Special Section article

Investigating which behaviour change techniques work for whom in which contexts delivered by what means: Proposal for an international collaboratory of Centres for Understanding Behaviour Change (CUBiC)

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Purpose. Behaviour change techniques are fundamental to the development of any behaviour change intervention, but surprisingly little is known about their properties. Key questions include when, why, how, in which contexts, for which behaviours, in what combinations, compared with what, and for whom behaviour change techniques are typically effective. The aims of the present paper are to: (1) articulate the scope of the challenge in understanding the properties of behaviour change techniques, (2) propose means by which to tackle this problem, and (3) call scientists to action.

Methods. Iterative consensus (O'Connor et al., 2020, *Br. J. Psychol.*, e12468) was used to elicit and distil the judgements of experts on how best to tackle the problem of understanding the nature and operation of behaviour change techniques.

Results. We propose a worldwide network of 'Centres for Understanding Behaviour Change' (CUBiC) simultaneously undertaking research to establish what are the single and combined properties of behaviour change techniques across multiple behaviours and populations. We additionally provide a first attempt to systematize an approach that

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CUBiC could use to understand behaviour change techniques and to begin to harness the efforts of researchers worldwide.

Conclusion. Better understanding of behaviour change techniques is vital for improving behaviour change interventions to tackle global problems such as obesity and recovery from COVID-19. The CUBiC proposal is just one of many possible solutions to the problems that the world faces and is a call to action for scientists to work collaboratively to gain deeper understanding of the underpinnings of behaviour change interventions.

Statement of contribution
What is already known on this subject?
- Behaviour change techniques are the building blocks of behaviour change interventions.
- A limited number of meta-analyses show that techniques exert unique effects on behaviour change.
- Finding what other techniques exert unique effects on behaviour change poses a substantial challenge.

What does this study adds?
- A vision for a worldwide network of 'Centres for Understanding Behaviour Change' (CUBiC).
- A first attempt at a systematic approach to help understand behaviour change techniques.
- A proposal for an accessible repository for CUBiC to facilitate global research on this topic.

Background

> He who would learn to fly one day must first learn to stand and walk and run and climb and dance; one cannot fly into flying [SIC]. Friedrich Nietzsche (1844–1900).

Behaviour change is fundamental to tackling the economic and social challenges we face, which include emerging challenges from the COVID-19 pandemic, and the more established challenges of global heating, increasing overweight and obesity, and the effects of ageing populations. In response to these challenges, policy makers and researchers have rapidly deployed behaviour change interventions with varying degrees of success. The haste with which policy makers and researchers have responded to economic and social challenges means that behaviour change interventions are often cases of 'flying into flying'. In other words, many attempts to change people's behaviour are based on intuition rather than evidence and are poorly articulated. Even when evidence is used, the interventions can often best be described as 'evidence-inspired' as opposed to 'evidence-based' (Michie & Abraham, 2004) and typically start life as 'complex', meaning they consist of numerous elements (Michie et al., 2013) from inception. The success or otherwise of behaviour change interventions is dependent on the state of the science underpinning it. We contend that, despite an extant and rapidly proliferating literature (e.g., http://www.cochranelibrary.com/), very little is known about the elements that comprise effective behaviour change interventions. The aims of the present paper are to: (1) articulate the scope of the challenge in understanding the properties of behaviour change techniques, (2) propose means by which to tackle this problem, and (3) call scientists to action.

One key advance in the field of behaviour change has been the development of taxonomies with which to articulate better the underpinnings of behaviour change interventions. Several such taxonomies exist (e.g., intervention mapping, Kok et al.,

2016) and are under constant revision in this emerging field (Michie et al.'s, 2013, behaviour change technique taxonomy is explicitly labelled 'version 1') and so any approach to understanding the elements that comprise effective behaviour change interventions needs to be flexible. At the same time, we recognize the need to prevent taxonomies from stifling creativity (Ogden, 2016). Thus, although we use the behaviour change technique taxonomy version 1 (BCTTv1; Michie et al., 2013) as an exemplar, we fully appreciate that any approach to understanding the properties of behaviour change techniques will need to be sufficiently flexible to incorporate BCTT 'version 2', complementary perspectives such as intervention mapping (Kok et al., 2016) as well as newly discovered behaviour change techniques.

The BCTTv1 describes single irreducible behaviour change techniques that constitute complex behaviour change interventions, and is in some respects analogous to the periodic table of elements. As shown in Figure 1, the 93 behaviour change techniques have unique code numbers and abbreviations and are grouped into 16 clusters, comparable with the periodic table of elements. However, the ancient origins of the periodic table of elements mean that the properties of, for example, copper, lead, gold, and their interactions with other elements are very well known. In contrast, the BCTTv1 is not yet a decade old, and so little is known about the properties of individual behaviour change techniques nor their interactions with one another. Full knowledge of when, why, how, in which contexts, for which behaviours, in what combinations, compared with what, and for whom behaviour change techniques are typically effective would allow people to tackle the major economic and social challenges that arise from human behaviour, by spelling out what is needed to develop complex behaviour change interventions that have the best chances of working. Given that at least 10 research questions require answers for each of the 93 behaviour change techniques (Table 1) merely to understand the current state of the science, then concerted co-ordinated effort would be required to avoid duplication and fragmentation of the evidence base.

The vision that we set out in the present paper is for a worldwide network of inter-related 'Centres for Understanding Behaviour Change' (CUBiC) simultaneously under-taking research to map out the single and combined properties of each of the behaviour change techniques listed in the BCTTv1 (Figure 1) and its future iterations. The following section outlines how the BCTTv1 is currently used; we then outline what steps need to be taken to map out 'what is known' about the properties of behaviour change techniques. In the final section, we outline a future in which a living repository keeps behaviour change researchers, practitioners, funders, and policy makers up to date with what is known, what is being done, and what needs to be done with respect to which behaviour change techniques to deploy under what circumstances.

The present proposal complements the work currently being undertaken in the Human Behaviour-Change Project (Michie et al., 2017) that addresses the same research question, motivated by the same aim of addressing the complexity and quantity of research to gain better understanding of behaviour change interventions. Unlike CUBiC, which aims to optimize what research questions need to be asked, the Human Behaviour-Change Project attempts to maximize whatever knowledge can be gained from past and current research. The Human Behaviour-Change Project is developing ontologies that are computer readable and therefore allow the evidence in research reports to be extracted, synthesized, and interpreted at scale and at a pace that keeps up with current research and makes the results easily accessible to users (Human Behaviour-Change Project, 2020). These ontologies include BCTTv1 but also ontologies for settings, populations, and mode of delivery, all of which are likely to be valuable in the CUBIC work. In addition, the
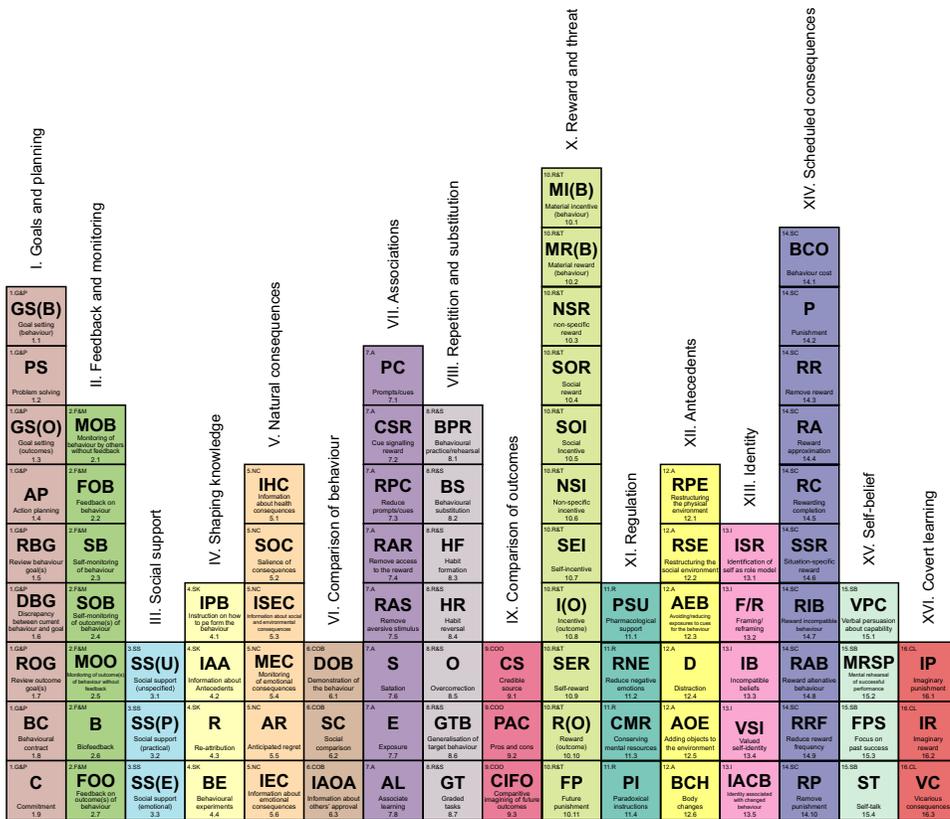
Figure 1. The 'periodic table' of behaviour change techniques, version 1. *Note.* Based on Michie et al. (2015). [Colour figure can be viewed at wileyonlinelibrary.com]

outputs from the Human Behaviour-Change Project knowledge system may prove useful at future stages of the CUBiC agenda.

Current use of the BCTTv1

Thus far, the predominant use of the BCTTv1 has been to unpick retrospectively complex behaviour change interventions to identify potential correlates of 'successful' behaviour change interventions, with a view to making recommendations for future intervention design. The approach typically focuses on a single behaviour and considers how closely correlated are behaviour change techniques with changes in behaviour (Bentley, Mitchell, & Backhouse, 2020). Although these post-mortems yield valuable information, such as whether the use of behaviour change theories enhances the effectiveness of interventions (Prestwich et al., 2014; Prestwich, Webb, & Conner, 2015), the lack of causal inference and historically poor reporting of behaviour change interventions in the published literature (Lorencatto, West, Stavri, & Michie, 2013) limit the approach. These difficulties should be overcome in the future because, in addition to providing a taxonomy of behaviour change techniques, the BCTTv1 offers researchers a language with which to describe their interventions that means future attempts to understand other people's interventions should be more straightforward.

Table 1. CUBiC template 1.0: key research questions and examples for two behaviour change techniques

Generic research question	Specific answer (based on Epton et al., 2017)	Example of research gaps identified (based on Epton et al., 2017)
1. Do the behaviour change techniques work?	Yes, interventions in which goal setting (behaviour) and goal setting (outcome) are manipulated are associated with small effect sizes when compared with control conditions that differ from the intervention condition solely by absence of goal setting	No studies investigated whether the effects of goal setting persisted beyond twelve months
2. For which behaviours do the behaviour change techniques work?	Goal setting (behaviour) and goal setting (outcome) work best for: • increasing recycling • health • sport	Only two studies examined recycling and there are several key behaviours for which goal setting has not yet been applied, including: • policy making • personal finance
3. What features of the behaviour change techniques maximize their effect size?	Larger effects of goal setting (behaviour) and goal setting (outcome) are associated with: • encouraging people to set sufficiently difficult goals, • setting their goals publicly, • and being part of a group for whom a goal has been set	There are numerous potentially important features of goal setting that have not yet been tested, most notably goal setting (behaviour) vs. goal setting (outcome)
4. In which contexts do the behaviour change techniques work?	Goal setting (behaviour) and goal setting (outcome) are most effective if set in: • a school or • workplace	There are numerous contexts in which there is a dearth of research into the effects of goal setting, including: • early years education • primary care

Table 1. (*Continued*)

Generic research question	Specific answer (based on Epton et al., 2017)	Example of research gaps identified (based on Epton et al., 2017)
5. Does the efficacy of the behaviour change techniques vary by population (e.g. age, ethnic background)?	Goal setting (behaviour) and goal setting (outcome) are particularly effective for: • males, • younger participants (especially school children), • people who are Asian and • people from the general population	There is a dearth of primary research investigating the effects of goal setting among people with varied socioeconomic status and ethnicity
6. How can we encourage people to engage in the behaviour change techniques?	Unknown	There is a dearth of primary research investigating how to encourage people to set goals
7. Which means of delivery (e.g., mHealth, face-to-face) is best for the behaviour change techniques?	Face-to-face delivery of goal setting (behaviour) and goal setting (outcome) is better than delivery via computer either online or offline	It is not currently clear what features of face-to-face delivery make it particularly effective (e.g, source credibility, communication style). It would be valuable to see whether new technologies have anything to offer in terms of delivering effective goal setting
8. How frequently should people be exposed to the behaviour change techniques?	The frequency of goal setting (behaviour) and goal setting (outcome) did not influence the magnitude of the effect size, implying that setting a single goal is sufficient to bring about behaviour change	There is a clear need to ensure that the proposal that setting a single goal is sufficient to bring about behaviour change is generalizable to the contexts, populations and delivery devices for which there is a dearth of research into goal setting outlined above

Continued

Table 1. (*Continued*)

Generic research question	Specific answer (based on Epton et al., 2017)	Example of research gaps identified (based on Epton et al., 2017)
9. Combined with which other behaviour change techniques do the focal behaviour change techniques work best?	The effectiveness of goal setting (behaviour) and goal setting (outcome) interventions was tested against complementary behaviour change techniques identified in goal setting theory (commitment, BCTTv1 1.9; discrepancy between current behaviour and goal, BCTTv1 1.6; feedback on behaviour, BCTTv1 2.2; feedback on outcomes of behaviour, BCTTv1 2.7; review behaviour goals, BCTTv1 1.5; review outcome goals, BCTTv1 1.7; behavioural contracts, BCTTv1 1.8) can only be signed once a goal has been set. Goal setting (behaviour) and goal setting (outcome) interventions work best when accompanied by monitoring of behaviour or outcome by others without feedback. Committing to the goal reduces the effectiveness of goal setting. All other tested behaviour change techniques did not influence the effectiveness of goal setting (behaviour) and goal setting (outcome)	It is plausible that lack of power might account for at least some of the observed null effects and that more of the 93 behaviour change techniques may yet turn out to enhance the effectiveness of goal setting
10. What are the mechanisms of action (and are there better ways to manipulate these mediators)?	Unknown	Mediators of goal setting have been proposed by goal setting theory however very few studies report the relationship between the mechanisms of action and changes in behaviour

The BCTTv1 has also been used to identify potential targets for intervention and is 'step 7' of the behaviour change wheel system (Michie, Atkins, & West, 2014). However, without knowledge of which behaviour change techniques work best, for whom, in which contexts, delivered by what means, it is difficult to provide advice as to which behaviour change techniques should be used to fulfil the various intervention functions (e.g., education, persuasion).

We have been using systematic review and meta-analysis to explore what is known about the unique properties of behaviour change techniques (Figure 1) and how they interact with other behaviour change techniques. Thus far, we (Brown, Smith, Epton, & Armitage, 2018; Epton, Currie, & Armitage, 2017) have completed systematic reviews of BCTTv1 1.1 (goal setting [behaviour]), BCTTv1 1.3 (goal setting [outcome]), BCTTv1 10.7 (self-incentives), and BCTTv1 10.9 (self-rewards), and are currently working on BCTTv1 6.2 (social comparison), BCTTv1 6.3 (information about others' approval), and BCTTv1 13.5 (identity associated with changed behaviour). These systematic reviews go some way to addressing the issue of which behaviour change techniques work best, for whom, in which contexts, delivered by what means, but each has identified yawning gaps in knowledge that require further primary research.

For example, we were unable to find a single study in which the behaviour change technique of self-reward (BCTTv1 10.7) had been uniquely tested in a randomized trial (Brown et al., 2018). Similarly, despite extracting 384 effect sizes, Epton et al. (2017) were unable to answer fully one of their key research questions, namely: 'which behaviour change techniques enhance the effects of goal setting on behaviour change?' due to the dearth of primary studies on the topic. Specifically, Epton et al. (2017) were only able to evaluate the ability of six techniques to augment/undermine the unique influence of goal setting on behaviour change. Five out of six potentially complementary behaviour change techniques derived from goal setting theory did not influence the effects of goal setting on behaviour change, namely: feedback (BCTTv1 2.2 and 2.7), review of outcome/ behavioural goals (BCTTv1 1.5 and 1.7), and behavioural contract (BCTTv1 1.8). The sixth behaviour change technique (commitment, BCTTv1 1.9) significantly weakened the effect of goal setting on behaviour change. Knowledge about how each behaviour change technique interacts with the others would not only help developers of interventions, but may also lead to new theoretical insights by allowing one to test existing theories or develop new theories on the basis of the evidence. Moreover, identifying underutilization of effective behaviour change techniques could yield some 'quick wins' for rapid improvements in the effectiveness of behaviour change interventions (Brown, Smith, & Armitage, 2019).

Thus, the systematic reviewing of just five behaviour change techniques has yielded a programme of research that could take decades to complete. Moreover, we are acutely aware that the analyses described above were conducted on small numbers of primary studies and so do not yet provide anything close to a definitive picture. In sum, we have come to realize that we have a long way to go to achieve our vision of understanding the properties of all 93 behaviour change techniques. Concurrently, we are aware that others have conducted systematic reviews and meta-analyses on other behaviour change techniques (Harkin et al., 2016; Hollands et al., 2016). In principle, such efforts should be combined to help complete our understanding of the properties of behaviour change techniques, but even small discrepancies in how the research questions are framed, what precise methodology is adopted (e.g., which electronic databases should be searched? What about grey literature?), and the compartmentalized way in which academia works (see Epton, Harris, Kane, van Koningsbruggen, & Sheeran, 2015 and Sweeney & Moyer,

2015 whose meta-analyses of BCTTv1 13.4 appeared in the same volume of the same journal) lead to redundancy. In short, we also have come to realize that we need to harness the ongoing efforts of behaviour change researchers worldwide in a co-ordinated effort at scale. Identifying the chemical elements and their properties has taken multiple laboratories worldwide hundreds of years; to achieve understanding of the unique and combined properties of behaviour change techniques and thus deliver truly evidence-based interventions will take a similar effort, but could be achieved with a worldwide network of small inter-related 'Centres for Understanding Behaviour Change' (CUBiC) simultaneously undertaking research to map out the properties of the BCTTv1 (Figure 1).

The first step in achieving a fully populated periodic table of behaviour change techniques is to start with a clear picture of 'what is known' about the unique effects of behaviour change techniques through a series of systematic reviews and meta-analyses. In order to overcome the difficulties of how research questions are framed, how systematic reviews are conducted, and how redundancy is avoided, we need consensus on three key elements, namely: (1) a template with which to shape the research questions, (2) an approach to systematic reviews and meta-analyses of the unique effects of behaviour change techniques on changes in behaviour, and (3) a central repository to minimize the risk of duplication and redundancy. The following sections describe our proposals for these three elements.

1. The CUBiC Approach and Template 1.0

The first step in gaining a co-ordinated approach to understanding behaviour change techniques would be an agreed template of key questions that the reviews would seek to address. Based on our previous work (Brown et al., 2018; Epton et al., 2017), we have developed what we call the CUBiC approach, which currently specifies: (1) a scoping review unrestricted by behavioural domain or scientific discipline to gauge the current state of knowledge, (2) a systematic review and also meta-analysis where there is sufficient evidence, and (3) identification of gaps in – or a surfeit of – primary research.

The CUBiC template 1.0 currently consists of 10 generic research questions, which are presented in Table 1 alongside examples of specific answers and identified research gaps using BCTTv1 1.1 (goal setting [behaviour]) and BCTTv1 1.3 (goal setting [outcome]) as examples (Table 1). The CUBiC template 1.0 (Table 1) has already been applied to BCTTv1 1.1 (goal setting [behaviour]), BCTTv1 1.3 (goal setting [outcome], Epton et al., 2017), BCTTv1 10.7 (self-incentives), and BCTTv1 10.9 (self-rewards, Brown et al., 2018), and we are currently working on BCTTv1 6.2 (social comparison), BCTTv1 6.3 (information about others' approval) and BCTTv1 13.5 (identity associated with changed behaviour). However, the CUBiC template 1.0 (Table 1), appropriately expanded, refined and based on consensus, could similarly be applied to the remaining 88 behaviour change techniques currently identified and any other behaviour change techniques identified in future taxonomies.

The CUBiC template 1.0 template differs from, and complements, the approach to systematic reviewing undertaken by the Cochrane Collaboration (2011). Cochrane reviews focus on evaluating the effects of complex interventions (e.g., advice from health professionals) that contain multiple behaviour change techniques and are targeted at a single outcome (e.g., smoking cessation) in a single setting (e.g., primary care). Therefore, although Stead et al.'s (2012) Cochrane review was able to conclude that physician advice exerted a small sized effect on smoking cessation, it was unable to ascertain what the

advice should be and whether it could be delivered as effectively outside primary care by people who are not doctors. The CUBiC template 1.0, on the other hand, focuses on examining the effectiveness of single techniques within behaviour change interventions in relation to multiple outcomes across diverse settings and disciplines.

2. Addressing divergences in methodologies

As with any systematic review, our work includes numerous micro-decisions about how many databases to search, which terms to use, to what extent data should be double-coded, what should be done with multiple intervention and/or control groups (Black et al., 2020) and/or follow-ups. Thus, not only are the single and combined effects of the majority of behaviour change techniques unknown (but see Brown et al., 2018; Epton et al., 2017; Harkin et al., 2016; Hollands et al., 2016), there is no consensus as to how best to conduct systematic reviews of behaviour change techniques (e.g., which databases to search; whether to include grey literature) meaning that divergences in the methodologies adopted by reviewers limit their comparability and hence the cumulative contributions such reviews can make to future intervention design (but see Brown et al., 2018; Epton et al., 2017, for two applications of the CUBiC approach). Serious progress could be made in understanding the unique effects of behaviour change techniques if there were a template to guide researchers in reviewing the current literature. Grounding such a template in the Cochrane Collaboration's (2011) procedures would represent a good start.

3. Towards a central resource

Thus far, we have presented our proposals for an approach to understanding the unique effects of behaviour change techniques. Future work on CUBiC 1.0 is immediately to embark on a consensus-building exercise that leads to the appropriate expansion and agreement of key elements of the CUBiC approach. Indeed, we anticipate that initial consensus work on CUBiC 2.0 may well be complete by the time this manuscript appears in print.

One of the key barriers to understanding the single and combined properties of behaviour change techniques, however, is a lack of co-ordination. There are many researchers working on projects that are of direct relevance to the CUBiC agenda, but no central rallying point. If we can gain consensus for a CUBiC approach, we could not only help to accelerate the pace at which effective behaviour change interventions are developed, but would be able to help major funders of research identify the gaps in research knowledge and channel limited resources into productive channels. A complementary approach might be to conduct reviews en-masse whereby large teams of researchers screen studies, extract elements of data and conduct analyses. Careful thought will be needed with respect to how researchers are incentivized (e.g., through co-authorship), quality control, training and online management. Coding of behaviour change techniques could be done by committee and thus rapidly and expertly, with further training and support to ensure that coder variance is minimized thereby promoting reliability. Consideration of the approach to science employed on the Human Genome Project, among other large-scale projects, may be applicable to behavioural science (National Human Genome Research Institute, 2020).

A living repository for identifying the gaps in knowledge and priorities for primary research in order to avoid omission and redundancy would be a good start in ensuring progress in developing effective behaviour change interventions. As current technology stands, we envisage a web platform similar to Prospero https://www.crd.york.ac.uk/prospero/, which collects together ongoing CUBiC systematic reviews in a 'live' format (Marshall & Wallace, 2019), but that focuses on identifying gaps, both in systematic reviews and empirical work. The latter is particularly important because if we have learned one lesson it is that the behaviour change literature is not as developed as one might imagine. For example, we were unable to find a single study in which the behaviour change technique of self-reward (BCTTv1 10.7) had been uniquely tested in a randomized trial and so were immediately able to set an agenda for future work (Brown et al., 2018). An online platform that highlighted these gaps and informed researchers as to studies already underway would ensure that progress would be smoother and more rapid than at present.

The big question, as ever, is 'who will fund this?'. The answer is complex but we believe that the social and economic benefits that could accrue from CUBiC are at least as valuable as the insights provided by the Human Genome Project (National Human Genome Research Institute, 2020). It is notable, for example, that on 2 October 2020, there were 193 registered COVID-19 candidate vaccines in clinical and preclinical trials (World Health Organization, 2020), but little evidence of resources being allocated to ensuring that sufficient numbers of people will take a COVID-19 vaccine to make it effective.

Conclusions

In sum, we posit that the substantial gap in knowledge about how we judge the effectiveness of a behaviour change technique represents a 'grand challenge' that we propose can only be addressed with a commensurate 'grand programme' of interconnected research. Given the need for more effective behaviour change interventions to address societal problems and the need to provide policy makers and practitioners with the timely information that they need (Whitty, 2015), there is a need to gain consensus on how to approach the key questions for behavioural science, namely: which behaviour change techniques work best, for whom, in which contexts, delivered by what means.

Next steps

1. Refine and gain consensus on the CUBiC template.
2. Promote use of the template by conducting CUBiC reviews.
3. Develop a central resource that will:

   a. promote use of the consensus-based template worldwide and sustain its use by developing an international membership group who will conduct CUBiC reviews;
   b. disseminate the template and identify the reviews that need to be done, describes the appropriate methods for these reviews and coordinates reviewing activities to correct omissions and minimize duplication and redundancy;
   c. identify the priorities for primary research; and
   d. be used to obtain buy-in from international funding bodies.

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Conflicts of interest

All authors declare no conflict of interest.

Author contributions

Christopher J. Armitage (Conceptualization; Funding acquisition; Methodology; Project administration; Resources; Supervision; Visualization; Writing – original draft; Writing – review & editing) Mark Conner (Conceptualization; Writing – review & editing) Andrew Prestwich (Conceptualization; Writing – review & editing) Marijn de Bruin (Conceptualization; Writing – review & editing) Marie Johnston (Conceptualization; Writing – review & editing) Falko Sniehotta (Conceptualization; Writing – review & editing) Tracy Epton (Conceptualization; Writing – review & editing).

Data availability statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

References

Bentley, M. R. N., Mitchell, N., & Backhouse, S. H. (2020). Sports nutrition interventions: A systematic review of behavioural strategies used to promote dietary behaviour change in athletes. *Appetite*, *150*, 104645. https://doi.org/10.1016/j.appet.2020.104645

Black, N., Eisma, M.C., Viechtbauer, W., Johnston, M., West, R., Hartmann-Boyce, J., . . . de Bruin, M. (2020). Variability and effectiveness of comparator group interventions in smoking cessation trials: A systematic review and meta-analysis. *Addiction*, *115*(9), 1607–1617. https://doi.org/10.1111/add.14969

Brown, E. M., Smith, D. M., & Armitage, C. J. (2019). Self-incentives uniquely boost cessation in community-based stop smoking programs: Randomized controlled trial. *Annals of Behavioral Medicine*, *53*, 442–452. https://doi.org/10.1093/abm/kay056

Brown, E., Smith, D., Epton, T., & Armitage, C. J. (2018). Do self-incentives and self-rewards change behavior? A systematic review and meta-analysis. *Behavior Therapy*, *49*, 113–123. https://doi.org/10.1016/j.beth.2017.09.004

Cochrane Collaboration (2011). The Cochrane handbook for systematic reviews of interventions. Retrieved from https://handbook-5-1.cochrane.org/index.htm

Epton, T., Currie, S., & Armitage, C. J. (2017). Unique effects of setting goals on behavior change: Systematic review and meta-analysis. *Journal of Consulting and Clinical Psychology*, *85*, 1182–1198. https://doi.org/10.1037/ccp000026

Epton, T., Harris, P. R., Kane, R., van Koningsbruggen, G. M., & Sheeran, P. (2015). The impact of self-affirmation on health-behavior change: A meta-analysis. *Health Psychology*, *34*, 187–196. https://doi.org/10.1037/hea0000116

Harkin, B., Webb, T. L., Chang, B. P. I., Prestwich, A., Conner, M., . . . Sheeran, P. (2016). Does monitoring goal progress promote goal attainment? A meta-analysis of experimental evidence. *Psychological Bulletin*, *142*, 198–229. https://doi.org/10.1037/bul0000025

Hollands, G. J., French, D. P., Griffin, S. J., Prevost, A. T., Sutton, S., King, S., & Marteau, T. M. (2016). The impact of communicating genetic risks of disease on risk-reducing health behaviour: Systematic review with meta-analysis. *British Medical Journal*, *352*, Article Number: i1102. https://doi.org/10.1136/bmj.i1102

Human Behaviour-Change Project. (2020). Retrieved from https://wellcomeopenresearch.org/collections/humanbehaviourchange

Kok, G., Gottlieb, N. H., Peters, G.-J.-Y., Mullen, P. D., Parcel, G. S., Ruiter, R. A. C., & Bartholomew, L. K. (2016). A taxonomy of behaviour change methods: An intervention mapping approach. *Health Psychology Review*, *10*, 297–312. https://doi.org/10.1080/17437199.2015.1077155

Lorencatto, F., West, R., Stavri, Z., & Michie, S. (2013). How well is intervention content described in published reports of smoking cessation interventions? *Nicotine and Tobacco Research*, *15*, 1273–1282. https://doi.org/10.1093/ntr/nts266

Marshall, I. J., & Wallace, B. C. (2019). Toward systematic review automation: A practical guide to using machine learning tools in research synthesis. *Systematic Reviews*, *8*. Article Number: 163. https://doi.org/10.1186/s13643-019-1074-9

Michie, S., & Abraham, C. (2004). Interventions to change health behaviours: Evidence-based or evidence-inspired? *Psychology & Health*, *19*, 29–49. https://doi.org/10.1080/0887044031000141199

Michie, S., Atkins, L., & West, R. (2014). *The behaviour change wheel: A guide to designing interventions*. Sutton, Surrey, UK: Silverback Publishing.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., . . . Wood, C. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, *46*, 81–95. https://doi.org/10.1007/s12160-013-9486-6

Michie, S., Thomas, J., Johnston, M., Mac Aonghusa, P., Shawe-Taylor, J., Kelly, M. P., . . . West, R. (2017). The Human Behaviour-Change Project: Harnessing the power of artificial intelligence and machine learning for evidence synthesis and interpretation. *Implementation Science*, *12*, Article Number: 121. https://doi.org/10.1186/s13012-017-0641-5

Michie, S., Wood, C. E., Johnston, M., Abraham, C., Francis, J. J., & Hardeman, W. (2015). Behaviour change techniques: The development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). *Health Technology Assessment*, *19* (99), 1–188. https://doi.org/10.3310/hta19990

National Human Genome Research Institute. (2020). Retrieved from https://www.genome.gov/human-genome-project

O'Connor, D. B., Aggleton, J. P., Chakrabarti, B., Cooper, C. L., Creswell, C., . . . Armitage, C. J. (2020). Research priorities for the COVID-19 pandemic and beyond: A call to action for psychological science. *British Journal of Psychology*, e12468. https://doi.org/10.1111/bjop.12468

Ogden, J. (2016). Theories, timing and choice of audience: Some key tensions in health psychology and a response to commentaries on Ogden (2016). *Health Psychology Review*, *10*, 274–276. https://doi.org/10.1080/17437199.2016.1190295

Prestwich, A., Sniehotta, F. F., Whittington, C., Dombrowski, S. U., Rogers, L., & Michie, S. (2014). Does theory influence the effectiveness of health behavior interventions? Meta-analysis. *Health Psychology*, *33*, 465–474. https://doi.org/10.1037/a0032853

Prestwich, A., Webb, T. L., & Conner, M. (2015). Using theory to develop and test interventions to promote changes in health behaviour: Evidence, issues and recommendations. *Current Opinion in Psychology*, *5*, 1–5. https://doi.org/10.1016/j.copsyc.2015.02.011

Stead, L. F., Perera, R., Bullen, C., Mant, D., Hartmann-Boyce, J., Lancaster, T. (2012). Nicotine replacement therapy for smoking cessation. *Cochrane Database of Systematic Reviews*, *11*. Art. No.: CD000146. https://doi.org/10.1002/14651858.CD000146.pub4

Sweeney, A., & Moyer, A. (2015). Self-affirmation and responses to health messages: A meta-analysis on intentions and behavior. *Health Psychology*, *34*, 149–159. https://doi.org/10.1037/hea 0000110

Whitty, C. J. M. (2015). What makes an academic paper useful for health policy? *BMC Medicine*, *13*, Article Number: 301. https://doi.org/10.1186/s12916-015-0544-8

World Health Organization (2020). *Draft landscape of COVID-19 vaccines*. Retrieved from https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines