotine replacement therapy to facilitate smoking cessation.
11.2 Reduce negative emotionsa	<p>Advise on ways of reducing negative emotions to facilitate performance of the behaviour (includes 'stress management')</p> <p>Note: if includes analysing the behavioural problem, also code 1.2, problem-solving.</p>	Advise on the use of stress management skills, e.g. to reduce anxiety about joining Alcoholics Anonymous.

Number label	Definition	Examples
11. Regulation		
11.3 Conserving mental resources	Advise on ways of minimising demands on mental resources to facilitate behaviour change.	Advise to carry food calorie content information to reduce the burden on memory in making food choices.
11.4 Paradoxical instructions	Advise to engage in some form of the unwanted behaviour with the aim of reducing motivation to engage in that behaviour.	Advise a smoker to smoke twice as many cigarettes a day as they usually do tell the person to stay awake as long as possible in order to reduce insomnia.
12. Antecedents		
12.1 Restructuring the physical environment	<p>Change, or advise to change the physical environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments).</p> <p>Note: this may also involve 12.3, avoidance/reducing exposure to cues for the behaviour; if restructuring of the social environment code 12.2, restructuring the social environment; if only adding objects to the environment, code 12.5, adding objects to the environment.</p>	Advise to keep biscuits and snacks in a cupboard that is inconvenient to get to arrange to move vending machine out of the school.
12.2 Restructuring the social environment	<p>Change, or advise to change the social environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments).</p> <p>Note: this may also involve 12.3, avoidance/reducing exposure to cues for the behaviour; if also restructuring of the physical environment also code 12.1, restructuring the physical environment.</p>	Advise to minimise time spent with friends who drink heavily to reduce alcohol consumption.
12.3 Avoidance/reducing exposure to cues for the behaviour	<p>Advise on how to avoid exposure to specific social and contextual/physical cues for the behaviour, including changing daily or weekly routines.</p> <p>Note: this may also involve 12.1, restructuring the physical environment and/or 12.2, restructuring the social environment; if the BCT includes analysing the behavioural problem, only code 1.2, problem-solving.</p>	Suggest to a person who wants to quit smoking that their social life focus on activities other than pubs and bars which have been associated with smoking.
12.4 Distraction	Advise or arrange to use an alternative focus for attention to avoid triggers for unwanted behaviour.	Suggest to a person who is trying to avoid between-meal snacking to focus on a topic they enjoy (e.g. holiday plans) instead of focusing on food.

Number label	Definition	Examples
12. Antecedents		
12.5 Adding objects to the environment	<p>Add objects to the environment in order to facilitate performance of the Behaviour.</p> <p>Note: provision of information (e.g. written, verbal, visual) in a booklet or leaflet is insufficient. If this is accompanied by social support, also code 3.2, social support (practical); if the environment is changed beyond the addition of objects, also code 12.1, restructuring the physical environment.</p>	Provide free condoms to facilitate safe sex. Provide attractive toothbrush to improve tooth brushing technique.
12.6 Body changes	Alter body structure, functioning or support directly to facilitate behaviour change.	Prompt strength training, relaxation training or provide assistive aids (e.g. a hearing aid).
13. Identity		
13.1 Identification of self as role Model	Inform that one's own behaviour may be an example to others.	Inform the person that if they eat healthily, that may be a good example for their children.
13.2 Framing/reframing	<p>Suggest the deliberate adoption of a perspective or new perspective on behaviour (e.g. its purpose) in order to change cognitions or emotions about performing the behaviour (includes 'cognitive structuring').</p> <p>Note: if information about consequences then code 5.1, information about health consequences, 5.6, information about emotional consequences or 5.3, information about social and environmental consequences instead of 13.2, framing/reframing.</p>	Suggest that the person might think of the tasks as reducing sedentary behaviour (rather than increasing activity).
13.3 Incompatible beliefs	Draw attention to discrepancies between current or past behaviour and self-image, in order to create discomfort (includes 'cognitive dissonance').	Draw attention to a doctor's liberal use of blood transfusion and their self-identification as a proponent of evidence-based medical practice.
13.4 Valued self-identity	Advise the person to write or complete rating scales about a cherished value or personal strength as a means of affirming the person's identity as part of a behaviour change strategy (includes 'self-affirmation').	Advise the person to write about their personal strengths before they receive a message advocating the behaviour Change.
13.5 Identity associated with changed behaviour	Advise the person to construct a new self-identity as someone who 'used to engage with the unwanted behaviour'.	Ask the person to articulate their new identity as an 'ex-smoker'.
14. Scheduled consequences		
14.1 Behaviour cost	Arrange for withdrawal of something valued if and only if an unwanted behaviour is performed (includes 'response cost') Note: if withdrawal of contingent reward code, 14.3, remove reward.	Subtract money from a prepaid refundable deposit when a cigarette is smoked.

Number label	Definition	Examples
14. Scheduled consequences		
14.2 Punishment	Arrange for aversive consequence contingent on the performance of the unwanted behaviour.	Arrange for the person to wear unattractive clothes following consumption of fatty foods.
14.3 Remove reward	Arrange for discontinuation of contingent reward following performance of the unwanted behaviour (includes 'extinction').	Arrange for the other people in the household to ignore the person every time they eat chocolate (rather than attending to them by criticising or persuading).
14.4 Reward approximation	Arrange for reward following any approximation to the target behaviour, gradually rewarding only performance closer to the wanted behaviour (includes 'shaping').	Arrange reward for any reduction in daily calories, gradually requiring the daily calorie count to become closer to the planned calorie intake.
14.5 Rewarding completion	Build up behaviour by arranging reward following final component of the behaviour; gradually add the components of the behaviour that occur earlier in the behavioural sequence (includes 'backward chaining'). Note: also code one of 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).	Reward eating a supplied low calorie meal; then make reward contingent on cooking and eating the meal; then make reward contingent on purchasing, cooking and eating the meal.
14.6 Situation-specific reward	Arrange for reward following the behaviour in one situation but not in another (includes 'discrimination training'). Note: also code one of 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).	Arrange reward for eating at mealtimes but not between meals.
14.7 Reward incompatible behaviour	Arrange reward for responding in a manner that is incompatible with a previous response to that situation (includes 'counter-conditioning'). Note: also code one of 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).	Arrange reward for ordering a soft drink at the bar rather than an alcoholic beverage.
14.8 Reward alternative behaviour	Arrange reward for performance of an alternative to the unwanted behaviour (includes 'differential reinforcement'). Note: also code one of 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome); consider also coding 1.2, problem-solving.	Reward for consumption of low fat foods but not consumption of high fat foods.

Number label	Definition	Examples
14. Scheduled consequences		
14.9 Reduce reward frequency	<p>Arrange for rewards to be made contingent on increasing duration or frequency of the behaviour (includes 'thinning').</p> <p>Note: also code one of 10.2, material reward (behaviour); 10.3, non-specific reward; 10.4, social reward, 10.9, self-reward; 10.10, reward (outcome).</p>	Arrange reward for each day without smoking, then each week, then each month, then every 2 months and so on.
14.10 Remove punishment	Arrange for removal of an unpleasant consequence contingent on performance of the wanted behaviour (includes 'negative reinforcement').	Arrange for someone else to do housecleaning only if the person has adhered to the medication regimen for a week.
15. Self-belief		
15.1 Verbal persuasion about capability	Tell the person that they can successfully perform the wanted behaviour, arguing against self-doubts and asserting that they can and will succeed.	Tell the person that they can successfully increase their physical activity, despite their recent heart attack.
15.2 Mental rehearsal of successful performance	Advise to practise imagining performing the behaviour successfully in relevant contexts.	Advise to imagine eating and enjoying a salad in a work canteen.
15.3 Focus on past success	Advise to think about or list previous successes in performing the behaviour (or parts of it).	Advise to describe or list the occasions on which the person had ordered a non-alcoholic drink in a bar.
15.4 Self-talk	Prompt positive self-talk (aloud or silently) before and during the behaviour.	Prompt the person to tell themselves that a walk will be energising.
16. Covert learning		
16.1 Imaginary punishment	Advise to imagine performing the unwanted behaviour in a real-life situation followed by imagining an unpleasant consequence (includes 'covert sensitisation').	Advise to imagine overeating and then vomiting.
16.2 Imaginary reward	Advise to imagine performing the wanted behaviour in a real-life situation followed by imagining a pleasant consequence (includes 'covert conditioning').	Advise the health professional to imagine giving dietary advice followed by the patient losing weight and no longer being diabetic.
16.3 Vicarious consequences	<p>Prompt observation of the consequences (including rewards and punishments) for others when they perform the behaviour.</p> <p>Note: if observation of health consequences, also code 5.1, information about health consequences; if of emotional consequences, also code 5.6, information about emotional consequences, if of social, environmental or unspecified consequences, also code 5.3, information about social and environmental consequences.</p>	Draw attention to the positive comments other staff get when they disinfect their hands regularly.

N.b. An additional technique, 'increases positive emotions', will be included in BCT Taxonomy v2.

Notes: Each of the BCTs in BCTTv1 has been given a number to aid navigation of the taxonomy. BCT numbers are given in column 1.

BCT labels and numbers listed here represent their labels and numbers in BCTTv1.

The definitions of BCTs:

- Contain verbs (e.g. provide, advise, arrange, prompt) that refer to the action(s).
- Taken by the person/s delivering the technique. BCTs can be delivered by an 'interventionist' or be self-delivered.
- Contain the term 'behaviour' referring to a single action or sequence of actions that includes the performance of wanted behaviour(s) and/or inhibition (non-performance) of unwanted behaviour(s).

Alternative coding is given for BCTs when relevant. Technical terms associated with particular theoretical frameworks are shown for BCTs when relevant (e.g. 'implementation intentions').

Note the technical terms associated with particular theoretical frameworks when relevant (e.g. 'including implementation intentions').

References

- Abraham, C. & Michie, S. (2008). A Taxonomy of Behavior Change Techniques Used in Interventions. *Health Psychology, 27*(3): 379–387.
- Allman-Farinelli, M., Partridge, S. R., McGeechan, K., Balestracci, K., Hebden, L., Wong, A., Phongsavan, P., Denney-Wilson, E., Harris, M. F. & Bauman, A. (2016). A Mobile Health Lifestyle Program for Prevention of Weight Gain in Young Adults (TXT2BFIT): Nine-month outcomes of a randomized controlled trial. *Journal of Medical Internet Research, 4*(2): e78.
- Appel, L. J., Clark, J. M., Yeh, H. C., Wang, N. Y., Coughlin, J. W., Daumit, G., Miller, E. R. 3rd, Dalcin, A., Jerome, G. J., Geller, S., Noronha, G., Pozefsky, T., Charleston, J., Reynolds, J. B., Durkin, N., Rubin, R. R., Louis, T. A. & Brancati, F. L. (2011). Comparative Effectiveness of Weight-Loss Interventions in Clinical Practice. *New England Journal of Medicine, 365*(21): 1959–1968.
- Berry, D., Savoye, M., Melkus, G. & Grey, M. (2007). An Intervention for Multiethnic Obese Parents and Overweight Children. *Applied Nursing Research, 20*(2): 63–71.
- Brownell, K. D., Kelman, J. H. & Stunkard, A. J. (1983). Treatment of Obese Children with and without Their Mothers: Changes in weight and blood pressure. *Pediatrics, 71*(4): 515–523.
- Bungum, T., Clark, S. & Aguilar B. (2014). The Effect of an Active Transport to School Intervention at a Suburban Elementary School. *American Journal of Health Education, 45*(4): 205–209.
- Burke, V., Beilin, L. J., Cutt, H. E., Mansour, J. & Mori, T. A. (2008). Moderators and Mediators of Behaviour Change in a Lifestyle Program for Treated Hypertensives: A randomized controlled trial (ADAPT). *Health Education Research, 23*(4): 583–591.
- Burke, V., Beilin, L. J., Cutt, H. E., Mansour, J., Williams, A. & Mori, T. A. (2007). A Lifestyle Program for Treated Hypertensives Improved Health-related Behaviors and Cardiovascular Risk Factors, a Randomized Controlled Trial. *Journal of Clinical Epidemiology, 60*(2): 133–141.
- Burke, V., Beilin, L. J., Cutt, H. E., Mansour, J., Wilson, A. & Mori, T. A. (2005). Effects of a Lifestyle Programme on Ambulatory Blood Pressure and Drug Dosage in Treated Hypertensive Patients: A randomized controlled trial. *Journal of Hypertension, 23*(6): 1241–1249.
- Butler, L., Furber, S., Phongsavan, P., Mark, A. & Bauman, A. (2009). Effects of a Pedometer-Based Intervention on Physical Activity Levels after Cardiac Rehabilitation: A randomized controlled trial. *Journal of Cardiopulmonary Rehabilitation and Prevention, 29*(2): 105–114.

- Calfas, K. J., Long, B. J., Sallis, J. F., Wooten, W. J., Pratt, M. & Patrick, K. (1996). A Controlled Trial of Physician Counseling to Promote the Adoption of Physical Activity. *Preventive Medicine*, 25(3): 225–233.
- Carels, R. A., Darby, L. A., Cacciapaglia, H. M. & Douglass, O. M. (2004). Reducing Cardiovascular Risk Factors in Postmenopausal Women Through a Lifestyle Change Intervention. *Journal of Women's Health*, 13(4): 412–426.
- Chambliss, H. O., Huber, R. C., Finley, C. E., McDoniel, S. O., Kitzman-Ulrich, H. & Wilkinson, W. J. (2011). Computerized Self-Monitoring and Technology-Assisted Feedback for Weight Loss with and without an Enhanced Behavioral Component. *Patient Education and Counseling*, 85(3): 375–382.
- Chen, J. L., Weiss, S., Heyman, M. B. & Lustig, R. H. (2010). Efficacy of a Child-Centred and Family-Based Program in Promoting Healthy Weight and Healthy Behaviors in Chinese American Children: a randomized controlled study. *Journal of Public Health*, 32(2): 219–229.
- Collins, C. E., Morgan, P. J., Jones, P., Fletcher, K., Martin, J., Aguiar, E. J., Lucas, A., Neve, M. J. & Callister, R. (2012). A 12-Week Commercial Web-Based Weight-Loss Program for Overweight and Obese Adults: Randomized controlled trial comparing basic versus enhanced features. *Journal of Medical Internet Research*, 14(2): e57.
- Craighead, L. W. & Blum, M. D. (1989). Supervised Exercise in Behavioural Treatment for Moderate Obesity. *Behavior Therapy*, 20(1): 49–59.
- Dallow, C. B. & Anderson, J. (2003). Using Self-Efficacy and a Transtheoretical Model to Develop a Physical Activity Intervention for Obese Women. *American Journal of Health Promotion*, 17(6): 373–381.
- Dubbert, P. M. & Wilson, G. T. (1984). Goal-Setting and Spouse Involvement in the Treatment of Obesity. *Behaviour Research and Therapy*, 22(3): 227–242.
- Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K. & Dyer, A. (2005). Two-Year Follow-Up Results for Hip-Hop to Health Jr.: A randomized controlled trial for overweight prevention in preschool minority children. *Journal of Pediatrics*, 146(5): 618–625.
- Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., Van Horn, L., KauferChristoffel, K. & Dyer, A. (2006). Hip-Hop to Health Jr. for Latino Preschool Children. *Obesity*, 14(9): 1616–1625.
- Ford, P. A., Perkins, G. & Swaine, I. (2013). Effects of a 15-Week Accumulated Brisk Walking Programme on the Body Composition of Primary School Children. *Journal of Sports Sciences*, 31(2): 114–122.
- Fylan, F. & Stradling, S. (2014). Behavioural Change Techniques in Road Safety Interventions for Young People. *Revue Européenne de Psychologie Appliquée/European Review of Applied Psychology*, 64(3): 123–129.

- Gentile, D. A., Welk, G., Eisenmann, J. C., Reimer, R. A., Walsh, D. A., Russell, D. W., Callahan, R., Walsh, M., Russell, D. W., Callahan, R., Walsh, M., Strickland, S. & Fritz, K. (2009). Evaluation of a Multiple Ecological Level Child Obesity Prevention Program: Switch what you do, view, and chew. *BMC Medicine*, 7: 49.
- Gilson, N., McKenna, J., Cooke, C. & Brown, W. (2007). Walking Towards Health in a University Community: A feasibility study. *Preventive Medicine*, 44(2): 167–169.
- Golley, R. K., Magarey, A. M., Baur, L. A., Steinbeck, K. S. & Daniels, L. A. (2007). Twelve-Month Effectiveness of a Parent-Led, Family-Focused Weight-Management Program for Prepubertal Children: A randomized, controlled trial. *Pediatrics*, 119(3): 517–525.
- Halbert, J. A., Silagy, C. A., Finucane, P. M., Withers, R. T. & Hamdorf, P. A. (2000). Physical Activity and Cardiovascular Risk Factors: Effect of advice from an exercise specialist in Australian general practice. *Medical Journal of Australia*, 173(2): 84–87.
- Hemmingsson, E., Uddén, J., Neovius, M., Ekelund, U. & Rössner, S. (2009). Increased Physical Activity in Abdominally Obese Women Through Support for Changed Commuting Habits: A randomized clinical trial. *International Journal of Obesity*, 33(6): 645–652.
- Hunter, C. M., Peterson, A. L., Alvarez, L. M., Poston, W. C., Brundige, A. R., Haddock, C. K., Van Brunt, D. L. & Foreyt, J. P. (2008). Weight Management Using the Internet. A randomized controlled trial. *American Journal of Preventive Medicine*, 34(2): 119–126.
- James, J. E. & May Hampton, B. A. (1982). The Relative Efficacy of Directive and Nondirective Treatment in Behavioral Weight Control. *Behavior Therapy*, 13(4): 463–475.
- Janicke, D. M., Sallinen, B. J., Perri, M. G., Lutes, L. D., Huerta, M., Silverstein, J. H. & Brumback, B. (2008). Comparison of Parent-Only vs Family-Based Interventions for Overweight Children in Underserved Rural Settings: Outcomes from project STORY. *Archives of Pediatrics & Adolescent Medicine*, 162(12): 1119–1125.
- Johnson, W. G., Hinkle, L. K., Carr, R. E., Anderson, D. A., Lemmon, C. R., Engler, L. B. & Bergeron, K. C. (1997). Dietary and Exercise Interventions for Juvenile Obesity: Long-term effect of behavioral and public health models. *Obesity Research*, 5(3): 257–261.
- Kalavainen, M. P., Korppi, M. O. & Nuutinen, O. M. (2007). Clinical Efficacy of Group-Based Treatment for Childhood Obesity Compared with Routinely Given Individual Counseling. *International Journal of Obesity*, 31(10): 1500–1508.
- Kraschnewski, J. L., Stuckey, H. L., Rovniak, L. S., Lehman, E. B., Reddy, M., Poger, J. M., Kephart, D. K., Coups, E. J. & Sciamanna, C. N. (2011). Efficacy of a Weight-Loss Website Based on Positive Deviance: A randomized trial. *American Journal of Preventive Medicine*, 41(6): 610–614.
- Kreuter, M. W., Oswald, D. L., Bull, F. C. & Clark, E. M. (2000). Are Tailored Health Education Materials Always More Effective than Non-Tailored Materials? *Health Education Research*, 15(3): 305–315.

- Lee, L. L., Kuo, Y. C., Fanaw, D., Perng, S. J. & Juang, I. F. (2012). The Effect of an Intervention Combining Self-Efficacy Theory and Pedometers on Promoting Physical Activity Among Adolescents. *Journal of Clinical Nursing*, 21(7–8): 914–922.
- Leermakers, E. A., Perri, M. G., Shigaki, C. L. & Fuller, P. R. (1999). Effects of Exercise-Focused Versus Weight-Focused Maintenance Programs on the Management of Obesity. *Addictive Behaviors*, 24(2): 219–227.
- Lorencatto, F., West, R., Bruguera, C., Brose, L. S. & Michie, S. (2016). Assessing the Quality of Goal Setting in Behavioural Support for Smoking Cessation and its Association with Outcomes. *Annals of Behavioral Medicine*, 50(2): 310–318.
- Lubans, D. & Sylva, K. (2006). Controlled Evaluation of a Physical Activity Intervention for Senior School Students: Effects of the lifetime activity program. *Journal of Sport and Exercise Psychology*, 28(3): 252–268.
- McKee, R., Mutrie, N., Crawford, F. & Green, B. (2007). Promoting Walking to School: Results of a quasi-experimental trial. *Journal of Epidemiology and Community Health*, 61(9): 818–823.
- McMinn, D., Rowe, D. A., Murtagh, S. & Nelson, N. M. (2012). The Effect of a School-Based Active Commuting Intervention on Children's Commuting Physical Activity and Daily Physical Activity. *Preventive Medicine*, 54(5): 316–318.
- Mendoza, J. A., Levinger, D. D. & Johnston, B. D. (2009). Pilot Evaluation of a Walking School Bus Program in a Low-Income, Urban Community. *BMC Public Health*, 9: 122.
- Mendoza, J. A., Watson, K., Baranowski, T., Nicklas, T. A., Uscanga, D. K. & Hanfling, M. J. (2011). The Walking School Bus and Children's Physical Activity: A pilot cluster randomized controlled trial. *Pediatrics*, 128(3): e537–544.
- Michie, S. & Abraham, C. (2008). Advancing the Science of Behaviour Change: A plea for scientific reporting. *Addiction*, 103(9): 1409–1410.
- Michie, S., Churchill, S. & West, R. (2011). Identifying Evidence-Based Competences Required to Deliver Behavioural Support for Smoking Cessation. *Annals of Behavioral Medicine*, 41(1): 59–70.
- Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A. & French, D. P. (2011a). A Refined Taxonomy of Behaviour Change Techniques to Help People Change Their Physical Activity and Healthy Eating Behaviours: The CALO-RE taxonomy. *Psychology & Health*, 26(11): 1479–1498.
- Michie, S., Hyder, N., Walia, A. & West, R. (2011b). Development of a Taxonomy of Behaviour Change Techniques Used in Individual Behavioural Support for Smoking Cessation. *Addictive Behaviors*, 36(4): 315–319.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J. & Wood C. E. (2013). The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, 46(1): 81–95.

Michie, S., Whittington, C., Hamoudi, Z., Zarnani, F., Tober, G. & West, R. (2012). Identification of Behaviour Change Techniques to Reduce Excessive Alcohol Consumption. *Addiction*, 107(8): 1431–1440.

Michie, S., Wood, C. E., Johnston, M., Abraham, C., Francis, J. J. & Hardeman, W. (2015). Behaviour Change Techniques: The development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). *Health Technology Assessment*, 19(99): 1–188.

Morrison, R., Reilly, J. J., Penpraze, V., Westgarth, C., Ward, D. S., Mutrie, N., Hutchison, P., Young, D., McNicol, L., Calvert, M. & Yam, P. S. (2013). Children, Parents and Pets Exercising Together (CPET): Exploratory randomised controlled trial. *BMC Public Health*, 13: 1096.

Nader, P. R., Stone, E. J., Lytle, L. A., Perry, C. L., Osganian, S. K., Kelder, S., Webber, L. S., Elder, J. P., Montgomery, D., Feldman, H. A., Wu, M., Johnson, C., Parcel, G. S. & Luepker, R. V. (1999). Three-Year Maintenance of Improved Diet and Physical Activity: The CATCH cohort. Child and Adolescent Trial for Cardiovascular Health. *Archives of Pediatrics & Adolescent Medicine*, 153(7): 695–704.

Nemet, D., Barkan, S., Epstein, Y., Friedland, O., Kowen, G. & Eliakim, A. (2005). Short- and Long-Term Beneficial Effects of a Combined Dietary-Behavioral-Physical Activity Intervention for the Treatment of Childhood Obesity. *Pediatrics*, 115(4): e443–449.

NICE (National Institute for Health and Care Excellence) (2014). Behaviour change: *individual approaches*. NICE. Retrieved 6 November 2016 from www.nice.org.uk/guidance/ph49.

Norris, S. L., Grothaus, L. C., Buchner, D. M. & Pratt, M. (2000). Effectiveness of Physician-Based Assessment and Counseling for Exercise in a Staff Model HMO. *Preventive Medicine*, 30(6): 513–523.

Prochaska, J. & DiClemente, C. C. (1983). Stages and Processes of Self-Change in Smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51(3): 390–395.

Prochaska, J. O., DiClemente, C. C. & Norcross, J. C. (1992). In Search of How People Change. Applications to addictive behaviors. *American Psychologist*, 47(9): 1102–1114.

Rapoport, L., Clark, M. & Wardle, J. (2000). Evaluation of a Modified Cognitive-Behavioural Programme for Weight Management. *International Journal of Obesity and Related Metabolic Disorders*, 24(12): 1726–1737.

- Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H., Lo Conte, R., Paton, J. Y. & Grant, S. (2006). Physical Activity to Prevent Obesity in Young Children: Cluster randomised controlled trial. *BMJ*, 333(7577): 1041.
- Riebe, D., Blissmer, B., Greene, G., Caldwell, M., Ruggiero, L., Stillwell, K. M. & Nigg, C. R. (2005). Long-Term Maintenance of Exercise and Healthy Eating Behaviors in Overweight Adults. *Preventive Medicine*, 40(6): 769–778.
- Riebe, D., Greene, G. W., Ruggiero, L., Stillwell, K. M., Blissmer, B., Nigg, C. R. & Caldwell, M. (2003). Evaluation of a Healthy-Lifestyle Approach to Weight Management. *Preventive Medicine*, 36(1): 45–54.
- Salmon, J., Ball, K., Crawford, D., Booth, M., Telford, A., Hume, C., Jolley, D. & Worsley, A. (2005). Reducing Sedentary Behaviour and Increasing Physical Activity Among 10-Year-Old Children: Overview and process evaluation of the 'Switch-Play' intervention. *Health Promotion International*, 20(1): 7–17.
- Sbrocco, T., Nedegaard, R. C., Stone, J. M. & Lewis, E. L. (1999). Behavioral Choice Treatment Promotes Continuing Weight Loss: Preliminary results of a cognitive-behavioral decision-based treatment for obesity. *Journal of Consulting and Clinical Psychology*, 67(2): 260–266.
- Schofield, L., Mummery, W. K. & Schofield, G. (2005). Effects of a Controlled Pedometer-Intervention Trial for Low-Active Adolescent Girls. *Medicine and Science in Sports and Exercise*, 37(8): 1414–1420.
- Shimon, J. M. & Petlichkoff, L. M. (2009). Impact of Pedometer Use and Self-Regulation Strategies on Junior High School Physical Education Students Daily Step Counts. *Journal of Physical Activity & Health*, 6(2): 178–184.
- Singh, A. S., Chin A Paw, M. J., Brug, J. & van Mechelen, W. (2009). Dutch Obesity Intervention in Teenagers: Effectiveness of a school-based program on body composition and behavior. *Archives of Pediatrics & Adolescent Medicine*, 163(4): 309–317.
- Sirard, J. R., Alhassan, S., Spencer, T. R. & Robinson, T. N. (2008). Changes in Physical Activity from Walking to School. *Journal of Nutrition Education and Behavior*, 40(5): 324–326.
- Slootmaker, S. M., Chinapaw, M. J., Seidell, J. C., van Mechelen, W. & Schuit, A. J. (2010). Accelerometers and Internet for Physical Activity Promotion in Youth? Feasibility and effectiveness of a minimal intervention [ISRCTN93896459]. *Preventive Medicine*, 51(1): 31–36.
- Sullman, M. J. M. & Dorn, L. (2015). *A Best Practice Review of Interventions Aimed at Improving the Road Safety of Pre-Drivers, Young Drivers and Passengers*. A report prepared for Transport for London.

- Tanner-Smith, E. E. & Lipsey, M. W. (2015). Brief Alcohol Interventions for Adolescents and Young Adults: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*, 51: 1–18.
- Tanofsky-Kraff, M., Wilfley, D. E., Young, J. F., Mufson, L., Yanovski, S. Z., Glasofer, D. R., Salaita, C. G. & Schvey, N. A. (2010). A Pilot Study of Interpersonal Psychotherapy for Preventing Excess Weight Gain in Adolescent Girls At-Risk for Obesity. *International Journal of Eating Disorders*, 43(8): 701–706.
- Tudor-Locke, C., Bell, R. C., Myers, A. M., Harris, S. B., Ecclestone, N. A., Lauzon, N. & Rodger, N. W. (2004). Controlled Outcome Evaluation of the First Step Program: A daily physical activity intervention for individuals with type II diabetes. *International Journal of Obesity and Related Metabolic Disorders*, 28(1): 113–119.
- Wen, L. M., Fry, D., Merom, D., Rissel, C., Dirkis, H. & Balafas, A. (2008). Increasing Active Travel to School: Are we on the right track? A cluster randomised controlled trial from Sydney, Australia. *Preventive Medicine*, 47(6): 612–618.
- West, R., Evans, A. & Michie, S. (2011). Behavior Change Techniques Used in Group-Based Behavioral Support by the English Stop-Smoking Services and Preliminary Assessment of Association with Short-Term Quit Outcomes. *Nicotine & Tobacco Research*, 13 (12): 1316–1320.
- Wing, R. R., Epstein, L. H., Nowalk, M. P., Koeske, R. & Hagg S. (1985). Behaviour Change, Weight Loss, and Physiological Improvements in Type II Diabetic Patients. *Journal of Consulting and Clinical Psychology*, 53(1): 111–122.

Bibliography

- Abraham, C., Wood, C. E., Johnston, M., Francis, J., Hardeman, W., Richardson, M. & Michie, S. (2015). Reliability of Identification of Behavior Change Techniques in Intervention Descriptions. *Annals of Behavioral Medicine*, 49(6): 885–900.
- Arnott, B., Rehackova, L., Errington, L., Sniehotta, F. F., Roberts, J. & Araujo-Soares, V. (2014). Efficacy of Behavioural Interventions for Transport Behaviour Change: Systematic review, meta-analysis and intervention coding. *International Journal of Behavioral Nutrition and Physical Activity*, 11: 133.
- Atkins, L. & Michie, S. (2015). Designing Interventions to Change Eating Behaviours. *Proceedings of the Nutrition Society*, 74(2): 164–170.
- Bayne-Smith, M., Fardy, P. S., Azzolini, A., Magel, J., Schmitz, K. H. & Agin, D. (2004). Improvements in Heart Health Behaviors and Reduction in Coronary Artery Disease Risk Factors in Urban Teenaged Girls Through a School-Based Intervention: The PATH program. *American Journal of Public Health*, 94(9): 1538–1543.
- Bélanger Gravel, A., Godin, G., Vézina-Im, L. A., Amireault, S. & Poirier, P. (2011). The Effect of Theory Based Interventions on Physical Activity Participation Among Overweight/Obese Individuals: A systematic review. *Obesity Reviews*, 12(6): 430–439.
- Belmon, L. S., Middelweerd, A., te Velde, S. J. & Brug, J. (2015). Dutch Young Adults Ratings of Behavior Change Techniques Applied in Mobile Phone Apps to Promote Physical Activity: A cross-sectional survey. *JMIR mHealth and uHealth*, 3(4): e103.
- Biddle, S. J., O'Connell, S. & Braithwaite, R. E. (2011). Sedentary Behaviour Interventions in Young People: A meta-analysis. *British Journal of Sports Medicine*, 45(11): 937–942.
- Biddle, S. J., Petrolini, I. & Pearson, N. (2014). Interventions Designed to Reduce Sedentary Behaviours in Young People: A review of reviews. *British Journal of Sports Medicine*, 48(3): 182–186.
- Bird, E. L., Baker, G., Mutrie, N., Ogilvie, D., Sahlqvist, S. & Powell, J. (2013). Behavior Change Techniques Used to Promote Walking and Cycling: A systematic review. *Health Psychology*, 32(8): 829–838.
- Bishop, F. L., Fenge-Davies, A. L., Kirby, S. & Geraghty, A. W. (2015). Context Effects and Behaviour Change Techniques in Randomised Trials: A systematic review using the example of trials to increase adherence to physical activity in musculoskeletal pain. *Psychology & Health*, 30(1): 104–121.
- Broekhuizen, K., Kroeze, W., van Poppel, M. N., Oenema, A. & Brug, J. A. (2012). A Systematic Review of Randomized Controlled Trials on the Effectiveness of Computer-Tailored Physical Activity and Dietary Behavior Promotion Programs: An update. *Annals of Behavioral Medicine*, 44(2): 259–286.

- Campbell, K. J. & Hesketh, K. D. (2007). Strategies Which Aim to Positively Impact on Weight, Physical Activity, Diet and Sedentary Behaviours in Children From Zero to Five Years. A systematic review of the literature. *Obesity Reviews*, 8(4): 327–338.
- Cane, J., Richardson, M., Johnston, M., Ladha, R. & Michie, S. (2015). From Lists of Behaviour Change Techniques (BCTs) to Structured Hierarchies: Comparison of two methods of developing a hierarchy of BCTs. *British Journal of Health Psychology*, 20(1): 130–150.
- Carlin, A., Murphy, M. H. & Gallagher, A. M. (2016). Do Interventions to Increase Walking Work? A systematic review of interventions in children and adolescents. *Sports Medicine*, 46(4): 515–530.
- Currie, S., Sinclair, M., Murphy, M. H., Madden, E., Dunwoody, L. & Liddle, D. (2013). Reducing the Decline in Physical Activity During Pregnancy: A systematic review of behaviour change interventions. *PLoS ONE*, 8(6): e66385.
- de Barros, M. V., Nahas, M. V., Hallal, P. C., de Farias Júnior, J. C., Florindo, A. A. & Honda de Barros, S. S. (2009). Effectiveness of a School-Based Intervention on Physical Activity for High School Students in Brazil: The Saude na Boa project. *Journal of Physical Activity & Health*, 6(2): 163–169.
- DeMattia, L., Lemont, L. & Meurer, L. (2007). Do Interventions to Limit Sedentary Behaviours Change Behaviour and Reduce Childhood Obesity? A critical review of the literature. *Obesity Reviews*, 8(1): 69–81.
- de Sa, J. & Lock, K. (2008). Will European Agricultural Policy for School Fruit and Vegetables Improve Public Health? A review of school fruit and vegetable programmes. *European Journal of Public Health*, 18(6): 558–568.
- Dombrowski, S. U., Sniehotta, F. F., Avenell, A., Johnston, M., MacLennan, G. & Araújo-Soares, V. (2012). Identifying Active Ingredients in Complex Behavioural Interventions for Obese Adults with Obesity-Related Co-Morbidities or Additional Risk Factors for Co-Morbidities: A systematic review. *Health Psychology Review*, 6(1): 7–32.
- Evans, C. E. L., Greenwood, D. C. & Cade, J. E. (2010). Systematic Review and Meta-Analysis of School-Based Interventions to Improve Fruit and Vegetable Intake. *Journal of Epidemiology & Community Health*, 64: A27.
- Free, C., Roberts, I. G., Abramsky, T., Fitzgerald, M. & Wensley, F. (2011). A Systematic Review of Randomised Controlled Trials of Interventions Promoting Effective Condom Use. *Journal of Epidemiology and Community Health*, 65(2): 100–110.
- French, D. P., Olander, E. K., Chisholm, A. & Mc Sharry, J. (2014). Which Behaviour Change Techniques Are Most Effective at Increasing Older Adults' Self-Efficacy and Physical Activity Behaviour? A systematic review. *Annals of Behavioral Medicine*, 48(2): 225–234.

Gardner, B., Smith, L., Lorencatto, F., Hamer, M. & Biddle, S. J. (2016). How to Reduce Sitting Time? A review of behaviour change strategies used in sedentary behaviour reduction interventions among adults. *Health Psychology Review*, 10(1): 89–112.

Gardner, B., Wardle, J., Poston, L. & Croker, H. (2011). Changing Diet and Physical Activity to Reduce Gestational Weight Gain: A meta-analysis. *Obesity Reviews*, 12(7): 602–620.

Golley, R. K., Hendrie, G. A., Slater, A. & Corsini, N. (2011). Interventions That Involve Parents to Improve Children's Weight-Related Nutrition Intake and Activity Patterns: What nutrition and activity targets and behaviour change techniques are associated with intervention effectiveness? *Obesity Reviews*, 12(2): 114–130.

Griffin, K. W., Botvin, G. J. & Nichols, T. R. (2004). Long-Term Follow-Up Effects of a School-Based Drug Abuse Prevention Program on Adolescent Risky Driving. *Prevention Science*, 5(3): 207–212.

Haggerty, K.P., Fleming, C. B., Catalano, R. F., Harachi, T. W. & Abbott, R. D. (2006). Raising Healthy Children: Examining the impact of promoting healthy driving behaviour within a social development intervention. *Prevention Science*, 7(3): 257–267.

Hankonen, N., Sutton, S., Prevost, A. T., Simmons, R. K., Griffin, S. J., Kinmonth, A. L. & Hardeman, W. (2015). Which Behavior Change Techniques Are Associated with Changes in Physical Activity, Diet and Body Mass Index in People with Recently Diagnosed Diabetes? *Annals of Behavioral Medicine*, 49(1): 7–17.

Hartmann Boyce, J., Johns, D. J., Jebb, S. A. & Aveyard, P. (2014). Effect of Behavioural Techniques and Delivery Mode on Effectiveness of Weight Management: Systematic review, meta analysis and meta regression. *Obesity Reviews*, 15(7): 598–609.

Hendrie, G. A., Brindal, E., Baird, D. & Gardner, C. (2013). Improving Children's Dairy Food and Calcium Intake: Can intervention work? A systematic review of the literature. *Public Health Nutrition*, 16(2): 365–376.

Hendrie, G. A., Brindal, E., Corsini, N., Gardner, C., Baird, D. & Golley, R. K. (2012). Combined Home and School Obesity Prevention Interventions for Children: What behavior change strategies and intervention characteristics are associated with effectiveness? *Health Education & Behavior*, 39(2): 159–171.

Heron, N., Kee, F., Donnelly, M., Tully, M. A. & Cupples, M. E. (2015). Systematic Review of the Use of Behaviour Change Techniques (BCTs) in Home-Based Cardiac Rehabilitation Programmes for Patients with Cardiovascular Disease: Protocol. *Systematic Reviews*, 4: 164.

Hingle, M. D., O'Connor, T. M., Dave, J. M. & Baranowski, T. (2010). Parental Involvement in Interventions to Improve Child Dietary Intake: A systematic review. *Preventive Medicine*, 51(2): 103–111.

- Howlett, N., Trivedi, D., Troop N. A. & Chater, A. M. (2016). What Are the Most Effective Behaviour Change Techniques to Promote Physical Activity and/or Reduce Sedentary Behaviour in Inactive Adults? A systematic review protocol. *BMJ Open*, 5(8): e008573.
- Kahwati, L., Viswanathan, M., Golin, C., Kane, H., Lewis, M. & Jacobs, S. (2016). Identifying Configurations of Behavior Change Techniques in Effective Medication Adherence Interventions: A qualitative comparative analysis. *Systematic Reviews*, 5: 83.
- Kamath, C. C., Vickers, K. S., Ehrlich, A., McGovern, L., Johnson, J., Singhal, V., Paulo, R., Hettinger, A., Erwin, P. J. & Montori, V. M. (2008). Clinical Review: Behavioral interventions to prevent childhood obesity. A systematic review and metaanalyses of randomized trials. *Journal of Clinical Endocrinology and Metabolism*, 93(12): 4606–4615.
- Kroeze, W., Werkman, A. & Brug, J. (2006). A Systematic Review of Randomized Trials on the Effectiveness of Computer-Tailored Education on Physical Activity and Dietary Behaviors. *Annals of Behavioral Medicine*, 31(3): 205–223.
- Kwasnicka, D., Penseu, J., White, M. & Sniehotta, F. F. (2013). Does Planning How to Cope with Anticipated Barriers Facilitate Health-Related Behaviour Change? A systematic review. *Health Psychology Review*, 7(2): 129–145.
- Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N. & Katzmarzyk, P. T. (2012a). Effect of Physical Inactivity on Major Non-Communicable Diseases Worldwide: An analysis of burden of disease and life expectancy. *Lancet*, 380(9838): 219–229.
- Lehtola, M. M., van der Molen, H. F., Lappalainen, J., Hoonakker, P. L., Hsiao, H., Haslam, R. A., Hale, A. R. & Verbeek, J. H. (2008). The Effectiveness of Interventions for Preventing Injuries in the Construction Industry: A systematic review. *American Journal of Preventive Medicine*, 35(1): 77–85.
- Lorencatto, F., West, R. & Michie, S. (2012). Specifying Evidence-Based Behavior Change Techniques to Aid Smoking Cessation in Pregnancy. *Nicotine & Tobacco Research*, 14(9): 1019–1026.
- McEwan, D., Harden, S. M., Zumbo, B. D., Sylvester, B. D., Kaulius, M., Ruissen, G. R., Dowd, A. J. & Beauchamp, M. R. (2016). The Effectiveness of Multi-Component Goal-Setting Interventions for Changing Physical Activity Behaviour: A systematic review and meta-analysis. *Health Psychology Review*, 10(1): 67–88.
- Mc Sharry, J., Olander, E. K. & French, D. P. (2015). Do Single and Multiple Behavior Change Interventions Contain Different Behavior Change Techniques? A comparison of interventions targeting physical activity in obese populations. *Health Psychology*, 34(9): 960–965.
- Maniccia, D. M., Davison, K. K., Marshall, S. J., Manganello, J. A. & Dennison, B. A. (2011). A Meta-Analysis of Interventions That Target Children’s Screen Time for Reduction. *Pediatrics*, 128(1): e193–210.

- Marquez, O., Racey, M., Preyde, M., Hendrie, G. A. & Newton, G. (2015). Interventions to Increase Dairy Consumption in Adolescents: A systematic review. *Childhood Obesity and Nutrition*, 7(5): 242–254.
- Martin, J., Chater, A. & Lorencatto, F. (2013). Effective Behaviour Change Techniques in the Prevention and Management of Childhood Obesity. *International Journal of Obesity*, 37(10): 1287–1294.
- Mauriello, L. M., Driskell, M. M., Sherman, K. J., Johnson, S. S., Prochaska, J. M. & Prochaska, J.O. (2010). Acceptability of a School-Based Intervention for the Prevention of Adolescent Obesity. *Journal of School Nursing*, 22(5): 269–277.
- Metcalf, B., Henley, W. & Wilkin, T. (2012). Effectiveness of Intervention on Physical Activity of Children: Systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54). *BMJ*, 345: e5888.
- Michie, S. & Abraham, C. (2004). Interventions to Change Health Behaviours: Evidence-based or evidence-inspired? *Psychology & Health*, 19(1): 29–49.
- Michie, S. & Johnston, M. (2012). Theories and Techniques of Behaviour Change: Developing a cumulative science of behaviour change. *Health Psychology Review*, 6(1): 1–6.
- Michie, S., Abraham, C., Whittington, C., McAteer, J. & Gupta, S. (2009). Effective Techniques in Healthy Eating and Physical Activity Interventions: A meta-regression. *Health Psychology*, 28(6): 690–701.
- Mullan, B., Smith, L., Sainsbury, K., Allom, V., Paterson, H. & Lopez, A-L. (2015). Active Behaviour Change Safety Interventions in the Construction Industry: A systematic review. *Safety Science*, 79: 139–148.
- Neumark-Sztainer, D. R., Friend, S. E., Flattum, C. F., Hannan, P. J., Story, M. T., Bauer, K. W., Feldman, S. B. & Petrich, C. A. (2010). New Moves—Preventing Weight-Related Problems in Adolescent Girls: A group-randomized study. *American Journal of Preventive Medicine*, 39(5): 421–432.
- Nudelman, G. & Shiloh, S. (2015). Mapping Health Behaviors: Constructing and validating a common-sense taxonomy of health behaviors. *Social Science & Medicine*, 146: 1–10.
- O'Brien, N., McDonald, S., Araújo-Soares, V., Lara, J., Errington, L., Godfrey, A., Meyer, T. D., Rochester, L., Mathers, J. C., White, M. & Sniehotta, F. F. (2015). The Features of Interventions Associated with Long-Term Effectiveness of Physical Activity Interventions in Adults Aged 55–70 Years: A systematic review and meta-analysis. *Health Psychology Review*, 9(4): 417–433.
- Ogilvie, D., Egan, M., Hamilton, V. & Petticrew, M. (2004). Promoting Walking and Cycling as an Alternative to Using Cars: Systematic review. *BMJ*, 329(7469): 763.

- Olander, E. K., Fletcher, H., Williams, S., Atkinson, L., Turner, A. & French, D. P. (2013). What Are the Most Effective Techniques in Changing Obese Individuals' Physical Activity Self-Efficacy and Behaviour: A systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 10: 29.
- Partridge, S.R., Allman-Farinelli, M., McGeechan, K., Balestracci, K., Wong, A. T. Y., Hebden, L., Harris, M. F., Bauman, A. & Phongsavan, P. (2016). Process Evaluation of TXT2BFIT: A multi-component mHealth randomised controlled trial to prevent weight gain in young adults. *International Journal of Behavioral Nutrition and Physical Activity*, 13: 7.
- Pfaeffli Dale, L., Dobson, R., Whittaker, R. & Maddison, R. (2016). The Effectiveness of Mobile-Health Behaviour Change Interventions for Cardiovascular Disease Self-Management: A systematic review. *European Journal of Preventive Cardiology*, 23(8): 801–817.
- Pollard, C. M., Miller, M. R., Daly, A. M., Crouchley, K. E., O'Donoghue, K. J., Lang, A. J. & Binns, C. W. (2008). Increasing Fruit and Vegetable Consumption: Success of the Western Australian Go for 2&5 campaign. *Public Health Nutrition*, 11(3): 314–320.
- Prestwich, A., Kellar, I., Parker, R., MacRae, S., Learmonth, M., Sykes, B., Taylor, N. & Castle, H. (2014). How Can Self-Efficacy Be Increased? Meta-analysis of dietary interventions. *Health Psychology Review*, 8(3): 270–285.
- Protogerou, C. & Johnson, B. T. (2014). Factors Underlying the Success of Behavioral HIV-Prevention Interventions for Adolescents: A meta-review. *AIDS and Behavior*, 18(10): 1847–1863.
- Rautiainen, R. H., Lehtola, M. M., Day, L. M., Schonstein, E., Suutarinen, J., Salminen, S. & Verbeek, J. (2008). Interventions for Preventing Injuries in the Agricultural Industry. *Cochrane Database of Systematic Reviews*, CD006398.
- Rose, S. A., Poynter, P. S., Anderson, J. W., Noar, S. M. & Conigliaro, J. (2013). Physician Weight Loss Advice and Patient Weight Loss Behavior Change: A literature review and meta-analysis of survey data. *International Journal of Obesity*, 37(1): 118–128.
- Scott-Sheldon, L. A., Carey, K. B., Elliott, J. C., Garey, L. & Carey, M. P. (2014). Efficacy of Alcohol Interventions for First-Year College Students: A meta-analytic review of randomized controlled trials. *Journal of Consulting and Clinical Psychology*, 82(2): 177–188.
- Sherrington, A., Newham, J. J., Bell, R., Adamson, A., McColl, E. & Araújo Soares, V. (2016). Systematic Review and Meta Analysis of Internet Delivered Interventions Providing Personalized Feedback for Weight Loss in Overweight and Obese Adults. *Obesity Reviews*, 17(6): 541–551.
- Singhal, N., Misra, A., Shah, P. & Gulati, S. (2010). Effects of Controlled School-Based Multi-Component Model of Nutrition and Lifestyle Interventions on Behavior Modification, Anthropometry and Metabolic Risk Profile of Urban Asian Indian Adolescents in North India. *European Journal of Clinical Nutrition*, 64(4): 364–373.

Sykes-Muskett, B. J., Prestwich, A., Lawton, R. J. & Armitage, C. J. (2015). The Utility of Monetary Contingency Contracts for Weight Loss: A systematic review and meta-analysis. *Health Psychology Review*, 9(4): 434–451.

Taylor, N., Conner, M. & Lawton, R. (2012). The Impact of Theory on the Effectiveness of Worksite Physical Activity Interventions: A meta-analysis and meta-regression. *Health Psychology Review*, 6(1): 33–73.

Van Achterberg, T., Huisman-de Waal, G. G., Ketelaar, N. A., Oostendorp, R. A., Jacobs, J. E. & Wollersheim, H. C. (2011). How to Promote Healthy Behaviours in Patients? An overview of evidence for behaviour change techniques. *Health Promotion International*, 26(2): 148–162.

Van Cauwenberghe, E., Maes, L., Spittaels, H., van Lenthe, F. J., Brug, J., Oppert, J. M. & De Bourdeaudhuij, I. (2010). Effectiveness of School-Based Interventions in Europe to Promote Healthy Nutrition in Children and Adolescents: Systematic review of published and 'grey' literature. *British Journal of Nutrition*, 103(6): 781–797.

Williams, S. L. & French, D. P. (2011). What Are the Most Effective Intervention Techniques for Changing Physical Activity Self-Efficacy and Physical Activity Behaviour: Are they the same? *Health Education Research*, 26(2): 308–322.



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