The Behavior Change Technique Taxonomy (v1) of 93 hierarchically-clustered techniques: building an international consensus for the reporting of behavior change interventions

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Abstract

Background

CONSORT guidelines call for precise reporting of behavior change interventions: we need rigorous methods of characterizing active content of interventions with precision and specificity.

Objectives

To develop an extensive, consensually agreed hierarchically structured taxonomy of techniques (BCTs) used in behavior change interventions.

Methods

In a Delphi-type exercise, 14 experts rated labels and definitions of 124 BCTs from six published classification systems. Another 18 experts grouped BCTs according to similarity of active ingredients in an open-sort task. Inter-rater agreement amongst 6 researchers coding 85 intervention descriptions by BCTs was assessed.

Results

This resulted in 93 BCTs clustered into 16 groups. Of the 26 BCTs occurring at least 5 times, 23 had adjusted Kappas of 0.60 or above.

Conclusions

"BCT taxonomy v1", an extensive taxonomy of 93 consensually agreed, distinct BCTs, offers a step change as a method for specifying interventions, but we anticipate further development and evaluation based on international, interdisciplinary consensus.

Key words: behavior change techniques, taxonomy, behavior change interventions

Introduction

Interventions to change behavior are typically complex, involving many interacting components [1]. This makes them challenging to replicate in research, to implement in practical applications and to synthesize in systematic literature reviews. Complex interventions also present challenges for identifying the active, effective components within them. Replication, implementation, evidence synthesis and identifying active components are all necessary if we are to better understand the effects and mechanisms of behavior change interventions and to accumulate knowledge to inform the development of more effective interventions. However, the poor description of interventions in research protocols and published reports presents a barrier to these essential scientific and translational processes [2, 3]. A well-specified intervention is essential before evaluation of effectiveness is worth undertaking: an under-specified intervention cannot be delivered with fidelity and, if evaluated, could not be replicated.

The CONSORT statement for randomized trials of 'non-pharmacological' interventions recommends precise specification of trial processes, including some details of the delivery of interventions and *"description of the different components of the interventions"* [4]. As currently constituted, CONSORT gives no guidance as to what this description or components should be. Intervention components have been identified by Davidson et al. [3] as: who delivers the intervention, to whom, how often, for how long, in what format, in what context and with what content. These are mainly procedures for delivery (often referred to as "mode" of delivery), except for the key intervention component, "content", i.e. the active ingredients that bring about behavior change (the "what" rather than the "how" of interventions).

The content, or active components of behavior change interventions, are often described in intervention protocols and published reports with different labels (e.g., 'self-

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monitoring' may be labeled 'daily diaries'); the same labels may be applied to different

techniques (e.g., 'behavioral counseling' may involve 'educating patients' or 'feedback, self-

monitoring, and reinforcement' [5]).   This may lead to uncertainty and confusion. For

example, behavioral medicine researchers and practitioners have been found to report low

confidence in their ability to replicate highly effective behavioral interventions for diabetes

prevention [6]. The absence of standardized definitions and labels for intervention

components means that systematic reviewers develop their own systems for classifying

behavioral interventions and synthesizing study findings [7, 8, 9, 10]. This proliferation of

systems is likely to lead to duplication of effort and undermines the potential to accumulate

evidence across reviews. It also points to the urgent need for consensus. Consequently, the

UK Medical Research Council (MRC)'s guidance [1] for developing and evaluating complex

interventions calls for improved methods of specifying and reporting intervention content in

order to address the problems of lack of consistency and consensus.

A method recently developed for this purpose is the reliable characterization of

interventions in terms of behavior change techniques (BCTs) [11]. By BCT, we mean an

observable, replicable and irreducible component of an intervention designed to alter or

redirect causal processes that regulate behavior; that is, a technique is proposed to be an

'active ingredient' (e.g., feedback, self-monitoring, reinforcement) [12, 13]. BCTs can be

used alone or in combination and in a variety of formats. Identifying the presence of BCTs in

intervention descriptions included in systematic reviews and national datasets of outcomes

has allowed the identification of BCTs associated with effective interventions. Effective

BCTs have been identified for interventions to increase physical activity and healthy eating

[14] and to support smoking cessation [15, 16], safe drinking [17], prevention of sexually

transmitted infections [7, 18] and changing professional behavior [19.

Abraham and Michie [11] developed the first cross-behavior BCT taxonomy, building

on previous intervention content analyses [7, 8]. These authors demonstrated reliability in

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identifying 22 BCTs and 4 BCT packages across 221 intervention descriptions in papers and manuals. This method has been widely used internationally to report interventions, synthesize evidence [14, 20, 21, 22, 23] and design interventions [6, 24]. It has also enabled the specification of professional competences for delivering BCTs [25, 26] and as a basis for a national training program (see www.ncsct.co.uk). Guidance has also been developed for incorporating BCTs in text-based interventions [27]**.**

Although the subsequent development of classification systems of defined and reliably-identifiable BCTs has been accompanied by a progressive increase in their comprehensiveness and clarity, this work has been conducted by only a few research groups. For this method to maximize scientific advance, collaborative work is needed to develop agreed labels and definitions and reliable procedures for their identification and application across behaviors, disciplines and countries.

Previous classification systems have either been in the form of an unstructured list or have been mapped to, or structured, according to categories (e.g. theory [7, 11], theoretical mechanism [25, 26]) judged to be the most appropriate by the authors. In addition, they have mainly been developed for particular behavioral domains (e.g. physical activity, smoking, or safer sex). A comprehensive taxonomy will encompass a greater number of BCTs and therefore require structure to facilitate recall and access to the BCTs and thus to increase speed and accuracy of use. A true, i.e. hierarchically structured, taxonomy provides the advantage of making it more coherent to, and useable by, those applying it [28]. As the number of identified BCTs has increased, so also has the need for such a structure, to improve the usability of the taxonomy.

Simple, reliable grouping structures have previously been used by three groups of authors. Dixon and Johnston [26] grouped BCTs according to "routes to behavior change", 'Motivation', 'Action' and 'Prompts/Cues'; Michie et al [15] grouped according to "function" in changing behavior, 'Motivation', 'Self-regulation Capacity/ Skills', 'Adjuvant' and 'Interaction';

and Abraham, Good, Warren, Huedo-Medina and Johnson [18] grouped according to

"change target", that is, Knowledge, Awareness of own behaviour, Attitudes, Social Norms,

Self-efficacy, Intention Formation, Action control, Behavioural maintenance, and Change

facilitators. However there is a need for a basic method of grouping which does not depend

on a theoretical structure. We therefore adopted an empirical approach to developing an

international consensus of BCT groupings.

Potential benefits

There are at least five potential benefits of developing a cross-domain, internationally

supported taxonomy. First, it will promote the *accurate replication* of interventions (and

control conditions in comparative effectiveness research), a key activity in accumulating

scientific knowledge and investigating generalizability across behaviors, populations and

settings. Second, specifying intervention content by BCT will facilitate *faithful implementation*

of interventions found to be effective. Third, *systematic reviews* will be able to use a reliable

method for extracting information about intervention content, thus identifying and

synthesizing discrete, replicable, potentially active ingredients (or combinations of

ingredients) associated with effectiveness. Earlier BCT classification systems, combined with

the statistical technique of meta-regression, have allowed reviewers to synthesize evidence

from complex, heterogeneous interventions to identify effective component BCTs [6, 14, 22,

29, 30]. Fourth, *intervention development* will be able to draw on a comprehensive list of

BCTs (rather than relying on the limited set that can be brought to mind) to design

interventions and it will be possible to report the intervention content in well-defined and

detailed ways. Fifth, linking BCTs with theories of behavior change has allowed the

investigation of possible *mechanisms of action* [14, 30, 31].

The work reported here represents the first stages of a program of work to develop an international taxonomic classification system for BCTs, building on previous work. The aims of the work reported in this paper are as follows.

1) To generate a taxonomy that:

   a) comprises an extensive hierarchical classification of clearly labeled, well defined BCTs with a consensus that they are proposed active components of behavior change interventions, that they are distinct (non-overlapping, non-redundant) and precise, and that they can be used with confidence to describe interventions,

   b) has a breadth of international and disciplinary agreement

2) To assess and report the reliability of using BCT labels and definitions to code intervention descriptions

Method

Design

The work involved three main tasks. The first involved the rigorous development of a list of distinct BCT labels and definitions, using Delphi methods, with feedback from a multidisciplinary International Advisory Board and members of the study team. The inter-rater reliability of coding intervention descriptions using the list of BCTs was then assessed in two rounds of reliability testing. The third task was the development of a hierarchical structure.

Participants

Participants were international behavior change experts (i.e. active in their field and engaged in investigating, designing and/or delivering behavior change interventions) who had agreed to take part in one or more of the study phases, members of the International

Advisory Board and the study team (including a 'lay' person). All Board members, as leaders in their field, were eligible to take part as a behavior change expert. However, in light of their advisory role commitments, members were not routinely approached for further participation unless it would help widen participation in terms of country, discipline and behavioral expertise.

For the Delphi exercise, 19 international behavior change experts were invited to take part. Experts were identified from a range of scientific networks on the basis of breadth of knowledge of BCTs, experience of designing and/or delivering behavior change interventions, and of being able to complete the study task in the allotted time. Recruitment was by email, with an offer of an honorarium of £140 (approx. US$200) on completing the task. Of the 19 originally approached, 14 agreed to take part (response rate of 74%). 10 participants were female, with an age range of 37 to 62 years ($M = 50.57$; $SD = 7.74$). Expert participants were from the UK (8), Australia (2), Netherlands (2), Canada (1) and New Zealand (1). Eleven were psychologists (six health psychologists, one clinical psychologist, three clinical and health psychologists and one educational psychologist); one a cognitive behavior therapist and two had backgrounds in health sciences or community health. Eleven were active practitioners in their discipline. Eleven had research or professional doctorates and two had registered psychologist status. There was a wide range of experience of using BCTs, with all having used at least six BCTs, more than half having used more than 30 BCTs and four having used more than 50 BCTs for intervention design, delivery and training (see Electronic Supplementary Materials Table 1 for more information).

For the international feedback phase, 16 of the 30 International Advisory Board members (see: http://www.ucl.ac.uk/health-psychology/BCTtaxonomy/collaborators.php) took part in discussions to comment on a prototype BCT classification system. Advisory Board members were identified by the study team as being leaders in their field within the key domains of interest (e.g., types of health-related behaviors, major disease types, disciplines such as behavioral medicine) following consultation of websites, journals and

scientific and professional organizations. Advisory Board members were from the USA,

Canada, Australia, UK, the Netherlands, Finland and Germany. Feedback was also provided

by members of the study team, who had backgrounds in psychology and/or implementation

science and a 'lay' person with a BA (Hons) in English but no background in psychology or

behavior change.

Five members of the UK study team conducted the first round of reliability testing and

six the second round. Eighteen of 19 participants approached from the pool of experts in

behavior change interventions completed the open-sort grouping task. Eight were women,

10 men with an age range of 27 to 67 years ($M = 43.94$) 16 were from the UK and two were

from Australia.

Procedure

Participants recruited for the Delphi exercise and open-sort grouping task provided

written consent and were assured that their responses would remain confidential. All

participants were asked to provide demographic information (i.e. age, gender and

nationality). Delphi exercise participants were also asked to provide their professional

background (i.e. qualifications, registrations, job title and area of work) and how many BCTs

they had used professionally in intervention design, face-to-face delivery and training

(reported in increments of 5 up to 50+).

A prototype classification system was developed by the study team based on all

known published classifications of BCTs following a literature review [28] (Step 1). An online

Delphi-type exercise (see Pill [32]) with two 'rounds' was used for initial evaluation and

development of the classification system. Participants worked independently and rated the

prototype BCT labels and definitions on a series of questions designed to assess omission,

overlap and redundancy (Step 2). The results of Step 2 subsequently informed the

development of an improved BCT list which was sent to the Delphi participants for round 2.

They were asked to rate BCTs for clarity, precision, distinctiveness and confidence of use

(Step 3). The resulting list of BCTs was then scrutinized by the Advisory Board, who

submitted verbal and written feedback, and was assessed by the lay and expert members of

the study team (Step 4). Following each of Steps 2, 3 and 4, the results were synthesized by

SM and MJ in preparation for the next step. Using the developed BCT list, members of the

study team coded published descriptions of interventions, and inter-rater agreement for the

presence of each BCT was calculated (Step 5). An open-sort grouping task was then carried

out to generate reliable and stable groupings and create a hierarchical structure within the

taxonomy (Step 6).

Step 1: Developing the prototype classification system

The labels and definitions of distinct BCTs were extracted from six BCT classification

systems identified by a literature search (the relevant papers are marked with an asterisk in

the reference section). For BCTs with two or more labels (n = 24) and/or definitions (n = 37),

five study team members rated their preferred labels and definitions. Where there was

complete or majority agreement the preferred label and/or definition was retained. Where

there was some, little or no agreement, new labels and definitions were developed by

synthesizing the existing labels and definitions across classification systems. Definition

wording was modified to include active verbs and to be non-directional (i.e., applicable to

both the adoption of a new wanted behavior and the removal of an unwanted behavior).

Step 2: Delphi exercise first round

Participants were provided with the study definition of a BCT [13] (i.e. having the

following characteristics: a) aim to change behavior, b) are proposed "active ingredients" of

interventions, c) are the smallest components compatible with retaining the proposed active

ingredients, d) can be used alone or in combination with other BCTs, e) are observable and

replicable, f) can have a measurable effect on a specified behavior/s, g) may or may not

have an established empirical evidence base. It was explained that BCTs could be delivered

by someone else or self-delivered.

The BCTs (labels and definitions) from Step 1 were presented in a random order and participants were asked five questions about each of them:

(i)   Does the definition contain what you would consider to be potentially active ingredients that could be tested empirically? Participants were asked to respond to this question using a five-point scale ('definitely no', 'probably no', 'not sure', 'probably yes' and 'definitely yes')

(ii)   Please indicate whether you are satisfied that the BCT is conceptually unique or whether you consider that it is redundant or overlapping with other BCTs. (with forced choice as to 'whether it was conceptually unique, redundant, or overlapping').

iii)   If participants indicated that the BCT was 'redundant', they were asked to state why they had come to this conclusion.

iv)   If they indicated that the BCT was 'overlapping', they were asked to state: a) with which BCT(s) and b) whether they can be separated ('Yes' or 'No')"

v)   If the BCTs were considered to be separate, participants were asked how the label or definition could be rephrased to reduce the amount of overlap or, if not separate, which label and which definition was better.

Participants were given an opportunity to make comments on the exercise and to detail any BCTs not included on the list. They were asked, 'does the definition and/or label contain unnecessary characteristics and/or omitted characteristics?' This question item was open-ended. The exercise was designed to take two hours; follow-up reminders were sent to participants after two weeks and all responses were submitted within one month of the initial request.

Frequencies, means and/or modes of responses to questions (i) and (ii) were considered for each BCT. Based on the distribution of responses, BCTs for which a) more than a quarter of participants doubted that they contained active ingredients and/or b) more than a third considered them to be overlapping or redundant were flagged as 'requiring

further consideration'. These data, along with the responses to questions (iii) to (v), guided the rewording of BCT labels and definitions and the identification of omitted BCTs. The BCTs for re-consideration and the newly identified BCTs were presented in the second Delphi exercise round.

Step 3: Delphi exercise second round

The BCTs identified as requiring further consideration were presented; the rest of the BCTs were included for reference only, to assist judgments about distinctiveness. For each BCT, participants were asked three questions and asked to respond using a five-point scale ('definitely no', 'probably no', 'not sure', 'probably yes' and 'definitely yes')

(i) If you were asked to describe a behavior change intervention in terms of its component BCTs, would you think the following BCT was a) clear, b) precise, c) distinct?

(ii) Would you feel confident in using this BCT to describe the intervention?

(iii) Would you feel confident that two behavior change researchers or practitioners would agree in identifying this BCT?

If participants responded 'probably no', 'definitely no', or 'not sure', to any question, they were asked to state their suggestions for improvement.

Frequencies, means and/or modes were calculated for all questions for each BCT. BCTs for which more than a quarter of participants responded 'probably no' or 'definitely no', or 'not sure', to any question were flagged as needing to be given special attention. Using information on the distribution of ratings, the modal scores and suggestions for improvement, SM and MJ amended the wording of definitions and labels. This included changes to make BCTs more distinct from each other where this had been identified as a problem and to standardize wording across BCTs. Where it was not obvious how to amend the BCT from the second round responses, other sources [33] were consulted for definitions of particular words or descriptions of BCTs.

Step 4: Feedback from the International Advisory Board

16 of the 30 members of the Advisory Board took part in 1 of 3, two-hour long teleconferences to give advice to the study team, and the BCT list was refined based on their feedback.

Step 5: Reliability testing round 1

Five members of the study team coded 45 intervention descriptions. The descriptions were selected from *Implementation Science*, *BMC Public Health Services* and *BMC Public Health* in 2009 and 2010 using quota sampling to ensure spread across preventive, illness management and health professional behaviors. The study team then discussed reasons for discrepancies in round 1 and amended the BCT list as needed.

Step 6: Investigating hierarchical structure of the BCT list

An open-sort grouping task was delivered via an online computer program. Participants were asked to sort the developed list of BCTs into groups (up to a maximum of 24) of their choice and to label the groups. They were asked to "group together BCTs which have similar active ingredients i.e. by the mechanism of change, NOT the mode of delivery". BCTs were presented to participants in a random order and definitions for each BCT were made available.

For data analysis, a binary dissimilarity matrix containing all possible BCT x BCT combinations was produced for each participant, where a score of 1 indicated BCTs which were not sorted into the same group and a score of 0 indicated items which were sorted into the same group. Individual matrices were aggregated to produce a single dissimilarity matrix which could be used to identify the optimal grouping of BCTs using Cluster Analysis. Using Hierarchical Cluster Analysis (HCA), the optimal number of groupings (2-20) were examined for suitability using measures of Internal Validity (Dunn's Index) and Stability (Figure of Merit, FOM) [34]. Bootstrap methods were used in conjunction with the HCA, whereby data were resampled 10,000 times, to identify which groupings were strongly supported by the data.

The Approximately Unbiased (AU) p-values yielded by this method indicated the extent to which groupings were strongly supported by the data with higher AU values (e.g. 95%) indicating stronger support for the grouping [35].

The words and phrases used in the labels given by participants were analyzed to identify any common themes and to help identify appropriate labels for the groupings. For each grouping, labels were created based on their content and, where applicable, based on the frequency of word labels given by participants. After the labels were assigned to relevant groupings the fully labeled groups with the word frequency analysis were sent out to a subset of five of the original participants for refinement.

Step 7: Reliability testing round 2

An additional member of the study team was recruited for the second round of reliability testing. The team coded 40 intervention descriptions using the amended list. The six members each coded 9-14 intervention descriptions.

For both rounds, each intervention description was coded independently by two team members and inter-rater agreement by BCT was assessed using Kappa's adjusted for prevalence and bias effects [36, 37]. Conventionally, a Kappa of <0.60 is considered poor to fair agreement, 0.61-0.80 strong, and more than 0.80 near complete agreement [38]. The more frequent the BCTs, the greater the confidence that the Kappa is a useful indicator of reliability of judging the BCT to be present. We therefore only report the Kappa scores for BCTs which were observed at least five times by either coder in the 40 intervention descriptions.

Step 8: Feedback from study team members

The BCT definitions were checked to ensure that they contained an active verb specifying the action required to deliver the intervention [39].The 'lay' member of the study team (FR) read through the list to ensure syntactic consistency and general

comprehensibility to those outside the field of behavioral science. Subsequently, the study team members made a final check of the resulting BCT labels and definitions.

Full details of the Procedure are available in Electronic Supplementary Materials Table 2.

Results

The evolution of the taxonomy at the different steps of the procedure is summarized in Electronic Supplementary Materials Table 2.

Step 1: Developing the prototype classification system

Of the 124 BCTS in the prototype classification system, 32 were removed: five composite BCTs and 26 BCTs overlapping with others were rated to have better definitions. One additional BCT was identified, given a label and definition informed by other sources and then added to the system. This produced a list of 94 BCTs.

Step 2: Delphi exercise first round

The means, modes and frequencies of responses to the Delphi exercise first round questions are shown in Table 1. On the basis of these scores, 21 BCTs were judged to be 'satisfactory' and 73 'requiring further consideration'. Of the 73 reconsidered BCTs, four were removed, four were divided, and one BCT was added (see Electronic Supplementary Materials Table 2 for more details of changes at each step), giving 70 BCTs. During this process, one reason for overlap became evident: there was a hierarchical structure meaning that deleting overlapping BCTs would end up with only the superordinate BCT and a loss of specific variation (for example, adopting the higher order BCT 'Consequences' would have deleted 'Reward').

Step 3: Delphi exercise second round

The means, modes and frequencies of responses to the five Delphi exercise second round questions are shown in Table 2. On the basis of these scores, 38 BCTs were judged to be 'satisfactory' and 32 'requiring further consideration'. Of the reconsidered BCTs, seven labels and 35 definitions were amended and seven BCTs were removed (see Electronic Supplementary Materials Table 2 for more details), giving 63 BCTs. Together with the 21 BCTs judged to be 'satisfactory' in the first round, there were 84 BCTs at the end of the Delphi exercise. Some further standardization of wording across all BCTs was made by study team members (e.g. specifying 'unwanted' or 'wanted' behaviors rather than the more generic 'target' behaviors and ensuring that all definitions included active verbs).

Step 4: Feedback from the International Advisory Board

The Advisory Board members made two general recommendations: First, to make the taxonomy more usable by empirically grouping the BCTs and secondly, to consider publishing a sequence of versions of the taxonomy (with each version clearly labeled) that would achieve a balance between stability/usability and change/evolution. Feedback from members led to the addition of two and the removal of four BCTs. Further refinement of labels and definitions resulted in a list of 82 BCTs.

Step 5 and 7: Reliability testing round 1 and 2

Inter-rater agreement for BCTs is shown in Table 3. For the first round of reliability testing 22 BCTs were observed five or more times and therefore could be assessed. Adjusted Kappa scores ranged from 0.38 to 0.85, with three scores below 0.60. Results from the first round of reliability testing led to the addition of five and the removal of one BCT resulting in a list of 86 BCTs.

For the second round of reliability testing 15 BCTs were observed five or more times. Adjusted Kappa scores ranged from 0.60 to 0.90. In all, 26 BCTs were tested for reliability, 23 of which achieved Kappa scores of 0.60 or above and met our criteria of a BCT (see Table 3).

Step 6: Investigating hierarchical structure of the BCT list

Participants created an average of 15.11 groups ($SD = 6.11;$ range 5-24 groups). Measures of internal validity indicated that the maximum internal validity Dunn Index value (.57) was for a 16-cluster solution using hierarchical cluster analysis (see Figure 1), with no increase in internal validity on subsequent cluster solutions (>16). Similarly, FOM values showed greater stability in the 16-cluster solution compared to the 2-15 cluster solutions and there was negligible increase in stability over cluster solutions 17-20. Therefore, hierarchical clustering methods identified the 16-cluster solution as the optimal solution. The frequency of the words and phrases used in the labels given by participants is shown in Table 4. On the basis of participant responses, the groups were assigned the following labels (number of component BCTs in brackets): Reinforcement (10), Reward & Threat (7), Repetition & Substitution (7), Antecedents (4), Associative Learning (8), Covert Learning (3), Consequences (6), Feedback & Monitoring (5), Goals & Planning (9), Social Support (3), Comparison of Behavior (3), Self-belief (4), Comparison of Outcomes (3), Identity (5), Shaping Knowledge (4), Regulation (4). Three of these labels were modified to facilitate comprehensibility across disciplines: 'Reinforcement' was changed to 'Scheduled Consequences' and 'Associative Learning' was changed to 'Associations'. 'Consequences' was then changed to 'Natural Consequences' to distinguish it from 'Scheduled Consequences'.

The final results of the cluster analysis are shown in Table 5. Seven of the 16 clusters (clusters 3, 4, 5, 8, 10, 15, and 16) showed AU values greater than 95%, indicating that these groupings were strongly supported by the data. Clusters 1, 2, 9, 12, and 13 had AU values between 90% and 95% and clusters 6, 7, 11, and 14 had AU values less than 90%, these were 73%, 85%, 83%, and 86% respectively. The Standard Errors (SE) of AU values for all clusters were less than 0.009.

Step 8: Feedback from study team members

Feedback from study team members, led to the addition of three BCTs, the division of one BCT and further refinement of labels and definitions. This resulted in a taxonomy of 93 BCTs.

Discussion

An extensive hierarchically organized taxonomy of 93 distinct BCTs has been developed in a series of consensus exercises involving 55 experts in delivering and/or designing behavior change interventions. These experts were drawn from a variety of disciplines including psychology, behavioral medicine and health promotion and from seven countries. The resulting BCTs therefore have relevance among experts from varied behavioral domains, disciplines and countries and potential relevance to the populations from which they were drawn. The extent to which we can generalize our findings across behaviors, disciplines and countries is an important question for future research. Building on a preliminary list generated from six published BCT classification systems, BCTs were added, divided and removed and their labels and definitions refined to capture the smallest components compatible with retaining the proposed active ingredients with the minimum of overlap. This resulted in 93 clearly defined, non-redundant BCTs, grouped into 16 clusters, for use in specifying the detailed content of a wide range of behavior change interventions. Of the 26 BCTs which could be assessed for inter-rater reliability, 23 had Kappa scores of 0.60 or above and met our definition of a reliable BCT. BCT Taxonomy v1 is the first consensus-based, cross-domain taxonomy of distinct BCTs to be published, with reliability data for the most frequent BCTs. The process of building a shareable consensus language and methodology is necessarily collaborative and will be an ongoing cumulative and iterative process, involving an international network of advisors and collaborators (see www.ucl.ac.uk/health-psychology/BCTtaxonomy/).

The methodologies used here represent an attempt to get a basic version of a taxonomy, a foundation on which to build future improvements. Like other classificatory

systems, e.g. Linnaeus's classification of plants, or even systems based on consensus such as DSM [40] or ICD [41], we anticipate and plan to continue to work on improvements. There is no agreed methodology for this work and there are limitations to the methods we have used. The purpose of the Delphi exercise was to develop a prototype taxonomy on which to build. It was one of a series of exercises adapted to develop the taxonomy. Our Delphi-type methods involved 14 individuals, an appropriate number for these methods [32], but a number that makes the choice of participants important. We attempted to ensure adequate coverage of behavior change experts (See Electronic Supplementary Materials Table 1). Whilst we had some diversity of expertise, we acknowledge the predominance of European experts from a psychological background within our sample. At various stages we made arbitrary decisions such as the cut-offs for amending BCT labels and descriptions and the minimum frequency of occurrence of BCTs for reporting reliability. In the absence of agreed standards for such decisions, we were guided by the urgent need to develop an initial taxonomy which was fit for purpose and would therefore form a basis for future development. Our amendments of the BCT labels and definitions also depend on the expertise available and we therefore based our amendments on a wide range of inputs: the data we collected from Delphi participants and coders, expert modification, international advice and lay user improvements.

Compared with many of the previous "taxonomies" which are more accurately described as "nomenclatures", BCT Taxonomy v1 is not only a list of reliable, distinct BCTs; it also has a hierarchical structure. Such a structure has been shown to improve processing of large quantities of information by organizing it into "chunks" [42] that compensates for human memory limitations. In turn, this enables the user to attend to and recall the full range of BCTs available when reporting and designing interventions.

Use of an open-sort grouping task is an improvement on previous efforts to develop hierarchical structure in that it allowed for the individual groupings defined by participants to hold equal weight within the final solution, rather than using consensus approaches amongst small groups of participants. Second, the groupings increase the practical use of BCTs by

aiding recall. Distinct sets of individual items with semantic similarity can be more easily

recalled than a single list of individual items both in the short-term and in the long-term,

particularly when the semantic category is cued [43, 44, 45]. The hierarchical structure

shown in the dendrogram (See Figure 1) gives an indication of the distance between clusters

of BCTs and can be used as a starting point to compare the conceptual similarities and

differences between BCTs. Sixteen clusters are too many for easy recall and a higher level

cluster would be desirable. A simpler, higher level structure of grouping BCTs has been used

by Dixon and Johnston [26] and Michie, Churchill and West [25]. However, such a structure

was not apparent in our data and points to the need for further research to refine the

hierarchical structure of this taxonomy.

Other advantages of v1 are that it is relevant to a wide range of behavior rather than

being restricted to a single behavioral domain, it provides examples of how the BCTs can be

implemented and gives users enough detail to operationalise BCTs.

The results indicated that using the taxonomy to code intervention descriptions was

generally reliable for those BCTs occurring relatively frequently. However it was not possible

to assess reliability for the 62 BCTs occurring with low frequency in the 85 coded

intervention descriptions. Of the BCTs which could be assessed, three had Kappa scores

below 0.60 ('Instruction on how to perform the behavior', 'Tailored personal message', and

'Goal setting (behavior)'. Exploring reasons for discrepancies between coders may help to

identify where further refinement of BCT labels/definitions and training may be required. For

example, users reported difficulties distinguishing between 'Goal setting (behavior)' (i.e.

when goal is unspecified, the most general BCT in the grouping should be coded) and other

goal-related BCTs, and between 'Instruction on how to perform the behavior' and

'Demonstration of the behavior'. In considering reasons for discrepancies, we agreed that

'Tailored personal message' was a mode of delivery rather than a BCT and therefore

removed it from the taxonomy. Since high reliability depends on both the content of the

taxonomy and the training of the user to use it, we are currently evaluating methods of BCT

user training and conducting more detailed analyses of reliability of application of the v1 classification system.

   Future developments

   This is a fast-moving field: the first reliable taxonomy of BCTs was published only four years before the current one [11]; whilst widely cited and influential, this 'taxonomy' included only 22 BCTs and 4 BCT packages so limiting the intervention content that could be classified. We anticipate that further refinement and development of BCT Taxonomy v1 will occur as a result of its use and feedback from primary researchers, systematic reviewers and practitioners (e.g. the BCT, 'increase positive emotions' appended as a footnote to Electronic Supplementary Materials table 3 has been identified and will be included in future revisions of the taxonomy). In order to continue the development of the taxonomy and to further improve the accuracy and reliability of its use, training courses and workshops involving researchers and practitioners from five countries, with varying scientific and professional backgrounds and level of expertise, are being coordinated internationally. This will facilitate the comparison of reliability across different populations (e.g., disciplinary background, behavior and continent). A web-based users resource, including the most recent version of the taxonomy, guidance on its use, and a discussion board for questions, comments and feedback, has been developed to facilitate collaboration and synthesis of feedback (see www.ucl.ac.uk/health-psychology/BCTtaxonomy/).

   Research is needed to link BCTs to theories of behavior change, for both designing and evaluating theory-based interventions. Preliminary attempts have been made to link BCTs to domains of theoretical constructs [46, 18] and this is part of an ongoing program of research. Guidance on developing interventions informed by considering theoretical determinants of behavior can be found in Kok et al. [47] and used in combination with the taxonomy. Work has also begun to link BCTs to a framework of behavior change interventions designed for use by policymakers, organizational change consultants and systems scientists [48]. While some of the BCTs such as those dealing with incentives or

environmental changes might be used in large scale interventions, including health policy interventions, many would only be appropriate for smaller scale, personally delivered interventions. The current BCT Taxonomy v1 is a methodological tool for specifying intervention content and does not, itself, make links with theory.

The aim is to produce a consensual "core" BCT Taxonomy that may be extended and/or modified according to context e.g. target behavior, country, specific setting. The BCT Taxonomy project will encourage authors to report how they have amended the core taxonomy so that other researchers can identify the links between the version used and the core taxonomy. Future work that increases the diversity of expertise and the geographical and cultural contexts in which BCTs are used would help to elucidate the extent to which BCT Taxonomy v1 is relevant across contexts, countries and cultures and the extent to which specific adaptations will be needed. To date, the taxonomy and coded interventions have predominantly focused on interventions delivered to the individuals whose behavior change is targeted. Further work needs to be done to extend it to the BCTs relevant to community and population-level interventions [48].

BCT Taxonomy v1 thus lays the foundation for the reliable and systematic specification of behavior change interventions. This significantly increases the possibility of identifying the active ingredients within interventions components and the conditions under which they are effective, and of replicating and implementing effective interventions, thus advancing the science of behavior change. Historically it has often been concluded that how behavior change techniques are delivered may have as great or larger impact on outcomes as the techniques themselves [49]. Dimensions of behavior change interventions other than content, such as mode and context of delivery [5] and competence of those delivering the intervention [25, 26] would thus also benefit from being specified by detailed taxonomies. Elucidation of how content, mode and context of delivery interact in their impact on outcomes is a key research goal for the field of behavioral science.

In summary, the work reported in this paper is foundational for our long-term goals of developing a comprehensive, hierarchical, reliable and generalizable BCT Taxonomy as a method for specifying, evaluating, and implementing behavior change interventions that can be applied to many different types of intervention, including organizational and community interventions, and that has multidisciplinary and international acceptance and use. The work reported here is a step toward the objective of developing agreed methods that permit and facilitate the aims of CONSORT and UK MRC guidance of precise reporting of complex behavioral interventions. The next steps underway are to test the reliability and usability of BCT Taxonomy v1 across different behaviors and populations and to set up a system for its continuous development guided by an international, multidisciplinary team.

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Table 1.

BCTs judged to be satisfactory and those requiring further consideration in Delphi exercise Round 1 (step 2): Means, Modes and Frequencies of responses to questions

Question	Satisfactory (BCTs = 21)			Reconsider (BCTs = 73)		
	Range of Means	Range of SDs	Frequency of Modes% (N)	Range of Means	Range of SDs	Frequency of Modes % (N)
1. Does the definition contain what you would consider to be potentially active ingredients that could be tested empirically?": 1 'definitely yes'; 2 'probably yes'; 3 'not sure'; 4 'probably no'; 5 'definitely no'.	1.21 (SD = 0.47) to 1.93 (SD = 0.92)	0.43 to 1.17	1=71%(15) 2=29%(6) 3=0%(0) 4=0%(0) 5=0%(0)	1.29 (SD =0.47) to 4.79 (SD=0.43)	0.43 to 1.34	1=44%(32) 2=51%(37) 3=4%(3) 4=1%(1) 5=0%(0)
2. "Please indicate whether you are satisfied that it is conceptually unique or whether you consider that it is redundant or overlapping with other BCTs (1 conceptually unique; 2 redundant; 3 overlapping)	N/A	N/A	1=100%(21)	N/A	N/A	1=60%(44) 2=0%(0) 3=40%(29)

Table 2.
BCTs judged to be satisfactory and those requiring further consideration in Delphi exercise Round 2 (step 3): Means, Modes and Frequencies of responses to questions

Question	Satisfactory (BCTs = 38)			Reconsider (BCTs = 32)		
1. If you were asked to describe a behavior change intervention in terms of its component BCTs, would you think the following BCT was:	Range of Means	Range of SDs	Frequency of Modes %(N)	Range of Means	Range of SDs	Frequency of Modes%(N)
a) Clear?	1.07 (0.27) to 1.79 (1.05)	0.27 to 1.15	1=95%(36) 2=5%(2) 3=0%(0) 4=0%(0) 5=0%(0)	1.13 (0.36) to 3.36 (1.15)	0.36 to 1.76	1=56%(18) 2=38%(12) 3=3%(1) 4=3%(1) 5=0%(0)
b) Precise?	1.07 (0.27) to 2.14 (1.29)	0.27 to 1.29	1=87%(33) 2=13%(5) 3=0%(0) 4=0%(0) 5=0%(0)	1.14 (0.36) to 3.07 (1.33)	0.36 to 1.33	1=56%(18) 2=41%(13) 3=0%(0) 4 =3%(1) 5=0%(0)
c) Distinct?	1.14 (0.36) to 2.14 (1.17)	0.36 to 1.38	1=89%(34) 2=11%(4) 3=0%(0) 4=0%(0) 5=0%(0)	1.64 (0.93) to 3.21 (1.05)	0.78 to 1.66	1=59%(19) 2=31%(10) 3=9%(3) 4=0%(0) 5=0%(0)
2. Confidence in identifying BCT: Would you feel confident in using this BCT to describe the intervention? (1 'definitely yes' 2 'probably yes' 3 'not sure' 4 'probably no' 5 'definitely no')	1.21 (0.43) to 1.93 (1.07)	0.43 to 1.12	1=87%(33) 2=13%(5) 3=0%(0) 4=0%(0) 5=0%(0)	1.14 (0.36) to 3.07 (1.00)	0.36 to 1.46	1=47%(15) 2=47%(15) 3=3%(1) 4=3%(1) 5=0%(0)
3. Confidence in others identifying BCT: Would you feel confident that two behavior change researchers or practitioners would agree in identifying this BCT? (1 'definitely yes' 2 'probably yes' 3 'not sure' 4 'probably no' 5 'definitely no')	1.21 (0.43) to 2.14 (0.95)	0.43 to 1.20	1=76%(29) 2=24%(9) 3=0%(0) 4=0%(0) 5=0%(0)	1.36 (0.63) to 3.29 (1.27)	0.51 to 1.46	1=46%(15) 2=41%(13) 3=6%(2) 4 =6%(2) 5=0%(0)

1

Table 3. Inter-rater agreement for each BCT [a]: adjusted Kappas for two rounds of reliability testing (Some BCT labels differ as a result of the consensus exercises; number in [ ] indicates related BCT in Electronic Supplementary Materials table 3)

Round 1 and 2	Adjusted kappa	Round 1 only	Adjusted kappa	Round 2 only	Adjusted kappa
Pharmacological support [11.1]	0.87, 0.85	Non-specific encouragement [b]	0.82	Social comparison [6.2]	0.90
Self-monitoring of behavior [2.3]	0.82, 0.75	Review of outcome goal [1.7]	0.78	Material reward [10.2 and 10.10]	0.85
Restructuring of the physical environment [30]	0.82, 0.85	Discrepancy between current behavior [1.6]	0.73	Incentive [10.1]	0.80
Social support (practical) [3.2]	0.78, 0.70	Self-monitoring of outcome of behavior [2.4]	0.73	Monitoring outcome of behavior by others without feedback [2.5]	0.70
Behavioral practice/rehearsal [8.1]	0.78, 0.70	Health consequences [5.1]	0.69		
Problem solving/coping planning [1.2]	0.73, 0.75	Feedback on behavior [2.2]	0.69		
Persuasive argument [9.1]	0.73, 0.60	Action planning (including implementation intentions) [1.4]	0.64		
Review behavior goal(s) [1.5]	0.69, 0.75	Social support (general) [3.1]	0.60		
Goal setting (outcome) [1.3]	0.64, 0.85	Goal setting behavior [1.1]	0.56		
Prompts/cues [7.1]	0.42, 0.70	Tailored personalized message [b]	0.50		
Demonstration of the behaviour [6.1]	0.87, 0.75	Instruction on how to perform the behavior [4.1]	0.38		

[a] Reliability shown for BCTs observed at least five times; [b] BCT not in taxonomy v1

Table 4. Hierarchical structure labeling (step 6): Frequency of words from labels given by participants (conjunctions removed)

Rank	Word/Phrase	Frequency
1	Behavior/behavioral	24
2	Monitoring	10
2	Emotional / emotion / emotions / emotional regulation	10
3	Environment / environmental	9
4	Consequences	8
4	Self-efficacy	8
5	Feedback	7
5	Motivation	7
5	Reinforcement / reinforcing	7
6	Change	6
6	Conditioning	6
6	Identity	6
6	Planning	6
7	Antecedents	5
7	Goal-setting	5
7	Information	5
7	Learning	5
7	Manipulate	5
7	Other	5
7	Persuasion	5
7	Punishment	5
7	Self-regulation	5
7	Social	5
7	Social-support	5
8	Cognitions	4
8	Goals	4
8	Outcome expectancies	4
9	Resources	4
9	Restructuring	4
9	Reward	4
10	Commitment	3
10	Contingencies	3
10	Cues	3
10	Factors	3
10	Increase	3
10	Influence	3
10	Knowledge	3
10	Modeling	3
10	Physical	3
10	Practice	3
10	Prompts	3

Note. Table shows most frequently used words ranked from 1-10

Table 5. Results of Hierarchical Cluster Analysis of Behavior Change techniques
(step 6): grouping within the 16 cluster solution, Approximately Unbiased p values (AU)
and standard errors

Cluster Label and Component BCTs Some BCT labels differ as a result of the consensus exercises (Number in [ ] indicates related BCT in Electronic Supplementary Materials table 3)	AU % (SE) [a]
1. SCHEDULED CONSEQUENCES Punishment [14.2] Response cost [14.1] Chaining [14.5] Extinction [14.3] Discrimination training [14.6] Shaping [14.4] Negative reinforcement [14.10] Counter-conditioning [14.7] Thinning [14.9] Differential reinforcement [14.8]	**91** (.004)
2. REWARD & THREAT Social Reward [10.4] Material Reward [10.2] Self-reward [10.9] Non-specific Reward [10.3] Threat [10.11] Anticipation of future rewards or removal of punishment [14.10] Incentive [10.1]	**90** (.005)
3. REPETITION & SUBSTITUTION Behavior substitution [8.2] Habit reversal [8.4] Habit formation [8.3] Graded tasks [8.7] Overcorrection [8.5] Behavioral rehearsal /practice [8.1] Generalization of a target behavior [8.6]	**97** (.002)
4. ANTECEDENTS Restructuring the physical environment [12.1]	**96** (.002)

Restructuring the social environment [12.2]	
Avoidance/changing exposure to cues for the behavior [12.3]	
Distraction [12.4]	
5. ASSOCIATIONS Discriminative (learned) cue [7.2] Time out [7.4] Escape learning [7.5] Satiation [7.6] Exposure [7.7] Classical conditioning [7.8] Fading [7.3] Prompts/cues [7.1]	**97** (.002)
6. COVERT LEARNING Vicarious reinforcement [16.3] Covert sensitization [16.1] Covert conditioning [16.2]	**73** (.008)
7. NATURAL CONSEQUENCES Health consequences [5.1] Social and environmental consequences [5.3] Salience of consequences [5.2] Emotional consequences [5.6] Self-assessment of affective consequences [5.4] Anticipated regret [5.5]	**85** (.006)
8. FEEDBACK & MONITORING Feedback on behavior [2.2] Biofeedback [2.6] Other(s) monitoring with awareness [2.1 and 2.5] Self-monitoring of outcome of behavior [2.4] Self-monitoring of behavior [2.3]	**97** (.002)
9. GOALS & PLANNING Action planning (including implementation intentions) [1.4] Problem solving/coping planning [1.2] Commitment [1.9]	**90** (.002)

Goal setting (outcome) [1.3]	
Behavioral contract [1.8]	
Discrepancy between current behavior and goal standard [1.6]	
Goal setting (behavior) [1.1]	
Review behavior goal(s) [1.5]	
Review of outcome goal(s) [1.7]	
10. SOCIAL SUPPORT	
Social support (practical) [3.2]	**100** (.001)
Social support (general) [3.1]	
Social support (emotional) [3.3]	
11. COMPARISON OF BEHAVIOR	
Modeling of the behavior [6.1]	**83** (.006)
Information about others' approval [6.3]	
Social comparison [6.2]	
12. SELF-BELIEF	
Mental rehearsal of successful performance [15.2]	
Self-talk [15.4]	**92** (.005)
Focus on past success [15.3]	
Verbal persuasion to boost self-efficacy [15.1]	
13. COMPARISON OF OUTCOMES	
Persuasive argument [9.1]	**90** (.005)
Pros and cons [9.2]	
Comparative imagining of future outcomes [9.3]	
14. IDENTITY	
Identification of self as role model [13.1]	
Self-affirmation [13.4]	**86** (.006)
Identity associated with changed behavior [13.5]	
Reframing [13.2]	
Cognitive dissonance [13.3]	
15. SHAPING KNOWLEDGE	
Reattribution [4.3]	**95** (.003)
Antecedents [4.2]	
Behavioral experiments [4.4]	

|	
Instruction on how to perform a behavior [4.1]	
16. REGULATION Regulate negative emotions [11.2] Conserving mental resources [11.3] Pharmacological support [11.1] Paradoxical instructions [11.4]	**98** (.001)

[a] AU = Adjusted Unbiased *p*-value, SE = Standard Error of AU

Figure 1

Results of Hierarchical Cluster Analysis (step 6): Dendrogram for 85 Behavior Change Techniques (BCTs) partitioned across 16 clusters
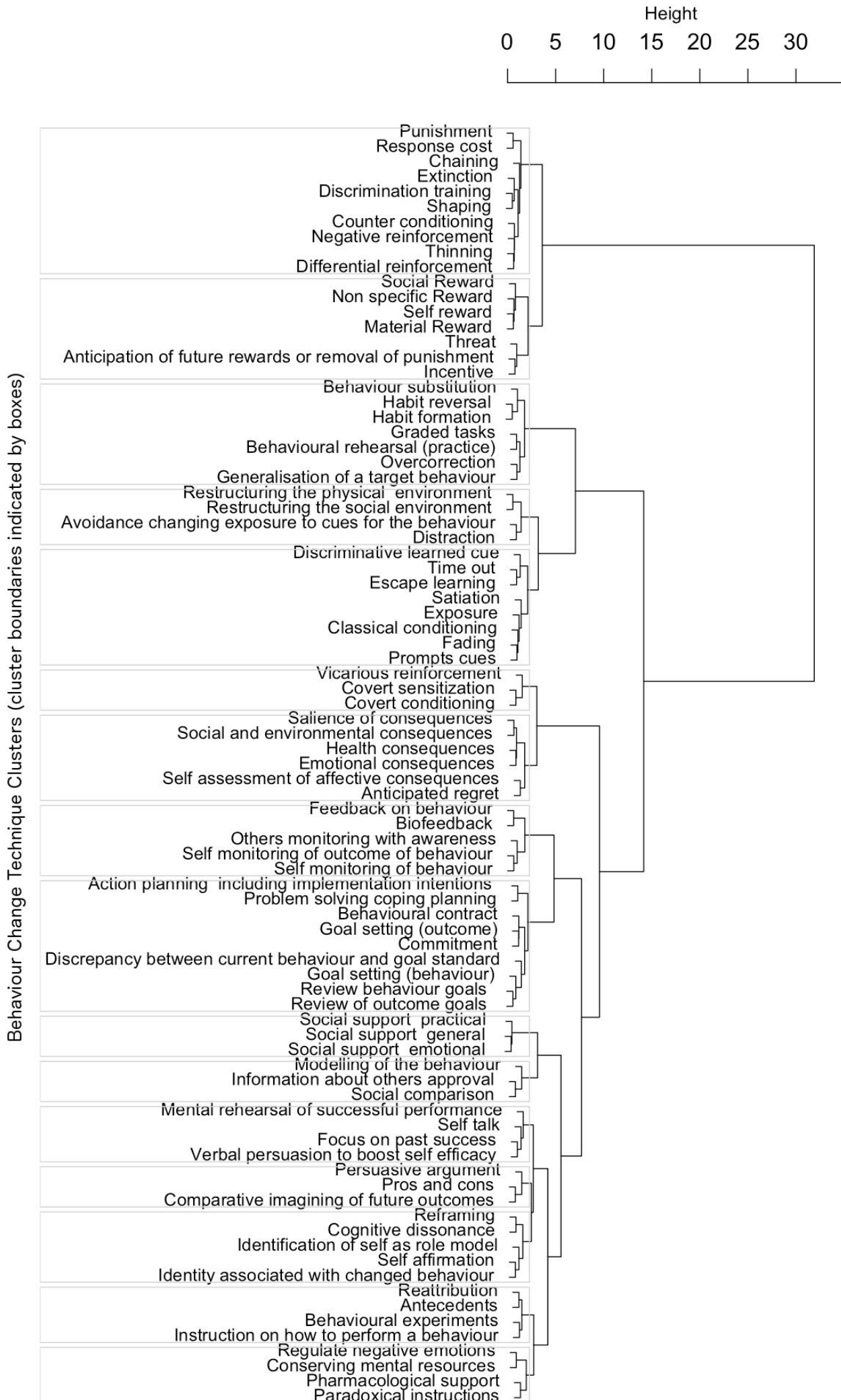
Electronic Supplementary Materials Table 1.

Participants in Delphi exercise (N=14) (steps 2 and 3). Number of BCTs participants have previously used (number of participants in brackets):

In intervention design (N)	In face to face delivery (N)	In training (N)
0 (0)	0(0)	0(2)
1-5(0)	1-5(1)	1-5 (0)
6-10(1)	6-10(1)	6-10(1)
11-15(2)	11-15(1)	11-15(1)
16-20(2)	16-20(1)	16-20(2)
21-25(1)	21-25(1)	21-25(0)
26-30(0)	26-30(1)	26-30(1)
31-35(1)	31-35(2)	31-35(0)
36-40(2)	36-40(1)	36-40(2)
41-45(1)	41-45(1)	41-45(1)
50+ (4)	50+ (4)	50+ (4)

Electronic Supplementary Materials Table 2. Evolution of the taxonomy: labels and definitions of BCTs modified (added, split or removed at each of 8 steps in the development).

Step number	Step description	Label	Definition	Added, split or removed.
1	Prototype classification	Conduct motivational interviewing	Adopt a formal motivational interviewing protocol	Removed
		Facilitate relapse prevention/ coping planning	Help the client understand how lapses occur and how they lead to relapse and to develop specific strategies for preventing lapses or avoiding lapses turning into relapse	
		Provide rational emotive therapy	Rational Emotive Therapy	
		Provide social skills training	Teach effective social interaction in specific situations (e.g. job interviews, eating out), may include techniques such as: behavior rehearsal, cognitive rehearsal, and assertiveness training	
		Provide assertiveness training	Teaching people to honestly express their needs and desires in a non-aggressive but confident manner	
		Desensitization	Identify and provide exposure to threatening experiences	

Step number	Step description	Label	Definition	Added, split or removed.
		Systematic desensitization	Provide graded exposure to increasingly threatening experiences	
		Stress inoculation	For clients experiencing stress consider using Stress-Inoculation Training (SIT): A four-phase training program for stress management often used in cognitive behavior therapy. Phase 1 entails the identification of reactions to stress; Phase 2 involves learning relaxation and self-regulation techniques; Phase 3 consists of learning coping self-statements; Phase 4 involves assisted progression through a series of increasingly stressful situations	
Step number	**Step description**	**Label**	**Definition**	**Added, split or removed.**
		Anger control training	A combination of techniques that are used to enable the client to control anger (e.g. a client who uses alcohol in response to anger might be trained to control anger in order to reduce alcohol consumption.)	
		Prompt fear arousal	Present information to highlight negative consequences of the behavior and make emotionally salient	

		Flooding	Expose client directly to a maximum-intensity anxiety-provoking situation or stimulus, either in the imagination or in reality. Flooding techniques aim to reduce anxiety that is interfering with desired behavior e.g. taking client to a gym to overcome anxiety about engaging in physical activity	
		Implosive therapy	Repeatedly encourage client to imagine an anxiety-arousing situation, and to experience anxiety as intensely as possible while doing so. Since there is no actual danger in the situation, the anxiety response is not reinforced and therefore is gradually extinguished	
		Coping strategies	Identify behaviors to be undertaken to avoid or reduce stressors	
		Provide normative information about others behavior and experience	Give information about how the client's experience compares with other people's experiences	
		Facilitate action planning/ *develop treatment plan*	Work with client to generate a clear plan to change the behavior including preparations (e.g. obtaining medication)	

Step number	Step description	Label	Definition	Added, split or removed.
		Coping planning	Identify and plan ways of overcoming barriers (note, this must include identification of specific barriers e.g. "problem solving how to fit into weekly schedule" would not count)	
Step number	Step description	Label	Definition	Added, split or removed.
		Provide information on where and when to perform the behavior	Involves telling the person about when and where they might be able to perform the behavior e.g. tips on places and times participants can access local exercise classes. This can be in either verbal or written form	
		Provide information on material consequences	Information focusing on what will happen if the person performs the behavior including the benefits and costs (or negative consequences) of action or inaction, including perceived severity of symptoms	
		Provide information about personal susceptibility to negative consequences	Personalized information about negative consequences for recipients, using pronouns such as "you" as in "you are at risk"	

13

Step number	Step description	Label	Definition	Added, split or removed.
		Negotiation skills training	Teaching people to understand others perspectives and seek compromises that allow people with conflicting needs or desires to find solutions that optimize achieving what everyone wants	
		Guided imagery to alter mood	Teach the person to use images of place, emotion and achievement to enhance positive mood and confidence.	
		Comparison	Provide comparative data (cf standard behavior, person's own past behavior, others' behavior)	
		Role play	Provide opportunities for client to perform behavior in simulated situation	
		Imagery	Use planned images (visual, motor, sensory) to implement behavior change techniques (Inc. mental rehearsal)	
		Cognitive restructuring	Change cognitions about causes and consequences of behavior	
		Behavioral information	Provide information about antecedents or consequences of the behavior, or connections between them, or behavior change techniques	
Step number	**Step description**	**Label**	**Definition**	**Added, split or removed.**
		Decision making	Generate alternative courses of action, and pros and cons of each, and weigh them up	

		Social support (non-specific)	Provide and/or identify sources of non-specific social support	
		Environmental change	Change the environment in order to facilitate the target behavior (other than prompts, rewards and punishments, e.g. choice of food provided)	
		General problem solving	Engage client in general problem-solving	
		Stress management	Behaviors undertaken to reduce stressors or impact of stressors	
		Comparative imagining of future outcomes	Facilitate imagining and comparing alternative future outcomes as a means of changing behavior	Added
2	Delphi exercise Round 1	Time out	Separate person from situations in which they can be reinforced in order to reduce unwanted behavior	Added

Step number	Step description	Label	Definition	Added, split or removed.
		Antecedents and consequences	Record/provide information about antecedents and consequences of behavior (e.g. social and environmental situations and events, emotions, cognitions)	Spit into Antecedents and Consequences, below
		- Consequences	Record/provide information about consequences of behavior (e.g. social and environmental situations and events, emotions, cognitions) that reliably follow the behavior	
		- Antecedents	Record/provide information about antecedents (e.g. social and environmental situations and events, emotions, cognitions) that reliably predict performance of the behavior	
Step number	**Step description**	**Label**	**Definition**	**Added, split or removed.**
		Information on consequences of the behavior in general	Give, or make more salient, information about the good and bad consequences of changing the behavior	Split into General information and Salience of consequences, below
		- General information on consequences	Give information about the consequences of changing the behavior in general	
		- Salience of consequences	Make information about the consequences of changing the behavior more salient	

		Emotional control techniques	Teach set of specific techniques that do not target the behavior directly but seek to reduce anxiety and stress to facilitate the performance of the behavior by controlling emotions, e.g., anxiety management, anger control and fear arousal. It might also include techniques designed to increase positive emotions that might help with the performance of the behavior	Split into Regulate negative emotions and Regulate positive emotions, below.
		- Regulate negative emotions	Teach methods of reducing anxiety, stress and/or anger to facilitate performance of target behavior	
		- Regulate positive emotions	Facilitate the performance of the behavior by teaching methods to increase the frequency and/or intensity of positive emotions	
		Environmental restructuring	Change the environment in order to facilitate, or create barriers to, the target behavior (other than prompts, rewards and punishments)	Split into Environmental restructuring and Social restructuring, below
		- Environmental restructuring	Change the physical environment in order to facilitate, or create barriers to, the target behavior (other than prompts, rewards and punishments)	
		- Social restructuring	Change the social environment in order to facilitate, or create barriers to, the target behavior (other than prompts, rewards and punishments)	

Step number	Step description	Label	Definition	Added, split or removed.
		Behavioral rehearsal	Advise how to identify opportunities to repeatedly perform or avoid performing the behavior, including by role play	Removed
		Changing routine	Advise on ways of changing daily or weekly routines to limit exposure to behavioral cues	
		Normative information about others' behavior	Providing information about what other people are doing i.e., indicates that a particular behavior or sequence of behaviors is common or uncommon amongst the population or amongst a specified group	
		Contingent reward	Give praise or reward when specified actions are performed	
3	Delphi exercise Round 2	Self-recording	Help to establish a routine of recording information useful for behavior change (e.g. situations or times when urges to relapse are strong and less strong), excluding self-monitoring of behavior	Removed
		Restructure social life	Choose social interactions so that they support, rather than interfere with, the behavior	
		Identification of a goal standard	Translate behavior goal into a quantifiable standard	

		Removal of a valued consequence (omission)	Identify and remove a contingent valued consequence of an unwanted behavior	
		Give tailored information on consequences of behavior	Provide tailored information about the benefits and costs of action or inaction to the individual or group based on their characteristics	
		Review of goal(s)	Review of previously set goals (outcome or behavior) and modify goal or behavior change strategy in light of achievement	
		Regulate positive emotions	Facilitate the performance of the behavior by teaching methods to increase the frequency and/or intensity of positive emotions	
4	Feedback from IAB	Monitoring outcome of behavior by others without feedback	Observe or record outcomes of behavior (e.g., *e.g., blood pressure, blood glucose, weight loss, physical fitness*) with the person's knowledge	Added
Step number	**Step description**	**Label**	**Definition**	**Added split and removed.**
		Body changes	Altering body structure, functioning or support to facilitate behavior change *e.g. strength training, relaxation training or providing assistive aids*	

		Time management	Instruct how to manage time in order to create opportunities when the wanted behavior could be performed	Removed
		Non-specific encouragement	Praise or reward for effort or performance without making this contingent on specific behavioral performance	
		Tailored personalized message	Tailor the message, verbal or written, provided to the individual or group, based on their characteristics	
		Anticipation of future rewards or removal of punishment	Inform that future rewards or removal of future punishment will be contingent on performance of behavior	Removed
5	Reliability testing Round 1	Review of outcome goal(s)	Review outcome goal(s) and modify goal in light of achievement	Added
		Material reward	Provide money, vouchers or other valued objects if and only if there has been effort and/or progress made towards performing the behavior	

		Other monitoring with awareness	Observe or record behavior with the person's knowledge	
		Incentive	Inform that performance will be rewarded contingent on behavior the future	
		Non-specific Reward	Reward if and only if there has been effort and/or progress made towards performing the behavior	
		Token economy	Reinforce the wanted behavior by offering tokens that can be exchanged for valued commodities	Removed
Step number	**Step description**	**Label**	**Definition**	**Added, split or removed.**
8	Feedback from study team members	Material reward (outcome)	Arrange for the delivery of a reward if and only if there has been effort and/or progress made towards achieving the behavioral outcome**.**	Added
		Feedback on outcome(s) of behavior	Provide feedback on the outcome of performance of the behavior	
		Adding objects to environment	Add objects to the environment in order to facilitate performance of the behavior.	

		Incentive	Inform that future rewards or removal of future punishment will be contingent on performance of behavior	Split into Material incentive (reward), Incentive (outcome), Social incentive, Non-specific incentive and Self-incentive; see below
		- Material incentive (behavior)	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 behavior	
		- Incentive (outcome)	Inform that a reward will be delivered if and only if there has been effort and/or progress in achieving the behavioral outcome	
		- Social incentive	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 behavior	
		- Non-specific incentive	Inform that a reward will be delivered if and only if there has been effort and/or progress in performing the behavior	
		- Self-incentive	Plan to reward self in future if and only if there has been effort and/or progress in performing the behavior	

Electronic Supplementary Materials Table 3. BCT Taxonomy (v1): 93 hierarchically-clustered techniques

Page	Grouping and BCTs	Page	Grouping and BCTs	Page	Grouping and BCTs
1	**1. Goals and planning**	8	**6. Comparison of behaviour**	16	**12. Antecedents**
	1.1. Goal setting (behavior)		6.1. Demonstration of the behavior		12.1. Restructuring the physical environment
	1.2. Problem solving		6.2. Social comparison		12.2. Restructuring the social environment
	1.3. Goal setting (outcome)		6.3. Information about others' approval		12.3. Avoidance/reducing exposure to cues for the behavior
	1.4. Action planning				12.4. Distraction
	1.5. Review behavior goal(s)	9	**7. Associations**		12.5. Adding objects to the environment
	1.6. Discrepancy between current behavior and goal		7.1. Prompts/cues		12.6. Body changes
	1.7. Review outcome goal(s)		7.2. Cue signalling reward		
	1.8. Behavioral contract		7.3. Reduce prompts/cues	17	**13. Identity**
	1.9. Commitment		7.4. Remove access to the reward		13.1. Identification of self as role model
			7.5. Remove aversive stimulus		13.2. Framing/reframing
3	**2. Feedback and monitoring**		7.6. Satiation		13.3. Incompatible beliefs
	2.1. Monitoring of behavior by others without feedback		7.7. Exposure		13.4. Valued self-identify
	2.2. Feedback on behaviour		7.8. Associative learning		13.5. Identity associated with changed behavior
	2.3. Self-monitoring of behaviour	10	**8. Repetition and substitution**		
	2.4. Self-monitoring of outcome(s) of behaviour		8.1. Behavioral practice/rehearsal	18	**14. Scheduled consequences**
	2.5. Monitoring of outcome(s) of behavior without feedback		8.2. Behavior substitution		14.1. Behavior cost
	2.6. Biofeedback		8.3. Habit formation		14.2. Punishment
	2.7. Feedback on outcome(s) of behavior		8.4. Habit reversal		14.3. Remove reward
			8.5. Overcorrection		14.4. Reward approximation
5	**3. Social support**		8.6. Generalisation of target behavior		14.5. Rewarding completion
	3.1. Social support (unspecified)		8.7. Graded tasks		14.6. Situation-specific reward
	3.2. Social support (practical)				14.7. Reward incompatible behavior
	3.3. Social support (emotional)	11	**9. Comparison of outcomes**		14.8. Reward alternative behavior
			9.1. Credible source		14.9. Reduce reward frequency
6	**4. Shaping knowledge**		9.2. Pros and cons		14.10. Remove punishment
	4.1. Instruction on how to perform the behavior		9.3. Comparative imagining of future outcomes		
	4.2. Information about Antecedents			19	**15. Self-belief**
	4.3. Re-attribution	12	**10. Reward and threat**		15.1. Verbal persuasion about capability
	4.4. Behavioral experiments		10.1. Material incentive (behavior)		15.2. Mental rehearsal of successful performance
			10.2. Material reward (behavior)		15.3. Focus on past success
7	**5. Natural consequences**		10.3. Non-specific reward		15.4. Self-talk
	5.1. Information about health consequences		10.4. Social reward		
	5.2. Salience of consequences		10.5. Social incentive	19	**16. Covert learning**
	5.3. Information about social and environmental consequences		10.6. Non-specific incentive		16.1. Imaginary punishment
	5.4. Monitoring of emotional consequences		10.7. Self-incentive		16.2. Imaginary reward
	5.5. Anticipated regret		10.8. Incentive (outcome)		16.3. Vicarious consequences
	5.6. Information about emotional consequences		10.9. Self-reward		
			10.10. Reward (outcome)		
			10.11. Future punishment		
		15	**11. Regulation**		
			11.1. Pharmacological support		
			11.2. Reduce negative emotions		
			11.3. Conserving mental resources		
			11.4. Paradoxical instructions		

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BCT Taxonomy (v1): 93 hierarchically-clustered techniques

Note for Users

The definitions of Behavior Change Techniques (BCTs):

i)   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 self-delivered

ii)   contain the term **"behavior"** referring to a single action or sequence of actions that includes the performance of **wanted** behavior(s) and/or **inhibition** (non-performance) of **unwanted** behavior(s)

iii)   note alternative or additional coding where relevant

iv)   note the technical terms associated with particular theoretical frameworks where relevant (e.g. 'including implementation intentions)

No.	Label	Definition	Examples
1. Goals and planning			
1.1	*Goal setting (behavior)*	Set or agree on a goal defined in terms of the behavior to be achieved *Note: only code goal-setting if there is sufficient evidence that goal set as part of intervention; if goal unspecified or a behavioral outcome, code **1.3, Goal setting (outcome)**; if the goal defines a specific context, frequency, duration or intensity for the behavior, <u>also</u> code **1.4, Action planning***	Agree on a daily walking goal (e.g. 3 miles) with the person and reach agreement about the goal Set the goal of eating 5 pieces of fruit per day as specified in public health guidelines
1.2	*Problem solving*	Analyse , or prompt the person to analyse, factors influencing the behavior and generate or select strategies that include overcoming barriers and/or increasing facilitators (includes '**Relapse Prevention***' *and* '**Coping Planning**') *Note: barrier identification without solutions is not sufficient. If the BCT does not include analysing the behavioral problem, consider **12.3, Avoidance/changing exposure to cues for the behavior, 12.1, Restructuring the physical environment, 12.2, Restructuring the social environment,** or **11.2, Reduce negative emotions***	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 to identify barriers preventing them from starting a new exercise regime e.g., lack of motivation, and discuss ways in which they could help overcome them e.g., going to the gym with a buddy

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1.3	*Goal setting (outcome)*	Set or agree on a goal defined in terms of a positive **outcome** of wanted behavior *Note: only code guidelines if set as a goal in an intervention context; if goal is a behavior, code **1.1, Goal setting (behavior)**; if goal unspecified code **1.3, Goal setting (outcome)***	Set a weight loss goal (e.g. 0.5 kilogram over one week) as an outcome of changed eating patterns
1.4	*Action planning*	Prompt detailed planning of performance of the behavior (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**') *Note: evidence of action planning does not necessarily imply goal setting, only code latter if sufficient evidence*	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
1.5	*Review behavior goal(s)*	Review behavior goal(s) jointly with the person and consider modifying goal(s) or behavior change strategy in light of achievement. This may lead to re-setting 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 *Note: if goal specified in terms of behavior, code **1.5, Review behavior goal(s)**, if goal unspecified, code **1.7, Review outcome goal(s)**; if discrepancy created consider also **1.6, Discrepancy between current behavior and goal***	Examine how well a person's performance corresponds to agreed goals e.g. whether they consumed less than one unit of alcohol per day, and consider modifying future behavioral goals accordingly e.g. by increasing or decreasing alcohol target or changing type of alcohol consumed
1.6	*Discrepancy between current behavior and goal*	Draw attention to discrepancies between a person's current behavior (in terms of the *form, frequency, duration, or intensity* of that behavior) and the person's previously set outcome goals, behavioral goals or action plans (goes beyond self-monitoring of behavior) *Note: if discomfort is created only code **13.3, Incompatible beliefs** and <u>not</u> **1.6, Discrepancy between current behavior and goal**; if goals are modified, also code **1.5, Review behavior goal(s)** and/or **1.7, Review outcome goal(s)**; if feedback is provided, <u>also</u> code **2.2, Feedback on behaviour***	Point out that the recorded exercise fell short of the goal set

1.7	*Review outcome goal(s)*	Review outcome goal(s) jointly with the person and consider modifying goal(s) in light of achievement. This may lead to re-setting the same goal, a small change in that goal or setting a new goal instead of, or in addition to the first *Note: if goal specified in terms of behavior, code **1.5, Review behavior goal(s)**, if goal unspecified, code **1.7, Review outcome goal(s)**; if discrepancy created consider also **1.6, Discrepancy between current behavior and goal***	Examine how much weight has been lost and consider modifying outcome goal(s) accordingly e.g., by increasing or decreasing subsequent weight loss targets
1.8	*Behavioral contract*	Create a written specification of the behavior to be performed, agreed on by the person, and witnessed by another *Note: <u>also</u> code **1.1, Goal setting (behavior)***	Sign a contract with the person e.g. specifying that they will not drink alcohol for one week
1.9	*Commitment*	Ask the person to affirm or reaffirm statements indicating commitment to change the behavior *Note: if defined in terms of the behavior to be achieved <u>also</u> code **1.1, Goal setting (behavior)***	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
2. Feedback and monitoring			
2.1	*Monitoring of behavior by others without feedback*	Observe or record behavior with the person's knowledge as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behavior, do not code; if feedback given, code only **2.2, Feedback on behavior**, and <u>not</u> **2.1, Monitoring of behavior by others without feedback**; if monitoring outcome(s) code **2.5, Monitoring outcome(s) of behavior by others without feedback**; if self-monitoring behavior, code **2.3, Self-monitoring of behaviour***	Watch hand washing behaviors among health care staff and make notes on context, frequency and technique used

2.2	*Feedback on behavior*	Monitor and provide informative or evaluative feedback on performance of the behavior *(e.g. form, frequency, duration, intensity)* *Note: if Biofeedback, code only **2.6, Biofeedback** and <u>not</u> **2.2, Feedback on behavior**; if feedback is on **outcome(s)** of behavior, code **2.7, Feedback on outcome(s) of behavior**; if there is no clear evidence that feedback was given, code **2.1, Monitoring of behavior by others without feedback**; if feedback on behaviour is evaluative e.g. praise, also code **10.4, Social reward***	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 behavior*	Establish a method for the person to monitor and record their behavior(s) as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behavior, do not code; if monitoring of outcome of behavior, code **2.4, Self-monitoring of outcome(s) of behavior**; if monitoring is by someone else (without feedback), code **2.1, Monitoring of behavior by others without feedback***	Ask the person to record daily, in a diary, whether 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 behavior*	Establish a method for the person to monitor and record the **outcome(s)** of their behavior as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behavior, do not code ; if monitoring behavior, code **2.3, Self-monitoring of behavior**; if monitoring is by someone else (without feedback), code **2.5, Monitoring outcome(s) of behavior by others without feedback***	Ask the person to weigh themselves at the end of each day, over a two week period, and record their daily weight on a graph to increase exercise behaviors

2.5	*Monitoring outcome(s) of behavior by others without feedback*	Observe or record outcomes of behavior with the person's knowledge as part of a behavior change strategy *Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behavior, do not code; if feedback given, code only **2.7, Feedback on outcome(s) of behavior**; if monitoring behavior code **2.1, Monitoring of behavior by others without feedback**; if self-monitoring outcome(s), code **2.4, Self-monitoring of outcome(s) of behavior***	Record blood pressure, blood glucose, weight loss, or physical fitness
2.6	*Biofeedback*	Provide feedback about the body *(e.g. physiological or biochemical state)* using an external monitoring device as part of a behavior change strategy *Note: if Biofeedback, code only **2.6, Biofeedback** and <u>not</u> **2.2, Feedback on behavior** or **2.7, Feedback on outcome(s) of behaviour***	Inform the person of their blood pressure reading to improve adoption of health behaviors
2.7	*Feedback on outcome(s) of behavior*	Monitor and provide feedback on the outcome of performance of the behavior *Note: if Biofeedback, code only **2.6, Biofeedback** and <u>not</u> **2.7, Feedback on outcome(s) of behavior**; if feedback is on behavior code **2.2, Feedback on behavior**; if there is no clear evidence that feedback was given code **2.5, Monitoring outcome(s) of behavior by others without feedback;** if feedback on behaviour is evaluative e.g. praise, also code **10.4, Social reward***	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)*	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 behavior. It includes encouragement and counselling, but only when it is directed at the **behavior** *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 Behavioral Therapy'***)*	Advise the person to call a 'buddy' when they experience an urge to smoke Arrange for a housemate to encourage continuation with the behavior change programme Give information about a self-help group that offers support for the behavior

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3.2	*Social support (practical)*	Advise on, arrange, or provide **practical** help *(e.g. from friends, relatives, colleagues, 'buddies' or staff)* for performance of the behavior *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.*	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)*	Advise on, arrange, or provide **emotional** social support *(e.g. from friends, relatives, colleagues, 'buddies' or staff)* for performance of the behavior *Note: if practical, code **3.2, Social support (practical)**; if unspecified, code **3.1, Social support (unspecified)***	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 behavior*	Advise or agree on how to perform the behavior (includes '**Skills training**') *Note: when the person attends classes such as exercise or cookery, code **4.1, Instruction on how to perform the behavior, 8.1, Behavioral practice/rehearsal** and **6.1, Demonstration of the behavior***	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 behavior and suggest alternative explanations *(e.g. external or internal and stable or unstable)*	If the person attributes their over-eating 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	*Behavioral experiments*	Advise on how to identify and test hypotheses about the behavior, 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
5. Natural consequences			
5.1	*Information about health consequences*	Provide information (e.g. written, verbal, visual) about health consequences of performing the behavior *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***	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 behavior
5.2	*Salience of consequences*	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) *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***	Produce cigarette packets showing pictures of health consequences e.g. diseased lungs, to highlight the dangers of continuing to smoke
5.3	*Information about social and environmental consequences*	Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behavior *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***	Tell family physician about financial remuneration for conducting health screening Inform a smoker that the majority of people disapprove of smoking in public places
5.4	*Monitoring of emotional consequences*	Prompt assessment of **feelings** after attempts at performing the behavior	Agree that the person will record how they feel after taking their daily walk

5.5	*Anticipated regret*	Induce or raise awareness of expectations of future regret about performance of the unwanted behavior *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***	Ask the person to assess the degree of regret they will feel if they do not quit smoking
5.6	*Information about emotional consequences*	Provide information (e.g. written, verbal, visual) about emotional consequences of performing the behavior *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***	Explain that quitting smoking increases happiness and life satisfaction
6. Comparison of behaviour			
6.1	*Demonstration of the behavior*	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**'). *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***	Demonstrate to nurses how to raise the issue of excessive drinking with patients via a role-play exercise
6.2	*Social comparison*	Draw attention to others' performance to allow comparison with the person's own performance *Note: being in a group setting does not necessarily mean that social comparison is actually taking place*	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 behavior. 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*	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behavior. The prompt or cue would normally occur at the time or place of performance *Note: when a stimulus is linked to a specific action in an if-then plan including one or more of frequency, duration or intensity* <u>also</u> *code* **1.4, Action planning**.	Put a sticker on the bathroom mirror to remind people to brush their teeth
7.2	*Cue signalling reward*	Identify an environmental stimulus that reliably predicts that reward will follow the behavior (includes **'<u>Discriminative cue'</u>**)	Advise that a fee will be paid to dentists for a particular dental treatment of 6-8 year old, but not older, children to encourage delivery of that treatment (the 6-8 year old children are the environmental stimulus)
7.3	*Reduce prompts/cues*	Withdraw gradually prompts to perform the behavior (includes **'<u>Fading'</u>**)	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 behavior can be rewarded in order to reduce the behavior (includes **'<u>Time out'</u>**)	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 behavior change (includes **'<u>Escape learning'</u>**)	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 behavior	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 behavior repeatedly until the neutral stimulus elicits that behavior (includes **'Classical/Pavlovian Conditioning'**) *Note: when a BCT involves reward or punishment, code one or more of:* **10.2, Material reward (behavior); 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	*Behavioral practice/ rehearsal*	Prompt practice or rehearsal of the performance of the behavior 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,* <u>*also*</u> *code* **8.3, Habit formation**	Prompt asthma patients to practice measuring their peak flow in the nurse's consulting room
8.2	*Behavior substitution*	Prompt substitution of the unwanted behavior with a wanted or neutral behavior *Note: if this occurs regularly,* <u>*also*</u> *code* **8.4, Habit reversal**	Suggest that the person goes for a walk rather than watches television
8.3	*Habit formation*	Prompt rehearsal and repetition of the behavior in the same context repeatedly so that the context elicits the behavior *Note:* <u>*also*</u> *code* **8.1, Behavioral practice/rehearsal**	Prompt patients to take their statin tablet before brushing their teeth every evening
8.4	*Habit reversal*	Prompt rehearsal and repetition of an alternative behavior to **replace** an unwanted habitual behavior *Note:* <u>*also*</u> *code* **8.2, Behavior substitution**	Ask the person to walk up stairs at work where they previously always took the lift
8.5	*Overcorrection*	Ask to repeat the wanted behavior in an exaggerated way following an unwanted behaviour	Ask to eat <u>only</u> fruit and vegetables the day after a poor diet
8.6	*Generalisation of a target behavior*	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 behavior 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*	Present verbal or visual communication from a credible source **in favour of or against** the behavior *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, <u>also</u> code 5.1, Information about health consequences, if about emotional consequences, <u>also</u> code 5.6, Information about emotional consequences; if about social, environmental or unspecified consequences also code 5.3, Information about social and environmental consequences*	Present a speech given by a high status professional to emphasise the importance of not exposing patients to unnecessary radiation by ordering x-rays for back pain
9.2	*Pros and cons*	Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behavior (includes '**Decisional balance'***)* *Note: if providing information about health consequences, <u>also</u> code 5.1, Information about health consequences; if providing information about emotional consequences, <u>also</u> code 5.6, Information about emotional consequences; if providing information about social, environmental or unspecified consequences <u>also</u> code 5.3, Information about social and environmental consequences*	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 versus unchanged behaviour	Prompt the person to imagine and compare likely or possible outcomes following attending versus not attending a screening appointment
10. Reward and threat			
10.1	*Material incentive (behavior)*	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 behavior (includes **'Positive reinforcement'**) *Note: if incentive is social, code **10.5, Social incentive** if unspecified code **10.6, Non-specific incentive,** and not **10.1, Material incentive (behavior)**; if incentive is for **outcome,** code **10.8, Incentive (outcome).** If reward is delivered also code one of: **10.2, Material reward (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	Inform that a financial payment will be made each month in pregnancy that the woman has not smoked
10.2	*Material reward (behavior)*	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 behavior (includes '**Positive reinforcement'**) *Note: If reward is social, code **10.4, Social reward**, if unspecified code **10.3, Non-specific reward**, and not **10.1, Material reward (behavior)**; 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)***	Arrange for the person to receive money that would have been spent on cigarettes if and only if the smoker has not smoked for one month

10.3	*Non-specific reward*	Arrange delivery of a reward if and only if there **has been** effort and/or progress in performing the behavior (includes '**Positive reinforcement'**) *Note: if reward is material, code **10.2, Material reward (behavior)**, 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)***	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
10.4	*Social reward*	Arrange verbal or non-verbal reward if and only if there **has been** effort and/or progress in performing the behavior (includes '**Positive reinforcement**') *Note: if reward is material, code **10.2, Material reward (behavior)**, 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)***	Congratulate the person for each day they eat a reduced fat diet
10.5	*Social incentive*	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 behavior (includes '**Positive reinforcement'**) *Note: if incentive is material, code **10.1, Material incentive (behavior)**, 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 (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	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 behavior (includes '<u>**Positive reinforcement'**</u>) *Note: if incentive is material, code **10.1, Material incentive (behavior)**, if social, code **10.5, Social incentive** and <u>not</u> **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 (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	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*	Plan to reward self in future if and only if there has been effort and/or progress in performing the behavior *Note: if self-reward is material, <u>also</u> code **10.1, Material incentive (behavior)**, if social, <u>also</u> code **10.5, Social incentive**, if unspecified, <u>also</u> 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 (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	Encourage to provide self with material (e.g., new clothes) or other valued objects if and only if they have adhered to a healthy diet
10.8	*Incentive (outcome)*	Inform that a reward *will be* delivered if and only if there has been effort and/or progress in achieving the behavioural **outcome** (*includes '*<u>*Positive reinforcement'*</u>*)* *Note: this includes social, material, self- and non-specific incentives for outcome; if incentive is for the **behavior** code **10.5, Social incentive, 10.1, Material incentive (behavior), 10.6, Non-specific incentive** or **10.7, Self-incentive** and <u>not</u> **10.8, Incentive (outcome).** If reward is delivered also code one of: **10.2, Material reward (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	Inform the person that they will receive money if and only if a certain amount of weight is lost

10.9	*Self-reward*	Prompt self-praise or self-reward if and only if there *has been* effort and/or progress in performing the behavior *Note: if self-reward is material, <u>also</u> code **10.2, Material reward (behavior)**, if social, <u>also</u> code **10.4, Social reward**, if unspecified, <u>also</u> 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)***	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)*	Arrange for the delivery of a reward if and only if there *has been* effort and/or progress in achieving the behavioral **outcome** (includes '**Positive reinforcement**') *Note: this includes social, material, self- and non-specific rewards for outcome; if reward is for the **behavior** code **10.4, Social reward, 10.2, Material reward (behavior), 10.3, Non-specific reward** or **10.9, Self-reward** and <u>not</u> **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)***	Arrange for the person to receive money if and only if a certain amount of weight is lost
10.11	*Future punishment*	Inform that future punishment or removal of reward will be a consequence of performance of an unwanted behavior (may include fear arousal) (includes **'Threat'**)	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*	Provide, or encourage the use of or adherence to, drugs to facilitate behavior change *Note: if pharmacological support to reduce negative emotions (i.e. anxiety) then <u>also</u> code **11.2, Reduce negative emotions***	Suggest the patient asks the family physician for nicotine replacement therapy to facilitate smoking cessation

11.2	*Reduce negative emotions* [b]	Advise on ways of reducing negative emotions to facilitate performance of the behavior (includes '**Stress Management**') *Note: if includes analysing the behavioural problem, <u>also</u> code **1.2, Problem solving***	Advise on the use of stress management skills, e.g. to reduce anxiety about joining Alcoholics Anonymous
11.3	*Conserving mental resources*	Advise on ways of minimising demands on mental resources to facilitate behavior 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 behavior 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*	Change, or advise to change the **physical** environment in order to facilitate performance of the wanted behavior or create barriers to the unwanted behavior (other than prompts/cues, rewards and punishments) *Note: this may also involve **12.3, Avoidance/reducing exposure to cues for the behavior**; 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***	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*	Change, or advise to change the **social** environment in order to facilitate performance of the wanted behavior or create barriers to the unwanted behavior (other than prompts/cues, rewards and punishments) *Note: this may also involve **12.3, Avoidance/reducing exposure to cues for the behavior**; if also restructuring of the physical environment also code **12.1, Restructuring the physical environment***	Advise to minimise time spent with friends who drink heavily to reduce alcohol consumption

12.3	*Avoidance/reducing exposure to cues for the behavior*	Advise on how to avoid exposure to specific social and contextual/physical cues for the behavior, including changing daily or weekly routines *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 behavioral problem, <u>only</u> code **1.2, Problem solving***	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
12.5	*Adding objects to the environment*	Add objects to the environment in order to facilitate performance of the behavior *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***	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 behavior 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 behavior 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*	Suggest the deliberate adoption of a perspective or new perspective on behavior (e.g. its purpose) in order to change cognitions or emotions about performing the behavior (includes '**Cognitive structuring**'); *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***	Suggest that the person might think of the tasks as reducing sedentary behavior (rather than increasing activity)

13.3	*Incompatible beliefs*	Draw attention to discrepancies between current or past behavior 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 behavior change strategy (includes **'Self-affirmation'**)	Advise the person to write about their personal strengths before they receive a message advocating the behavior change
13.5	*Identity associated with changed behavior*	Advise the person to construct a new self-identity as someone who 'used to engage with the unwanted behavior'	Ask the person to articulate their new identity as an 'ex-smoker'
14. Scheduled consequences			
14.1	*Behavior cost*	Arrange for withdrawal of something valued if and only if an unwanted behavior 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
14.2	*Punishment*	Arrange for aversive consequence contingent on the performance of the unwanted behavior	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 behavior (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 behavior, gradually rewarding only performance closer to the wanted behavior (includes **'Shaping'**) *Note: also code one of **59-63***	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 behavior by arranging reward following final component of the behavior; gradually add the components of the behavior that occur earlier in the behavioral sequence (includes **'Backward chaining'**) *Note: also code one of **10.2, Material reward (behavior); 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 behavior in one situation but not in another (includes **'Discrimination training'**) *Note: also code one of **10.2, Material reward (behavior); 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 behavior*	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 (behavior); 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 behavior*	Arrange reward for performance of an alternative to the unwanted behavior (includes **'Differential reinforcement'**) *Note: also code one of **10.2, Material reward (behavior); 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
14.9	*Reduce reward frequency*	Arrange for rewards to be made contingent on increasing duration or frequency of the behavior (includes **'Thinning'**) *Note: also code one of **10.2, Material reward (behavior); 10.3, Non-specific reward; 10.4, Social reward, 10.9, Self-reward; 10.10, Reward (outcome)***	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 behavior (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 behavior, 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 behavior 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 behavior (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 behavior	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** behavior 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** behavior 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*	Prompt observation of the consequences (including rewards and punishments) for others when they perform the behavior *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***	Draw attention to the positive comments other staff get when they disinfect their hands regularly

[a] Notes are provided underneath most BCTs to help distinguish them from similar techniques

[b] An additional technique 'Increase positive emotions' will be included in BCT Taxonomy v2

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