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Developing a method for specifying the components of behaviour change interventions in practice: the example of smoking cessation

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ABSTRACT

Objective: There is a difference between interventions as planned and as delivered in practice. Unless we know what was actually delivered, we cannot understand "what worked" in effective interventions. This study aimed to: i) assess whether an established taxonomy of 53 smoking cessation behaviour change techniques (BCTs) may be applied or adapted as a method for reliably specifying the content of smoking cessation behavioural support consultations ii) develop an effective method for training researchers and practitioners in the reliable application of the taxonomy.

Methods: Fifteen transcripts of audio-recorded consultations delivered by English Stop Smoking Services were coded into component BCTs using the taxonomy. Inter-rater reliability and potential adaptations to the taxonomy to improve coding were discussed following three coding waves. A coding training manual was developed through expert consensus and piloted on ten trainees, assessing coding reliability and self-perceived competence before and after training.

Results: An average of 33 BCTs from the taxonomy were identified at least once across sessions and coding waves. Consultations contained on average 12 BCTs (range: 8-31). Average inter-rater reliability was high (88% agreement). The taxonomy was adapted to simplify coding by merging co-occurring BCTs and refining BCT definitions. Coding reliability and self-perceived competence significantly improved post-training for all trainees.

Conclusions: It is possible to apply a taxonomy to reliably identify and classify BCTs in smoking cessation behavioural support delivered in practice, and train inexperienced coders to do so reliably. This method can be used to investigate variability in provision of behavioural support across services, monitor fidelity of delivery, and identify training needs.

Key words: behaviour change, smoking cessation, intervention delivery, fidelity

INTRODUCTION

The effectiveness of a range of interventions in promoting behaviour change in health behaviours, such as physical activity and healthy eating, has been established (Michie, Abraham, Whittington et al., 2009). However, there is limited knowledge as to which intervention components are the 'active ingredients' contributing to effective outcomes. Behaviour change interventions are typically complex in that they are broadly defined and comprise multiple, potentially interacting, component behaviour change techniques (BCTs). Furthermore, limited information is often provided regarding how much of an intervention's original protocol was actually delivered by intervention providers. Methods have recently been developed to accurately specify the content of interventions described in treatment protocols and published reports using taxonomies of BCTs. This has been achieved for healthy-eating, physical activity, alcohol use and smoking cessation (Michie, Ashford, Sniehotta, et al. 2011; Michie, Whittington, Hamoudi, et al. 2012; Michie, Hyder, West et al. 2010; Michie, Churchill, West 2011). Yet, methods for specifying the content of interventions as actually delivered in practice are currently lacking. This study sets out to develop such a method in the context of smoking cessation behavioural support interventions.

Behavioural support involves advising on and facilitating activities aimed at helping a quit attempt to succeed, by maximising motivation to quit, teaching self-regulation skills and helping prevent relapse (West & Stapleton, 2008). There is strong evidence for the effectiveness of behavioural support (Lancaster & Stead, 2009). Such interventions are increasingly delivered in practice settings, such as by the English national Stop Smoking Services, which offer

medications and free weekly behavioural support sessions to approximately 800,000 smokers annually. Considerable variation in quit outcomes across individual trials and services exist (Lancaster & Stead, 2009; NHS 2011). Heterogeneity in quit outcomes is likely to be attributable in part to variation in the content of behavioural support provided across individual trials or services. However, due to their complexity, there is limited understanding or clarity as to what the content of currently delivered behavioural support interventions is. Although guidance documents are available outlining the recommended content of behavioural support sessions in terms of specific BCTs (West, McNeil & Raw, 2000), the level of detail and terminology typically used to describe intervention content is often inconsistent (Michie, Fixsen, Eccles et al. 2009). Conversely, biomedical and pharmacological interventions are defined precisely; with the pharmacological composition, dose, frequency of administration and mechanism of action for medications clearly established. Such contrast is of particular relevance to health behaviours such as smoking cessation for which both biomedical (e.g. nicotine replacement therapies) and behavioural interventions (e.g. behavioural support) are available. Unclear descriptions of intervention content limits the ability to replicate and readily implement effective trials in practice, as well as hampering evidence synthesis and the establishment of the causal mechanisms underpinning behaviour change.

The recent development of a comprehensive and theory-linked taxonomy of smoking cessation BCTs has provided a reliable method for clearly specifying and reporting the content of behavioural support interventions (Michie, et al. 2010). The taxonomy comprises 43 BCTs, later extended to a nomenclature of 53 competences for delivering these BCTs (Michie, Churchill & West, 2011). Each BCT has specified criteria for its operationalisation and is defined using consistent terminology and clear labels that can be used to categorize and report intervention

components. Each BCT is classified hierarchically according to one of four behaviour change functions: 1) boosting motivation; 2) maximising self-regulatory capacity; 3) adjuvant activities; 4) general aspects of the role/interaction. The latter functions were derived from the PRIME theory of motivation and applied to smoking cessation (West, 2009).

The taxonomy has been used as a coding framework for specifying the content of the behavioural support interventions in published trial reports and English NHS Service treatment protocols in terms of component BCTs (Michie et al. 2010; Michie, Churchill, West, 2011; Lorencatto, West, Michie 2012), plus to investigate the association between BCTs in protocols and quit outcomes (West, Walia, Michie et al., 2010). Such efforts represent important first steps towards highlighting the active ingredients comprising behavioural support interventions delivered in both research trials and practice settings, and towards establishing the causal mechanisms underlying intervention outcomes.

Descriptions of intervention content in published trial reports and service protocols represent 'intended' or 'recommended' practice and may not reflect what was actually done in the intervention when it was administered (Borrelli, 2011). The fidelity with which complex interventions are actually delivered is rarely uniform (Bellg, Borrelli, Resnick, et al. 2004). Where the fidelity of delivery and therapist adherence to protocol of complex interventions has been assessed, it has often been found to be classifiable as low (~44-50%) (Borrelli, 2011; Hardeman, Michie, Fanshawe et al. 2009). The problem of fidelity to protocol is particularly relevant for behavioural support delivered in practice services such as in the national English Stop Smoking Services since they provide support on a wide scale in naturalistic and uncontrolled settings by healthcare professionals from a range of disciplines. These factors

enhance susceptibility to inconsistencies in delivery and the likelihood of key intervention components being modified or omitted (Mihalic, 2001).

Methods for describing the content of interventions as delivered in terms of their specific component BCTs have been developed for physical activity (Hardeman, Michie, Fanshawe et al. 2009); and excessive alcohol use (Tober, Clyne, Finnegan, et al. 2008). Both involve the gold-standard method for monitoring and objectively verifying delivery of interventions: audio-recording intervention sessions and coding session transcripts using a-priori defined criteria to ascertain which intervention components were actually delivered by practitioners (Borrelli, 2011). There is currently no such method for smoking cessation behavioural support.

The taxonomy of smoking cessation BCTs has demonstrated reliability for coding published and protocol descriptions of behavioural support. By reliability we refer to the consistency with which the same techniques may be identified by independent researchers in intervention descriptions using the taxonomy as a coding framework. Identifying techniques as delivered in practice is inherently different from identifying BCTs in protocols, where techniques are specified as single instructions (i.e. 'set a quit date with the client'). On the other hand, in practice techniques are embedded in conversation and clinical interactions, with interventions differing according to provider, context and client. The extent to which the taxonomy may be used to specify the content of behavioural support as delivered whilst maintaining reliability is unclear.

This study aimed to examine whether the BCT taxonomy (Michie et al. 2011) could be developed as a method for reliably identifying and categorising component techniques present in audio-recordings of behavioural support consultations delivered in practice by the English Stop

Smoking Services. A secondary aim of this study was to develop and evaluate the effectiveness of a manual for training novice coders in the application of the taxonomy.

METHODS

The study received ethical approval from the University College London departmental ethics committee (CEHP/2010A/015).

Stage 1: Applying and evaluating the taxonomy to specify BCTs delivered in behavioural support for smoking cessation

Sample and materials

The original published taxonomy and list of competences (Michie et al., 2011; Michie et al., 2010), 53 BCTs in total, was expanded into a coding framework for specifying BCTs in transcripts of audio-recorded behavioural support consultations. The taxonomy's original structure, behaviour change functions, BCT codes, labels and definitions were retained. Additional sections for data extraction and accompanying coding guidelines were included in the framework. These were informed by existing coding frameworks for physical activity and excessive alcohol use interventions (Hardeman et al. 2009; Tober et al. 2008).

Fifteen audio-recordings of behavioural support consultations were obtained. The sample size was similar to that used to establish the reliability of the original published taxonomy of BCTs (n=14 manuals) (Michie et al. 2010). Audio-recordings were obtained from three sources: the NHS Centre for Smoking Cessation and Training (NCSCT, 2011) (n=1), a community pharmacy NHS Stop Smoking Service (n=5), and a core NHS Stop Smoking Service (n=9). The core NHS service and pharmacy service transcripts were of one-to-one routine consultations occurring in regular practice, and were recorded by practitioners using discrete audio-recording devices. The audio-recordings represented a mixture of consultations with smokers at different stages of

quitting: pre-quit (n=7), quit-day (n=4) and post-quit (n=4). Informed consent was obtained from both practitioners and smokers prior to audio-recording the consultation. The NCSCT audio-recording was of simulated behavioural support consultations, scripted to illustrate the delivery of specific BCTs. It thus served as ideal material on which to pilot the initial version of the taxonomy coding framework.

Procedure and Analysis

Transcripts were coded in three distinct coding waves in the following order: the NCSCT transcript, the NHS pharmacy service transcripts, and the core NHS service transcripts. Transcripts were coded independently by three research psychologists with prior coding experience (coder initials: FL, NS, and EK). Using the taxonomy coding framework, coders identified and categorised BCTs embedded within the practitioner's speech, and assigned BCT labels from the taxonomy where appropriate. The number of transcripts each BCT featured in, and the frequency with which each BCT featured within and across transcripts was examined. Specific instances of BCT use were extracted as exemplary quotes.

After each coding wave inter-rater reliability was assessed between pairs of coders using percentage agreement. If coders identified the same BCT within a section of text, agreement was registered. Where two coders identified a BCT and the other not, or a different BCT was identified, disagreement was registered. If an instance arose in which no BCT label from the taxonomy suitably described the support being delivered, coders recorded and discussed the instance as potential identification of a new technique. Discrepancies were resolved through discussion or consultation with a behaviour change expert (SM). Percentage agreement was used rather than Cohen's Kappa as the latter corrects for potential chance agreement amongst multiple coders. Given our high number of available categories (i.e. 53 BCTs), the probability of chance

selecting a particular BCT code is low, and use of kappa may therefore produce a conservative estimate of reliability.

Following Wave 1 of piloting, issues emerging from the reliability analysis informed changes to the taxonomy to improve reliability or simplify coding. The adapted framework was then piloted in waves 2 and 3 and reliability re-assessed in a cyclical and iterative process until high reliability (at least 75% agreement; Cohen, 1968) was achieved.

Stage 2: Development and evaluation of a BCT coding training manual

Samples and materials

Existing manuals for coding the content of other health behaviour interventions (Hardeman et al. 2009; Tober et al. 2008) were used by experienced coders (FL, NS, and SM) to inform the development of a manual for training new coders to use the taxonomy to specify the content of behavioural support interventions. There were two sections: i) a background to smoking cessation, behavioural support, and taxonomies; and ii) an introduction to the coding framework, detailed coding instructions, guidelines, hints and tips, plus four practice exercises enabling trainees to familiarise themselves with individual BCTs and the taxonomy, and practice applying the taxonomy to code excerpts of behavioural support transcripts.

To evaluate the training, a 13-item questionnaire assessing trainees' self-perceived coding competence on a scale from 1 'not at all confident' to 5 'highly confident' was developed (Items in table 4). Before and after training, trainees completed a competence questionnaire and coded a transcript of a behavioural support consultation using the taxonomy as a coding framework, and a second transcript post-training. No feedback was given to trainees about their performance following the pre-training coding exercise. The transcripts used in the pre/post training exercises were purposively sampled so that they were matched for the number of BCTs that they included,

Administration of the transcripts for the coding exercises was counterbalanced. The BCT codes agreed upon by experienced coders in stage 1 were taken as a 'gold standard' and used as the answer-key for the coding exercise. BCTs identified by trainees were compared against BCTs in the gold standard answer key and inter-rater reliability assessed. Trainee demographics were also recorded.

Participants

Ten trainees, purposively sampled to include equal number of research psychologists (n=5) and non-psychologist practitioners (tobacco programme delivery managers and project coordinators) (n=5).

Procedure

i) *Delivery of training*

Trainees were sent the coding competence questionnaire and pre-training coding exercise to complete one week prior to attending a coding training workshop lasting approximately three hours where the trainers (FL, NS) presented the core content of the training manual. Trainees individually completed the four practice exercises, discussed answers with a partner and then as a group. Trainers addressed any emerging questions or issues.

ii) Evaluation of training

Upon completion of the workshop, trainees evaluated the course on a rating scale from 1 (Poor) to 5 (excellent), and provided written feedback about which parts of the course were most and least useful. Within one-week post-training, trainees were required to complete the post-training coding exercise and competence questionnaire. Mean course ratings were calculated. Within-subject differences in perceived competence ratings between pre and post training were evaluated using a paired-samples t-test. Each trainee's coding results on the pre/post training

coding exercises were compared to the relevant "gold standard" set of agreed codes and percentage agreement assessed. Discrepancies between percentage agreement levels pre and post training were examined for each trainee and average percentage improvement calculated.

RESULTS

Stage 1: Applying and evaluating the taxonomy to code behavioural support in practice

Coding Wave 1: NCSCT training-video transcript

Of the 53 BCTs originally included in the taxonomy, 42 (79.3%) were accurately and reliably identified and categorised at least once in the NCSCT transcript (Appendix 1). Inter-rater reliability across transcripts was high (93.4% agreement). All discrepancies were resolved through discussion. No new BCTs were identified or any major theoretical or structural problems with the taxonomy. Three minor adaptations were proposed: i) reduce the number of items in the framework by merging typically co-occurring and theoretically related BCTs, and ii) enhance clarity and facilitate distinctions between BCTs by refining existing BCT definitions and labels, or iii) creating definitions where previously absent. A full list of adaptations is available in Appendix 2, and summary examples of each in Appendix 3. The refined taxonomy comprised 40 BCTs (Table 1).

Coding Wave 2: Community pharmacy transcripts re-piloting of the revised taxonomy

Of the 40 BCTs in the revised taxonomy, 20 (50%) were identified at least once across session transcripts (Table 1). Sessions lasted an average of 5 minutes 31 seconds each (Range 2:50-7:53) and contained an average of 12 BCTs per session (Range: 8-17). The most frequently featured BCTs (n=5 sessions) were: 'boost motivation,' 'build rapport,' 'general communication approaches,' and 'information gathering and assessment.' Of those delivered at least once, the least frequently delivered BCTs (n=1) were: 'strengthen ex-smoker identity,' 'action planning,'

'goal setting,' facilitate restructuring of social life,' and 'emphasise choice.' Average inter-rater reliability was high (78.4%) and no additional BCTs or further potential adaptations to the taxonomy were proposed.

Coding Wave 3: Core NHS Service transcripts- re-piloting of the revised taxonomy.

Of the 40 BCTs in the revised taxonomy, 37 (92.5%) were identified at least once (Table 1). Core NHS behavioural support sessions lasted on average 11 minutes 49 seconds (range 5:17-17:43) and contained on average 20 BCTs per session (range 12-31) (Table 1). Eight BCTs were featured in all sessions (n=9), including 'provide feedback on performance,' 'provide reassurance,' and 'provide normative information on others' experiences.' Of those featured at least once, the least frequently delivered BCTs were 'prompt commitment from the client there and then (n=2),' 'prompt self-recording (n=1),' and 'advise on weight control (n=1).' Average inter-rater reliability across transcripts was high (95.7%) and no further proposed adaptations to the taxonomy or additional BCTs identified. An illustration of the application of the taxonomy to deconstruct and code an excerpt from a transcript of a core NHS service behavioural support session into component BCTs is provided in Figure 1.

Stage 2: Development and evaluation of a BCT coding training manual

Trainee characteristics

Trainees had an average age of 29.3 years (range: 23-38). None had prior experience of coding. Five were psychologists, familiar with qualitative methodology and had heard of the original taxonomy; the other five had minimal familiarity with qualitative methods and had not heard of the taxonomy.

Coding performance pre/post training

Complete follow-up data on coding performance was obtained for eight trainees (n=2 missing). Before training percentage agreement between trainees and the gold-standard was on average 32.2% (‘poor,’ Cohen, 1963), but improved significantly to 61.6%) (‘good’) post-training (Table 2). The average increase was 29.5%, $t(7) = -19.7$, $p<0.001$. There were no significant differences between the more experienced psychologist and less experienced trainees.

Self-perceived coding competence

Before training, average self-perceived coding competence was 2.39 (SD 0.26), equating to ‘low’ confidence. Post-training, average ratings for all 13 items increased, with a mean rating of 3.74 (SD 0.29) post-training (‘moderate’ – ‘good’ confidence). Improvements were statistically significant for all questionnaire items (Table 3)

Course evaluation

Seven trainees completed the course evaluation. The average course rating was 4.86 (SD 0.23), equivalent to ‘excellent.’ The elements of the course most frequently cited as beneficial to training were the practice exercises (n=6) and group discussions (n=4).

Discussion

This study examined the extent to which components of complex behaviour interventions delivered in practice can be reliably specified, taking smoking cessation behavioural support as an example. Inter-rater reliability for consistently identifying and categorising the same BCTs within transcripts of behavioural support consultations using the taxonomy as a coding framework was high (average percentage agreement 88%), a level similar to those achieved in previous studies applying the taxonomy to code the content of published trial reports and NHS service protocols (Michie et al. 2011; Michie et al. 2010). This finding contributes to the growing

body of evidence illustrating the reliability and versatility of taxonomy coding approaches for specifying the content of complex behaviour change interventions (Michie, Whittington, Hamoudi et al. 2012*;* Michie, Abraham, Whittington et al. 2009; West et al. 2010). Establishing a method for specifying the content of behavioural support interventions in practice represents an important first step towards counter-acting the typically inconsistent and poor specification of the content of complex behaviour change interventions (Craig, Dieppe, Macintyre et al., 2008). To our knowledge, this is the first published attempt to systematically specify the content of smoking cessation behavioural support as delivered in practice. This study also developed an effective training manual to train new, inexperienced coders from multi-disciplinary professional backgrounds to reliably specify intervention content using the taxonomy. To our knowledge, this manual is also the first of its kind to be formally evaluated and represents a feasible, easily administered approach to train future coders.

The ability to reliably apply the taxonomy to specify the content of delivered behavioural support is of potential relevance to service monitoring and evaluation. Since the taxonomy has now demonstrated equal levels of reliability for coding both treatment manuals (Michie et al. 2010, West et al. 2010) and transcripts of practice consultations, this method can be used to investigate discrepancies between recommended and actual practice, that is, assessing fidelity of delivery of behavioural support interventions in practice. This enables examination of how practice content varies across individual services. Furthermore, it supports investigation of implementation issues and may help explain why evidence-based interventions are not effective in certain settings and why outcomes may vary across services or providers. This in turn can help identify practitioner training needs to be targeted in future training programmes.

Applying taxonomies in research can also aid theoretical understanding: specifying the content of interventions in terms of specific BCTs enables identification of mechanisms of action by which effective outcomes are achieved. The original taxonomy has previously been applied to code the content of NHS service manuals into component BCTs and examine associations between identified BCTs and quit outcomes (West et al. 2010). A sub-set of sixteen BCTs significantly associated with self-reported and CO-validated quit outcomes were identified, such as 'strengthen ex-smoker identity' and 'facilitate relapse prevention and coping.' These results identify which specific BCTs appear to be effective and further our current understanding as to what comprises effective behavioural support. These results have also been combined with BCTs identified in effective behavioural support trials selected from relevant Cochrane Reviews (Lancaster & Stead, 2009; Stead & Lancaster, 2005) to provide the basis for the learning outcomes and curricula of a national stop smoking practitioner training programme available across England and Wales by the NCSCT (NCSCT, 2011). Having established the reliability of the taxonomy to code the content of support delivered in practice, such analyses need to be repeated using representative samples of audio-recorded behavioural support consultations to establish which BCTs are effective in practice. Furthermore, the presently developed methods will support the evaluation of the NCSCT training programme by enabling comparisons of, not just questionnaire ratings of competence, but measures of actual practice pre- and post-training.

The extent to which this method may be applied to specify the content of behavioural support delivered in practice contexts other than the English NHS services remains to be ascertained. In addition, given the continuously evolving nature of taxonomy-based research, the adapted taxonomy and training manual will require future revisions as the taxonomy is further adapted with the emergence of new evidence and BCTs, as well as applications to new practice settings.

A further limitation to this methodological approach is that audio-recordings were used rather than video-recordings. Audio-recordings are more practical and economical. While video-taped consultations provide additional non-verbal content, with the exception of few BCTs such as 'building rapport,' all BCTs within the taxonomy require a degree of verbalization in order to be delivered, and can therefore be coded on the basis of audio data. Also, one question is whether or not BCTs have been delivered; another is how well they have been delivered. Methods to assess and quantify quality of delivery have been established in medicine (Salgado, Moles, Benrimoj et al. 2011) and are emerging for health behaviour change interventions (Hardeman et al. 2011; Tober et al. 2008). The development of such quality assessment methods should be the focus of future research.

In conclusion, this study establishes the reliability and utility of a taxonomy coding method for specifying the content of smoking cessation behavioural support interventions delivered in practice. This method, including an effective BCT coding training manual, can be used in future research to address gaps in our current understanding of how behavioural support is delivered and how it can be improved. It provides a common language and reliable methodology for specifying the content of complex behaviour change interventions in different formats, from treatment manuals to transcripts of actual intervention practice sessions. Whilst developed in the context of smoking cessation, this approach can be applied to other behavioural domains. For example, taxonomies now exist for a range of other health behaviours such as physical activity, healthy eating, and alcohol use (Abraham & Michie 2008; Michie, Whittington, et al. 2012). The extent to which these may be successfully adapted to specify the content of behaviour change interventions delivered in practice for these additional health behaviours is yet to be determined.

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Table 1. Results from coding Waves 2 and 3, including total number of community and core NHS Service (SSS) transcripts each BCT was identified in, plus the total number of citations per BCT.

			CORE NHS SSS		COMMUNITY PHARMACY SSS	
BCT Label	**BCT Code**	**BCT Description**	**Total No. of transcripts featured in Max n=9**	**Total. No. Citations across sessions**	**Total No. of transcripts featured in Max n=5**	**Total. No. Citations across sessions**
'BM' Specific focus on behaviour (B) and addressing motivation (M)'						
BM1	Provide information on the health consequences of smoking and smoking cessation	Give, or make more salient, information about the physical/health harms caused by smoking and the benefits of stopping; distinguish between the harms from smoking and nicotine; debunk myths about low tar and own-roll cigarettes.	4	6	3	9
BM2	Boost motivation and self-efficacy	Give encouragement and bolster confidence in ability to stop. Can include telling the person that they can successfully stop smoking, arguing against self-doubts and asserting that they can and will succeed.	9	84	5	2
BM3	Provide feedback on current behaviour and progress	Give feedback arising from assessment of current self-reported or objectively monitored behaviour (e.g. expired-are CO) and/or progress towards becoming a permanent non-smoker.	9	68	3	13
BM4	Provide rewards contingent on not smoking	Give praise or rewards if the person has not smoked.	5	9	0	0
BM5	Provide normative information about others' behaviour and experiences	Involves providing information about how the smoker's experience compares with that of other smokers who are trying to quit, as to indicate that a particular behaviour or sequence of behaviours are common, or uncommon, amongst other smokers trying to quit.	9	34	3	7
BM6	Prompt commitment from the client there and then	Encourage the smoker to affirm or reaffirm a strong commitment to start, continue or restart the quit attempt.	2	5	0	0
BM7	Provide rewards contingent on effort or progress	Give praise or other rewards for the effort the smoker is making in relation to smoking cessation and if the smoker has engaged in activities that aid cessation, such as correct medication use.	6	10	0	0
BM8	Strengthen ex-smoker identity	Explain the importance of regarding smoking that is 'not an option,' including the 'not a puff' rule, and construct a new identity as someone who 'used to smoke'	5	14	1	1
BM9	Facilitate identification of reasons for wanting and not wanting to stop smoking	Help the smoker to arrive at a clear understanding of his or her feelings about stopping smoking, why it is important to stop and any conflicting motivations.	7	15	3	2
BM10	Explain the importance of abrupt cessation	Explain why it is better to stop abruptly rather than cut down gradually if at all possible.	3	3	0	0
BM11	Measure CO and explain the purposes of CO monitoring	Measure expired- air carbon monoxide concentration and explain to the smoker the reasons for measuring CO at different time points (e.g. before and after the quit date)	7	47	2	4
BM12	Conduct motivational interviewing	Adopt a formal motivational interviewing protocol	0	0	0	0
'BS' Specific focus on behaviour (B) and maximising self-regulatory capacity/skills (S)						

BS1	Facilitate barrier identification and problem solving	Help the smoker identify general barriers that might make it harder to stay off cigarettes (e.g. susceptibility to cigarettes). Help the smoker develop general ways of addressing and overcoming these, and increasing facilitators (e.g. by generating alternative courses of action and pros and cons of each and weighing them up)	5	19	0	0
BS2	Facilitate relapse prevention and coping	Help the smoker understand how lapses occur and how they lead to relapse. Plan how to maintain behaviour that has changed, by helping identify in advance situations in which the changed behaviour may not be maintained, and develop specific strategies for preventing lapses or avoiding lapses turning into relapse.	5	21	0	0
BS3	Facilitate action planning/ develop a treatment plan	Work with the smoker to encourage generation of a clear, detailed quit plan including preparations for the quit attempt (e.g. obtaining medication).	6	19	1	2
BS4	Facilitate goal setting	Help the smoker set a quit date and goals that support the aim of remaining abstinent	6	42	1	4
BS5	Prompt review of set goals	Review how far the smoker has achieved the main goal of abstinence and any other goals that are supportive of it (e.g. putting in place plans to avoid triggers). In most cases this will follow previous goal setting and an attempt to act on those goals, followed by a version of revision or readjustment of goals and/or means to attain them.	4	7	2	1
BS6	Prompt self-recording	Help the smoker establish a routine of recording potentially useful information (e.g. situations or times when urges are strong and less strong)	1	1	0	0
BS7	Advise on changing routine	Advise on ways of changing daily or weekly routines to minimize exposure to smoking cues	4	12	0	0
BS8	Advise on environmental restructuring	Advise on ways of changing the physical environment to minimize exposure to physical smoking cues (e.g. removing ashtrays from the house)	3	20	0	0
BS9	Set graded tasks	Set small achievable goals where appropriate (e.g. take one day at a time)	0	0	0	0
BS10	Advise on conserving mental resources	Advises on ways of minimizing stress and other demands on mental resources (activities that require mental effort)	4	5	0	0
BS11	Advise on avoiding social cues for smoking	Give specific advice on how to avoid being exposed to social cues for smoking (e.g. explaining to friends that you have stopped and asking them not to smoke around you)	7	22	0	0
BS12	Facilitate restructuring of social life	Advise on ways of changing social interactions so that they support rather than interfere with smoking cessation	4	15	1	1
BS13	Advise on methods of weight control	Advise on methods of weight control, including diet and/or exercise	1	1	0	0
BS14	Teach relaxation techniques	Teach specific relaxation techniques and how and when to apply them	0	0	0	0

Promoting adjuvant activities 'A' – including general aspects of the interaction focusing on delivery of the intervention

A1	Advise on stop smoking medication	Includes one or more of the following: - explaining the benefits of medication, safety, potential side-effects, contra-indications, how to use them most effectively, - advising on the most appropriate medication for the smoker - promoting effective use - explaining how to obtain medications, enacting the necessary procedures to ensure the smoker gets their medication easily and without charge where appropriate	9	179	3	60
A2	Advise on/facilitate use of social support	Advise on or facilitate development of social support from friends, relatives, colleagues or	2	6	0	0

		buddies.				
A3	Ask about experiences of stop smoking medication that the smoker is currently using	Asses usage, side effects and benefits experienced of medication that the smoker is currently using.	7	38	0	0
A4	Give options for additional and later support	Give information about options for additional support where these are available (e.g. websites, self-help groups, telephone helpline)	5	12	3	2
'RC' General aspects of the interaction (R) focusing on general communication (C)						
RC1	Build general rapport	Establish a positive, friendly and professional relationship with the smoker and foster a sense that the smoker's experiences are understood	9	46	5	10
RC2	General practitioner communication approaches	Communication that Includes one or more of the following: eliciting and answering questions, using reflective listening, summarizing information, and confirming client decisions	9	311	5	78
RC3	Emphasise choice	Emphasise client choice within bounds of evidence based practice	4	12	1	0
RC4	Provide reassurance	Give general reassurance to the smoker that his/her experiences are normal and time limited, and provide positive expectations of success based on experience with other smokers in the same situation	9	94	5	20
RC5	Tailor interactions appropriately	Use relevant information from the client to tailor the behavioural support provided	4	6	0	0
RC6	Offer/direct towards appropriate written materials	Distinguish what are, and are not, appropriate written materials and offer/direct clients to these in ways that promote their effective use	4	7	0	1
RC7	Information gathering and assessment	Any information gathering that provides the practitioner with the knowledge needed from the client for appropriate behaviour change techniques to be delivered. Includes one or more of the following: - Assessing current and past smoking behaviour - Assessing current readiness and ability to quit - Assessing past history of quit attempts - Assessing withdrawal symptoms - Assessing nicotine dependence - Assessing number of contacts who smoke - Assessing attitudes to smoking - Assessing level of social support - Assessing physiological and mental functioning	9	47	5	15
RC8	Explain how tobacco dependence develops	Give an explanation of the development of tobacco dependence and the effect of nicotine	4	12	2	8
RC9	Explain expectations regarding the treatment programme	Explain to the smoker the treatment programme, what it involves, the active ingredients, and what it requires of the smoker	7	24	3	6
RC10	Provide information on withdrawal symptoms	Describe to smokers what are and are not nicotine withdrawal symptoms, how common they are, how long they typically last, what causes them and what can be done to alleviate them.	4	20	0	0

Table 2. Trainee coding inter-rater reliability pre- and post- training

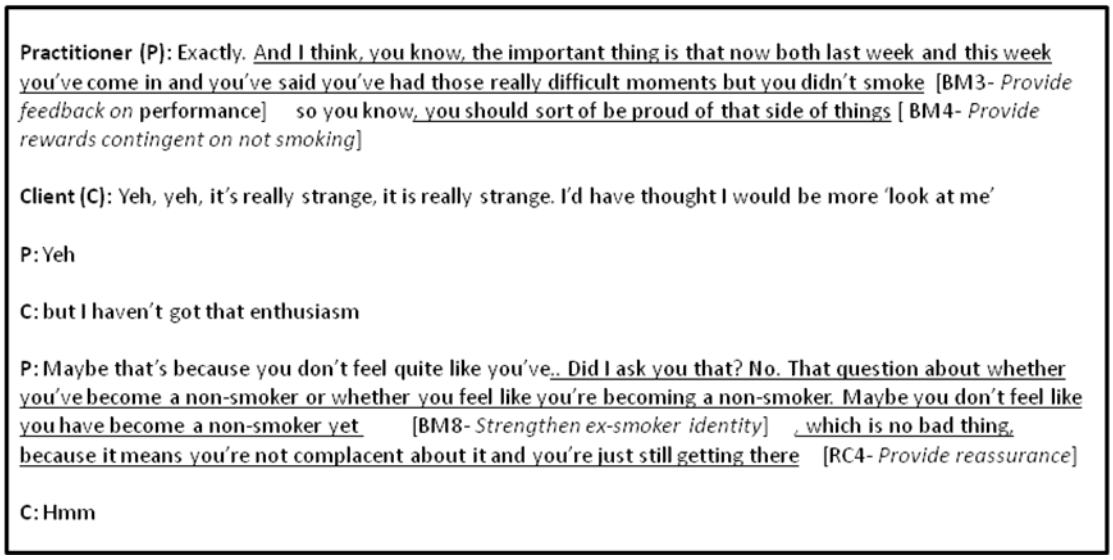
Trainee ID (P= Psychologist; NP= Non-psychologist)	**% agreement pre-training**	**% agreement post-training**
1(P)	46.1%	70.1%
2 (P)	31.1%	58.6%
3 (P)	32.6%	62.8%
4 (P)	32.9%	63.4%
5(NP)	32.2%	58.1%
6 (NP)	23.8%	60%
7 (NP)	25.6%	57.4%
8 (NP)	32.11%	62.2

Table 3. Average trainee ratings of self-perceived coding competence (from 1= 'not at all confident' to 5 ='highly confident') pre-and post training

Questionnaire item	Mean Rating pre-training	Mean Rating post-training	Significance of difference
1. Identifying the components of a behaviour change intervention in smoking cessation	2.70	3.90	t(8)=-4.40 p<0.001
2. Clearly describing the components of a behaviour change intervention in smoking cessation	2.40	3.70	t(8)=-5.66 p<0.001
3. Categorising the components of a behaviour change intervention in smoking cessation	2.00	3.50	t(8)=-8.22 p<0.001
4. Using qualitative data analysis methods	2.30	3.20	t(8)=-3.41 p<0.005
5. Identifying the behaviour change techniques (BCTs) delivered during a behavioural support intervention for smoking cessation	2.40	4.10	t(8)=-5.77 p<0.001
6. Using a taxonomy of smoking cessation BCTs to label BCTs identified in a	2.30	4.10	t(8)=-4.88 p<0.001

behavioural support session			
7. Applying a coding framework based on a taxonomy of smoking cessation BCTs to identify and categorise BCTs	2.40	3.90	t(8)=-5.29 p<0.001
8. Conducting a content analysis of transcripts of audio-recorded behavioural support sessions	2.10	3.60	t(8)=-4.13 p<0.005
9. Describing what a BCT for smoking cessation is	3.00	4.00	t(8)=-4.40 p<0.05
10. Explaining the aims and components of behavioural support interventions for smoking cessation	2.50	3.70	t(8)=-3.77 p<0.005
11. Assessing how often different BCTs are used during a behavioural support session	2.30	3.80	t(8)=-4.91 p<0.001
12. Pointing out when a stop smoking practitioner delivers a BCT	2.50	3.90	t(8)=-5.66 p<0.001
13. Deconstructing a health behaviour change intervention into its functional components (i.e. active ingredients)	2.20	3.20	T(8)=-4.63, p<0.05

Figure 1. Example of the taxonomy of smoking cessation BCTs applied to code an excerpt from a transcript of a behavioural support session being delivered in a core NHS service. Identified BCT labels are presented in italics and brackets next to the relevant segment of text.



Practitioner (P): Exactly. And I think, you know, the important thing is that now both last week and this week you've come in and you've said you've had those really difficult moments but you didn't smoke [BM3- *Provide feedback on* performance] so you know, you should sort of be proud of that side of things [BM4- *Provide rewards contingent on not smoking*]

Client (C): Yeh, yeh, it's really strange, it is really strange. I'd have thought I would be more 'look at me'

P: Yeh

C: but I haven't got that enthusiasm

P: Maybe that's because you don't feel quite like you've.. Did I ask you that? No. That question about whether you've become a non-smoker or whether you feel like you're becoming a non-smoker. Maybe you don't feel like you have become a non-smoker yet [BM8- *Strengthen ex-smoker identity*] , which is no bad thing, because it means you're not complacent about it and you're just still getting there [RC4- *Provide reassurance*]

C: Hmm

APPENDICES

APPENDIX 1: BCTs and total number of citations identified in the NCSCT transcripts

BCT Code	BCT label	BCT definition	Total No. Citations
BM1	Provide information on consequences of smoking and smoking cessation	Give, or make more salient, information about the harm caused by smoking and the benefits of stopping or staying quit; distinguish between the harms from smoking and nicotine; debunk myths about low tar and own-roll cigarettes and cutting down	3
BM2	Boost motivation and self efficacy	Give encouragement and bolster confidence in ability to stop	10
BM3	Provide feedback on current behaviour and progress	Give feedback arising from assessment of current self-reported or objectively monitored behaviour (e.g. expired-air CO) and/or progress towards becoming a permanent non-smoker	8
BM4	Provide rewards contingent on successfully stopping smoking	Give praise or other rewards if the person has not smoked	4
BM5	Provide normative information about others' behaviour and experiences	Give information about how the smoker's experience compares with other people's	17
BM6	Prompt commitment from the client there and then	Encourage the smoker to affirm or reaffirm a strong commitment to start, continue or restart the quit attempt	4
BM7	Provide rewards contingent on effort or progress	Give praise or other rewards for the effort the smoker is making and if the smoker has engaged in activities such as correct use of medication that aid cessation	7
BM8	Strengthen ex-smoker identity	Explain the importance of regarding smoking as something that is 'not an option', including the 'not a puff' (NAP) rule, encourage the smoker to re-evaluate the attraction to smoking, and construct a new identity as someone who 'used to smoke'	11
BM9	Conduct motivational interviewing	Adopt a formal motivational interviewing protocol	5
BM10	Identify reasons for wanting and not wanting to stop smoking	Help the smoker to arrive at a clear understanding of his or her feelings about stopping smoking, why it is important to stop and any conflicting motivations	4
BM11	Explain the importance of abrupt cessation	Explain why it is better to stop abruptly rather than cut down gradually if at all possible	1
BM12	Measure carbon monoxide (CO)	Measure expired air CO to assess extent of smoke exposure prior to quitting and to confirm successful abstinence; use the measurement as a motivational tool	0

Specific focus on behavior (B) maximising self-regulatory capacity/skills (S)			
BS1	Facilitate barrier identification and problem solving	Help the smoker to identify general barriers (e.g. susceptibility to stress) that might make it harder to stay off cigarettes and develop general ways of addressing these	6
BS2	Facilitate relapse prevention and coping	Help the smoker understand how lapses occur and how they lead to relapse and to develop specific strategies for preventing lapses or avoiding lapses turning into relapse	3
BS3	Facilitate action planning/develop treatment plan	Work with smoker to generate a clear quit plan including preparations for the quit attempt (e.g. obtaining medication)	2
BS4	Facilitate goal setting	Help the smoker to set a quit date and goals that support the aim of remaining abstinent	8
BS5	Prompt review of goals	Review how far the smoker has achieved the main goal of abstinence and any other goals that are supportive of it (e.g. putting in place plans to avoid triggers)	6
BS6	Prompt self-recording	Help the smoker to establish a routine of recording potentially useful information (e.g. situations or times when urges are strong and less strong)	0
BS7	Advise on changing routine	Advise on ways of changing daily or weekly routines to minimise exposure to smoking cues	0
BS8	Advise on environmental restructuring	Advise on ways of changing the physical environment to minimise exposure to smoking cues (e.g. removing ashtrays from the house) or to provide cues to sustain quitting	3
BS9	Set graded tasks	Set small achievable goals where appropriate (e.g. take one day at a time)	0
BS10	Advise on conserving mental resources	Advise on ways of minimising stress and other demands on mental resources (activities that require mental effort)	3
BS11	Advise on avoidance of cues for smoking	Give specific advice on how to avoid being exposed to social or other cues for smoking (e.g. staying away from places where people smoke)	1
BS12	Facilitate restructuring of social life	Advise on ways of changing social interactions with family, friends and colleagues so that they support, rather than interfere with, the goal of remaining abstinent	2
BS13	Advise on methods of weight control	Advise on ways of minimising weight gain that do not increase motivation to smoke (e.g. take exercise, carry around 'healthy snacks')	0
BS14	Teach relaxation techniques	Teach specific relaxation techniques and how and when to apply them	0
Promote adjuvant activities (A)			
A1	Advise on stop-smoking medication	Explain the benefits of medication, safety, potential side effects, contra-indications, how to use them most effectively, and how to get them; advise on the most appropriate medication for the smoker and promote effective use	24
A2	Advise on/facilitate use of social support	Advise on or facilitate development of social support from friends, relatives, colleagues or 'buddies'	7

A3	Adopt appropriate local procedures to enable clients to obtain free medication	Enact the necessary procedures of a stop smoking service to ensure that the smoker gets his/her medication easily and without charge where appropriate	0
A4	Ask about experiences of stop smoking medication that the smoker is using	Assess usage, side effects and benefits experienced of medication(s) that the smoker is currently using	4
A5	Give options for additional and later support	Give information about options for additional support outside the programme where these are available (e.g. websites, self-help groups, telephone helpline)	0
General aspects of the interaction (R) focusing on delivery of the intervention (D)			
RD1	Tailor interactions appropriately	Use relevant information from the client to tailor the behavioural support provided	1
RD2	Emphasise choice	Emphasise client choice within the bounds of evidence based practice	0
General aspects of the interaction (R) focusing on information gathering (I)			
RI1	Assess current and past smoking behaviour	Assess amount smoked, age when started, pattern of smoking behaviour	6
RI2	Assess current readiness and ability to quit	Assess current level of motivation to stop and confidence in success	1
RI3	Assess past history of quit attempts	Assess number and duration of past quit attempts and experiences related to these, including factors that led back to smoking	2
RI4	Assess withdrawal symptoms	Assess the presence and severity of nicotine withdrawal signs and symptoms	1
RI5	Assess nicotine dependence	Assess the degree of nicotine dependence	2
RI6	Assess number of contacts who smoke	Assess how many friends, relatives and work colleagues smoke	1
RI7	Assess attitudes to smoking	Assess positive and negative beliefs and feelings about smoking	0
RI8	Assess level of social support	Assess the extent to which friends, relatives and work colleagues will be supportive of the quit attempt and more generally	2
RI9	Explain how tobacco dependence develops	Explain the process by which smokers become addicted to cigarettes and the role that nicotine plays in this	4
RI10	Assess physiological and mental functioning	Assess physiological functioning such as lung function and mental states such as anxiety and depression levels	0

General aspects of the interaction (R) focusing on general communication (C)			
RC1	Build general rapport	Establish a positive, friendly and professional relationship with the smoker and foster a sense that the smoker's experiences are understood	4
RC2	Elicit and answer questions	Prompt questions from the smoker and answer clearly and accurately	6
RC3	Explain the purpose of CO monitoring	Explain to the smoker the reasons for measuring CO at different time points, e.g. before and after the quit date	3
RC4	Explain expectations regarding treatment programme	Explain to the smoker the treatment programme, what it involves, the active ingredients and what it requires of the smoker	8
RC5	Offer/direct towards appropriate written materials	Distinguish what are, and are not, appropriate written materials and offer/direct clients to these in ways that promote their effective use	0
RC6	Provide information on withdrawal symptoms	Describe to smokers what are, and are not, nicotine withdrawal symptoms, how common they are, how long they typically last, what causes them and what can be done to alleviate them	9
RC7	Use reflective listening	Adopt a style of interaction that involves listening carefully to the smoker and where appropriate reflecting back to the smoker key elements of what s/he is saying	8
RC8	Elicit client views	Prompt the client to give views on smoking, smoking cessation and any aspects of the behavioural support programme	3
RC9	Summarise information / confirm client decisions	Provide a summary of information exchanged and establish a clear confirmation of decisions made and commitments entered into	3
RC10	Provide reassurance	Give general reassurance to the smoker that his/her experiences are normal and time limited, and provide positive expectations of success based on experience with other smokers in the same situation	7

Appendix 2: Full list of adaptations to the original published taxonomy of smoking cessation BCTs (Michie et al. 2010)

BCT Code	BCT Label	Original BCT description	Adaptation
BM1	Provide information on the consequences of smoking and smoking cessation	Give, or make more salient, information about the harm caused by smoking and the benefits of stopping; distinguish between the harms from smoking and nicotine; debunk myths about low tar and own-roll cigarettes and **~~cutting down~~**	*Existing BCT description refined for clarification purposes; 'cutting down' removed as conflicted with BM10- explain importance of abrupt cessation.*
BM2	Boost motivation and self-efficacy	Give encouragement and bolster confidence in ability to stop. **Can include** telling the person that they can successfully stop smoking, arguing against self-doubts and asserting that they can and will succeed.	*Existing BCT description refined for clarification purposes.*
BM4	Provide rewards contingent on ~~successfully stopping smoking~~ **not smoking**	Give praise or rewards if the person has not smoked.	*Existing BCT label was refined to greater reflect the corresponding BCT description. The BCT description implies that this BCT is not necessarily about a successful quit attempt but rather about 'not smoking.' 'Successfully stopping smoking' was omitted to clarify.*
BM5	Provide normative information about others' behaviour and experiences	~~Give information about how the smoker's experience compares with other people's.~~ **Involves providing information about how the smoker's experience compares with that of other smokers who are trying to quit, as to indicate that a particular behaviour or sequence of behaviours are common, or uncommon, amongst other smokers trying to quit.**	*Existing BCT description expanded to include a clearer, more detailed definition adopted from other existing taxonomies of BCTs (Michie and Abraham, 2008) for clarification and understanding purposes.*
BM8	Strengthen ex-smoker identity	Explain the importance of regarding smoking that is 'not an option,' including the 'not a puff' rule, **~~encourage the smoker to re-evaluate the attraction to smoking,~~** and construct a new identity as someone who 'used to smoke.'	*Existing BCT description refined. Text was removed to minimize confusion with BCT BM9- help identify reasons for wanting and not wanting to stop smoking.*
BM9	**~~Help~~ Facilitate** identification of reasons for	Help the smoker to arrive at a clear understanding of his or her feelings about stopping smoking, why it is important to	*BCT label refined.*

	wanting and not wanting to stop smoking	stop and any conflicting motivations.	
BM11 RC3 [previously]	Measure CO **and explain the purposes of CO monitoring**	Measure expired- air carbon monoxide concentration **and explain to the smoker the reasons for measuring CO at different time points (e.g. before and after the quit date)**	*Originally separate BCTs BM11 (measure CO) and RC3 (explain purpose of CO monitoring)* *were merged together as they typically co-occur together in practice.*
BM12	Conduct motivational interviewing	**Adopt a formal motivational interviewing protocol**	*Description created.*
BS1	Facilitate barrier identification and problem solving	Help the smoker identify general barriers that might make it harder to stay off cigarettes (e.g. susceptibility to cigarettes). Help the smoker develop general ways of **addressing and overcoming these, and increasing facilitators (e.g. by generating alternative courses of action and pros and cons of each and weighing them up)**	*Existing BCT description expanded to better differentiate between BCTs BS1, BS2 and BS3. Definitions expanded using BCT descriptions from other taxonomies of BCTs.*
BS2	Facilitate relapse prevention and coping	Help the smoker understand how lapses occur and how they lead to relapse. **Plan how to maintain behaviour that has changed, by helping identify in advance situations in which the changed behaviour may not be maintained,** and develop specific strategies for preventing lapses or avoiding lapses turning into relapse.	*Existing BCT description expanded to better differentiate between BCTs BS1, BS2 and BS3. Definitions expanded using BCT descriptions from other taxonomies of BCTs.*
BS5	Prompt review of set goals	Review how far the smoker has achieved the main goal of abstinence and any other goals that are supportive of it (e.g. putting in place plans to avoid triggers). **In most cases this will follow previous goal setting and an attempt to act on those goals, followed by a version of revision or readjustment of goals and/or means to attain them.**	*Existing BCT description expanded using BCT descriptions from other taxonomies for clarification and understanding purposes.*
BS8	Advise on environmental	Advise on ways of changing the **physical** environment to minimize exposure to physical smoking cues (e.g. removing	*Existing BCT description refined. 'Physical' added to the description to help further differentiate this BCT*

	restructuring	ashtrays from the house)	*from BS11- advise on avoidance of social cues for smoking*
BS12	Facilitate restructuring of social life	Advise on ways of changing social interactions so that they support rather than interfere with smoking cessation	*Description created.*
BS13	Advise on methods of weight control	Advise on methods of weight control, including diet and/or exercise	*Description created.*
BS14	Teach relaxation techniques	Teach specific relaxation techniques and how and when to apply them	*Description created.*
A1 A3 [previously]	Advise on stop smoking medication	**Includes one or more of the following:** **- explaining the benefits of medication, safety, potential side-effects, contra-indications, how to use them most effectively,** **- advising on the most appropriate medication for the smoker** **- promoting effective use** **- explaining how to obtain medications, enacting the necessary procedures to ensure the smoker gets their medication easily and without charge where appropriate**	*Originally separate BCTs A1 (advising on stop smoking medication) and A3 (adopt appropriate local procedures to enable clients to obtain free medication) were merged, as they typically co-occur.*
RC2 Merge of previous BCTs: RC2, RC7, RC9, RC8	**General practitioner communication approaches**	**Communication that Includes one or more of the following: eliciting and answering questions, using reflective listening, summarizing information, and confirming client decisions**	*New BCT label was created by merging several BCTs such as eliciting and answering questions, using reflective listening, summarizing information, and elicit client views which are just general communication techniques. These occurred throughout the entire NCSCT scripts as part of normal conversation and interaction, and coding each instance of each communication technique would be*

			repetitive and not very informative.
RC3	Emphasise choice	Emphasise client choice within bounds of evidence based practice	***BCT moved from sub-function RD to function RC.***
RC5	Tailor interactions appropriately	Use relevant information from the client to tailor the behavioural support provided	***BCT moved from sub-function RD to function RC.***
RC7 Merge of previous BCTs: RI1, RI1, RI3, RI4, RI5, RI6, RI7, RI8, RI10	**Information gathering and assessment**	**Any information gathering that provides the practitioner with the knowledge needed from the client for appropriate behaviour change techniques to be delivered. Includes one or more of the following:** - **Assessing current and past smoking behaviour** - **Assessing current readiness and ability to quit** - **Assessing past history of quit attempts** - **Assessing withdrawal symptoms** - **Assessing nicotine dependence** - **Assessing number of contacts who smoke** - **Assessing attitudes to smoking** - **Assessing level of social support** - **Assessing physiological and mental functioning**	*BCTs merged/ New BCT label created. All previous assessment related BCTs originally under the information gathering behaviour change sub-function (RI) were merged to form one large information gathering for simplification purposes.*
RC8	Explain how tobacco dependence develops	**Give an explanation of the development of tobacco dependence and the effect of nicotine**	*Description created.* ***Moved from BCT sub-function RI to function RC.***

Appendix 3: Types of adaptations to the original taxonomy of smoking cessation BCTs

Type of Adaptation	**No. of BCTs applied to**	**Example**
Merging theoretically similar and/or co-occurring BCTs	17	Merged BM11 (Measure CO) and RC3 (Explain purposes of CO monitoring)
Expand/refine existing BCT definitions	11	BS5 Prompt review of set goals: 'Review how far the smoker has achieved the main goal of abstinence and any other goals supportive of it. [Expanded to include] *In most cases this will follow previous goal setting and an attempt to act on those goals, followed by a version of revision or readjustment of goals and/or means to attain them*.
Create new BCT definitions where previously unavailable	8	BS12 Facilitate restructuring social life: 'advise on ways of changing social interactions so they support rather than interfere with smoking cessation.