

## A taxonomy of behaviour change methods: an Intervention Mapping approach

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### ABSTRACT

In this paper, we introduce the Intervention Mapping (IM) taxonomy of behaviour change methods and its potential to be developed into a coding taxonomy. That is, although IM and its taxonomy of behaviour change methods are not in fact new, because IM was originally developed as a tool for intervention development, this potential was not immediately apparent. Second, in explaining the IM taxonomy and defining the relevant constructs, we call attention to the existence of parameters for effectiveness of methods, and explicate the related distinction between theory-based methods and practical applications and the probability that poor translation of methods may lead to erroneous conclusions as to method-effectiveness. Third, we recommend a minimal set of intervention characteristics that may be reported when intervention descriptions and evaluations are published. Specifying these characteristics can greatly enhance the quality of our meta-analyses and other literature syntheses. In conclusion, the dynamics of behaviour change are such that any taxonomy of methods of behaviour change needs to acknowledge the importance of, and provide instruments for dealing with, three conditions for effectiveness for behaviour change methods. For a behaviour change method to be effective: (1) it must target a determinant that predicts behaviour; (2) it must be able to change that determinant; (3) it must be translated into a practical application in a way that preserves the parameters for effectiveness and fits with the target population, culture, and context. Thus, taxonomies of methods of behaviour change must distinguish the specific determinants that are targeted, practical, specific applications, and the theory-based methods they embody. In addition, taxonomies should acknowledge that the lists of behaviour change methods will be used by, and should be used by, intervention developers. Ideally, the taxonomy should be readily usable for this goal; but alternatively, it should be clear how the information in the taxonomy can be used in practice. The IM taxonomy satisfies these requirements, and it would be beneficial if other taxonomies would be extended to also meet these needs.

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## Introduction

Recent attempts to establish a cumulative science of behaviour change have used taxonomies of behaviour change techniques (or methods; BCTs) to derive effectiveness of such techniques through meta-analysis of intervention evaluations (Michie & Johnston, 2012). These taxonomies

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have been widely applied and developed further, for example, geared towards physical activity and diet (Michie et al., 2011). Useful though they are, being taxonomies that are developed as a means to categorise intervention content, ‘evidence of “efficacy” or “effectiveness” is not part of the definition of BCTs’ (Michie, Johnson, & Johnston, 2015, p. 25). This means that although these taxonomies contain effective behaviour change methods (techniques), they also contain ineffective methods, and may even contain counter-effective methods. Thus, while well-suited for intervention *coding*, such taxonomies are not a good basis for intervention *development*. Although a taxonomy for intervention development has existed for some time (Bartholomew, Parcel, & Kok, 1998), it has never been published as such. The current contribution presents this taxonomy, which is extracted from the Intervention Mapping (IM) protocol for the development, implementation, and evaluation of behaviour change interventions (IM; Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011).

Whereas taxonomies for coding interventions generally consist of descriptions of BCTs, taxonomies for developing interventions need to acknowledge a number of additional aspects of the dynamics of behaviour change. Three such aspects emerged in a recent critique of the approach to use BCT taxonomies in meta-analyses (De Bruin, Crutzen, & Peters, 2015; Peters, de Bruin, & Crutzen, 2015). Specifically, first, the selection of behaviour change methods should include a careful match with determinants that they can in fact change (e.g., guided practice is an effective method to enhance self-efficacy or to train skills, but not to change subjective norms); second, a precursor to intervention development should assure that these determinants indeed predict the relevant behaviour (e.g., if a behaviour is exceptionally easy to perform, targeting self-efficacy will not yield behaviour change); and third, when change methods are applied, the parameters for a method’s effectiveness must be satisfied (e.g., successful modelling requires reinforcing an appropriate model). Before explaining this more in depth and providing definitions for these concepts, we will briefly introduce the IM protocol.

### **Origins, the dynamics of behaviour change, and definitions of the proposed taxonomy**

The IM protocol (Bartholomew et al., 2011) describes the iterative path from problem identification to problem-solving or mitigation. Each of the six steps of IM comprises several tasks each of which integrates theory and evidence. The completion of the tasks within a step creates a product that is the guide for the subsequent step. The completion of all of the steps serves as a blueprint for designing, implementing, and evaluating an intervention based on a foundation of theoretical, empirical, and practical information. The six steps and related tasks of the IM process are: (1) conduct a needs assessment or problem analysis by identifying what, if anything, needs to be changed and for whom; (2) create matrices of change objectives by combining (sub-)behaviours with behavioural determinants to identify which beliefs should be targeted by the intervention; (3) select theory-based intervention methods that match the determinants into which the identified beliefs aggregate, and translate these into practical applications that satisfy the parameters for effectiveness of the selected methods; (4) integrate the practical applications into an organised programme; (5) plan for adoption, implementation, and sustainability of the programme in real-life contexts by identifying programme users and supporters and determining what their needs are and how these should be fulfilled; (6) generate an evaluation plan to conduct effect and process evaluations to measure programme effectiveness. The keywords in IM are planning, research, and theory. IM provides a vocabulary for programme planning, procedures for planning activities, and technical assistance with identifying theory-based determinants and matching them with appropriate methods for change.

### **Determinants**

Changing something requires understanding it first. In the case of behaviour change, it is necessary to understand why people engage (or do not engage) in the behaviour of interest. These reasons, as far

as they exist within an individual, are commonly seen as ideas, or cognitions, or emotions, or beliefs, or processes, or automatic associations, etc. The literature commonly distinguishes two levels for such reasons; the lowest level, containing the individual thoughts, emotions, automatic associations, or elements of a process; and an aggregate level, where similar and related thoughts, emotions, automatic associations, and process elements exist aggregated in so-called 'determinants' (Peters, 2014). Thus, an individual might believe that condoms decrease the likelihood of contracting a sexually transmitted infection; that condoms decrease the sensations during intercourse; that most of her friends do not use condoms; and that her health-care provider endorses condom use. The first two beliefs are generally thought to aggregate into the determinant 'attitude'; the last two beliefs into the determinant 'social norm'. This aggregation is based on functional similarity; attitudinal beliefs have a similar structure, and influence behaviour similarly; beliefs underlying self-efficacy are also similar but different (i.e., they all concern ability and control, but cover different aspects of a behaviour), etc. This functional aggregation of similar beliefs into determinants has enabled development of theories that can be used to explain a wide variety of behaviours in a wide variety of populations and contexts.

Thus, behavioural determinants are generic aggregates of beliefs, which instead are specific to behaviour, population, and context. It follows from this that we define personal determinants as generic modifiable psychological variables or regulatory processes that are assumed, on the basis of empirical or theoretical evidence, to be causal antecedents of behaviour. We define beliefs as the specific lower level elements of these determinants that together make up each determinant. Note the breadth of this definition of a belief. Traditionally, beliefs are often defined to be similar to reasons for behaviour. Instead, in the current definition, beliefs can also be elements of a process (e.g., monitoring or goal selection), and therefore, determinants can also be processes (e.g., self-regulation or goal setting). Behaviour change methods try to change behaviour by trying to change determinants. However, as determinants are defined generically, they cannot be targeted directly. Instead, behaviour change methods target specific beliefs, and therefore, for any behaviour change method, it must be clear which belief(s) are targeted (and into which determinant(s) these beliefs aggregate). When a belief has been selected as intervention target, it is generally known as a 'change objective'.

It is very common in descriptions of behaviour change interventions in the scientific literature to include no, or only cursory, descriptions of the determinants targeted by the intervention. With no determinants hypothesised, it is impossible for a reader to judge whether the theory-based change methods chosen to influence behaviour are the correct ones. As has been argued before, '[...] what is effective for a given behaviour, delivered in a particular way, in a given target group and a given context may not be effective for other behaviours [and] target groups [...]', which is in no small part due to differences in relevant determinants or differential matched between determinants and methods (Michie & West, 2013, p. 14).

### ***Theory-based methods for change***

We define theory-based methods, or behaviour change methods, as general techniques or processes that have been shown to be able to change one or more determinants of behaviour of members of the at-risk group or of environmental decision-makers (Abraham & Michie, 2008; Bartholomew et al., 2011). Note that by 'theory based', we mean that the methods 'have their origins in behavioural and social science theories' (Bartholomew et al., 1998), and it is not uncommon that evidence for a method is provided in several theories. The theory explains how the mechanism of action works, and thus testifies as to *why* we can expect a causal link between application of the method and behaviour change. As such, theory-based methods are based on the literature regarding effective behaviour change. Such research almost never concerns methods for influencing behaviour directly: in almost all cases, general methods are studied for influencing generic determinants, such as attitude or self-efficacy, that in turn are supposed to

influence the behaviour. The generic nature of these determinants and the methods to change them is consistent with psychologists' aim to study human behaviour and psychology in general; yet at the same time, this means that such methods cannot immediately be applied in behaviour change interventions. After all, such interventions will always take place in specific populations and environments: they must contain specific messages that target selected beliefs within the determinants of interest, and require specific translation to practical applications to reach optimal fit.

### **Practical applications**

We define practical applications as specific translations of theory-based methods for practical use in ways that fit the intervention population and the context in which the intervention will be conducted (Bartholomew et al., 2011). Note that practical applications therefore have as one of their characteristics one or more mode(s) of delivery, such as 'face to face', 'internet', or 'telephone' (Hoffmann et al., 2014). For example, a group discussion is an example of a practical application, and can be held face to face or using the internet (i.e., with different modes of delivery). In addition, specifying the mode of delivery would not suffice to describe the application: the exact content of group discussion protocols or a recording are also part of the application. This is important because any thorough description of an application needs to make clear how satisfaction of the parameters of effectiveness of the embodied methods of behaviour change is secured. For example, group discussions can increase knowledge only if the correct schemata are activated in those discussions (see Table 2 in the supplementary materials or at <http://osf.io/sqtuz>). Therefore, a part of the application must be a system for ensuring that these schemata are addressed in the discussions, regardless of mode of delivery (e.g., face to face).

For example, change objectives for an intervention might be to increase adolescents' self-efficacy beliefs to resist social pressure to use drugs. The accompanying belief would be, for example, 'When I am at a party and a friend offers drugs, it is hard to resist'. Successfully changing this belief into: 'When I am at a party and a friend offers drugs, I am confident that I can resist', would increase adolescents' self-efficacy (the overarching determinant) to refuse offered drugs. To achieve this change objective, theory-based methods might include *modelling*, *guided practice with feedback*, and *reinforcement*. One application for *modelling* in a school setting could be a videotaped step-by-step demonstration by adolescents of how to resist peer pressure in situations they commonly encounter. However, for a different population, such as low-income middle-aged migrants, a discussion session that incorporates a role playing session with a professional actor might be more appropriate. Thus, the same method can be translated into a myriad of possible applications depending on the specific population and context. Similarly, one application can be a manifestation of multiple methods, as illustrated in Table 15 in the supplementary materials or at <http://osf.io/sqtuz> (also see Figures 2 and 3 in Kok, 2014).

The situation commonly encountered in the 'real world' of intervention development (possibly as compared to a tightly controlled research development situation) is that theory-based methods tend to disappear in translation. In other words, even when there is a clear plan for what determinants to target and what theory-based method to use to promote change, in the end, when translating these methods to actual materials and messages, programmes are often missing necessary methods. Some methods may be lost in translation because logistical issues of development and production of programme components and materials may begin to seem overwhelming and cuts are made to the plan. Other times, attempts are made to attach theory-based change methods to influence each determinant, but the ways in which the practical applications are conceptualised and delivered do a poor job of translating the methods. We explicate this problem further in the discussion in the next section – parameters for methods.

### Parameters for methods

Translating methods into practical applications demands a sufficient understanding of the theory behind the method, especially the theoretical parameters under which the theoretical process is effective or not (Kok, Gottlieb, Panne, & Smerecnik, 2012; Schaalma & Kok, 2009). Parameters of effectiveness of a theoretical method are defined as the conditions that must be satisfied in practical applications for the method to be effective. In other words, if a practical application embodies a given theoretical method but violates one or more parameters of effectiveness of that method, it will be less effective or may even be counter effective. For example, *modelling* is a strong method but only when certain parameters are met, for instance reinforcement of the modelled behaviour (McAlister, Perry, & Parcel, 2008). People or environmental decision-makers do not usually imitate behaviour simply because a model demonstrates that behaviour; they behave comparably to the model only when the model exhibits certain characteristics, such as being reinforced for that particular behaviour and when they expect to be reinforced in a similar way. Translating the method *modelling* to a practical application includes taking care that in the actual programme, from the perspective of the programme participants, the model is reinforced (but see Table 1 in the supplementary materials or at <http://osf.io/sqtuz> for the other parameters). As a second example, *goal setting* can be a very effective method, but only when the goal is challenging as well as acceptable for the actor. People often choose goals outside those parameters (see Table 7 in the supplementary materials or at <http://osf.io/sqtuz>). A third classic example is provided by the method *implementation intentions*. While very effective when properly applied, violation of its parameter for effectiveness (a pre-existing intention to perform the behaviour) greatly reduces or eliminates this effectiveness. Finally, *fear appeals* are only effective when the at-risk population has high (self-)efficacy and they may be counter effective when efficacy is low (Peters, Ruiter, & Kok, 2013). Nevertheless, many expect *fear appeals* to be generally effective (Peters, Ruiter, & Kok, 2014; Ten Hoor et al., 2012).

All theory-based methods have such parameters, which have to be taken into account when translating a method into a practical application. These parameters are generally specified in the theoretical evidence for a given method, which is why this basis in theory is so important. This also illustrates the importance of distinguishing between theoretical methods of behaviour change and practical applications. An intervention consisting entirely of effective methods of behaviour change can fail to show any effect if the applications of these methods fail to satisfy each method's parameters of effectiveness (Kok, 2014).

### Methods at environmental levels: an ecological approach

It is very difficult to imagine a health promotion intervention setting that is not embedded in some kind of social or physical system (Golden & Earp, 2012). A child with asthma is in an environment with parents, nurses, doctors, and other children with asthma. An adolescent in an HIV-prevention programme is in an environment with friends, sexual partners, parents, teachers, and community leaders. Worksite employees participating in a smoking-cessation programme are in an environment with colleagues, health professionals, supervisors, and worksite policies. However, most taxonomies focus on individual behaviour change and only a few also include behaviour change of environmental agents (Bartholomew et al., 2011; Khan et al., 2009). Environmental conditions are not likely to be under the direct control of the individuals at risk for the health problem. They are controlled by decision-makers, external agents such as peers, teachers, managers, and other gatekeepers. Such external agents exist at various environmental levels: interpersonal, organisational, community, and societal levels (Kok, Gottlieb, Commers, & Smerecnik, 2008). To select methods for changing environmental conditions, the first thing to do is to find out who may be in a position to make the expected change. The programme planner has to identify the desired behaviours for the agent who will actually change the environmental condition. The health promoter then applies methods for influencing the determinants of the agent's behaviour using methods which are

appropriate for changing determinants at environmental levels. For example, a basic method for all environmental levels is *advocacy*, a method for the interpersonal level is *enhancing network linkages*, for the organisational level *sense-making*, for the community level *social action*, and for the societal level *agenda setting*. Again, there are theoretical parameters for effectiveness of these environmental level methods; for example, *agenda setting* requires appropriate timing, and *social action* needs to start where the community is (Bartholomew et al., 2011).

Because environmental change always requires human agency, methods at the individual level can also be used for agents at higher ecological levels (Kok et al., 2012). The theoretical process behind the method is the same for all levels (see Figure 1 in the supplementary materials or at <http://osf.io/sqtuz>); however, often the application of the method is somewhat different, depending on the target. For instance, a study integrating information from interventions to change environmental conditions (Kok et al., 2012) found that the method *persuasion* was applied targeting environmental agents at various levels, by actors who themselves were located at various levels (e.g., organisational methods could be used by health promotion agencies to target the management of an organisation, or by the management of an organisation to target their employees). In a project to decrease carbon dioxide transmission (Kok et al., 2008), the health promoter reported a *persuasion* approach that illustrated to businesses, corporations, and other companies the advantages of approaching and dealing with the issue of carbon dioxide emissions. The health promoter showed them how carbon dioxide reduction is profitable and made it clear to companies that being environmentally friendly is positive for the company image. The potential effect on the image of and profit for the company are typical organisational level arguments.

## A taxonomy of behavioural change methods

### *Behaviour change methods*

The taxonomy we propose in the accompanying tables (provided in the supplementary materials and at <http://osf.io/sqtuz>) includes behaviour change methods derived from theory and presented in the IM protocol (Bartholomew et al., 2011). We include the definition of the methods and the reference to an original theoretical foundation. The first series of tables presents basic methods and methods geared to changing certain determinants (e.g., attitude and skills) of the at-risk individuals. In the second series of tables, we present methods for change at environmental levels. It is important for health promotion planners to realise that individual behaviour change is almost always embedded in one or more environmental levels and that methods for individual change (Tables 1–8) need to be complemented with methods for change at those environmental levels (Tables 9–14).

We combine comparable determinants from different theories, for example, attitudes, beliefs, and outcome expectations. The various determinants are not independent of each other; we will start with knowledge as the basis for many other determinants, such as risk perception, attitudes, and skills. Risk perception in turn is a specific part of attitude. Methods described for one determinant may sometimes be used for other determinants as well (e.g., Elaboration). If we think that a method may be applied to almost any determinant we present that method in the table of 'Basic Methods'. The theoretical background for all methods is provided in Bartholomew et al. (2011) and mentioned in the tables (see the supplementary materials or <http://osf.io/sqtuz>).

### *Origins of the definitions*

IM originated in response to questions by students how to use theory in intervention development. We began to examine programmes developed in our own work and to identify general principles and procedures we used in our development, which led to the stepwise process of conducting a needs assessment, creating matrices of change objectives, selecting theory-based intervention methods, and translating these into practical applications, developing the programme, planning for

implementation, and planning for evaluation (Bartholomew et al., 1998). The description, definitions, parameters, and examples of the behaviour change methods are the product of a process of joint conceptual analysis that was repeated over time with the various editions (Bartholomew et al., 2011, 2016; Bartholomew, Parcel, Kok, & Gottlieb, 2001, 2006). Most of our definitions of intervention methods are directly derived from the theory involved as published in textbooks on theories of (health) behaviour and change or in reviews and meta-analyses. Some of our definitions are based on definitions by others (e.g., Abraham & Michie, 2008). At two moments we involved colleagues in the field of health promotion and health psychology for consensus building, evaluation, and improvement. Preparing the 2011 editions, we sent our definitions to 50 colleagues. About 40 colleagues responded with suggestions and in Bartholomew et al. (2011) we reformulated the definitions. For the current paper we adapted some definitions based on another round of comments from 20 of the same 40 colleagues (Kok et al., 2012). We do not presume to give the only possible definition; in our consensus studies we noticed that definitions differ among experts. Together with the definitions we provide the parameters for use: the conditions under which the theory-based method will be effective. We also adapted the parameters, based on recent meta-analyses and reviews (e.g. Peters et al., 2013). These lists of methods and parameters are not to be used as a cook book. The list is meant to stimulate programme planners to judge the evidence to support the potential of the methods on the list to produce change as well as to assure that the parameters, within which particular methods can be expected to work, are considered.

### **Evidence base underlying these tables**

The first column of these tables includes a reference to literature syntheses that discuss the method's effectiveness and the identified parameters that moderate this effectiveness. Often, these syntheses are narrative reviews, whereas ideally, one or more meta-analyses would be available for each method. However, recently, meta-analyses addressing the effectiveness of behaviour change methods have failed to take into account the four conditions for a method to effectively influence behaviour: first, a method can only influence behaviour if it targets beliefs that underlie a determinant that the method can change; second, these beliefs (and the overarching determinant) must in fact be relevant predictors of the behaviour; third, the method must be translated into a practical application that fits with the target population, its culture, and the relevant context; and fourth, the parameters for effectiveness of the method must be satisfied in the final application (De Bruin et al., 2015; Peters et al., 2015). This means that currently, the evidence base underlying these methods is less grounded in inferential statistics than is desirable. We therefore echo the call for more meta-analyses of fundamental studies, and indeed, more fundamental studies, of Peters et al. (2015). Notwithstanding this urgent need for more research, note that these methods are derived from psychological theory, and theories in themselves are a codification of an accumulation of empirical evidence. Thus, all included methods, even those lacking meta-analytical support, do have an evidence base, albeit not always one that is quantified.

### **How to use the tables**

This description assumes that the intervention developer has identified which behaviour to change, and whose behaviour this is (i.e., either of a target population individual or of an environmental agent). It also assumes that the relevant determinants and underlying beliefs have been identified. When selecting methods for individuals from the target population, for each determinant, Tables 1–8 can be consulted to get an initial list of methods that can be used to change that determinant. For example, Table 1 contains methods that can be used for most determinants, whereas Table 3 contains methods to change awareness and risk perception, and Table 6 contains methods to change perceived social influence. For each potential method, inspect the definition and the parameters to determine whether the method is applicable given the situation. Then, use the references included

in the tables to study the relevant literature, and use bibliographic databases such as Google Scholar to locate more recent literature. Repeat these steps for all determinants, until methods have been identified to target all determinants and beliefs. Then, translate these methods into practical applications, making sure that the parameters for effectiveness are respected. It is important to note that these parameters for effectiveness are subject to change as new literature is published. Also, the strength of the evidence for each method varies, new methods can emerge, and evidence can accumulate that certain methods are better avoided (e.g., threatening communication in populations low in self-efficacy).

When selecting methods to target environmental agents, the process is similar. Depending on the environmental level of the agent, consult Tables 9–14 to get an initial list of methods. For example, Table 9 contains basic methods that can be used for agents at all environmental levels, whereas Table 11 contains methods that can be used to target agents at the organisational level. Because each environmental agent is a person (or several), in addition to these environmental methods, Tables 1–8 can also be consulted to get a list of methods at the individual level. Of course, at the environmental level, it is also necessary to consult the literature, both those publications cited in the tables and recent updates.

## Discussion

### *Development versus coding taxonomies*

In the same way that coding taxonomies are unfit for intervention development, the taxonomy we just described is unfit for coding in its current form. Because of the different goals of the two types of taxonomy, each type has been optimised for different uses. Instruments for intervention development have to acknowledge, and provide a procedure for dealing with, the dynamics of behaviour change as explained above; and instruments for intervention coding have to provide clear, mutually exclusive definitions and categories that are optimised for reliable coding. Nonetheless, both types of taxonomies deal with behaviour change, and so both types can be developed further to meet both goals. For example, de Bruin, Viechtbauer, Hospers and Schaalma (2009) as well as Van Achterberg et al. (2011) successfully integrated both approaches in their coding systems. The practical difference is that for a coding taxonomy, the distinction between every pair of comparable methods has to be very clearly defined, while for a development taxonomy, methods drawn from different theories may overlap, and the goal is to provide a toolbox that most efficiently enables planners to select the method that fits their circumstances. A consequence is that in a development taxonomy, methods may vary in their level of specificity, and may even encompass each other. For example, providing *arguments* always entails *persuasive communication*; as explained before, methods on the environmental level are often bundles of other methods; and many methods are *tailored* (see e.g., Mullen, Green, & Persinger, 1985).

These differences mean that there is still work to be done to integrate these two approaches. At the same time, working towards such integration seems beneficial. Coding with a taxonomy that both acknowledges the dynamics of behaviour change and provides mutually exclusive, reliably applicable categories has clear advantages. Such a coding procedure would yield not only a list of behaviour change methods used in an intervention, but a description of targeted determinants (and preferably beliefs or change objectives), behaviour change methods matched to those determinants, parameters for effectiveness for those methods, and the applications that together make up the intervention. This distinction of the different aspects of a behaviour change intervention makes coding easier and more accurate: furthermore, the resulting coding is more sensitive and specific, creating more powerful predictors, or study outcomes.

Similarly, developing and describing interventions using the same taxonomy that is used to code intervention content in meta-analyses can significantly improve meta-analysis quality. After all, coding intervention descriptions is more like a necessary evil than desirable in itself. Fisher famously



stated, 'To call in the statistician after an experiment is finished is often no more than asking him to conduct a post mortem examination. He can perhaps say what the experiment died of' (1938, p. 17); and something similar is true for intervention development. Ideally, coding is redundant because thorough documentation is provided detailing the intervention components, the decisions that were taken, and the justifications. To code the terse intervention descriptions that are currently frequently encountered can provide some indication as to which behaviour change methods were used, whether these matched the targeted determinants, and whether the parameters for effectiveness were preserved during the translation to applications; but much information will have been lost.

Currently, many intervention developers do not yet develop their interventions systematically, as was shown by recent qualitative (Peters et al., 2014; Schaafsma, Stoffelen, Kok, & Curfs, 2013) and quantitative evidence (Godin, Gagnon, Alary, Levy, & Otis, 2007). Clearly, it is important not only to develop a toolbox of behaviour change methods, but also to explore how interventions are currently developed. Such studies will often yield qualitative data, and such data sets can also be successfully coded using the IM taxonomy, as was recently shown by Schaafsma et al. (2013). In such coding efforts, the more extensive vocabulary afforded by the IM taxonomy is valuable in describing intervention developers' reasoning and choices in sufficient detail. Ideally, the same taxonomy that is used for meta-analyses can be used in such qualitative studies. After all, the ultimate goal of any taxonomy is to enhance the quality of intervention development, and this requires that the taxonomy can either be directly used by practitioners to develop interventions, or that it interfaces with a system for intervention development.

Finally, using one system for both intervention development and description on the one hand and coding for meta-analyses on the other hand will provide a shared vocabulary that facilitates scientific communications. A recent initiative to establish such a vocabulary for knowledge translation illustrates the need for such a unified vocabulary (Colquhoun et al., 2014). The integration of coding and development taxonomies, and the requisite acknowledgement of all aspects of behaviour change dynamics (e.g., the distinction between theoretical methods or BCTs and practical applications, the role of determinants and beliefs as intervention targets, and the role of parameters for effectiveness in determining a method or BCTs effectiveness), would enable working towards such a shared vocabulary. A shared vocabulary would also greatly enhance reporting of intervention descriptions and evaluations in the literature conform reporting guidelines.

### ***The IM taxonomy and reporting guidelines***

Reporting guidelines such as consolidated standards of reporting trials (CONSORT) (published simultaneously by three top medical journals in 2001, that is, Moher, Schultz, and Altman for the CONSORT Group and most recently updated in 2010 by Schultz, Altman, and Moher for the CONSORT Group) have had substantial impact on the completeness of reporting of study reports, that is, randomised controlled trials (Turner, Shamseer, Altman, Schulz, & Moher, 2012; Turner, Shamseer, Altman, Weeks, et al., 2012). Their primary impact has been on titles (specifying the study design), methods sections (i.e., blinding of data collectors), and results sections (i.e., the well-known CONSORT flowchart). Intervention descriptions have been far slower to catch up. The CONSORT family now numbering nine official extensions (<http://consort-statement.org/extensions>) only offers 'non-pharmacologic interventions' to health promotion researchers, with checklist items regarding 'details of the treatment', tailoring, standardisation, and adherence to the protocol (Boutron, Moher, Altman, Schulz, & Ravaud, 2008). Previously, frustrated reviewers had a very low bar – provider, format, setting, recipient, intensity, duration, and fidelity (Whitlock, Orleans, Pender, & Allan, 2002) – which was endorsed by Society for Behavioral Medicine members the next year (Davidson et al., 2003).

Very recently, a new CONSORT extension was proposed: this checklist and guidance, the Template for Intervention Description and Replication (TIDieR), extends item five of the CONSORT statement (Hoffmann et al., 2014). Of the 12 items in the TIDieR checklist, 3 can be taken to deal with the aspects of behaviour change as just described. These are the second ('any rationale, theory, or

goal of the elements essential to the intervention'), third, 'any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers', and the fourth ('each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities'). The second checklist item could be used to provide detailed information about the targeted beliefs, determinants and behaviour change methods; the third about applications, how the chosen methods were translated, and how the parameters for effectiveness were safeguarded; and the fourth about behaviour change methods. However, the nature and level of detail of the information in the examples provided implies that this is not how the authors envision these checklist items (Hoffmann et al., 2014). Following the TIDieR checklist and guidance may still frequently yield intervention descriptions where it remains unclear which determinants and beliefs were targeted; which methods were chosen to target these determinants and beliefs; to which practical applications these methods were translated, and how the parameters for effectiveness, population characteristics, and context were respected in this translation.

These guidelines are undisputedly a great step forwards in the completeness and transparency of the reporting of interventions, especially when combined with full disclosure of all intervention materials and documents used in the development (Peters, Abraham, & Crutzen, 2012). At the same time, there appears to remain room for improvement when it comes to behaviour change interventions. For such interventions, adding the additional elements recommended here could make a needed contribution to clearer reporting of behavioural and multi-level interventions, with the potential to improve intervention development (Popham et al., 2012). We suggest that authors include in their methods sections a table as follows: determinants targeted by the intervention, specific theoretical method(s) used to address each determinant, with the parameters that were enlisted, the application(s) for each method, and how the population, context, and parameters were taken into account when the method was translated to application. An example can be found in Table 15 in the supplementary materials or at <http://osf.io/sqtuz>. Note that the last column of this table corresponds to the third item in the TIDieR checklist, while the first three cover the second and possibly fourth items. Finally, ideally the beliefs that were targeted within each determinant would be published as supplemental materials.

## Conclusion

In this contribution, we have done three things. First, we introduced the IM taxonomy of behaviour change methods and its potential to be developed into a coding taxonomy. That is, although IM and its taxonomy of behaviour change methods are not in fact new (Bartholomew et al., 1998), because IM was originally developed as a tool for intervention development, this potential was not immediately apparent (Schaalma & Kok, 2009). Second, in explaining the IM taxonomy and defining the relevant constructs, we called attention to the existence of parameters for effectiveness of methods, and explicated the related distinction between theory-based methods and practical applications and the probability that poor translation of methods may lead to erroneous conclusions as to method-effectiveness (Peters et al., 2015 explain the problems more in depth). Third, we have recommended a minimal set of intervention characteristics that may be reported when intervention descriptions and evaluations are published. Specifying these characteristics can greatly enhance the quality of our meta-analyses and other literature syntheses.

In conclusion, the dynamics of behaviour change are such that any taxonomy of methods of behaviour change needs to acknowledge the importance of, and provide instruments for dealing with, three conditions for effectiveness for behaviour change methods. For a behaviour change method to be effective: (1) it must target a determinant that predicts behaviour; (2) it must be able to change that determinant; (3) it must be translated into a practical application in a way that preserves the parameters for effectiveness and fits with the target population, culture, and context. Thus, taxonomies of methods of behaviour change must distinguish the specific

determinants that are targeted, practical, specific applications, and the theory-based methods they embody. In addition, taxonomies should acknowledge that the lists of behaviour change methods will be used by, and *should* be used by, intervention developers. Ideally, the taxonomy should be readily usable for this goal; but alternatively, it should be clear how the information in the taxonomy can be used in practice. The IM taxonomy satisfies these requirements, and it would be beneficial if other taxonomies would be extended to also meet these needs.

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