

The compendium of self-enactable techniques to change and self-manage motivation and behaviour (v1.0)

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ABSTRACT

Behaviour change techniques describe the content of behaviour change interventions, but do not adequately account for the actions that people must themselves undertake to successfully change or self-manage motivation or behaviour. This paper describes the development of a compendium of self-enactable techniques, which combines behaviour- and motivation-regulation techniques across six existing classifications of behaviour change techniques and three scoping reviews. The compendium includes 123 techniques, each of which is labelled, defined and presented with instructive examples to facilitate self-enactment. Qualitative feedback was gathered from intervention developers and the general public to improve techniques' utility, congruence, and ease of self-enactability. This integrative index of self-enactable techniques can help intervention developers select appropriate self-directed techniques to help people self-manage their motivation and behaviour. Future research with this compendium can expand on the number of behaviours covered by the instructive examples and link techniques with their potential impacts on factors that influence behaviours.

While behaviour change interventions undoubtedly take place within complex systems involving many parts, there is evidence that individual-level interventions can change health-related (and other) behaviours¹ and outcomes², and these interventions are increasingly being used to reduce costs in healthcare systems across Western societies³. To be effective, many behaviour change interventions require that people undertake specific actions to bring about behaviour change (e.g., weighing pros and cons of changing, setting goals). This entails that individuals need to be equipped with the necessary skills, abilities, tools and techniques to effectively change their own behaviour, a process collectively referred to as self-management or self-regulation. As such, the keys to improving health and well-being, as well as other issues which arise from the behaviour of individuals⁴, lie in the capabilities that people have at their disposal to successfully self-manage their own motivation and behaviour.

Behaviour change interventions often draw from behavioural theories, and target changes in important factors related to the behaviour (i.e. determinants, or influences on behaviour) to change the behaviour itself⁵. Historically, the descriptions of such interventions have lacked specificity, as broad treatment labels such as “cognitive therapy” or “lifestyle counselling” do not immediately reveal an intervention’s component parts⁶. For example, two interventions with the same overarching label might contain different techniques, while, at the same time, two interventions with identical component techniques might receive different overarching treatment labels. This lack of granularity in intervention descriptions has led to a ‘black box’ problem in intervention research⁷, and has limited the scientific understanding of which ‘active ingredients’ effectively change behaviour within interventions.

Behaviour change techniques are the active components of behaviour change interventions^{8,9}, which have been enumerated in several recently-developed taxonomies of behaviour change techniques. These include the 93-item behaviour change techniques taxonomy v1 (BCTTv1)¹⁰; the 99-item intervention mapping (IM) taxonomy¹¹, which arranges behaviour change techniques (or ‘behaviour change methods,’ in IM terminology) by the theoretical determinants that each is presumed to target as a precursor to behaviour change; the 38-item motivational interviewing (MI) taxonomy¹², which specifies the content-based and relational techniques present within MI counselling approaches¹³; the 112-item Oxford food and activity behaviours (OxFAB) taxonomy¹⁴; taxonomies derived from self-determination theory (25 items)¹⁵ and self-regulation theory (15 items)¹⁶; and the TIPPME intervention typology¹⁷, which describes micro-environmental techniques to change behaviour. Taken together, these taxonomies offer researchers and practitioners an elaborated classification of the many methods available to change behaviours and some common language with which they can describe the content of behaviour change interventions. This has led to improved consistency in the description of behaviour change interventions, allowing for greater replicability of interventions, and offers those aiming to synthesise evidence across intervention studies means to adequately compare and classify intervention content.

Across taxonomies, however, several shortcomings remain, including a lack of focus on individual people and technique enactment, limited scope, and insufficient examples of use. This study presents the development of the compendium of self-enactable techniques, which seeks to address these shortcomings.

The most important outstanding issue within existing taxonomies is what the recipients of behaviour change interventions (i.e. people in the target population whose behaviour needs to change) can do on their own to facilitate behaviour change and maintenance. While some existing taxonomies indicate that techniques may be self-delivered¹⁰, the definitions and examples they provide focus largely on the actions that intervention providers (e.g., nurses, community workers, designers of public health campaigns) would take when delivering a technique to someone (e.g., prompting behavioural goal setting, demonstrating the target behaviour, or providing information). This leaves some doubt about which techniques people can “self-deploy”¹⁸ to change behaviour and how that should occur¹⁹. For example,

within the BCTTv1, technique 11.2 (reduce negative emotions) states that intervention providers should “advise on ways of reducing negative emotions” to facilitate behavioural performance, but it does not elucidate the actions that recipients of that technique would need to take in order to bring about change. In other words, how should people go about reducing their own negative emotions? Furthermore, some techniques from existing taxonomies do not lend themselves to self-enactment at all. This includes techniques from the IM taxonomy¹¹ and TIPPMIE intervention typology¹⁷, which apply only to actors at other environmental levels (e.g., public policy or organisational change methods), and relational techniques from MI¹³, which are only applicable to those delivering MI in one-on-one practitioner-client sessions. While one existing taxonomy (the Oxford Food and Activity Behaviours taxonomy – OxFAB)¹⁴ has focused on self-enacted behaviour change and self-management, its techniques were drawn exclusively from weight management protocols, and have unknown applicability to other behavioural domains. The present study aims to compile a new domain-general list of techniques which focuses specifically on self-enactable techniques, which will offer intervention developers and the general public a clearer overview of the available options for successful self-management of behaviours related to health, environmental protection, and other outcomes.

By focusing primarily on behaviour change techniques that are delivered within interventions, existing taxonomies also do not specifically address the issue of technique enactment, which is imperative when investigating the behaviour change of people within complex systems^{20,21}. For an intervention to have its effects, providers must successfully deliver intervention techniques; individuals must successfully receive (i.e., comprehend and understand) the techniques; and they must then also successfully enact the techniques in their daily lives²². A growing body of evidence suggests that sustained behaviour change following interventions depends on the extent to which people self-enact or utilise behaviour change techniques themselves^{23–25}, but existing taxonomies do not indicate what successful self-enactment should look like, or which techniques require enactment beyond delivery. Furthermore, complex systems approaches to behaviour change suggest that the delivery-receipt-enactment chain can break down when person-level and contextual factors are not properly aligned to support enactment²⁶. As this compendium considers people as active agents who continuously adapt their behaviour in response to changes in their environments²⁷ (including interventions), it will promote flexible yet coherent intervention designs which allow individuals to self-tailor to person-level and contextual factors to facilitate self-enactment, thereby bridging the gap between intervention receipt and the adoption and maintenance of new behaviours.

Second, existing technique classifications do not capture all possible techniques that might be used to change or regulate behaviour or its influences or determinants (e.g., motivation), so drawing techniques from a wider range of behavioural domains could reveal additional techniques. For example, within work and occupational psychology, ‘job crafting’ interventions, which allow people to alter their working patterns or conditions to better meet their own needs, have been shown to increase well-being, job satisfaction and productivity^{28,29}. Within sport psychology a number of studies have linked cognitive self-management techniques, such as self-talk, imagery, and attentional focus, with improved behavioural performance^{30,31}. Attentional focus techniques have also been linked to improved learning and behavioural performance within educational psychology³², as have self-guided learning paradigms³³. This work will therefore explore the self-management and behaviour change intervention methods from various applied domains, which could unearth new techniques to supplement existing taxonomies and make them more complete.

Finally, while existing taxonomies offer some examples of how techniques might be applied in practice, these are generally limited in scope and described using technical terminology. This makes the meaning and operationalisation of individual techniques less accessible and comprehensible to

practitioners and members of the general public who may lack expertise in behavioural science. The current work aims to increase the likelihood of successful self-enactment, by writing self-enactable techniques in plain, accessible language and by including adequate instructions and examples to facilitate ease of use by practitioners and the general public.

The present study aimed to develop an integrative compendium of self-enactable techniques to change or self-manage motivation and behaviour, with a focus on techniques which require conscious participation and initiation on the part of an individual. Specifically, this research will (a) identify, assess, and integrate techniques across existing taxonomies and various domains of psychological research (sport, education and work); (b) identify how people can take active roles in enacting the identified techniques to change or manage their motivation and behaviour; and (c) compile a comprehensive list of self-enactable techniques that intervention developers can incorporate into interventions aimed at changing or self-managing motivation and behaviour. To achieve this, our group undertook an iterative development process that involved searching and content-analysing existing research on behaviour change interventions and extant taxonomies; discussions within the research team and an advisory group comprising behaviour change experts; feedback from experienced intervention developers; and qualitative interviews with members of the public. This process involved: identifying relevant techniques; outlining how the techniques could be self-enacted; developing appropriate definitions, descriptions, and self-enactable formats; producing instructive examples; and identifying information about dependencies between techniques. Table 1 outlines the steps taken during this research, and further details are available in the methods section.

Results

Developing the compendium of self-enactable techniques involved three distinct phases: Initial development work (Phase 1); external reviews (Phase 2); and the refinement of the compendium into its final form (Phase 3). The Methods section provides further detail on the processes undertaken during the three phases (and seven individual steps) shown in Table 1.

Phase 1: Initial development

In step one, the 230 techniques from the three primary source taxonomies¹⁰⁻¹² were consolidated in a spreadsheet, leading to a provisional listing (v0.1) containing 125 techniques. This provisional listing was then supplemented with the 13 additional techniques shown in Table 2, which were derived from three scoping reviews (in the areas of work, sport and education psychology (Step 2; supplementary files 4, 5 and 6; available from the authors at <https://osf.io/pqfjz/>), and three additional classifications of behaviour change techniques¹⁴⁻¹⁶ (Step 3). Steps two and three resulted in an expanded provisional listing of 138 techniques (v0.2). Finally, in step four, the text of each technique in v0.2 was re-written into a self-enactable form and supplemented with a plain-language instructive example of how to self-enact it. This resulted in a first draft of the compendium (v0.3; supplementary file 7, available from the authors at <https://osf.io/pqfjz/>) which contained 123 techniques. Figure 1 shows the flow of techniques from original sources through to the final compendium, and specifies reasons for removal of techniques.

Table 1. Outline of the steps taken in developing the compendium of self-enactable techniques.

Phase	Step	Methods	Outputs
1. Initial development	1. Integrating three existing global taxonomies of behaviour change techniques/methods	Group discussions within research team; consultations with authors of previous technique classifications	A provisional list of technique definitions (v0.1; n = 125)
	2. Identifying techniques from applied psychology literature	Three scoping reviews of self-management in the sport, education and work psychology domains	Additional self-enactable techniques for potential inclusion.
	3. Adding in content from scoping reviews and other previous (domain-specific) classifications of behaviour change techniques	Group discussions within research team; consultations with authors of previous technique classifications	An expanded provisional list of technique definitions (v0.2; n = 138)
	4. Creating instructive examples to improve ease of self-enactability	Group discussions within research team; consultations with authors of previous technique classifications and other behaviour change experts	A draft list of technique definitions and examples (v0.3; n = 123)
2. External reviews	5. Assessing acceptability of a subset of techniques	Qualitative interviews with members of the public (n = 19)	Possible improvements of the definitions and examples in v0.3
	6. Assessing utility, congruence and ease of self-enactability of technique definitions and examples	Online survey of external experts in intervention development (n = 17)	Possible improvements of the definitions and examples in v0.3
3. Refinement and finalising	7. Improving technique definitions, examples, and overall usability	Group discussions within research team to reach consensus on final wording of technique definitions and examples	The final compendium (v1.0; n = 123), which includes introductory text and a glossary

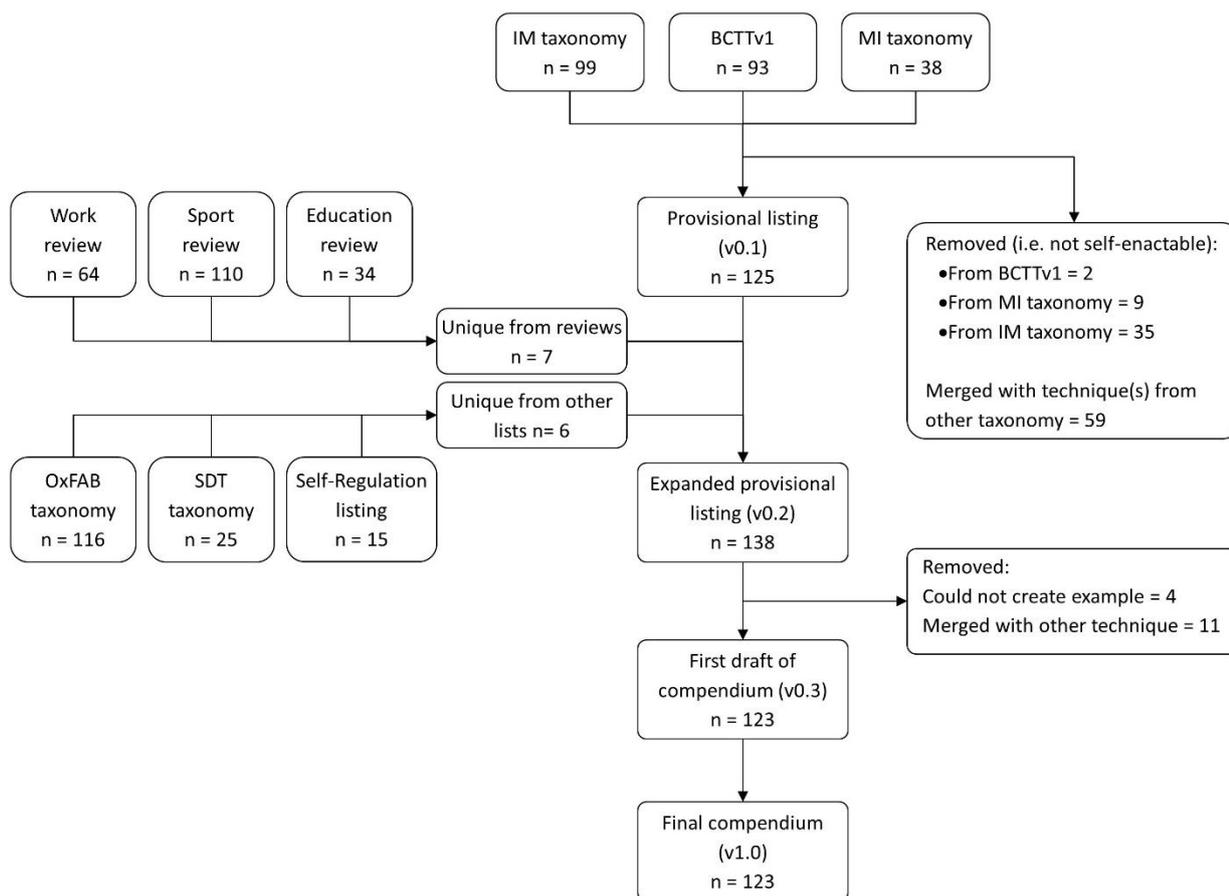


Figure 1. Outline of the compendium development process. Potential techniques came from various sources. This figure illustrates the flow of techniques into the final compendium (v1.0).

Phase 2: External reviews by end users and experts

In step five, we conducted qualitative interviews with members of the general public (n=19) to examine the acceptability of a subset of the techniques from version 0.3. These interviews revealed several issues with the definitions and examples of some techniques, which limited their potential acceptability as part of self-enacted behaviour change interventions. The interviews identified the presence of technical language which interviewees had difficulty understanding. Some interviewees expressed doubts about the personal relevance of some techniques (e.g., “I could see how this might be good for someone else, but not me”). Some interviewees found it difficult to identify ways to implement the techniques beyond what was explicitly mentioned in the technique definitions or examples. The full results of these interviews are presented in supplementary file 11 (available from the authors at <https://osf.io/pqfjz/>).

In step six, external experts in intervention development (n = 17) used an online system to rate the labels, definitions, and examples of included techniques on three dimensions: utility, congruence, and ease of self-enactability. Experts also provided comments about how each technique, and the draft compendium as a whole, could be improved. Rates of agreement across experts ranged from 70.5% for utility, to 64.9% for congruence, to 53.7% for ease of self-enactability. We did not calculate Fleiss’ kappa for multiple raters, as the review exercise aimed to identify possible problems with the techniques as written and did not aim to achieve a consensus or final agreed-on rating for each technique³⁴. The full results of the review exercise are presented in supplementary file 9, and a breakdown of quantitative responses is presented in Figure 2.

In total, results of the expert review indicated that the utility of 28 techniques, the congruence of 34 techniques, and the ease of self-enactability of 62 techniques required improvements to the definitions and examples. Fifty-five techniques did not require improvement in any of these three dimensions, 28 needed improvement in one dimension, 24 needed improvement in two dimensions, and 16 needed improvement in all three dimensions. The results of Phase 2 indicated several clear ways to improve the definitions and examples in Phase 3.

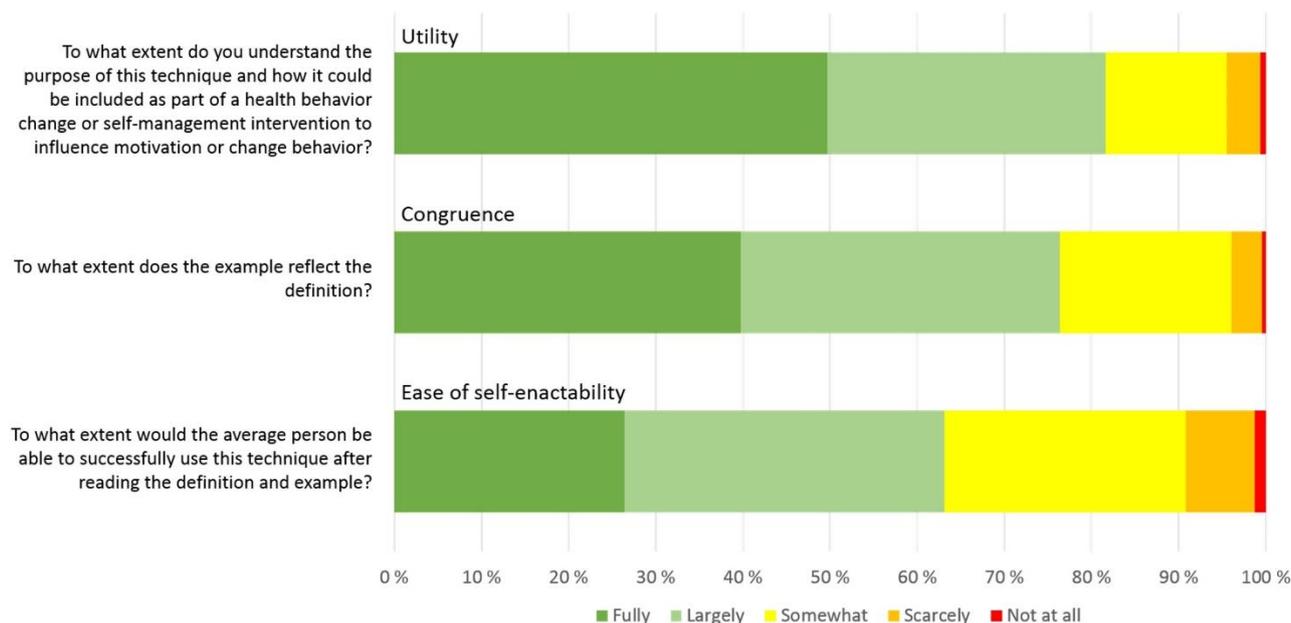


Figure 2. Results of the expert review exercise. Percentages of expert responses (n = 492) to questions about utility, congruence and ease of self-enactability for the labels, definitions and examples in the draft compendium (v0.3). Problematic definitions and examples were then revised, resulting in the final compendium (v1.0).

Phase 3: Refinements and finalising

The results of Phase 2 informed the final Phase of development, wherein we used qualitative feedback from intervention development experts and the general public to adapt the compendium into its final revised form. This involved rewriting definitions and instructive examples of problematic techniques to improve utility, congruence and ease of self-enactability. In addition, based on suggestions from the expert review, each technique was supplemented with information about possible unintended adverse effects, and information to distinguish between techniques that would likely require instruction on delivery, and those that are more readily and independently self-enactable based on the provided definitions and instructive examples alone. As a final step, the examples were edited to improve the Flesch Reading Ease score³⁵ from 57.1 (fairly difficult) to 62.8 (standard) and the Flesch-Kincaid grade level³⁶ from 9.4 to 8.2. This resulted in the tabular form of the final compendium (v1.0) presented in supplementary file 3. A streamlined list version of the v1.0 compendium was then produced for ease of presentation and printing (see supplementary file 1). Based on suggestions in the qualitative data, a primer and glossary were added (supplementary file 2) to summarise the purposes of the compendium for the general public, to offer guidance on how to use it, and to define key terms from the technique definitions and examples.

Discussion

Taxonomies of behaviour change techniques provide a common set of terms for describing the unique components of behaviour change interventions, and improve the uniformity of descriptions to facilitate replicability and evidence synthesis. This integrative compendium of self-enactable techniques builds on existing taxonomies in three key ways: by reconceptualising techniques as actions that people can themselves undertake to change or self-manage motivation or behaviour; by combining techniques across existing taxonomies and from applied psychological research in the areas of work, sport, and education; and by including instructive examples, information about adverse effects and dependencies between techniques, and a guide to facilitate self-directed use of the techniques. These advances offer researchers and intervention developers a comprehensive resource for accounting for the participant perspective when building behaviour change interventions, and have the potential to facilitate self-enactment of these techniques among the general public. This compendium is a first step in this direction (v1.0), and our group plans to further develop, expand and update it as additional evidence comes to light. All updates will be made available via the project's OSF page (<https://osf.io/pqfjz/>).

As this work focuses on the actions that people can themselves take to bring about change, it draws attention to the importance of fidelity of receipt and enactment within behaviour change interventions²². Many existing interventions are not delivered or enacted as intended, which can reduce the effectiveness of these interventions. By conceptualising techniques not only in terms of what is delivered, but also in terms of the actions that intervention recipients must themselves take to bring about change, this work has the potential to help intervention developers to carefully consider and plan ways to increase fidelity of receipt and enactment. It also facilitates a way of thinking about interventions that aligns with complex systems approaches, allowing individuals to self-organise their behaviour change and self-management efforts.

Behaviour change researchers may also find this compendium useful for examining whether and how self-enactable techniques are discussed during consultations between intervention providers and recipients. For example, audio recordings could be analysed to identify which techniques the provider suggested the recipient self-deliver after the session and how this was done, as well as which techniques the recipient specifically mentioned self-enacting and how they went about it³⁷. Using the compendium for this purpose could help to identify differences in technique delivery and enactment across participants, which could be examined as possible moderators of intervention effectiveness. The compendium could also be used to code the self-enactable techniques present within self-help intervention materials. However, due to the known under-reporting problems in published intervention descriptions³⁸, piloting work is needed before we could recommend using this compendium to retrospectively code published articles for the presence of these self-enactable techniques.

The detailed instructive examples which accompany the techniques in this compendium aim to facilitate self-enactment. Each instructive example offers a rationale for using the technique, and lists the actions an individual should take to enact the technique to self-manage or change behaviour or motivation. While not a guarantee of successful self-enactment, these brief and informative instructive examples capture the essence of each technique, and have been reviewed and refined based on the inputs of intervention developers and members of the general public alike. This means that they meet a minimal threshold of prospective acceptability³⁹, and could be used as off the shelf options in face-to-face or technology-assisted self-management or behaviour change interventions. However, this work does not yet provide evidence for the concurrent acceptability or efficacy of any techniques, and future testing is needed to examine how well people can self-enact these techniques based on these definitions and examples alone. With further refinements based on the results of such testing, the techniques could open

new possibilities for self-delivered interventions. This is an important contribution, as effective self-delivered or technology-assisted interventions have great potential to reduce the costs associated with primary prevention and medical management of chronic disease⁴⁰, and in improving other outcomes.

In addition to their usefulness for researchers and intervention developers, the instructive examples offer members of the public direct access to self-enactable techniques that they could use to self-manage or change their own behaviour. This includes techniques that are best used before (e.g., obtaining information, mental rehearsal), during (e.g., action control, distraction), or after (e.g., reviewing behavioural goals, self-reward) engaging in a target behaviour. It also includes techniques that would be expected to change behaviour or motivation via reflective and deliberative processes (e.g., goal setting, graded tasks), and those that target automatic or impulsive response (e.g., habit formation, training executive function). As this work focused solely on the actions that people can themselves take to bring about change, we excluded behaviour change techniques that target microenvironments and operate (largely) outside of an individual's awareness (e.g., choice architecture or nudging), as well as techniques which could not be reasonably self-initiated (e.g., policy-level interventions). We did, however, include techniques which might (potentially) require external inputs (e.g., from other people, the internet or healthcare professionals), but which people could nevertheless self-deploy (e.g., obtain social support); and techniques by which an individual might automatise their behavioural patterns (e.g. habit formation). The final listing distinguishes between techniques that might require external inputs and those which do not, and provides additional information about prerequisite techniques, to avoid self-enactment of techniques for which the necessary preconditions have not been met. However, the compendium does not yet indicate each technique's parameters for effectiveness, nor does it indicate in which phase of behaviour change (e.g., motivation, action, maintenance) a technique might be best applied. Our group plans to expand the information accompanying each technique to include these features in the future, and any additions will be accessible via the Open Science Framework (<https://osf.io/pqfjz/>).

Based on our expert review and interviews with potential end users, we also added an introductory text to the compendium, which outlines how it can be used and defines several key terms from the behaviour change literature. While this accessibility and user-friendliness goes beyond that offered by existing taxonomies, which provide no such guidance to members of the public looking to change their health behaviours on their own, it stops short of being a fully self-guided intervention platform. Rather, in its present form, the listing offers the general public a list of ideas about how to go about changing or managing their own lifestyle behaviours or motivation, from which they could choose their own path forward.

As the compendium at this point lacks the capability to fully guide people through the process of behaviour change, several areas of concern for misuse and unintended consequences of techniques require highlighting. During the expert review phase, several techniques were flagged as potentially having adverse effects when used incorrectly⁴¹, or when applied to a different behaviour than the ones included in the instructive examples. As an example, when the technique 'satiation' (#69) is targeted toward physical activity (i.e., sitting for an extended period until physical activity feels like a nice change from sitting), no immediate adverse events would be expected. However, when applied to reducing unhealthy snack intake, the technique could lead to unhealthy binge eating behaviours and potentially contribute to the development of eating disorders⁴². Although most potentially adverse effects from technique misuse were mild (e.g., frustration at not achieving a goal, placing a burden on friends), we found it important to proactively identify and clearly indicate these to potential end users of this compendium, and have added such designations where applicable. While we see this as currently sufficient, future development of this compendium into a standalone system for self-delivered behaviour change interventions would necessitate

a more complete identification of worst-case scenarios and implementation of more rigorous safeguards to protect people who might unknowingly misapply these self-enactable techniques.

In developing this compendium, our research team followed a systematic and stepwise process that was informed by past experiences with taxonomy development^{12,15,43}. This included extensive in-depth discussions and consensus-reaching procedures, scoping reviews, input from a panel of expert intervention developers, and input from authors of published taxonomies and other topic-area experts. The development process also included the novel aspect of qualitative interviews with the public to assess and improve the acceptability of a subset of techniques.

Despite these strengths, several limitations of this work related to both the final product and the development process bear mentioning. First, the instructive examples currently relate to only one or two health-related behaviours (e.g. physical activity, healthy eating, smoking cessation) per technique. During the expert review phase, several experts called for an extension of the examples to cover a wider range of health and environmental protection behaviours. This is important, as some techniques may be better suited to changing some behaviours than they are to others. For example, the technique “Remove access to rewards for unwanted behaviour” could be better suited to changing “stop” than “start” behaviours, and the technique “Exposure” might not be suitable for changing behaviours with addictive elements. Given the wide range of behaviours that interventions might target, it was not feasible to extend the compendium beyond its current form within the current project. To expand this work in the future, our group has set up a crowdsourcing platform⁴⁴, through which researchers and others can contribute their own examples of how each technique could be used to target health behaviours not currently covered. While facilitating this crowdsourcing approach presents quality control and logistical challenges, which themselves require resources to overcome, expanding on this work via a collaborative effort of the scientific community is an exciting possibility. We welcome submissions for new examples via the online form at <http://bit.do/SubmitAnExample>.

Second, while most of these techniques have been included as part of previous behaviour change interventions, this has rarely done in a specifically self-enactable form. There is therefore little evidence about the efficacy of these techniques when self-enacted. Instead of making claims about technique efficacy, this compendium of self-enactable techniques supports the development of self-enactable intervention components, the efficacy of which would need to be tested separately. Relatedly, this listing also does not include comprehensive information about how each technique relates to motivational constructs and other influences on behaviour. Other research groups are currently working to establish an evidence-base for the linkages between behaviour change techniques and various influences on behaviour (i.e. an ontology of behaviour change)^{45–47}, which may be tied into this work in the future. For the time being however, we refer interested readers to the Theory and Techniques Tool⁴⁸, which summarises the known evidential links between techniques from the BCTTv1¹⁰ and theoretical mechanisms of action.

Finally, interviews with members of the public about the perceived acceptability and utility of techniques only covered 20 of the techniques included here. While these interviews led to several improvements in these 20 techniques, we were unable to conduct interviews for all included techniques. Furthermore, these qualitative interviews were conducted with a well-educated convenience sample. Conducting similar qualitative work with a purposive sample of people with low education or socioeconomic status could reveal larger comprehension issues or problems with the techniques not identified within the process reported here. Work is underway to expand upon the qualitative findings presented here, and any resultant improvements to technique definitions or instructive examples will be integrated into the compendium in due course (<https://osf.io/pqfjz/>). We would therefore like to echo previous calls for further research into uptake and enactment of behaviour change techniques^{24,49}.

In taking this work further, one could envision an online system to offer members of the public guided, individualised access to these techniques. By utilising principles of computer tailoring^{50,51} and ongoing ontological work to improve the evidential links between behaviour change techniques and changes in theoretical influences on behaviour^{45,46}, such a system could account for individuals' current states and offer choices of the best techniques they could self-enact to change or manage their behaviour in real time. Paucity of research on some behaviour change techniques, especially when used in a self-enactable way, means that fully realising this type of evidence-based system would require substantial advances in the breadth and depth of the evidence base. However, such a system could also work to expand the evidence base on its own.

This compendium could also be used to develop measures of self-enactment processes for assessing fidelity within interventions. Measuring enactment of intervention techniques requires short technique definitions that can be readily utilised as questionnaire items. Hartmann-Boyce and colleagues have previously created a questionnaire based on their OxFAB taxonomy work¹⁴, and a similar process could be undertaken utilising the self-enactable techniques presented here. Developing adequate measures is key to improving scientific understanding of what individuals themselves do to change and manage their motivation and behaviour.

In conclusion, this integrative compendium of self-enactable techniques to change and self-manage motivation and behaviour builds upon existing taxonomies of behaviour change techniques, and clarifies the actions needed for successful self-enactment. It also extends previous taxonomies by pulling together their component techniques into a single listing, and by including clear instructions for how to use each technique in practice. In its present form, researchers can use this list to develop behaviour change interventions that optimally account for enactment by intervention recipients. This also offers members of the public access to definitions and instructive examples of self-enactable techniques that they could themselves use to change or manage their behaviour, although further research is needed to ensure that these are comprehensible and useful to people with lower education backgrounds. With further refinements and contributions from theory and evidence, these intervention delivery and self-enactment perspectives could be brought together into a generalised, self-guided behaviour change system which meets the needs of most people.

Methods

The University of Helsinki Ethical Review Board in the Humanities and Social and Behavioural Sciences provided a favourable assessment for this work. All portions of this work which involved human participants complied with all relevant ethical regulations. In the early stages of the project, NH and MS defined the purpose and scope of the compendium, and considered alternative ways for carrying out the project.

Step 1: Integrating existing primary taxonomies

In creating this compendium, the intervention mapping taxonomy¹¹, the BCTTv1¹⁰, and the motivational interviewing taxonomy¹² were chosen as primary sources, as they each identify and describe behaviour change techniques that are applicable across multiple behavioural domains. Efforts were then made to map these taxonomies onto one another (i.e., to combine them while accounting for overlaps). First, the 93 techniques from the BCTTv1 were placed in a spreadsheet. The BCTTv1 was used as the starting point, as it is extensively used within behaviour change intervention research. Then, each subsequent technique from the other two taxonomies was examined individually in relation to the techniques present in the BCTTv1. If a subsequent technique was judged to overlap (or partially overlap)

with a technique present in the spreadsheet, then these techniques were mapped on to one another by placing the label of this new technique in the cell adjacent to the one containing the existing technique. If no match or overlap with the existing list was perceived, then a new row containing this new technique was added to the spreadsheet. In case of any uncertainty regarding the overlap of techniques from new sources, notes were made for later discussion with other members of the research team. The result of this mapping exercise and any uncertainties encountered were fully reviewed and discussed in detail until consensus on the mapping was reached within the study group (MB, NH, MH, KK, MS). Where consensus was not reached during discussions within this group, the study advisory group (MSH, WH, MMM), the authors of source taxonomies and additional topic experts were consulted via email, skype or in person for clarity on how they would differentiate between techniques from different taxonomies. These opinions informed further discussions within the study group to reach consensus.

After this initial mapping exercise, all techniques from the combined post-mapping list were evaluated for potential conversion into a self-enactable technique by a study group member (MH or KK). Techniques which were adjudged to have limited possibility of self-enactability were maintained and discussed with the rest of the research team. After these discussions, techniques were only removed due to lack of self-enactability when all members of the study group agreed the technique was not self-enactable.

In the next step, MB, NH, MH, KK and MS (with inputs from MMM and WH) worked collaboratively to rewrite each technique definition in a self-enactable way, using three pre-specified criteria: First, each technique had to contain at least one verb (e.g., seek out, obtain, arrange, reflect on) that refers to the action an individual would need to take to self-enact the technique. Second, each rewritten technique had to refer to either the performance of, and/or motivation for, a specific target behaviour. This could include engaging in a wanted behaviour and/or refraining from engaging in an unwanted behaviour. Definitions were worded to accommodate both possibilities where applicable. Finally, all techniques were written under the assumption that an individual has already identified a specific target behaviour that they are considering changing or already desire to change. One technique (#1 - Agenda mapping) was an exception to this rule however, as it involved choosing a behavioural domain. In writing the definitions, wordings present in the BCTTv1 were used as a guide, and these were supplemented or altered where necessary to accommodate self-enactment and to include operationalisations of techniques from other sources.

Step 2: Scoping reviews to identify additional techniques

Three scoping reviews were undertaken by MB and MS to identify potential additional techniques from the domains of sport, education, and work psychology. These scoping reviews included examining topic-related reviews, interventions, theories and questionnaire items from each of these three domains. The full methods and findings of the scoping reviews in the work, sport, and education domains are reported in supplementary files 4, 5 and 6 respectively (available from the authors at <https://osf.io/pqfjz/>).

Step 3: Integrating techniques from scoping reviews and additional taxonomies

One member of the study team (KK) examined all techniques identified in the scoping reviews, and made notes on their possible overlaps with those already present in the merged taxonomy. These notes were then reviewed by additional members of the study team (NH, MH, MMM), and non-overlapping techniques were added to the existing list. Similarly, each technique from three additional classifications¹⁴⁻¹⁶ was reviewed by at least one researcher (MB, NH, MH, KK, MMM). Techniques identified as potentially unique were then discussed by NH, MH, KK, and MMM until consensus was reached on uniqueness or overlap with existing techniques in the listing. Authors of secondary sources were contacted for additional information where consensus could not immediately be reached within the study group. Techniques added

to the listing during Step 3 were reworded into a self-enactable form following the same procedures as in Step 1, after consensus had been reached on their inclusion (See Table 2).

Step 4: Creating instructive examples

Each technique from the expanded provisional listing (v0.2) was then supplemented by an instructive example which could allow the average person to self-enact the technique to change or self-manage a behaviour. While the techniques could, strictly speaking, be used to self-manage any behaviour, we elected to focus the contents of initial examples on health-related behaviours. To create the examples, five techniques from v0.2 were selected at random, and members of the study group (FE, NH, MH, KK, MMM) worked independently to create instructive examples for each of these same five techniques. The group then met to collaboratively discuss the positive and negative aspects of each of these independently-created instructive examples, and co-wrote instructive examples that best represented the five techniques in question. The characteristics of the resulting instructive examples, as well as the positives and negatives of the independently-created instructive examples were then worked into guidelines for the creation of subsequent instructive examples. The guidelines stated that each instructive example should: (1) be consistent with the technique's definition; (2) be written in an instructive way that would enable a lay person reading it to implement the technique on their own; and (3) refer to a specific health-related behaviour (e.g., physical activity, diet, smoking). Additionally, examples were required to follow a uniform structure: An introduction sentence; 2-3 specific examples written in complete sentences, with one sentence per example the standard; and an optional additional sentence with information on the best ways of doing the technique and/or its relation to other techniques. Furthermore, the created examples should not contain instructions that could constitute another technique, include any unnecessary verbs that are not put into action in the example (e.g., "Think about doing..." should simply be "do..."), or contain unnecessary linking words that might have unintended meanings (e.g., alternatively, conversely).

In the next step, a draft example was created for each technique by a randomly selected member of the study group (FE, MH, KK, or MMM) according to the guidelines above. All created examples were then checked by a second researcher (FE, NH, MH, KK, or MMM) to ensure adherence to the guidelines. In instances where the created example did not fulfil the guidelines, the second researcher made edits to ensure that it did. Any edits to the examples were then checked by the researcher who had created the initial example, and if he or she agreed with the new wording, this was accepted as is. If there was disagreement with the new version, then the example was discussed and revised within the group (FE, NH, MH, KK, MMM) until consensus was reached. These consensus-based examples coupled with the self-enactable definitions created in Step 3 made up the draft version of the compendium (v0.3) in supplementary file 7.

Step 5: Qualitative interviews to assess acceptability of techniques

To examine the prospective acceptability of a subset of 20 techniques among members of the general public, qualitative interviews were conducted with adults recruited via convenience sampling and social media, who were living in Finland and could read and converse in English (n=19, 73% female, mean age=27 years). This sample size was chosen so that each technique would be reviewed by 12 different participants, and that interview times could be kept to around 60 minutes, allowing five minutes for each of 12 techniques.

Table 2. Final forms of techniques added during Phase 1, Step 3 of the development process.

#	Label	Definition	Source
29	Task crafting (enjoyment)	Restructure the target behaviour to make performing it more enjoyable	OxFAB taxonomy; Work scoping review
30	Task crafting (skills and ability)	Introduce new approaches to the target behaviour that are congruent with current skills and ability	Work scoping review
31	Add challenge	Add challenges to the target behaviour.	Work scoping review
32	Goal integration	Modify (or choose ways of doing) the behaviour such that it allows for simultaneously engaging in other valued behaviours and/or pursuing valued outcomes	Work scoping review; Group discussion
52	Support others	Provide support to others in relation to the target behaviour	OxFAB taxonomy; Work scoping review
57	Remind of outcome goal content	Remind yourself of your outcome goal(s).	Work scoping review; Group discussion
58	Action control (keep goals in mind)	Make efforts to consciously keep the target behaviour and your goals in mind	Self-regulation listing; Sport scoping review
59	Action control (maximise effort)	Maximise effort toward undertaking the target behaviour	Self-regulation listing; Sport scoping review; Education scoping review
103	Critically assess beliefs	Evaluate and challenge the accuracy of your own beliefs	Work scoping review
109	Focus on enjoyment (pleasant aspects) of behaviour	Focus thinking on pleasant rather than unpleasant aspects of the target behaviour.	Work scoping review
120	Identify sources of pressure for behaviour	Identify sources of pressure (external or internal) and expectations to perform the target behaviour	SDT taxonomy
121	Identify ways of dealing with pressure	Take steps to manage or limit the effects of pressure (external or internal) to perform the target behaviour	SDT taxonomy
123	Prayer	Appeal to a higher power for changes in motivation or behaviour	Education scoping review

The 20 assessed techniques were selected based on the results of a rating exercise, in which nine experts in self-determination theory rated the likelihood of each technique to impact upon autonomous and controlled forms of motivation⁵². The 20 techniques rated as having the greatest likelihood to increase autonomous forms of motivation and decrease controlled forms of motivation were selected for the interviews.

Within the interviews, each participant sequentially reviewed a random selection of 12 techniques, including its label, definition and instructive example from v0.3. Following a pilot-tested interview protocol, and after obtaining informed consent, one researcher (FE) asked participants whether the technique definitions and instructive examples were understood as intended, whether participants utilised the techniques themselves, and how they might be able to implement the techniques in their own lives (e.g. to increase physical activity levels). Information on how to improve each technique was also gathered. Interview sessions lasted approximately 75 minutes per participant, and participants were rewarded with a movie ticket. Acceptability was assessed using the Theoretical Framework of Acceptability³⁹. For further description of the methods and study participants see supplementary file 11 (available from the authors at <https://osf.io/pqfjz/>).

Step 6: Review of techniques and instructive examples by experienced intervention developers

After compiling the preliminary draft version of the compendium (v0.3), we undertook an expert review to examine: (a) the extent to which each technique was clearly understood from an intervention development standpoint (utility); (b) the extent to which each technique's instructive example was congruent with its definition (congruence); and (c) the extent to which members of the general public would be able to successfully enact each technique based on reading the definition and example (ease of self-enactability). In addition, the expert review aimed to gather experts' qualitative assessments of how each of these aspects could be improved.

Based on discussions within our study group, a list of 37 external experts in the development of health behaviour change interventions and/or in the use of existing taxonomies of behaviour change techniques for coding intervention descriptions was identified. These 37 experts were approached via email to participate. Seventeen experts agreed to participate, and this allowed us to obtain four expert reviews for each of 123 techniques, with each expert reviewing a maximum of 30 techniques due to time considerations.

Experts were sent a link to an online form which allowed them to review of a random selection of between 28 and 40 self-enactable techniques. Each technique's definition and instructive example was presented on its own page, along with the following three items measuring the (a) utility, (b) congruence, and (c) ease of self-enactability of each technique: (a) "Based on your reading of the definition and example, to what extent do you understand the purpose of this technique and how it could be included as part of a health behaviour change or self-management intervention to influence motivation or change behaviour?", (b) "To what extent does the example reflect the definition?"; and (c) "To what extent would the average layperson be able to successfully use this technique after reading the definition and example?". Experts responded to each item on a 5-point Likert scale with options of 'fully,' 'largely,' 'somewhat,' 'scarcely,' and 'not at all'. If an expert gave a rating of 'somewhat,' 'scarcely,' or 'not at all,' the system prompted him or her to complete follow-up free response items to elicit their opinions on ways in which the utility, congruence, or ease of self-enactability might be improved. Space was also provided for the experts to provide opinions about each technique and the listing as a whole. For verbatim methods of this step, see supplementary file 8 (available from the authors at <https://osf.io/pqfjz/>).

Step 7: Finalising the compendium

Study team members (NH, MH, KK, MMM) convened to review all techniques for which the expert review had revealed potential problems with utility, congruence, or ease of self-enactability. All techniques which at least one expert had rated as 'scarcely' or 'not at all,' or which two or more experts had rated as 'somewhat,' in any domain were reviewed. The team reviewed the qualitative responses given during the expert review for each problematic domain of a technique, came to a decision about whether a change to the definition or example was required, and collaboratively brainstormed ways in which utility, congruence, or ease of self-enactability of the technique definition and example could be improved in line with the reviewers' comments. This included re-wording techniques' labels, definitions or examples to improve clarity or precision, defining key terms that are necessary in explaining a definition or example, or adding additional information about the intended or appropriate uses of a technique. In some cases, no action could be taken on the expert's qualitative responses, as it would have pushed the work beyond its pre-defined boundaries. Changes made during this phase were logged and are presented in supplementary file 10 (available from the authors at <https://osf.io/pqfjz/>). After these refinements, techniques were re-numbered to group similar techniques and support a logical flow within the listing. The final compendium (v1.0) is presented in list format in supplementary file 1, and in tabular format in supplementary file 3, which includes additional information about each technique and the sources from which each technique was derived. A primer and glossary were written to spell out the purposes of the compendium and to define key terms for members of the general public (supplementary file 2). As a final step during the peer review process, the Hemingway App⁵³ was used (by KK) to improve readability of the instructive examples. The improved examples were then checked (by MB) to ensure congruence with the original wordings, and any discrepancies were discussed until consensus on a final wording was reached.

Data availability statement

All data generated or analysed during this study are included in this published article and its supplementary information files. They are also available from <https://osf.io/pqfjz/>, where any future updates will also be made available.

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Author contributions

NH conceived the study and acquired funding; KK, MH, MMM, MS, MSH, WH, NH contributed to its design; KK, MH, MMM, MS, MB, FE, NH acquired data; KK, MH, MMM, MS, MB, FE, NH analysed data; KK, MH, MMM, MS, MB, FE, WH, NH interpreted data; KK, MH, MMM, MS, MB, FE, NH drafted the manuscript; All authors substantively revised the manuscript; All authors approved of the submitted manuscript and any substantially modified version that involves the author's contribution to the study; All authors agree both to be personally accountable for the author's own contributions, and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

Competing interests

MSH, WH and MMM are co-authors of existing taxonomies of behaviour change techniques which have informed this work. The authors declare no other competing interests.

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