A Classification of Motivation and Behavior Change Techniques Used in Self-Determination Theory-Based Interventions in Health Contexts

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Abstract

While evidence suggests that interventions based on self-determination theory have efficacy in motivating adoption and maintenance of health-related behaviors, and in promoting adaptive psychological outcomes, the motivational techniques that comprise the content of these interventions have not been comprehensively identified or described. The aim of the present study was to develop a classification system of the techniques that comprise self-determination theory interventions, with satisfaction of psychological needs as an organizing principle. Candidate techniques were identified through a comprehensive review of self-determination theory interventions and nomination by experts. The study team developed a preliminary list of candidate techniques accompanied by labels, definitions, and function descriptions of each. Each technique was aligned with the most closely-related psychological need satisfaction construct (autonomy, competence, or relatedness). Using an iterative expert consensus procedure, participating experts (N=18) judged each technique on the preliminary list for redundancy, essentiality, uniqueness, and the proposed link between the technique and basic psychological need. The procedure produced a final classification of 21 motivation and behavior change techniques (MBCTs). Redundancies between final MBCTs against techniques from existing behavior change technique taxonomies were also checked. The classification system is the first formal attempt to systematize self-determination theory intervention techniques. The classification is expected to enhance consistency in descriptions of self-determination theory-based interventions in health contexts, and assist in facilitating synthesis of evidence on interventions based on the theory. The classification is also expected to guide future efforts to identify, describe, and classify the techniques that comprise self-determination theory-based interventions in multiple domains.

Keywords: Self-determination theory interventions; Autonomous motivation; Autonomy support; Need satisfaction; Motivational technique

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Theory-Based Interventions in Health Contexts

Chronic non-communicable diseases and conditions such as cancer, cardiovascular

disease, obesity, and diabetes contribute to a large proportion of population morbidity and

mortality worldwide, and also account for a substantive proportion of healthcare costs (Li et

al., 2018; OSBBR, 2016; The US Burden of Disease Collaborators, 2018). In response,

national departments of health and healthcare organizations have advocated prevention through

interventions to promote participation in health-related behaviors, such as participation in

physical activity, healthy eating, avoiding tobacco, and treatment adherence (Dunton,

Cousineau, & Reynolds, 2010; Ueda et al., 2018; Wood et al., 2018). Given that current

population-level participation in these behaviors is insufficient to confer health benefits and

prevent chronic disease, developing behavioral interventions and testing their efficacy and

effectiveness in increasing health behavior participation rates is considered a public health

priority (Bartholomew & Mullen, 2011; Glanz & Bishop, 2010; Johnson & Acabchuk, 2018).

Psychologists and behavioral scientists have applied motivational theories to identify

the modifiable factors and mechanisms that relate to health behaviors, which can be used as a

basis for the development and evaluation of behavioral interventions (Hagger, Cameron,

Hamilton, Hankonen, & Lintunen, 2020; Rothman et al., 2015; Sheeran, Klein, & Rothman,

2017). Self-determination theory (Deci & Ryan, 1985, 2000; Ryan & Deci, 2017) is a

prominent theory of motivation that has demonstrated promise in identifying the psychological

factors and processes that determine motivated behavior in diverse health contexts. In addition,

interventions based on the theory have been shown to be efficacious in promoting motivation

toward, and actual participation in, health behavior across multiple populations, contexts, and

behaviors (e.g., Chatzisarantis & Hagger, 2009; Emm-Collison, Jago, Salway, Thompson, &

Sebire, 2019; Gillison, Rouse, Standage, Sebire, & Ryan, 2018; Ng et al., 2012; Teixeira,

Carraca, Markland, Silva, & Ryan, 2012; Williams, McGregor, Sharp, Kouides, et al., 2006;

Williams, McGregor, Sharp, Levesque, et al., 2006). While there has been some previous research specifying and defining the content of self-determination theory-based interventions in education contexts (e.g., Aelterman et al., 2019; Cheon & Reeve, 2013; Reeve & Jang, 2006; Su & Reeve, 2011; Tessier, Sarrazin, & Ntoumanis, 2008), there have been few attempts to develop descriptions of the essential and distinct techniques that comprise interventions based on the theory (Gillison et al., 2018; Ryan, Patrick, Deci, & Williams, 2008). Moreover, considerable variability in how the theory is currently applied and tested in health behavior settings has been noted (Silva, Marques, & Teixeira, 2014). For example, interventions based on the theory have tended not to identify the theory-based constructs targeted by the intervention content, or clearly specify links between the content with the targeted constructs, or conduct appropriate analyses to test whether the intervention content leads to changes in both the construct and the outcome of interest, often a behavioral measure.

There is, therefore, a need to systematically identify and describe the practices or *techniques* that comprise self-determination theory-based interventions (Ryan et al., 2008). Identifying these techniques will be valuable to stakeholders (e.g., researchers, administrators) interested in developing behavioral interventions based on the theory and conducting research to establish their efficacy and effectiveness since it will provide a common set of descriptions of the techniques that make up the content of the interventions. It will also contribute to research aimed at developing an evidence base of optimally efficacious and effective intervention techniques based on the theory. The purpose of the present study was to develop an organized description of the essential techniques implemented within interventions based on self-determination theory in health contexts using an expert consensus approach.

Self-Determination Theory and Basic Psychological Needs

Self-determination theory is a theory of human motivation that has demonstrated efficacy in predicting motivated behavior in multiple contexts and populations, and for a variety of behaviors (Deci & Ryan, 1985, 2000; Ryan & Deci, 2017), including health

behaviors such as physical activity, healthy eating, and smoking cessation (Ng et al., 2012; Patrick & Williams, 2012; Ryan & Deci, 2017). Self-determination theory is unique among theories of motivation due to its focus on the *quality* of motivation rather than quantity alone. Self-determination theory emphasizes the importance of the *kind* of motivation that drives people's behavior, alongside considerations of *how much* they are motivated. Central to the theory is the distinction between self-determined or *autonomous*, and non-self-determined or *controlled* forms of motivation (Deci & Ryan, 2000; Ryan & Deci, 2017). These motivational subtypes reflect the degree to which actions are fully self-endorsed by the individual. Autonomous motivation reflects self-endorsed reasons for engaging in a behavior or pursuing a particular goal. Individuals acting for autonomous reasons experience their actions as freely chosen and consistent with their genuine sense of self, values, and personal goals, and feel that they are the origin of their actions (Ryan & Deci, 2006). In contrast, controlled motivation reflects reasons for acting that are not self-endorsed. Individuals citing controlled reasons for action view their behavior as originating outside their self and feel that their actions are controlled by external contingencies (Sheldon & Elliot, 1998; Sheldon et al., 2004). A third form of regulation is *amotivation*, a state which reflects a lack of any motivational force to act. Individuals who feel their actions are *amotivated* offer no discernible reason, motive, or intention for action (Deci & Ryan, 2000; Ntoumanis, Pensgaard, Martin, & Pipe, 2004). Across numerous health contexts, a cogent body of research has consistently found that autonomous forms of motivation are associated with behavioral persistence and healthier psychological outcomes (Hagger & Chatzisarantis, 2015; Ng et al., 2012; Pihu, Hein, Koka, & Hagger, 2008; Ryan & Deci, 2017; Teixeira et al., 2012).

A further key premise of the theory is that the quality of motivation experienced by individuals when acting is determined by the extent to which they view their actions to be consistent with, and in the service of, three basic psychological needs – autonomy, competence, and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2017). The needs are

considered universal, and are implicated in the process that gives rise to the type of motivation experienced in behavioral contexts (i.e., hallmarks) of each of the three psychological needs. The need to experience autonomy reflects actions as freely chosen and self-endorsed, reflecting the need for individuals to experience a sense of ownership and responsibility over their actions. The need for competence refers to the experience of being effective in one's environment, mastering mentally or physically challenging tasks, and perceiving sufficient capacity to perform actions. The need for relatedness reflects the need to feel accepted and respected, and to gain a sense of connectedness and mutual concern with important others (Deci & Ryan, 2000; Ryan & Deci, 2017). A summary of the three basic psychological needs from the theory is provided in Table 1. Large-scale research has supported the primacy of the needs for autonomy, competence, and relatedness above other candidate needs (Sheldon, Elliot, Kim, & Kasser, 2001) and across different cultural contexts (Chen et al., 2015). In addition, satisfaction of the needs have been shown to mediate the associations between autonomous motivation and behavioral persistence in multiple contexts including health behavior change (Ng et al., 2012). Analogously, the frustration of these basic psychological needs has been shown to mediate the associations between controlled forms of motivation and behavioral disengagement and lower wellbeing (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015; Silva et al., 2014; Vansteenkiste & Ryan, 2013).

Whether a person's psychological needs are satisfied or frustrated depends largely on the extent to which the person's surrounding environment and relationships support or thwart those needs (Deci, Eghrari, Patrick, & Leone, 1994; Deci & Ryan, 1985; Ryan & Deci, 2017). The behaviors displayed, or messages provided, by social agents (e.g., health practitioners, teachers, coaches, parents, peers, family members and colleagues) operating in an individual's social environment, or the content of messages communicated by other means (e.g., leaflets, websites, text messages, smartphone 'apps'), can be more or less supportive or thwarting of the

psychological needs. If the agents' behaviors or messages support the satisfaction of individuals' psychological needs, then these individuals are likely to experience their actions as autonomously motivated, and may engage with and/or maintain health behaviors (Deci & Ryan, 2000; Ntoumanis, Quested, Reeve, & Cheon, 2018; Ryan & Deci, 2017). In contrast, behaviors and messages that do not support, or actively hinder, satisfaction of psychological needs likely undermine autonomous motivation and promote controlled forms of motivation or amotivation, which may lead to maladaptive outcomes and behavioral disengagement (Deci & Ryan, 2000; Ntoumanis et al., 2018; Ryan & Deci, 2017). Providing guidance on the behaviors displayed by social agents, and specifying the content of messages, are potentially effective means to promote autonomous motivation and sustained behavior change. The process by which these interventions affect the quality of motivation is through the satisfaction of the three basic psychological needs. Satisfaction of the needs is considered a key mediator of self-determination theory-based interventions on outcomes, particularly behavior change.

Ryan, Patrick, Deci, and Williams (2008) proposed an integrative process model that draws together the key components of self-determination theory. The model specifies the theory-based processes by which need supportive actions and messages, and other dispositional factors, relate to health behavior participation and outcomes. An adapted form of this model is presented in Figure 1. As specified in the model, social agents' (e.g., health practitioners, teachers, coaches, parents, peers, family members and colleagues) behaviors and messages that support autonomy, competence, and relatedness determine whether actors' basic psychological needs are supported or frustrated (path 1, Figure 1). The extent to which needs are satisfied or frustrated will determine the type of motivation experienced (path 2, Figure 1), and the extent to which the individual engages in, and persists with, health-related behaviors (path 3, Figure 1). The experience of actions as autonomous, controlled, or amotivated will also determine whether an individual experiences adaptive emotional outcomes and overall levels of satisfaction (path 4, Figure 1). Finally, the type of motivation experienced will determine the

extent to which individuals report adaptive or maladaptive mental (path 5a, Figure 1) and

physical (path 5b, Figure 1) health-related outcomes, respectively. Research has supported the

proposed relations among the constructs of the process model, including relations between

need-supportive interventions and need satisfaction, and between these interventions and

behavioral and health-related outcomes (Ng et al., 2012; Su & Reeve, 2011). There is also

evidence demonstrating effects of interventions based on the theory on health behavior through

need satisfaction and autonomous motivation, but tests of these mediating effects are relatively

sparse (Chatzisarantis & Hagger, 2009; Duda et al., 2014; Ng et al., 2012).

Specifying the 'Techniques' of Self-Determination Theory Interventions

As outlined in the previous section, the specific behavioral and communicative

techniques can both signal and support basic psychological need satisfaction and, in turn,

promote autonomous motivation. Often, interventions based on self-determination theory

comprise a number of these techniques, and previous work has aimed to identify and catalogue

these techniques. For example, research in the field of education has developed autonomy

support training programs in which teachers are trained on the necessary skills and techniques

to foster students' need satisfaction in classroom contexts (e.g., Aelterman et al., 2019; Cheon

& Reeve, 2013; Cheon, Reeve, & Moon, 2012; Cheon, Reeve, & Ntoumanis, 2018; Lonsdale

et al., 2019; Reeve & Jang, 2006; Reeve et al., 2014; Tessier, Sarrazin, & Ntoumanis, 2010).

Within the context of education, Reeve and Jang (2006) produced a list of instructional

behaviors and lesson content that classroom teachers were observed to use to support

autonomy. This list has been updated and organized according to whether the behaviors were

autonomy-supportive or controlling (Reeve et al., 2014). Behaviors and instructions classified

as autonomy-supportive were: taking the students' perspective, creating opportunities for

student input and initiative, providing explanatory rationales for teacher requests,

acknowledging and accepting expressions of negative affect, and displaying patience.

Instructional behaviors considered to be controlling were: taking only the teacher's

perspective, introducing extrinsic incentives, uttering directives without explanations, relying on pressuring language to silence students' complaints, and pushing students into immediate compliance with the teacher's agenda.

These descriptions have been incorporated into the training programs designed to develop autonomy-supportive behaviors in teachers and help them avoid the use of controlling behaviors. By intervening to change teachers' autonomy-supportive techniques, the programs are expected to promote students' autonomous motivation in class and, over time, better academic engagement and attainment. The techniques included in these programs have also been used in observational checklists to assess teachers' use of autonomy supportive strategies in class, and to assess changes in the use of more autonomy supportive strategies after their delivery. In addition, this approach has been used to describe autonomy supportive intervention content in multiple contexts (e.g. healthcare, education, the workplace, sport and coaching, parenting, and therapy) and guide development of future educational interventions based on self-determination theory (e.g., Aelterman, Vansteenkiste, Van den Berghe, De Meyer, & Haerens, 2014; Carpentier & Mageau, 2016; Froiland, 2015; Gagné & Deci, 2005; Halvari & Halvari, 2006; Jungert et al., 2015; McLachlan & Hagger, 2010; Zuroff et al., 2007).

There is also research that has isolated techniques aimed at promoting motivation through support for competence and relatedness needs. Techniques to support competence focus on promoting a sense of satisfaction on tasks or toward goals, with a focus on making progress toward self-referenced goals, attaining mastery, and developing greater skills. For example, research has identified three essential techniques for competence support: stating clear expectations; providing 'how-to' guidance; and giving constructive/positive feedback. Studies have demonstrated the efficacy of these techniques in promoting motivation and adaptive outcomes (e.g., Carpentier & Mageau, 2016; Jang, Reeve, & Deci, 2010; Sierens, Vansteenkiste, Goossens, Soenens, & Dochy, 2009; Tessier et al., 2010). A parallel line of research has focused on techniques that support relatedness. Research identified several

essential techniques purported to support relatedness: fostering individualized conversation; promoting cooperation and teamwork; demonstrating awareness and care; and engaging in warm, friendly communication (Sparks, Dimmock, Lonsdale, & Jackson, 2016; Sparks, Lonsdale, Dimmock, & Jackson, 2017). Taken together, these research findings indicate sets of techniques that promote motivation and behavioral outcomes through support for autonomy, competence, and relatedness needs.

While numerous approaches to specifying the content of self-determination theory interventions exist, no formal system has been developed to identify and describe the techniques that comprise self-determination theory interventions. By comparison, relatively recent research has developed systems to identify, describe, and organize the essential techniques used in behavioral interventions more broadly. The development of classification systems for these techniques, referred to as *behavior change techniques*, is a prerequisite to be able to consistently describe behavioral interventions. The classification of behavior change techniques as *taxonomies* are typically developed through expert consensus methods. The development of taxonomies of behavior change techniques using the expert consensus method provides an opportunity to develop a formal organized description of techniques that comprise self-determination theory interventions. Development of a formal classification of techniques of self-determination theory interventions will provide the research community with a common set of terms to describe the content of interventions based on the theory, and allow for future empirical testing of which techniques or sets of techniques are most efficacious in promoting motivation and associated outcomes.

The Present Study

The purpose of the present study was to identify, define, and classify the unique techniques that comprise interventions based on self-determination theory, and develop the first classification of techniques comprising self-determination theory interventions in health behavior contexts. We used an iterative expert-consensus method to develop the classification,

consistent with methods used to develop taxonomies of behavior change techniques (Kok et al., 2016; Michie, Ashford, et al., 2011; Michie, Hyder, Walia, & West, 2011; Michie et al., 2013; Michie et al., 2015). Unlike existing behavior change technique taxonomies, we organized the current classification system according to links between the techniques and the psychological constructs stipulated in the process model based on self-determination theory (see Figure 1; Ryan et al., 2008). Specifically, we hypothesized intervention techniques to exert their effects on behavior and associated outcomes through changes in psychological need satisfaction, as well as autonomous and controlled forms of motivation, and amotivation. As the focus of the techniques was on change in motivation types defined by self-determination theory, rather than behavior specifically, the identified techniques are referred to as motivation and behavior change techniques (MBCTs). The development of the classification system[1] should be viewed as a first step in an ongoing, iterative process, progressively informed by empirical investigation of the effects of MBCTs on behavioral outcomes mediated by satisfaction of psychological needs of autonomy, competence, and relatedness.

Method

The unique MBCTs based on self-determination theory were identified, labelled, defined, and classified using an iterative expert consensus procedure, similar to procedures used to develop taxonomies of behavior change techniques (e.g., Michie, Ashford, et al., 2011; Michie, Hyder, et al., 2011; Michie et al., 2013; Michie et al., 2015). An MBCT was defined as a distinct, observable and replicable component of an intervention, designed to influence a person's behavior directly or indirectly by impacting the person's[2] perceptions of autonomy, relatedness, and/or competence need satisfaction in relation to a particular behavior or group of

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[1]We refer to a *classification system* rather than *taxonomy* as our proposed list of MBCTs is not expressed as a taxonomic structure, i.e., a hierarchical relationship in which lower level entities have only one type of relationship with a higher-order entity. The current classification is not, therefore, considered a true taxonomy.
[2]The 'person' refers to the individual or group (e.g., a client, patient, intervention participant) that is the target of the intervention.

related behaviors. The definition was based on previous definitions used in taxonomies of

behavior change techniques (Michie et al., 2013), and a recent classification of motivational

interviewing techniques (Hardcastle, Fortier, Blake, & Hagger, 2017). Descriptions of

motivational interviewing techniques were useful to inform the definition due to the expressed

conceptual links between motivational interviewing and self-determination theory-based

intervention techniques (Markland, Ryan, Tobin, & Rollnick, 2005; Vansteenkiste & Sheldon,

2006). For example, many of the techniques from motivational interviewing, such as

supporting autonomy and exploring change expectations, have good congruence with strategies

used in autonomy-support interventions focusing on choice and setting self-referenced goals

(Hardcastle et al., 2017; Vansteenkiste, Williams, & Resnicow, 2012).

Participants

Experts (N = 18, 11 men, 7 women) participating in the consensus procedure were

leading researchers with expertise in designing, conducting, and evaluating self-determination

theory-based interventions in the health domain. Participants were identified from the network

of self-determination theory researchers (www.selfdeterminationtheory.org) and recruited by

email. Fourteen were psychologists, three were physical activity specialists, and one was a

physician and health psychologist. Experts were based in the United Kingdom (n = 5), United

States (n = 4), Australia (n = 3), Belgium (n = 2), Sweden (n = 2), Canada (n = 1), and South

Korea (n = 1). The core study team (PJT, MM, MS, MSH) developed the first list of

techniques, and were responsible for the feedback, discussion, and refinement of the MBCTs.

Their collective expertise is in social psychology, behavioral science, medicine, preventive

medicine, and exercise and nutrition sciences, and all have specific expertise in self-

determination theory.

Procedure

A seven-step expert consensus procedure was adopted (Table 2). The procedure began

with the development of an exhaustive list of candidate techniques based on the pooled

knowledge of the lead author group and a content analysis of previous self-determination theory interventions. This was followed by a series of expert consensus exercises aimed at refining descriptions and content of the candidate items, removing redundancy, and establishing links between the techniques and need-satisfaction constructs from self-determination theory.

Step 1: Development of the first list of MBCTs. The study team members generated an initial 'long list' of distinct MBCTs used in self-determination theory-based interventions, derived from a content analysis of published interventions, manipulations, and autonomy support training programs (e.g., Chatzisarantis & Hagger, 2009; Cheon & Reeve, 2013; Deci et al., 1994; Haerens et al., 2013; McLachlan & Hagger, 2010; Patrick, Resnicow, Teixeira, & Williams, 2013; Reeve & Jang, 2006; Su & Reeve, 2011; Tessier et al., 2008)[3]. For each potential distinct MBCT, initial labels and definitions were formulated and discussed among the core study team members (PJT, MM, MS, MSH) until majority agreement was achieved. Specifically, as in taxonomies of behavior change techniques (e.g., Michie, Ashford, et al., 2011; Michie, Hyder, et al., 2011; Michie et al., 2013; Michie et al., 2015), definitions of MBCTs were formulated using active verbs (e.g., elicit, prompt, use).

Step 2: Consensus exercise – Round 1. An initial group of experts (N = 8) was asked to provide written feedback on the initial list of MBCTs from Step 1, regarding the clarity and content of each label and definition, as well as critical details any MBCTs would insufficiently capture[4].

Step 3: Consensus exercise – Round 2. Based on these experts' comments from Round 1 and on further discussion among the core team (PJT, MM, MS, MSH), the initial list of MBCTs was refined. Comments from Round 1 led to the decision to conduct a second round with an additional pool of experts. In addition, the core team added a function to each MBCTs.

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[3]References of all included studies are available as an online supplement: https://osf.io/ytfbq/
[4]Guidelines provided to the experts are available as an online supplement: https://osf.io/f42pe/

The function description outlined the purpose of the MBCT thereby specifying how it targets the proposed primary mechanism of action (i.e., the corresponding need from self-determination theory). The label, definition, and function descriptions of each MBCT were discussed among the core study team members until majority agreement was achieved.

In this round, a larger group of experts (N = 18), including the eight experts from Round 1, was asked to respond to a maximum of eight questions about each of 24 MBCTs from the refined list through an online questionnaire, using online surveys administered via the Qualtrics[TM] software. The task was divided in two parts. In the first part, experts rated the need-sensitivity of each MBCT, that is, the extent to which each MBCT targeted each of the three psychological needs – autonomy, relatedness and competence, starting with the need hypothesized to be most closely related to the MBCT (Questions 1, 2, and 3)[5]. Reponses were provided on a 5-point scale (1 = *definitely no* and 5 = *definitely yes*). Experts also rated the essentiality of each MBCT is to a self-determination theory-based health intervention (Question 4; coded 1 = *essential*, 2 = *important but not essential*, 3 = *not important*, and 4 = *uncertain/don't know*). In the second part, experts assessed the specificity of each MBCT by assessing its uniqueness in relation to any of the other MBCTs listed (Question 5; coded 1 = *sufficiently unique*, 2 = *overlapping considerably*, and 3 = *uncertain/don't know*). If experts responded "overlapping considerably", they were asked to indicate which of the other technique(s) the MBCT overlapped with (Question 6), and what changes could be done to reduce it (Question 7). Finally, all experts were asked if they wanted to make any other comments on each MBCT, such as changing labels, definitions, or function descriptions (Question 8). Responses to this question were optional, and it used an open-ended response format.

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[5]The reference list of definitions of basic psychological needs and their focus used by the experts is available as an online supplement: https://osf.io/msu97/

Prior to participating in this exercise, experts were informed about the expected task completion time and they could interrupt at any point, preferably after a set of related questions (i.e., an MBCT). They were also asked to familiarize themselves with the full list of MBCTs – label, definition, and function description – before starting the task. Follow-up reminders were sent to experts after 10 days, and all responses were submitted within 2 weeks.

To avoid confusion during the consensus exercise, experts were further informed that (1) when rating the MBCT-need link, each link should be considered separately, irrespective of whether other needs are targeted by the same MBCT; (2) each MBCT should be considered on its own, even if the MBCT is rarely used in isolation in self-determination theory-based interventions; (3) when rating the uniqueness of each MBCT, potential interactions between these techniques should not be considered; and (4) presenting each need separately does not imply that the effect of any MBCT on a given need is independent of other needs.

For the specificity, essentiality, and uniqueness questions, frequencies and mode averages of responses were calculated for each MBCT. Each MBCT was marked as requiring further consideration, if at least one-quarter (25%) of the experts considered: (1) the technique did not target the need theoretically hypothesized to be more closely linked to the MBCT (by responding 'definitely no', 'probably no' or 'uncertain' to Question 1); (2) at least one of the other two needs to be strongly targeted by the MBCT (i.e. by responding 'definitely yes' to Questions 2 or 3); (3) the technique to be unimportant in a self-determination theory-based health intervention (Question 4); and (4) the technique yielded considerable overlap considerably with other MBCTs (Question 5).

Step 4: Discussion and feedback from core team members. Based on the expert feedback in step 3, the core team members refined the list of MBCTs, based on the results Round 2 of the consensus exercise. For MBCTs rated (a) not important in the context of a self-determination theory-based intervention (Question 4), or (b) overlapping considerably with other MBCTs (Question 5), by the panel of experts, the team discussed their removal or

rewording until majority agreement was achieved. All labels, definitions and function descriptions were revised for comprehensiveness based on the experts' suggestions provided in Question 8.

Step 5: Consensus exercise – Round 3. The same group of experts (N = 18) was asked an additional set of questions about the MBCTs that required further consideration from the previous round; they were also asked to conduct a fine-grained review of the MBCT descriptions for clarity. In addition, for any MBCTs added to the list in this round, experts were asked the same set of questions as in Round 2.

For all MBCTs, where a consensus on their specificity was not reached, experts were asked to rate how (Question 1). Experts could select one of five responses: 1 = *Confident that it is largely specific to the [basic psychological need]*, 2 = *Uncertain/don't know*, 3 = *Confident that it is not specific*, and 4 = *Confident that it is not specific. It also targets* [alternate basic psychological need] *to a large extent*, 5 = *Confident that it is not specific. It also targets [alternate basic psychological need] and [alternate basic psychological need] to a large extent*. Experts selecting option 2 on Question 1 were asked to provide suggestions to rephrase the function description to improve the specificity of the MBCT (Question 2; open-ended question). Experts selecting options 3, 4, or 5 on Question 1 were asked to indicate how the MBCT targeted each of the needs selected (i.e., the proposed function), (Question 3; open-ended question).

For all MBCTs where a consensus on their uniqueness was not reached, experts were asked how satisfied they were that the MBCT was sufficiently unique in relation to others considered to be overlapping in Round 2, to justify being listed separately (Question 4; coded 1 = *sufficiently unique*, 2 = *overlapping considerably*, and 3 = *uncertain/don't know*). If participants responded "overlapping considerably", they were asked to describe why they considered the MCBTs to overlap, and suggest changes to the label, definition and/or function description, to reduce overlap (Question 5 open-ended question).

Finally, experts were presented with a group of four MBCTs (randomly selected), one at a time, and asked to review the label, definition, and function description for clarity of English language, and suggest minor changes where appropriate. This was an optional, open-ended response format.

As in Round 3, frequencies and mean or mode averages of responses were calculated for each MBCT. Each MBCT was marked as requiring further consideration, if at least one-quarter (25%) of experts considered that it was not specific to the stipulated need, and/or targeted an alternate need, by returning a 2, 3, 4, or 5 response to Question 1 (i.e. confidence that each MBCT is specific to each of the three psychological needs – autonomy, competence, and relatedness), and that it overlapped considerably with one or both of the other MBCTs by returning a 2 response to Question 4 (i.e., the MBCT is sufficiently unique in relation to other MBCTs or considered to be overlapping).

In addition, intraclass correlation coefficients (ICC) were computed in Rounds 2 and 3 to assess inter-rater reliability of experts' specificity, essentiality, and uniqueness ratings.

Step 6: Revision and finalization of the list of MBCTs. Based on the ratings provided in Round 3, and suggestions for improvement, the core study team refined the list of MBCTs, including amendments to the wording of definitions, labels, and function descriptions to make them more distinct from each other, and exclude redundant MBCTs. No further rounds were required.

Step 7: Comparison of MBCTs and Techniques from the Behavior Change Techniques Taxonomy (BCTT) v1. The core study team members compared the final list of MBCTs with the BCTTv1 (Michie et al, 2013). The aim was to identify MBCTs that could overlap with the ones presented in the BCTTv1, and in these cases, clarify the uniqueness of the MBCT.

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Results

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Initial Classification: Steps 1 and 2

The initial 'long list' of MBCTs identified by the core study team from the literature review and expert nomination identified 39 candidate techniques organized under the three psychological need satisfaction categories from self-determination theory – autonomy, competence and relatedness[6]. MBCTs considered to be vague, redundant, or overlapping by participating experts in Round 1 of the consensus method were reformulated or removed. The revised list comprised 24 MBCTs, eight for each need satisfaction category[7]. The label, definition, and function description of each MBCT was revised for clarity. A definitions key for each psychological need under which the MBCTs were classified was also developed to accompany the list of MBCTs.

Refining the Techniques: Steps 3 and 4

In Round 2, experts provided responses to each of the three criteria for rating the candidate MBCTs identified in Round 1: specificity, essentiality, and uniqueness[8]. With respect to the specificity criterion, all MBCTs were rated as sufficient in targeting the primary need, with responses ranging from "probably yes" to "definitely yes". There were some instances where MBCTs were identified as targeting needs other than the hypothesized need. Specifically, the "facilitate autonomous goals or outcomes" (autonomy) and "support client's initiatives and explorations around behavior change" (autonomy) MBCTs were rated as "definitely yes" as also targeting competence by 38.9% and 44.4% of experts, respectively. In addition, the "acknowledge and accept client's perspectives" (relatedness) and "encourage client to ask questions" (relatedness) MBCTs were both rated "definitely yes" as also targeting autonomy by half of the experts. The "ask permission to provide information or give advice" (relatedness) MBCT was rated "definitely yes" as also targeting autonomy by 38.9% of

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[6]The list of MBCTs for all rounds are presented as an online supplement: https://osf.io/2vh8y
[7]Changes are documented in an online supplement: https://osf.io/2vh8y
[8]A summary table of experts' ratings of the MBCTs in Round 2 of the consensus survey is provided as an online supplement (https://osf.io/fu38t/), along with a table providing full results for each MBCT (https://osf.io/cf3n7/).

experts. In addition, a substantive proportion of experts (33.3%) considered the MBCT

"explore sources of support from others" (competence) to also target relatedness.

With respect to essentiality, all MBCTs were considered essential or important

techniques for self-determination theory-based interventions. A substantive minority (27.8%)

of experts expressed uncertainty over the importance of the "explore means to manage and

cope with pressure" (competence) MBCT.

In terms of uniqueness ratings, only six of the MBCTs were judged to be conceptually

unique and free of considerable overlap with other MBCTs[9]. From experts' comments and

suggestions to reduce overlap, it became clear that, when answering this question, some

experts were considering the interactions that occur between MBCTs in a given intervention,

rather than their potential conceptual overlap (e.g., the "acknowledge and accept the client's

perspectives" and "acknowledge feelings" MBCTs were rated as overlapping by 55.6% of

experts). In Round 3, instructions for this section were improved.

The ICC values showed good consensus on ratings of specificity (ICC = .929, 95% CI

[.873, .968]), essentiality (ICC = .784, 95% CI [.623, .902]), and uniqueness (ICC = .902, 95%

CI [.823, .957]).

Based on these ratings, one MBCT was removed ("Support client's initiatives and

explorations around behavior change"), and two further MBCTs were added under the

autonomy need satisfaction category: "explore intrinsic rewards" and "encourage the person to

be supportive towards others with a similar condition". Changes were also made to the wording

of the labels, definitions, and function descriptions of the MBCTs. The refined classification

comprised 25 MBCTs, classified under the autonomy (n = 9), relatedness (n = 8), and

competence (n = 8) need satisfaction categories, respectively[10].

Finalizing the Classification: Steps 5 and 6

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[9]Full details of overlapping MBCTs are provided in an online supplement: https://osf.io/cf3n7/
[10]A full description of changes made to the MBCTs is provided in an online supplement: https://osf.io/2vh8y/

In Round 3 of the expert consensus procedure, experts (n = 16) were asked to rate the two additional MBCTs using the same procedure as in Round 2[11]. With respect to the uniqueness criterion, the majority of the experts (68.8%) judged the "encourage the person to be supportive towards others with a similar condition" MBCT to be more relevant to competence and relatedness needs rather than its original classification under the autonomy need. Both new MBCTs were judged to be conceptually unique and not overlapping with all the other MBCTs, except for the overlap between the "explore intrinsic rewards" and "facilitate autonomous goals or outcomes" MBCTs (43.8% of experts).

In terms of specificity judgements, the "acknowledge and respect perspectives" (relatedness), "ask permission to provide information or give advice" (relatedness), and "explore sources of support from others" (competence) MBCTs, were again judged by a substantive proportion of the experts (56.3%, 31.3%, and 43.7%, respectively) as targeting autonomy and relatedness.

Focusing on the uniqueness ratings, most MBCTs from the previous round were still judged by experts as overlapping with other MBCTs. However, the number of MBCTs with which each MBCT was judged to overlap decreased. For example, the "explore life aspirations and values" MBCT was considered to overlap with four other MBCTs in Round 2, while in the current round it was judged by a majority (56.3%) of experts to overlap with the "facilitate autonomous goals or outcomes" MBCT alone. In addition, the "show unconditional regard" and "take interest the person" MBCTs were rated conceptually unique.

The ICC scores showed good consensus on ratings of specificity (ICC = .658, 95% CI [.334, .859]), and uniqueness (ICC = .955, 95% CI [.917, .981]).

Based on the ratings and suggestions from experts on the wording of the MBCTs, the core study team revised the list of MBCTs. For the autonomy need category, the new

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[11]Full results of the consensus procedure for Round 3 are provided in an online supplement: https://osf.io/amnr4/

"encourage the person to be supportive towards others with a similar condition" MBCT and the "facilitate autonomous goals or outcomes" MBCT were consolidated into the "provide choice" MBCT. The "acknowledge and respect perspectives" and "acknowledge feelings" MBCTs were consolidated, and the "ask permission to provide information or give advice" MBCT was removed and integrated with the "use empathic listening" MBCT. In addition, the "explore sources of support from others" MBCT was reclassified from the competence need category to the relatedness category. In addition, the wording of labels, definitions, and function descriptions of the MBCTs was also revised based on experts' suggestions. The final classification of MBCTs (N = 21) with formal agreed labels, definitions, function descriptions, and categorization according to their primary psychological need is presented in Table 3[12].

Commonalities with Other Taxonomies: Step 7

The core study team matched the final list of MBCTs produced after the Round 3 consensus procedure with key BCTs from BCTTv1[13]. Seven MBCTs were considered overlapping with existing BCTs, five of which were techniques hypothesized to improve competence[13]. However, it is important to note that the definitions and function descriptions of the MBCTs set these techniques aside from the matched BCTTv1. This is because each MBCT is aligned with a theoretical construct from self-determination theory integral to the mechanism by which it is purported to change motivation and behavior. Specifically, each MBCT is defined in terms of the psychological need expected to mediate its effect on behavior change. Whilst BCTTv1 has been linked using consensus and literature reviewing methods to theoretical constructs (Carey et al., 2019; Connell et al., 2018), there has been no taxonomy or classification linking MBCTs to the key constructs of self-determination theory. In addition,

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[12]Illustrative examples of each MBCT for client-practitioner interactions are provided in an online supplement: https://osf.io/mhw5x/
[13]Full results of the matching exercise are provided in an online supplement: https://osf.io/8jtm3/

the MBCTs are proposed to evoke change in motivation as well as behavior as end-points, while techniques from BCTTv1 are exclusively defined in terms of changing behavior.

Discussion

The current research aimed to identify, describe, and classify the techniques employed in motivation and behavior change interventions based on self-determination theory in health contexts. The research extends knowledge on behavioral interventions based on the theory in the health domain by providing a common set of terms and definitions for the identified techniques. This classification is organized by the links between techniques and the psychological need satisfaction constructs implicated in the mechanism by which the techniques change motivation and behavior in accordance with Ryan et al.'s (2008) process model (Figure 1). Consistent with the focus of self-determination theory on motivation quality, techniques aimed at the end-points of motivation and behavior were labelled motivation and behavior change techniques (MBCTs). We used an iterative expert consensus procedure to identify, define, and classify techniques used in self-determination theory-based interventions, similar to the procedures used to develop taxonomies of behavior change techniques (Michie et al., 2005; Michie et al., 2013; Michie et al., 2015). This procedure yielded 21 MBCTs with accompanying labels, definitions, and function descriptions, and each MBCT was classified into autonomy, competence, and relatedness need satisfaction categories.

Interrelatedness Among Techniques and Relations to 'Motivating Styles'

While the expert panel and iterative procedure used in the current analysis led to general consensus on the techniques that comprise self-determination theory-based interventions, and that each technique principally targeted change in one of the three basic psychological needs, the experts also suggested that many of the techniques targeted change in other needs. This is consistent with the premises of self-determination theory. Although clear conceptual distinctions are proposed among the basic needs, the theory also states that the needs are *complimentary*. According to Ryan and Deci (2017), "the three basic needs are

interdependent" because "the satisfaction of one need supports the satisfaction of the other two

needs" (p. 249). In addition, at the empirical level, measures of the three needs routinely

intercorrelate and factor analyses reveal that measures of satisfaction of the three psychological

needs form a higher order need satisfaction factor (Hagger, Chatzisarantis, & Harris, 2006).

That the MBCTs identified in the current research had close affinity to one need, but were also

linked to satisfaction of one or both of the other needs, is consistent with this premise.

Furthermore, although there is evidence to suggest that individual techniques can alone be

efficacious in changing motivation and outcomes (e.g., provision of choice, Patall, Cooper, &

Robinson, 2008), many techniques are designed to be used interactively. For instance, an

intervention providing a rationale for engaging in a task or behavior (MBCT5) is not likely to

promote autonomy satisfaction by itself, but a rationale paired with perspective taking

(MBCT1) and acknowledgement of negative feelings (MBCT8) is more likely to promote

autonomy satisfaction, and engagement (e.g., Deci et al., 1994; Jang et al., 2010; Reeve, Jang,

Hardre, & Omura, 2002). Similar effects have been found in the setting of intrinsic goals

(Vansteenkiste, Simons, Lens, & Sheldon, 2004; Vansteenkiste, Simons, Soenens, & Lens,

2004). Taken together, these theoretical perspectives and research suggest considerable

interrelatedness among the MBCTs and the underlying constructs they are proposed to change.

MBCT interrelatedness is consistent to the notion that promoting motivation change

using self-determination theory interventions involves adoption of 'motivating styles' by social

agents. Such 'agents' operate in multiple contexts such as healthcare (Williams & Deci, 1996),

education (Reeve & Jang, 2006), the workplace (Gagné & Deci, 2005), sport and coaching

(Carpentier & Mageau, 2016), parenting (Joussemet, Landry, & Koestner, 2008), and therapy

(Zuroff et al., 2007), and are responsible for supporting and nurturing autonomy among their

supervisees including patients, students, employees, athletes, and clients. The motivating styles

adopted by social agents frequently involve the simultaneous display of multiple MBCTs that

act synergistically in promoting need support and motivation change. Research has sought to

identify and describe motivating styles of social agents (Aelterman et al., 2019; Aelterman et al., 2014; Delrue et al., 2019). A recent approach has been to characterize motivating styles in a circumplex structure, with identified motivating styles differing in terms of their need-supportive vs. need-thwarting character and their level of directiveness, with either the motivating agent taking more the lead in the interaction or the person to be motivated being more in charge (Aelterman et al., 2019). Within this circumplex, four broader motivating styles get partitioned into two distinct approaches, that is, participative and attuning (i.e., autonomy support), guiding and clarifying (i.e., structure), demanding and domineering (i.e., control), abandoning and awaiting (i.e., chaos). These eight subareas display an ordered pattern with individuals' motivation and need satisfaction (Aelterman et al., 2019; Delrue et al., 2019), with the most pronounced positive correlates being observed for the most need-nurturing approaches (i.e., guiding, attuning) and the most negative correlates being observed for the most need-thwarting approaches (i.e., domineering, abandoning). Interestingly, the other identified subareas fall in between these two extremes, suggesting that some motivating techniques are more strongly conducive to need satisfaction than others. This pattern of gradations may also surface for the identified techniques herein, with some techniques being more strongly conducive to the psychological needs and others instead creating the optimal conditions for need satisfying experiences for clients to emerge.

The interrelatedness among the MBCTs and the adoption of a motivating styles approach seems, at first glance, to be at loggerheads with the notion of identifying separate, unique MBCTs. A primary function of taxonomies of behavior change techniques is to develop a common set of descriptions and definitions of the unique techniques that comprise behavioral interventions. A further goal of taxonomies is to provide researchers with means to develop studies that isolate the unique and interactive effects of individual intervention techniques on behavior change using factorial designs. This is aimed at developing optimally effective and efficient interventions that work in given contexts, populations, and behaviors. Applying this

approach to produce the current classification of MBCTs serves a similar function, and allows researchers to develop tests to establish the unique and interactive effects of the different techniques of self-determination theory interventions in evoking change in need satisfaction, motivation, and behavior. However, such a 'micro' approach to self-determination theory-based interventions does not need to be irreconcilable with the more 'macro' approach epitomized by motivating styles. In fact, they may be complimentary by using the classification to describe specific groups of behaviors expected to be displayed in each motivating style. Potentially, each style could be characterized by groups of MBCTs derived from the current classification in a 'profile' approach, and this may be a direction for future research.

Mechanisms of Effect

A unique feature of the current classification of MBCTs is that it specifies explicit links between the MBCTs and the psychological need satisfaction constructs from self-determination theory. Organizing behavior change techniques according to the theoretical constructs they are purported to change provides important information on how interventions are likely to 'work' in changing behavior (Carey et al., 2019; Connell et al., 2018). The current organization of MBCTs may inform efforts to identify possible mediators of intervention effects, and, therefore, the mechanisms by which self-determination theory interventions promote motivation change and affect outcomes (Hagger et al., 2020; Sheeran et al., 2017). Consistent with the process model presented in Figure 1 (Ryan et al., 2008), employing the MCBTs from the current classification in behavior interventions is expected to affect change in the satisfaction of their respective psychological need. Specifically, autonomy-supportive MBCTs are proposed to support autonomy need satisfaction in that they facilitate individuals' sense of self-endorsed satisfaction, volition, sense of choice, ownership, and personal endorsement of the task or behavior. Competence-supportive MBCTs are expected to support competence need satisfaction through facilitation of individuals' sense of satisfaction in making progress, improvement, attaining mastery, and greater skill development on mental and

physical tasks and behaviors. Relatedness-supportive MBCTs are predicted to foster

relatedness need satisfaction by engendering individuals' sense of interpersonal connectedness,

closeness, acceptance, understanding, intimacy, and unconditional regard. The links between

the MBCTs and specific need satisfaction constructs highlight the imperative of including

measures of the relevant need satisfaction constructs in research evaluating effects of MBCT-

based interventions to test the proposed mechanisms.

Links with Other Classifications of Techniques

We also compared the set of MBCTs identified in current classification with those from

BCTTv1 (Michie et al., 2013), a procedure which has been conducted for other classifications

of behavior change techniques (Hardcastle et al., 2017). The goal of the comparison was to

identify commonalities and redundancies across techniques and illustrate the distinctiveness of

the self-determination theory-based techniques identified in the current classification. Results

of the comparison illustrated that many of the MBCTs (five out of seven) classified under

competence need satisfaction shared similar content to those of existing taxonomies,

particularly the BCTTv1 (Michie et al., 2013). The congruent techniques are likely those aimed

at promoting change through changes in constructs such as self-efficacy, confidence, and

control. However, comparisons across the techniques from existing taxonomies should also be

interpreted in light of the explicit alignment of the MBCTs with self-determination theory, and

the focus on both motivation and behavior change. While recent work has specified links

between 56 behavior change techniques and 26 mechanisms of action (Carey et al., 2019;

Connell et al., 2018; Michie et al., 2015), these were not theory-specific. Although there were

techniques identified as having close content across the taxonomies in our comparison, we

opted to retain the MBCTs in the current classification because they have explicitly been

linked to the need satisfaction constructs from self-determination theory, and have a different

focus to those specified in existing taxonomies.

Strengths and Directions for Future Research

The current research advances knowledge by identifying the sets of techniques that comprise self-determination theory-based interventions, providing a common set of labels and descriptions for the techniques, and producing a classification system of the techniques with basic psychological needs as an organizing principle. A major strength of the research is the adoption of a rigorous expert-consensus procedure in order to arrive at agreed definitions, descriptions, and classifications of self-determination theory intervention content. The panel of experts comprised career researchers with considerable experience in applying self-determination theory interventions across multiple behaviors, populations, and contexts, and had in-depth knowledge of the extant research literature on self-determination theory interventions. The panel applied this pooled knowledge in their evaluation of the candidate set of techniques during the consensus rounds. The panel did not flag any omissions from the set, lending support for its comprehensiveness. The procedure provided strong quality control over the finalized terminology and descriptions of the techniques. Therefore, we are confident our strategy was sufficiently comprehensive in identifying relevant techniques from the extant literature, and developing common terms and descriptions of MBCTs that can be adopted by future researchers to describe the content of self-determination theory-based interventions.

The present research also represents a step forward in specifying the content of self-determination theory-based intervention in health behavior contexts. A key feature of our classification system is the development of standardized labels, definitions, and function descriptions for each MBCT. We encourage future researchers and interventionists to apply the common terminology developed in the current classification when describing the content of interventions based on self-determination theory. This will minimize variability and increase precision in future descriptions of intervention content, and facilitate comparisons in content across interventions based on self-determination theory, a key goal of classification systems (Michie, Ashford, et al., 2011; Michie, Hyder, et al., 2011; Michie et al., 2013; Michie et al., 2015).

In addition, we expect the increased capacity to directly compare intervention content afforded by the classification will improve syntheses of evidence across self-determination theory-based interventions, which have been somewhat hindered by a lack of consensus in means to describe and characterize essential techniques that comprise these interventions (Michie & Abraham, 2008; Ryan et al., 2008). The lack of consensus in descriptions creates considerable problems for researchers attempting to synthesize findings across studies because it makes it difficult to establish equivalence of intervention content across studies and, therefore, evaluate intervention efficacy. The current classification is an essential pre-requisite to the future development of coding systems that enable researchers to effectively link the descriptions of self-determination theory interventions extracted from studies with the MBCTs from the current classification (see Cane, Richardson, Johnston, Ladha, & Michie, 2015 for examples; Michie et al., 2015). Together, such work will permit evaluation of the efficacy of MBCTs in changing behavior through meta-analytic syntheses of intervention studies based on self-determination theory. Such syntheses can assist in establishing whether the presence or absence of specific MBCTs from the classification are efficacious in changing behavior. That, in itself, is challenging given that few studies adopt factorial designs testing effects of individual techniques, so such analyses are always going to be hampered by the presence of other potentially confounding, co-occurring, or interacting techniques (Peters, de Bruin, & Crutzen, 2015). Nevertheless, the current analysis is expected to pave the way for future syntheses evaluating effects of individual, isolated intervention techniques based on self-determination theory on behavior change, or the effects of particular combinations of techniques. These syntheses contribute to the development of a database of information that researchers can draw from when developing behavior change intervention based on self-determination theory.

Related to the previous point, we expect the classification will help researchers develop interventions testing the efficacy of particular techniques or groups of techniques in changing

motivation and behavior. We expect it will inform the development of studies using factorial designs to test the unique and, importantly, interactive effects of groups of techniques on motivational and behavioral outcomes. Such research may, ultimately, facilitate research syntheses on the efficacy of individual technique in changing motivation and behavior of the kind alluded to earlier. It will also inform the development of more efficient interventions through the selection of techniques shown to be effective, and the elimination of those shown to be ineffective, in changing motivation and behavior.

Our current research was developed in the domain of health behavior, a decision based on the extensive research applying self-determination theory in this domain, and the importance of behavior change and its maintenance to the prevention of chronic disease. However, the classification system could be applied to behavior change interventions in different domains, such as education and the workplace. Further research is needed to examine the cross-domain generalizability of the MBCTs identified in the current classification. Further, the expert consensus procedures adopted in the current research may also have implications for the development of similar classifications of techniques for other theories in the motivation and social psychological literature, and our approach based on theory, evidence, and expert consensus may provide a template for doing so.

Limitations

Some limitations of the current research should be acknowledged. Although experts were generally supportive of the use of psychological needs as a general organizing principle, and that each MBCTs is classified under its 'primary' or most closely matched psychological need but may also be related to other needs, no hierarchy is offered. In fact, for some MBCTs there was debate among experts as to which of the need satisfaction constructs was the closest match. While we report the ancillary need satisfaction constructs linked to the techniques in the course of the consensus procedure, the current classification does not provide an elaborated

'map' of relations between the techniques and the needs they are likely to satisfy, and this should be a goal of future research.

A further caveat is that although the links between psychological needs and the MBCTs were derived through a rigorous expert-consensus procedure, they are not based on empirical evidence from health behavior change interventions. So, the classification does not reflect the quality or strength of evidence for the links that have been tested. Instead, the links specified in the current classification should be viewed as guidance on the potential mediators of the effects of MBCTs on motivation and behavior. The classification should, therefore, inform future research that synthesizes evidence on the mechanisms by which self-determination theory-based interventions change behavior, as well inform the design of studies to test proposed relations for which no previous evidence exists or is lacking. In such cases, the links expressed in the current classification should be treated as theoretical predictions subject to confirmation or rejection through empirical tests (Hagger, Gucciardi, & Chatzisarantis, 2017). Such research will move knowledge and understanding of which techniques work in changing motivation and behavior in health contexts forward, and assist in identifying the mechanisms responsible. To speculate, it may be that some individual or groups of MBCTs have larger effects on motivational and behavioral outcomes than others, and over time cumulative empirical evidence may assist in identifying a 'core' set of self-determination theory techniques that are most reliably efficacious in changing motivation and behavior.

A related issue of note is that our classification of MBCTs is silent on the effects of the techniques themselves on outcomes including motivation and behavior. In fact, this is a feature of all taxonomies of behavior change techniques (e.g., Michie, Ashford, et al., 2011; Michie et al., 2013). This is because the goal was to develop a means to describe and classify the content of behavior change interventions based on self-determination theory, rather than providing an evaluation of whether each technique is efficacious in determining change. In fact, such an endeavor is difficult for the very reason the current classification was developed in the first

place – it is difficult to evaluate effects of techniques across studies because studies have

tended not to intervention content with sufficient precision, vary in the terms and language

used, and also differ in the number and combination of techniques used. As the field moves

toward more elaborated ontologies of behavior change (Larsen et al., 2016; Michie &

Johnston, 2017), the content of the current classification may be merged with syntheses of

research demonstrating MBCT efficacy and further links between MBCTs and constructs

representing mechanisms of effect. Such ontologies will provide intervention designers with

the comprehensive theory- and evidence-based knowledge necessary to develop interventions

that have optimal efficacy, and the current classification is an important step forward in their

development.

In addition, research is needed to determine whether specific MBCTs identified in the

current classification interact with conditions that moderate their efficacy in change and

maintenance of motivation, health behaviors, well-being, and disease burden. Such conditions

may include, but are not limited to, contact time between the practitioner or social agent and

the client or patient, frequency of contact, duration of intervention, type and training of social

agents (e.g., peer, family member, co-worker, teacher, clinician, or public health scientist), and

intervention cost. Once efficacy of interventions adopting individual or groups of MBCTs has

been established, they need to be tested for efficacy and effectiveness, cost-effectiveness,

implementation, and dissemination. In addition, the experts that contributed to the current

classification comprise largely of psychologists and behavioral scientists. Input is needed from

other stakeholders and practitioners (e.g., health professionals, teachers, public health

scientists, medical ethicists, peers, family members) who may assist in refining the content of

the current techniques, or may identify additional techniques that may satisfy psychological

needs and promote health behaviors that are currently not included in this classification.

Finally, recent research on self-determination theory has made the distinction between

need-supporting and need-thwarting strategies in evoking change in different types of

motivation and behavioral engagement (e.g., Bartholomew et al., 2011; Haerens et al., 2015; Hein, Koka, & Hagger, 2015; Vansteenkiste & Ryan, 2013). While the lack of satisfaction of psychological needs has been linked with reduced propensity to engage in behaviors for autonomous reasons and reduced likelihood of attaining adaptive outcomes, including behavioral persistence (Deci & Ryan, 2000; Deci, Spiegel, Ryan, Koestner, & Kauffman, 1982; Koestner, Ryan, Bernieri, & Holt, 1984), recent research has identified the deleterious effects of thwarting or frustration of psychological needs on outcomes including behavioral avoidance or disengagement (Bartholomew et al., 2011; Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013). In fact, recent theory has proposed a 'dual process' framework, proposing that motivation is a function of need supportive and need thwarting processes that act in parallel (Jang, Kim, & Reeve, 2016). Just as the need-supportive techniques identified in the current classification enhance autonomous motivation, need thwarting strategies, such as controlling interpersonal styles (e.g., use of contingent rewards), undermine autonomous motivation and engender controlled motivation. Although avoidance of controlling techniques is referred to within the current classification (e.g., "Use non-controlling, informational language", MBCT 3), there has been no formal inclusion of techniques that thwart psychological needs. Future research should seek to augment the current classification to encompass need-thwarting techniques so that their effect can be also further explored and tested.

Conclusion

The present study developed an organized classification of the unique motivation and behavior-change techniques (MBCTs) used in self-determination theory interventions to change motivation toward, and participation in, health behavior. Our theory-based, expert consensus procedure found support for 21 MBCTs organized according to the primary psychological need (autonomy, competence, or relatedness) they are purported to change. A key goal of the current classification is to provide researchers and interventionists with a common set of terms and definitions to describe the content of self-determination theory-based

interventions in health contexts, and we expect it to facilitate the precision of descriptions of future self-determination interventions. As with taxonomies of behavior change techniques, the current classification is designed to be a first step in specifying the content of self-determination theory-based interventions in health behavior contexts. The classification should therefore be viewed as one that is flexible and open to modification as new evidence is made available. Future research should aim to use the classification to inform the development of self-determination theory-based interventions that test the efficacy of specific techniques in changing health behavior. The classification system may also inform future coding of research aimed at synthesizing evidence for self-determination theory-based interventions. Finally, although the current classification is focused on health contexts, it may have broader implications in other contexts. For example, the classification may form the basis of research aimed at classifying and describing techniques used in self-determination theory-based interventions in educational, organizational, and environmental contexts.

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Table 1

Conceptual Definitions of the Three Psychological Needs from Self-Determination Theory

Psychological need	Conceptual definition
Autonomy	The psychological need to experience self-direction and personal endorsement in the initiation and regulation of one's behavior. The hallmarks of autonomy need satisfaction are volitional action and wholehearted self-endorsement (i.e., personal ownership) of that action.
Competence	The psychological need to be effective in one's interactions with the environment, and it reflects the desire to extend one's capacities and skills and, in doing so, to seek out optimal challenges, take them on, and exert effort and strategic thinking until personal growth is experienced.
Relatedness	The psychological need to establish close emotional bonds and attachments with other people, and it reflects the desire to be emotionally connected to and interpersonally involved in warm relationships. The hallmarks of relatedness need satisfaction are feeling socially connected and being actively engaged in both the giving and receiving of care and benevolence to the significant people in one's life.

Note. Conceptual definitions are based on Ryan and Deci (2017).

Table 2

Steps in the Development of the Classification of Motivation and Behavior Change Techniques (MBCTs)

Steps	Methods
1. Development of the first list of MBCTs	Content analysis from published SDT interventions; Group discussions within core research team
2. Consensus exercise – Round 1	Feedback from 8 experts on clarity and content of the MBCTs; Group discussions within core research team
3. Consensus exercise – Round 2	Online expert feedback consensus ($N = 18$) on the need-sensitivity, essentiality and uniqueness of each MBCT
4. Discussion and refinement of the MBCTs	Core research team members discussed and refined the MBCTs, based on the results from step 3
5. Consensus exercise – Round 3	Online expert feedback consensus with same poof of experts, for 1) MBCTs which didn't reach a sufficient inter-rater agreement; 2) new MBCTs
6. Revision and finalization of the MBCTs	Core research team members discussed and finalized the MBCTs, based on the results from step 5
7. Mapping MBCTs to the Taxonomy of Behavior Change Techniques v1	The core study team members compared the final list of MBCTs with the Taxonomy of Behavior Change Techniques v1

Table 3

Classification of Motivation and Behavior Change Techniques

Label	Definition	Function description
Autonomy-Support Techniques		
MBCT1. Elicit perspectives on condition or behavior	Encourage exploration and sharing of perspectives on current behavior (e.g., causes, perpetuating factors etc.).	Allows exploration of behavior in more depth (self-knowledge), which can inform the program and personal choices.
MBCT2. Prompt identification of sources of pressure for behavior change	Prompt identification of possible sources of external (or partially internalized) pressures and expectations, and explore how they may relate to client's desired goals and outcomes.	Explores locus of causality and potential sources of external/introjected regulation and its consequences.
MBCT 3. Use non-controlling, informational language	Use informational, non-judgmental language that conveys freedom of choice, collaboration, and possibility when communicating (avoiding constraining, pressuring, or guilt-inducing language). For example, use "might" or "could" instead of "should" and "must".	Avoids being a source of pressure or creating internal pressure, countering external locus of causality for actions.
MBCT 4. Explore life aspirations and values	Prompt identification and listing of important life aspirations, values, and/or long-term interests and explore how changes in behavior (or maintaining the status quo) could be linked to them.	Explores integrity and internal coherence between aspirations, values, and goals/behaviors, which can sustain autonomous regulation.
MBCT 5. Provide a meaningful rationale	Prompt client to identify rationale for behavior change and its maintenance that is tailored, explanatory, and personally meaningful or valuable.	Highlights and reinforces motives/reasons that could form the basis of autonomous motivation.
MBCT 6. Provide choice	Provide opportunities to make choices from a collaboratively-devised menu of behavioral options and autonomous goals. It includes the decision not to change, delay change, select focus/intensity of change, personally endorsed intrinsic goals and standards for success, including the timing or pace for certain outcomes.	Promotes personal input and ownership over behavior change and responsibility through choice.

MBCT 7. Encourage the person to experiment and self-initiate the behavior	Prompt the person to experiment and self-initiate (new) target behavior that could be fun and enjoyable, is experienced as positive challenge, opportunity for learning or personal expression, and/or are associated with skill development, all of which provide experiential / immediate positive reinforcement".	Supports autonomous action via intrinsic motivation.

Relatedness-support techniques

MBCT 8. Acknowledge and respect perspectives and feelings	Provide statements of empathy and acknowledgment of the person's perspective, conflicts/ambivalence, distress and negative affect (fear, confusion, etc.) and also expression of positive feelings when communicating with client (concerning the target behavior, treatment, or other related matters).	Indicates attention and respect for the person's attitudes, thoughts perceptions, and feelings, which creates an accepting and warm social environment.
MBCT 9. Encourage asking of questions	Prompt the client to pose questions regarding their goals/behavioral progress.	Creates an open and collaborative relation that promotes trust.
MBCT 10. Show unconditional regard	Express positive support regardless of success or failure.	Demonstrates unconditional respect, care and support and promotes warm social environment.
MBCT 11. Demonstrate/show interest in the person	Provide statements of interest and curiosity about the person's thoughts and perceptions, personal history and background, social context, life events, etc. when communicating.	Displays involvement, indicates to the person that their experiences and input are valued.
MBCT 12. Use empathic listening	Demonstrate attentiveness to the client's responses (e.g., stay silent to allow the person to complete sentences), and provide reflective and summary statements when appropriate (directed at affect or content) when communicating. Prompt permission to provide new information, guidance or advice.	Creates open, collaborative relation; promotes trust; Displays respect for the person.
MBCT 13. Providing opportunities for ongoing support	Offer the person an appropriate venue and means to contact you in the event of difficulties or questions during the behavior change process.	Shows care and personal involvement.
MBCT 14. Prompt identification and	Prompt identification of sources of support for behavior change (if relevant),	Includes strategies that will help in feeling

seek available social support	acknowledge challenges in recruiting adequate support (autonomous vs controlled), and promote effective ways of seeking positive support.	confident to overcome potential challenges and meet behavioral goal (e.g., information about available programs, active involvement of others such as family members).
Competence-support techniques		
MBCT 15. Address obstacles for change	Prompt identification of likely barriers to behavior change, based on previous attempts, and explore how to overcome them (e.g., what may have worked in the past).	Increases confidence and reinforces existing skills.
MBCT 16. Clarify expectations	Prompt statements of client's own expectations in terms of behavior change (e.g., identify a clear goal or learning objective), both its experiential elements (process) as well as outcomes.	Provides structure and minimizes future failure (and perceived incompetence).
MBCT 17. Assist in setting optimal challenge	Assist in identification of goals that are realistic, meaningful challenging, and achievable.	Provides structure and minimizes future failure (and perceived incompetence)
MBCT 18. Offer constructive, clear, and relevant feedback	Provide relevant, tailored, non-evaluative feedback on goal/behavioral progress. This can include specific, process-focused feedback.	Provides encouragement and information to guide future behavior.
MBCT 19. Help develop a clear and concrete plan of action	Develop and provide summary of action plan to work toward a behavioral goal.	Provides structure, increases confidence, and minimizes future failure (and perceived incompetence).
MBCT 20. Promote self-monitoring	Prompt monitoring of progress, skill level, or performance such as suggesting options for monitoring tools/means and metrics for success, including steps in the direction of behavior change.	Provides structuring information that reinforces success and self-awareness.
MBCT 21. Explore ways of dealing with pressure	Provide information to manage and limit effects of pressuring contingencies that would undermine competence such as extrinsic rewards, criticism, negative feedback.	Increase confidence to deal with sources of controlling pressure from others and themselves.

Note. Reference to "the person" in technique descriptions refers to the individual or group whose behavior is to be changed (e.g., a client, patient or participant). MBCT = Motivation and behavior change technique.

Figure 1. A basic process model of self-determination theory in health contexts.