

Developing an evidence-based online method of linking behaviour change techniques and theoretical mechanisms of action: a multiple methods study

Susan Michie,^{1*} Marie Johnston,²
Alexander J Rothman,³ Marijn de Bruin,^{2,4}
Michael P Kelly,⁵ Rachel N Carey,¹
Lauren EC Bohlen,^{1,6} Hilary NK Groarke,⁷
Niall C Anderson^{1,8} and Silje Zink^{1,9}

¹Centre for Behaviour Change, University College London, London, UK

²Institute of Applied Health Sciences, College of Life Sciences and Medicine, University of Aberdeen, Aberdeen, UK

³Department of Psychology, University of Minnesota, Minneapolis, MN, USA

⁴Radboud University Medical Center, Radboud Institute for Health Sciences, IQ Healthcare, Nijmegen, the Netherlands

⁵Primary Care Unit, Cambridge Institute of Public Health, University of Cambridge, Cambridge, UK

⁶Department of Kinesiology, College of Health Sciences, University of Rhode Island, Kingston, RI, USA

⁷Department of Psychology, National University of Ireland Galway, Galway, Ireland

⁸National Institute for Health Research (NIHR) Health Protection Research Unit in Behavioural Science and Evaluation, University of Bristol, Bristol, UK

⁹National Advisory Unit on Rehabilitation in Rheumatology, Diakonhjemmet Hospital, Oslo, Norway

*Corresponding author s.michie@ucl.ac.uk

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Scientific summary

Linking BCTs and theoretical MoAs

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Scientific summary

Background

Many of the health challenges worldwide may be addressed by changing people's behaviour. Behaviours such as physical inactivity, alcohol misuse and smoking, as well as some dietary behaviours, contribute to the global increase in diseases such as cardiovascular diseases, cancer and respiratory diseases, resulting in disability and premature mortality, increased requirements for health services and significant economic costs. Thus, there is an urgent need for effective and cost-effective interventions to change these behavioural risk factors.

Behavioural intervention research has been developing rapidly, yet the extent to which this has resulted in behaviour change has been highly variable, with small effects that are typically not sustained over time. Behaviour change interventions are often complex as they contain many interacting components and can be difficult to deliver. Progress could be improved and accelerated by gaining greater understanding of the components that are the active ingredients in the intervention and the ways in which they bring about change.

Behavioural science has made advances in identifying key determinants of behaviour, such as motivation or self-efficacy, and proposes that these are the mechanisms of action through which interventions achieve changes in behaviour. At the same time, there have been substantial improvements in methods of standardising the reporting of interventions. In particular, the development of a methodology for reporting the active content of behaviour change interventions has facilitated communication across disciplines and enabled intervention replication and implementation. The 93-item taxonomy of behaviour change techniques is a prominent and widely cited example of a method for communicating these principles by providing a systematised set of labels and definitions that describe the active content of behaviour change interventions.

Further progress could be achieved by developing a better understanding of which behaviour change techniques might target which mechanisms of action to bring about change. For example, are behaviour change techniques such as goal-setting and self-monitoring relevant to the mechanism of action 'motivation', or are they more relevant to the mechanism of action 'beliefs about capabilities'? Identification of the links between behaviour change techniques and the mechanisms of action they target to change behaviour would assist researchers, policy-makers and practitioners in designing effective interventions and enable those interpreting the current body of evidence to explain how and why intervention effects are obtained. It would be impractical to conduct extensive studies for all possible links between 93 behaviour change techniques and a potential list of hundreds of mechanisms of action. Therefore, we set out to produce a data set that might serve as a guide to the links that were most likely to be worth implementing and further investigation.

The aim of this programme of research was to establish an initial framework that specifies potential links between behaviour change techniques and mechanisms of action, which, in turn, can serve as a basis for choosing behaviour change techniques to incorporate in new interventions and to elucidate results of existing interventions, especially when synthesising evidence across diverse studies. For the results to be useful, we additionally aimed to make the results available in an online interactive form that would not only guide readers to likely links and non-links but also enable sharing of resources, collaborative discussion and further research among users. It is worth noting that this project was designed as part of a wider programme of research, the Human Behaviour Change Project, where a Behaviour Change Intervention Ontology is currently being developed. The Mechanism of Action Ontology is a subontology within the Behaviour Change Intervention Ontology.

Studies

Four studies were planned. The first two studies examined links between behaviour change techniques and mechanisms of action in literature and by expert consensus, the third study triangulated the findings of the first two, and the final study examined whether or not groups of behaviour change techniques frequently identified in the literature might reveal underlying theory.

Study 1: behaviour change technique–mechanism of action links in published intervention literature

The aim of this study was to assess the frequency of behaviour change technique–mechanism of action links described by the authors of published intervention reports. Links made with greater frequency could be interpreted as representing the assumptions that guided intervention designers over the period of development and publication of these interventions. Two coders extracted all links made explicitly by authors between behaviour change techniques and 26 commonly occurring mechanisms of action in 277 behaviour change intervention articles. The relative frequency of each observed link was examined using binomial tests. The most frequently found link, occurring in 65 of the 277 papers, was between the behaviour change technique ‘problem-solving’ and the mechanism of action ‘beliefs about capabilities’. Overall, 2636 behaviour change technique–mechanism of action links were found, with an average of approximately 10 links per intervention report. In total, 70 out of 93 behaviour change techniques were linked to at least one mechanism of action. Each behaviour change technique had between one and five linked mechanisms of action, and each mechanism of action had between one and eight linked behaviour change techniques. This extensive review gave the first systematic description of how intervention designers conceptualise the links between behaviour change techniques and mechanisms of action, providing an initial guide to the theoretical understanding of interventions and a potential resource for developing interventions. However, the results were derived from a single source of evidence and represented historical rather than current thinking.

Study 2: behaviour change technique–mechanism of action links by expert consensus

The aim of this study was to gain consensus from international behaviour change experts about which were likely mechanisms of action for each behaviour change technique (i.e. ‘links’) and which were unlikely (i.e. ‘non-links’). For each behaviour change technique–mechanism of action combination investigated, we aimed to obtain a quantitative estimate of the confidence that they were links or non-links based on current expertise. International behaviour change experts ($n = 105$) participated in a consensus exercise involving three rounds (rating each behaviour change technique–mechanism of action combination, discussion and final rating). They rated a total of 61 commonly occurring behaviour change techniques and the same 26 mechanisms of action as in study 1 (1586 possible links). The criterion for consensus was that at least 80% of experts needed to agree to establish a behaviour change technique–mechanism of action pair as a link or a non-link. Fifty-one out of 61 behaviour change techniques had a link with at least one and up to four mechanisms of action. Twenty out of 26 mechanisms of action had a link with at least one and up to nine behaviour change techniques; the mechanism of action ‘motivation’ was linked to nine behaviour change techniques. There were 90 links and 464 non-links with the remaining 1032 being rated ‘possible’ or ‘unsure’ links. These data provided a second, complementary source of guidance for developing and interpreting interventions. Study 3 provided the opportunity to compare and integrate the observations generated by studies 1 and 2.

Study 3: triangulation of findings from studies 1 and 2

The first aim of this study was to examine the extent of agreement between the two earlier studies that had each provided evidence addressing the same questions but with different methodologies. Triangulation of the findings gives greater confidence in the results. The second aim was to reconcile differences in the findings of the two studies and to present usable results in an online interactive tool. Similarities between the findings of the two studies were investigated first by examining concordance between the links found in the two studies for the 56 behaviour change techniques and 26 mechanisms

of action that they had in common and then by examining the relationships using statistical modelling. Uncertainties and disagreements were brought forward into a consensus study with 16 new experts to reconcile the findings of the two studies. There was clear statistical evidence of agreement between the two studies and, following the concordance stage, 37 links and 460 non-links had been identified. For example, the behaviour change technique 'information about health consequences' was linked to the mechanisms of action 'knowledge', 'beliefs about consequences' and 'perceived susceptibility/vulnerability' in both studies. After reconciliation there was a total of 92 links and 465 non-links. This triangulation of two distinct sources of evidence provides greater confidence in the resulting guidance on how behaviour change techniques may affect the mechanisms that change behaviour than either of the studies could alone. All evidence for each of the 1456 possible behaviour change technique–mechanism of action combinations was used to generate the online tool as a resource for behaviour change intervention designers, researchers and theorists, supporting intervention design, research synthesis and collaborative research (<https://theoryandtechniquetool.humanbehaviourchange.org/>); accessed 1 March 2020.

Study 4: linking behaviour change techniques to underlying theory

Studies 1–3 linked behaviour change techniques to mechanisms of action but not directly to theories. Theories of behaviour typically detail the mechanisms of action (or determinants) of behaviour but, often, unless the theories explicitly focus on behaviour change, do not detail the techniques that might be used to change behaviour through these mechanisms of action. Authors of intervention reports may be explicit in reporting the theory informing the selection of behaviour change techniques, or the theory may go unreported or even remain implicit. At present, there is a lack of theory-based guidance on how to use combinations of behaviour change techniques in interventions. In this study, frequently occurring combinations of behaviour change techniques used in published interventions were investigated to examine how combinations of behaviour change techniques are used in the literature and whether or not these combinations indicated an underlying implicit or explicit theory. First, co-occurring groups of behaviour change techniques in 277 intervention reports were identified using factor analysis. The resulting groups of behaviour change techniques were presented to 25 behaviour change experts in a consensus study to examine links between the behaviour change technique groupings and behaviour change theories. These linked theories were then compared with explicitly reported theories described in intervention reports that used a majority of the behaviour change techniques from a grouping. Five groups of co-occurring behaviour change techniques with between 3 and 13 behaviour change techniques each were found. At least 80% of experts agreed on links for three out of the five behaviour change technique groupings, linking them with five behaviour change theories. For four out of the five links, the theories identified by experts were comparable to the explicit theories stated by study authors in intervention reports that used a majority of the behaviour change techniques from a particular behaviour change technique group. These results suggest that intervention designers frequently use the same groups of behaviour change techniques in interventions and that some of these groups of behaviour change techniques may share an underlying theoretical rationale. Sometimes this theoretical rationale is explicitly reported by theory authors, and frequently authors using the same groups of behaviour change techniques report use of the same theory. These results indicate the need for more comprehensive, shared descriptions of the behaviour change technique–mechanism of action links that can be derived from theories of behaviour change.

Discussion

These studies have generated much-needed evidence about how behaviour change techniques, the presumed active components of behaviour change interventions, might be linked to mechanisms of action, the processes through which a behaviour change technique affects behaviour. The resulting online tool gives users access to all of the data generated from studies 1–3 in a readily usable form, with a simple interface showing each behaviour change technique–mechanism of action combination that permits searching by behaviour change technique, by mechanism of action or by specific behaviour change technique–mechanism of action combination.

It is anticipated that these results will be usable in the following main ways. First, they suggest 'best bets' for intervention designers that should help them to select behaviour change techniques to incorporate into an intervention and understand which behaviour change techniques would be unlikely to be effective. This should help investigators move beyond intuitive choices and provide a transparent and explicit process for the selection of intervention techniques. Second, the results suggest which behaviour change technique–mechanism of action links should be investigated for evidence of their effectiveness in changing behaviour; it would seem appropriate to put most effort into evaluating links that previous literature and expert consensus consider likely to be effective.

A key strength of this work is that, by providing guidance on behaviour change technique–mechanism of action links and non-links, it addresses a gap in resources needed for designing, reporting, improving, tailoring, interpreting and comparing behaviour change interventions. Users can apply the results when selecting behaviour change techniques to include in interventions (i.e. with a view to targeting a specific mechanism of action) and considering those that they may wish to avoid (i.e. those that are less likely to be appropriate). Researchers may use the evidence obtained to select behaviour change technique–mechanism of action combinations (where there was strong support for the link) for further investigation. Readers of research reports may be able to infer an underlying theoretical framework in intervention reports where none has been explicitly stated. Nevertheless, they need to be mindful of the status of this evidence. We have shown which behaviour change techniques experts and authors of behaviour change interventions have agreed are plausible means for affecting behaviour change. We have not shown that they are effective and would expect that researchers seeking to investigate intervention effectiveness might choose to put effort into examining some of the 'best bets' arising from our evidence.

A second strength of the work is the use of two different methods and the triangulation of findings. All of the 92 'links' gained support in two studies. This support was gained by directly comparing the literature and expert studies, or by achieving consensus in the reconciliation study (that focused on links that appeared promising from the literature and consensus studies). This gives strength to the findings both scientifically and as a basis for application.

The study also benefited from having multidisciplinary, international input and by generating a tool that can enable collaboration and pooling of resources across diverse interest groups.

Finally, a major strength of the work is the resulting Theory and Technique Tool (<https://theoryandtechniquetool.humanbehaviourchange.org/>), which makes the findings accessible to diverse users. The tool is restricted to the 1924 behaviour change technique–mechanism of action combinations that were practical to investigate. However, these were selected as the most commonly used behaviour change techniques and the most commonly cited mechanisms of action. Further work will be necessary to expand the range of mechanisms of action and behaviour change techniques.

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