Behaviour change techniques: the development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data)

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Declared competing interests of authors: Charles Abraham acknowledges funding from the UK National Institute for Health Research and the Peninsula Collaboration for Leadership in Applied Health Research and Care.

Published November 2015
DOI: 10.3310/hta19990
Scientific summary

Background

Interventions to change behaviour are ‘co-ordinated sets of activities designed to change specified behaviour patterns’ (Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011;6:42). They are often complex and involve multiple, interacting components. Lack of a methodology for unpacking this ‘black box’ prevents progress in developing more effective interventions and in reliably implementing effective ones. Detailed specification of interventions is important for basic and applied behavioural science. A methodology for achieving this is to specify intervention content in terms of their ‘active ingredients’, that is, behaviour change techniques (BCTs). The UK Medical Research Council (MRC) guidance for developing and evaluating complex interventions advocates this approach (Craig P, Dieppe O, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ 2008;337:a1655).

Structured lists, otherwise known as ‘taxonomies’, of BCTs have been developed to enable the clear specification of intervention content in terms of BCTs. The first cross-domain BCT taxonomy consisted of 22 BCTs and four BCT packages. Taxonomies have been developed for different behavioural domains: physical activity, healthy eating, smoking, alcohol consumption and condom use. Using taxonomies with standardised labels, clear definitions and examples will improve current practice in that any given BCT will be described by the same label and that label will be used to describe the same BCT. There is a need for consensus about labels and definitions that can be understood across disciplines, behavioural domains and countries. A key objective of the programme of research reported here was to develop such a consensus and to facilitate the use of a shared language to describe BCTs.

Objectives

The aim was to develop a method for specifying interventions to change behaviour in terms of component BCTs. Objectives were as follows.

Phase 1: development

Develop a taxonomy made up of BCTs that:

i. are applicable to an extensive range of behaviour change interventions (BCIs)
ii. are agreed by an international consensus to be potential active components of BCIs
iii. are clearly labelled and well defined to promote reliable application by researchers and intervention developers from a range of disciplines and countries
iv. are distinct (non-overlapping, non-redundant) and precise, and can be used with confidence to describe interventions
v. are hierarchically organised to improve ease of use.
Phase 2: evaluation

i. Assess the effectiveness of two programmes of taxonomy user training in improving reliable identification of BCTs.

ii. Assess and report the reliability and validity of using the developed taxonomy to code intervention descriptions into BCTs.

iii. Assess whether or not use of the taxonomy leads to clearer and more replicable written intervention descriptions.

Phase 3: supporting use of the developed taxonomy (Behaviour Change Technique Taxonomy version 1)

Develop accessible resources to facilitate reliable, valid and confident use of the developed taxonomy including:

i. a website providing regular updates on progress of the Behaviour Change Technique Taxonomy version 1 (BCTTv1) project

ii. an online, interactive training resource for users of BCTTv1

iii. a smartphone application version of BCTTv1 available across mobile platforms.

Cross-phase: implementation and dissemination

Ensure that development of the taxonomy:

i. is supported by a range of multidisciplinary and international researchers, practitioners, funders, journal editors and policymakers, and

ii. lays foundations for co-ordinated advances in behavioural science.

Empirical studies included in the project

Phase 1: development

Study 1: developing a comprehensive list of behaviour change techniques

Study 2: Behaviour Change Technique Taxonomy version 1 with hierarchical structure
The 93-item BCT list poses problems for easy recall of, and ready access to, the BCTs and thus its speed and accuracy of use. Study 2 aimed to provide a structure for the list to increase ease of use and to compare a pragmatic ‘bottom-up’ method with a theoretical ‘top-down’ method for generating structure. The objectives were to (1) develop a hierarchical structure using an open-sort task (‘bottom-up’ method), (2) identify whether or not BCTs could reliably be linked to domains of theoretical constructs using a closed-sort task (‘top-down’ method) and (3) identify any overlap between ‘bottom-up’ and ‘top-down’ groupings. The ‘bottom-up’ method resulted in 16 groupings, which had some overlap with the theory-driven groupings.

Phase 2: evaluation

Study 3: Behaviour Change Technique Taxonomy version 1 training development and evaluation
The process of coding interventions into BCTs is a highly skilled task requiring familiarity with labels and definitions and ability to make a series of complex interpretative judgements. This requires an effective programme of coder training to ensure sufficient level of skills to demonstrate reliability and validity of identifying BCTs. Reliability can be measured by the extent to which coders agree with each other on the presence and absence of BCTs in interventions while validity can be measured by the extent to which coders agree with expert consensus (i.e. the judgement consensus of the BCTTv1 study team). Study 3 developed two training programmes: 1-day workshops and distance group tutorials. Effectiveness was evaluated in terms of whether or not training enhanced coding reliability, validity, confidence in identifying BCTs and coding competence. Both methods of training improved trainee agreement with expert consensus, doubling the proportion achieving a satisfactory level of performance and confidence in identifying the BCTs assessed but did not improve intercoder agreement. Training was evaluated positively by trainees with both types of training receiving uniformly high ratings in terms of usefulness.

Study 4: identifying behaviour change technique in interventions using Behaviour Change Technique Taxonomy version 1 – reliability and validity
Study 4 investigated the reliability and validity of BCTTv1 when used by trained coders (from study 3). Intercoder and test–retest reliability (measured at two time points, 1 month apart) were used to assess reliability of using BCTTv1 to code BCTs in published intervention descriptions. Validity was assessed by the extent to which coding agreed with consensus by the BCTTv1 study team as to which BCTs were present. We also investigated trained coders’ confidence in identifying BCTs and whether or not descriptions varied in the ease with which BCTs could be identified. Good intercoder reliability was observed for 80 of the 93 BCTs. Reliability did not differ across the two time points and there was good test–retest reliability. Of the 15 BCTs agreed by expert consensus to be present in the descriptions, good agreement was achieved for 14, thus indicating good validity.

Study 5: reporting intervention descriptions using Behaviour Change Technique Taxonomy version 1 – clarity and distinctiveness
The final study, consisting of three substudies, evaluated the extent to which using BCTTv1 improved clarity of reporting descriptions that had been observed and compared this in trained and untrained users. Writers were shown videos of BCIs as delivered in practice and wrote descriptions. Descriptions generated were then rated for quality (i.e. clarity, ease of understanding and ease of replicability), recognition of BCTs and the extent to which different interventions could be recognised and distinguished. Results were mixed: providing BCTTv1 plus training resulted in descriptions of poorer quality when comparing trained with untrained writers (study 5b) but resulted in improvement when investigated in a within-person study (study 5c), while only providing the taxonomy made no difference (study 5a). However, reliability of BCT identification was greater for descriptions written by trained than untrained writers, with BCTTv1 (study 5b) but not in the within-person study (study 5c). Providing BCTTv1 both with and without training did not improve validity of BCT identification.
Design
The five empirical studies used the following methods:

- Delphi methods with feedback from a multidisciplinary IAB to generate a list of distinct BCT labels and definitions.
- Open-sort methods to categorise BCTs and generate a hierarchical structure.
- Comparison of user’s intercoder reliability using prevalence- and bias-adjusted kappa (PABAK; for which $PABAK > 0.60$ is considered good reliability), agreement with expert consensus (in this case, ‘expert’ is defined as individuals with at least 15 years’ experience of researching and coding interventions) and user confidence in identifying BCTs after, compared with before, being trained.
- Assessment of agreement between trained coders (intercoder reliability), agreement over time (test–retest reliability) and trained coder agreement with expert consensus (validity).
- Within- and between-participant experimental designs to compare quality of intervention descriptions reported by untrained and trained writers, with and without access to BCTTv1.

Participants
A total of 400 participants were involved across the studies (note: some participants took part in more than one study).

Study 1 ($n = 41$)
Nineteen international behaviour change experts, active in their field and engaged in investigating, designing and/or delivering interventions, 16 of the 30 members of the BCTTv1 project IAB, five BCTTv1 team members and a ‘lay’ person.

Study 2 ($n = 36$)
Eighteen of the 19 international experts from the first study and 18 additional experts with experience of designing interventions, writing manuals or protocols and/or conducting narrative or systematic reviews of behaviour change literature.

Study 3 ($n = 161$)
One-hundred and sixty one trainee coders (systematic reviewers, researchers, practitioners and policy-makers engaged in investigating, reviewing, designing and delivering interventions).

Study 4 ($n = 40$)
Forty trained coders who had also taken part in the third study.

Studies 5 (a, b, c) ($n = 190$)
One hundred and sixty-six trainee intervention reporters (systematic reviewers, practitioners, policy-makers engaged in investigating, reviewing, designing, delivering or describing interventions), 12 smoking cessation practitioners with no experience of using BCT taxonomies, 12 trained coders from studies 3 and 4.
Results

Study 1
The BCTTv1 is the first cross-behaviour taxonomy to be established by an international group of experienced BCT coders. It comprises 93 distinct, clearly labelled, well-defined BCTs hierarchically organised into 16 groupings.

Study 2
Groupings were created by those with experience of BCIs: average of 15.11 groupings (standard deviation 6.11, range 5–24 groupings). BCTs relating to ‘Reward and Punishment’ and ‘Cues and Cue Responses’ were perceived as markedly different from other BCTs. Fifty-nine of the BCTs were reliably allocated to 12 of the 14 theoretical domains; 47 were significant and 12 were of borderline significance. There was a significant association between the 16 ‘bottom-up’ groupings and the 13 ‘top-down’ groupings, chi-squared = 437.80; p < 0.001. Thirty-six of the 208 ‘bottom-up’ × ‘top-down’ pairings (i.e. 16 × 13) showed greater overlap than expected by chance. However, only six combinations achieved satisfactory evidence of similarity. The moderate overlap between the groupings indicates some tendency to implicitly conceptualise BCTs in terms of the same theoretical domains.

Study 3
Training was effective in improving application of BCTTv1. Trainee agreement with expert consensus improved across workshop and distance group tutorial trainees (both p < 0.05), with the proportion achieving competence (i.e. agreement with expert consensus PABAK > 0.60) doubling (both p < 0.05). Forty-six per cent of workshop trainees and 78% of tutorial trainees achieved competence after training. Trainee confidence in identifying BCTs assessed improved in workshops (p < 0.001). Intercoder agreement did not improve for either method (workshops p = 0.08 and tutorials p = 0.57).

Study 4
The BCTTv1 can be used accurately and reliably by trained coders to specify BCTs in BCIs: good intercoder reliability was observed across 80 BCTs identified in the protocols: 64 of the 80 BCTs (i.e. 80%) achieved a mean PABAK score of > 0.70 and 59 of the 80 BCTs (i.e. 74%) achieved a mean PABAK score of > 0.70. Good test–retest reliability was achieved within coders (between baseline and 1 month) (p < 0.001). Reliability was poorer for frequent BCTs; 9 out of the 16 frequently identified BCTs failed to achieve a good level of reliability, that is a PABAK score of > 0.70. Good concurrent validity was achieved for 14 out of the 15 BCTs identified by experienced coders to be present in published descriptions.

Studies 5 a, b, c
It is unclear whether or not BCTTv1 benefits reporting of descriptions of observed interventions.

Study 5a: quality, reliability of BCT identification (between trained coders) and validity (trained coder agreement with expert consensus) did not differ for descriptions written by untrained writers with and without BCTTv1 (all p > 0.05).

Study 5b: quality of descriptions written by untrained raters without BCTTv1 was rated as greater than descriptions written by trained writers, with BCTTv1 (all p < 0.05). Reliability of BCT identification (between trained coders) was greater for descriptions written by trained writers, with BCTTv1 (mean PABAK trained = 0.87; untrained = 0.84; p < 0.05).

Study 5c: quality of descriptions written by trained writers, with BCTTv1, was higher than descriptions written by the same writers, before training and not using BCTTv1 (all p < 0.05 except replicability of mode of delivery). There were no differences in reliability (p = 0.50) or validity (p = 0.28).
Conclusions

With regard to BCTTv1, ‘v1’ refers to version 1, to indicate that we envisage development of this taxonomy in the future. It is an extensive, hierarchically organised taxonomy of 93 distinct BCTs with clear definitions and examples that offer a generally reliable method for specifying the active content of interventions. Eighty out of these 93 were found in 40 published intervention descriptions, indicating the need for such an extensive list of BCTs. Both methods of BCTTv1 training improve reliability and validity for most BCTs. BCTTv1 can be used by trained coders to identify BCTs accurately in intervention descriptions. However, there is room for improvement in terms of clarifying some BCT definitions and in developing further training to improve reliability and validity. It is not yet clear whether or not BCTTv1 enhances reporting as our evaluation method only used observed interventions. BCTTv1 represents a useable method for research and practitioner communities when interpreting and implementing BCIs.

Funding

This project was funded by the MRC Ref: G0901474/1. Funding also came from the Peninsula Collaboration for Leadership in Applied Health Research and Care.
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