The Human Behaviour-Change Project: Developing a Behaviour Change Intervention Ontology

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ABSTRACT

Behaviour change is essential to improve population health, the self-management of illness, chronic conditions and health professional practice. Evidence about behaviour change interventions is currently being produced at such a rate that manual systems for evidence review and synthesis cannot keep up. Neither can they account for all the relevant features of interventions.

The Human Behaviour-Change Project (HBCP) aims to bring together behavioural scientists, computer scientists and system architects to advance progress in behaviour change. It aims to answer variants of the 'big question' of behaviour change: 'What works, compared with what, how well, with what exposure, with what behaviours (for how long), for whom, in what settings, and why?'

The main outputs will be: 1) an ontology of behaviour change interventions; 2) an AI system capable of extracting and interpreting evidence from published literature and making predictions; 3) an interface allowing users (researchers, policy-makers, practitioners) to access the knowledge base and answer specific questions about behaviour change.

1 INTRODUCTION

Behaviour change interventions are policies, activities, services or products designed to cause people to act differently from how they otherwise would have done (West & Michie, 2016). They involve enabling change amongst members of the target population (e.g. knowledge, skills, beliefs, feelings or habits) or their social and/or physical environment, or both. Typically, the goal is to achieve change that is sustained over an extended period of time (such as reducing smoking prevalence in the general population or increasing levels of habitual physical activity).

Knowledge of behaviour change interventions tends to be fragmented, generated by studies with variable methods and from partial, unspecified intervention evaluation reports. Evidence about behaviour change interventions is being generated at such a high rate that manual systems for evidence review, interpretation and synthesis cannot keep up (Elliot et al., 2014). For example, systematic reviews of health interventions currently take an average of almost 6 years to finish (Bragge et al, 2011), often making their results outdated by the time of publication.

Advances in organising the fragmented evidence about behaviour change interventions are urgently needed to improve our understanding of behaviour and how to change it. By accomplishing this we can improve our ability to develop behaviour change interventions to solve real-world problems, such as the global burden of disease and unsustainable climate change.

Recent research has developed a method for specifying behaviour change interventions in terms of their component techniques e.g. The Behaviour Change Technique Taxonomy v1 (BCTTv1; Michie et al., 2013) specifies 93 'active ingredients' of behaviour change interventions. To fully understand how interventions have their effects, we need to extend this method of specification to how interventions are delivered, their reach, the target population and intervention setting, the target behaviour and the mechanisms of action of the intervention. (Larsen et al., 2016). *Ontologies*, which are coherent structures for representing knowledge, have been used to unify many areas of science allied to behaviour change, such as for mental disorders and mental functioning (Hastings, 2012; Larsen et al, 2016). The current programme of research seeks to develop an ontology of behaviour change interventions.

1.1 Introducing the Human Behaviour-Change Project (HBCP)

The vision of the Human Behaviour-Change Project (HBCP; www.humanbehaviourchange.org) is to synthesise evidence about behaviour change interventions and develop an automated knowledge system to identify patterns in the published literature and generate new, up-to-date evidence. A collaboration of behavioural scientists, computer scientists and system architects to answer variants of the 'big question' of behaviour change: 'What works, compared

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with what, how well, with what exposure, with what behaviours (for how long), for whom, in what settings, and why?'

This project involves:

1. Developing an ontology of behaviour change interventions evaluations: including aspects of intervention (techniques and delivery), target population, context, mechanisms of action, behaviours, outcomes, study methods and reporting features.
2. Using this ontology to annotate behaviour change interventions evaluation reports. These annotations will be used to develop and train an automated system to extract key information from research reports.
3. Developing and evaluating Machine Learning and automated reasoning systems to synthesise and interpret the annotated evidence and make predictions.
4. Developing and evaluating an online interface to interrogate the knowledge base contained within the system.

1.2 Top-level entities of the Behaviour Change Intervention Ontology (BCIO)

To synthesise the fragmented evidence, an essential element of HBCP is the development of a Behaviour Change Intervention Ontology (BCIO). At the heart of this ontology is the 'behaviour change intervention scenario' whose top-level entities are shown in Figure 1. Each scenario corresponds to an intervention condition within an evaluation.

- **Target Behaviour:** behaviour that the intervention seeks to change (e.g., 6 months of smoking abstinence)
- **Intervention:** set of policies, activities, services or products that is intended to result in a difference in the target behaviour. This includes *content* (i.e. techniques used, such as goal-setting or restructuring the physical environment; Michie et al. 2013) and *delivery* (i.e who and what provides the intervention)
- **Context:** attributes of the target *population* (e.g aged 16+) and the intevention *setting* (e.g GP practices)
- **Exposure:** the extent and nature of the target population's access to, receipt of, and engagement with the intervention, including *reach* (e.g proportion of sample that was exposed to intervention) and *engagement* (e.g extent participants interacted with intervention components)
- **Mechanisms of action:** processes by which intervention influences the target behaviour (e.g., by providing a cue to action)
- **Outcome:** the property of the target behaviour in the given scenario (e.g., 25%)
- **Effect:** an estimate of the comparison between the outcomes in the evaluated scenarios (i.e. each pair of intervention conditions)

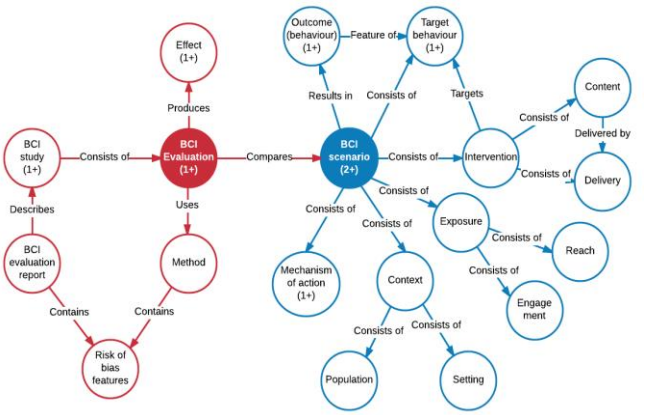

Fig 1. Top-level of Behaviour Change Intervention Ontology scenario and their putative interactions

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