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original article

Testing theory in practice: The example of self-determination theory-based interventions

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Leonardo da Vinci once said that, "*He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may cast*". Similarly, advancing behavioral science requires a good understanding of how interventions are informed by theory, how they can better test theory, and which behavior change techniques should be selected as a function of theory (or theories). However, simply claiming that an intervention is theory-based does not necessarily make it so. Critical evaluation of applied theory is needed for a more integrated understanding of behavior change interventions, their usefulness, and their effectiveness.

The *Theory Coding Scheme* (TCS; Michie & Prestwich, 2010) was recently developed with the aim of providing a reliable research tool to describe and evaluate the theoretical basis of interventions. It includes a list of items assessing whether relevant constructs of a certain theory are targeted, how well they are measured, which behavior change techniques are used to impact those constructs, and whether study design allows for theory itself to be tested and refined. The TCS encourages a careful consideration of what constitutes a theory-based intervention (i.e. provides means for a more rigorous and systematic examination of the use of theory within intervention research), and how these interventions can be most usefully developed and evaluated serving as a structure to inform the design of theory-based interventions.

A recent meta-analysis (Prestwich et al., 2014) tested the application of the TCS, investigating i) the extent and type of theory use in health behavior change interventions to increase physical activity and healthy eating, and ii) the associations between theory use and intervention effectiveness. The authors found poor reporting on the application of theory in intervention design and evaluation. For example, few interventions targeted and measured changes in all theoretical constructs defined by the theory or linked all the behavior change techniques to those constructs. Since this meta-analysis tested the TCS framework with only two theories (Social Cognitive Theory [SCT] and the Transtheoretical Model), more research is needed to test the fidelity to theory in health behavior change interventions based on other frameworks and its differential impact on interventions effectiveness. One such framework is Self-Determination Theory (SDT; Deci & Ryan, 2000), which is increasingly being used in the area of behavioral nutrition and physical activity (Teixeira et al., personal communication, May 22, 2014).

In this paper we will focus on the development, implementation, and evaluation of theory-based interventions, using SDT as the example. This paper follows on the first two articles of this issue by Peters (2014) and Kok (2014), which highlight the importance of identifying and selecting theory-based constructs and appropriated methods to develop effective complex behavior change interventions.

Self-Determination Theory-based interventions in health

SDT has emerged as a popular theoretical framework to explain the motivational dynamics

behind the regulation of health behaviors, focusing on the psychological antecedents, mechanisms, and basis for interventions in health contexts. Evidence regarding its rationale and utility in facilitating and explaining health behavior change and maintenance is rapidly increasing (Fortier, Duda, Guerin, & Teixeira, 2012; Ng et al., 2012; Ryan, Patrick, Deci, & Williams, 2008; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Readers are encouraged to consult Deci and Ryan (2000) and Vansteenkiste, Niemec and Soenens (2010) for a summary of the fundamental theoretical premises of SDT.

Briefly, SDT postulates that human beings have three essential psychological needs - autonomy (feeling of being the origin of one's own behaviors), competence (feeling effective), and relatedness (feeling understood and cared for by others). These needs represent "psychological nutriments" that are essential for ongoing psychological growth, integrity, and well-being (Deci & Ryan, 2000). Support and subsequent satisfaction of these needs provides the basis for the psychological energy that is predicted to, and has been empirically confirmed to, motivate the initiation and long-term maintenance of health behaviors (Ryan et al., 2008; Silva et al., 2011).

The issue of the *quality* of motivation is central to SDT, which is less concerned with "how much" motivation people have, and more about "which type" (or types) of motivation prevails in goal pursuit. Unlike some perspectives that only posit the intrinsic vs. extrinsic distinction, viewing extrinsically motivated behavior as invariantly non-autonomous, SDT proposes that extrinsic motivation can vary greatly in the degree of internalization (i.e. self-congruence). In short, the fundamental distinction is between *autonomous* and *controlled* forms of motivation and behavioral regulation. Autonomous motivation is based on deeply reflected endorsement of one's behavior. When feeling autonomous, people perceive that their behavior emanates from the self and is self-authored, and they act because they find interest in or are challenged by the experience of behavior, or because they find personal meaning in what results from it. The predominant feeling is what is sometimes referred to as "willingness" ('I truly chose and want to…'). By contrast, in controlled motivation, the predominant feeling is pressure, which is often associated with ambivalence. The pressure (or "controls") that regulates the behavior can either stem from external (rewards or demands) or internal (guilt, shame, pride) pressures (Deci & Ryan, 2000). Expressions such as 'must' and 'should' are typically associated with this form of motivation.

Importantly, different types of motivation have been associated with different outcomes and a growing body of research has demonstrated the importance of autonomous motivation for a range of health behaviors. To put it simply, the more autonomously motivated individuals are, the more adaptive their behavioral and health outcomes have shown to be (e.g. Ng et al., 2012; Teixeira, Carraça, et al., 2012).

SDT mechanisms of action and intervention component techniques

Social-environmental factors decisively influence cognitive, behavioral, and affective patterns exhibited in health behavior change processes. According to the SDT process model (Ryan et al., 2008), the effect of the environment on motivation and behavioral regulation is not direct, but occurs as a result of the support for, and consequent satisfaction of the three universal psychological needs. Thus, the most important social environmental factor within an SDT-based motivational climate concerns the degree of *need-supportiveness* or the extent to which others and the environment more broadly support vs. thwart these needs, objectively and as perceived by the individual. Indeed, one of the strengths of SDT is that it proposes processes of behavior change that can be targeted in different health behavior interventions. In these interventions, techniques are developed and implemented to satisfy

the three basic psychological needs, thus fostering the process of internalization (i.e. the active transformation of controlled regulation into more autonomous forms of [self-] regulation), in turn leading to increased *integration* of this regulation into a person's personality, and positive behavior change (Fortier et al., 2012; Ryan et al., 2008; Su & Reeve, 2011).

Key component techniques of need-support have been described in several papers and chapters and some operational definitions for each interpersonal condition have been advanced (see for example, Haerens et al., 2013; Reeve, 2009; Su & Reeve, 2011). These are briefly summarized next:

i) Autonomy support: Relevance, by providing a clear and meaningful rationale for activities, facilitating self-endorsement; Respect, by acknowledging the importance of clients' perspective, feelings, and agenda; Choice, by encouraging clients to follow their own interests and providing options whenever possible; Avoidance of control, by not using coercive, authoritarian, or guilt-inducing language or methods.

ii) Structure (support for competence): Clarity of expectations, by collaboratively setting realistic goals and discussing what to expect and not expect from the behavior-linked outcomes; Optimal challenge, by tailoring strategies and goals to individuals´ skills; feedback, offering clear and relevant informational feedback (e.g. on goal progress), in a non-judgmental manner; Provision of instrumental and practical skills-training, guidance, and support.

iii) Involvement (support for relatedness): Empathy, by attempting to see the situation through the client's perspective; Affection, by displaying genuine appreciation and concern for the person; Attunement, through paying careful attention to and gathering knowledge about the person; Dedication of resources, through volunteering time and energy; Dependability, through availability in case of need.

A recent meta-analysis (Ng et al., 2012) quantitatively synthesized the relatively large volume of empirical studies (k = 184) in health care and health promotion contexts addressing SDT-related constructs, and analyzed the relations among support for patients' psychological need satisfaction, autonomous regulation, and physical and mental health. Results from this meta-analysis showed that the relations of personal and contextual SDT constructs with each other, and with relevant positive health/exercise outcomes, were in the directions hypothesized by the theory. These findings were in accordance with those from a systematic review in the context of exercise behaviors (Teixeira, Carraça, et al., 2012), and are generally consistent across different study designs, health behaviors, and treatment settings.

Are SDT interventions theory-based? Preliminary results of a systematic review

Since SDT is increasingly advocated as a highly applicable and practically useful framework for designing physical activity, weight management, and dietary behavior change interventions, especially those aiming at long-term adherence (Fortier et al., 2012; Su & Reeve, 2011), it is important to analyze how adequately SDT has been applied in these domains.

This section summarizes the preliminary results of an ongoing systematic review, presented at the 2014 Annual Meeting of the International Society of Behavioral Nutrition and Physical Activity (Teixeira et al., personal communication, May 22, 2014), which assessed the extent of theory use in SDT-based interventions using the aforementioned TCS (Michie & Prestwich, 2010).

We first conducted a comprehensive search of studies published in peer-review journals in electronic databases (e.g. Pubmed) and key scientific journals (e.g. International Journal of Behavioral Medicine).

Studies were included if they reported on SDT-based interventions conducted with adults, measuring at least one of the outcomes of interest (physical activity/exercise, eating-related outcomes, weight change), assessed at post-treatment and/or follow-up. There were no restrictions with respect to the study design (randomized controlled trials – RCT; non-controlled trials), type of comparison condition (e.g. waiting list, active treatment), format and length of intervention and assessment points, and targeted population (e.g. healthy adults, chronic disease patients). Twenty-eight published studies reporting on 18 unique (controlled or non-controlled) trials were included (List of references of studies included available at: https://osf.io/hufpj/).

For the purpose of this review, the most relevant items of the TCS were combined, based on similarity of content, into the following categories: Theory-relevant constructs (items 2, 5), Link of behavior change techniques to theoretical constructs (7-11), Assessment of theory-relevant constructs (12, 13), Changes in theory-relevant constructs (15), Mediation of theory-relevant constructs (16), and Link between results and theory (17).

With respect to the first category (*Theory-relevant constructs*), all interventions targeted relevant SDT-related constructs. In most of the trials intervention techniques derived from theoretical constructs. Nonetheless there was great variability between studies on how thoroughly these constructs were described.

In *Link of intervention techniques to theoretical constructs*, less than half of the studies explicitly linked all behavior change techniques to SDT-relevant construct(s), and in the majority of the remaining studies either one technique or a group of techniques were linked to these construct(s). Three of the reviewed studies (Fortier et al., 2011; Hasse, Taylore, Fox, Thorp, & Lewis, 2010; and Hsu, Buckworth, Focht, & O'Connell, 2013), are good examples of studies that present the behavior change techniques used in the intervention in good detail, and describe link to theoretical constructs, namely need satisfaction. Several trials reported the combined used of i) motivational interviewing (MI) techniques (e.g. personal values clarification used to support autonomy), ii) self-regulation skills training (such as goal-setting, self-monitoring, strategies for overcoming barriers, and problem solving) used to promote competence need satisfaction; or the 5 A's framework to promote need support at different levels.

In most studies, *SDT-relevant constructs were assessed* at pre and post-treatment, using measures with adequate validity and/or reliability. However, in a substantial number of trials a limited set of SDT-related constructs were measured, and often this was restricted to motivational regulations (e.g. autonomous and controlled motivation). Aspects such as need-support, needs satisfaction, or intrinsic/extrinsic goals were rarely reported.

In about two thirds of the studies (excluding ongoing trials: $k = 4$), *the intervention led to a significant favorable change in at least one SDT-relevant construct*. In addition, in all studies conducting mediation analysis of SDT-relevant constructs ($k = 5$), significant mediation effects were observed. However, we found a limited use of formal mediation analysis, with the PESO (Silva et al., 2011) and PAC (Fortier et al., 2011) trials as the only two studies reporting formal tests of mediation. Thus, more research is needed on whether changes in SDT-related constructs explain interventions´ effect on behavior. Finally, in almost all studies, results of trials were *discussed in relation to the SDT premises*.

Overall, despite the limited pool of available studies and variability in the format and delivery of interventions, usefulness of SDT for behavior change is supported and the present scenario is encouraging of further testing and refinement. The preliminary results of the review indicate a moderately good use of SDT-based intervention studies in exercise, diet, and weight management. Furthermore, good descriptions of the behavior change techniques used in SDT-based interventions are increasingly available, most of which presenting clear links to theory

constructs. However, only half of the studies were completely clear in reporting specific intervention techniques and their theoretical underpinnings. An improvement in this criterion would not only strengthen researchers' ability to make statements regarding an intervention's theoretical grounding, but also allow other researchers to rely on the strategies employed in previous interventions.

Additional considerations

Because of its unique characteristics, the application of SDT to health behavior change interventions often raises additional questions. We will briefly address three of these questions, related to interventions' appropriate choice of outcomes, to the broader application of the SDT qualitative "criterion" (autonomous vs. controlled), and to meta-theoretical considerations in theory-based intervention research.

SDT is a broad theory of human motivation and, as such, its usefulness to explain the processes underlying behavioral regulation (choice, persistent, engagement, etc.) is straightforward. However, the organismic nature of SDT, deeply rooted in philosophical and psychological humanistic traditions, determines that SDT is ultimately concerned with human harmonic development and (eudaimonic) well-being (Deci & Ryan, 2000). Although "health behavior" should naturally relate to health and well-being – and in the biological sense, it usually does (e.g., a healthful diet tends to improve metabolic risk factors) – behavior change alone is not necessarily indicative of improved *psychological* outcomes. For example, one can think of rigid eating patterns aiming at obsessive weight loss as one case when success at dieting and weight loss is accompanied by psychological ill-being (Verstjuif, Patrick, Vansteenkiste, & Teixeira, 2012). A unique feature of SDT is that the key processes postulated to lead to adaptive motivation and behavior change – basic needs satisfaction – are also, and simultaneously, theoretically linked to improved psychological health (Ng et al., 2012). Moreover, one of these processes, perceived autonomy, is considered a positive and irrevocable outcome in its own right, particularly in health care bioethics (Beauchamp & Childress, 2008). In brief, the application of SDT to health care may create a crossroad between choosing behavior change as the primary outcome and the satisfaction of "higher-order" human psychological needs, seen as essential conditions for wellness. This has several implications, one of which is that autonomous non-compliance – when a client or patient, upon informed reflection, decides he/she does not want to change – can, and in most cases, should be seen as a *positive* outcome despite the absence of behavior change. Another, more practical implication is that interventions based on SDT should first target the satisfaction of psychological needs (see above) and focus on behavior change as one possible consequence of that path. As we have indicated, the two are not necessarily linked.

We have addressed the SDT perspective on adequate choice of outcomes in health behavior interventions (for weight management) in more detail elsewhere (Teixeira, Silva, et al., 2012). Indeed, we went a step further, proposing that if autonomy, competence, and relatedness are accepted as basic psychological nutriments (i.e., essential needs), then health professionals should contemplate the possibility that, by promoting the satisfaction of those needs, they are creating the conditions for personal change at a level *beyond* what is currently designated as "behavior change". Research linking autonomous/intrinsic motivation with higher levels of behavioral engagement (Cesaroli, Nicklin, & Ford, 2014), more vitality and less ego depletion (Muraven, Gagné, Rosman, & 2008), and transfer of self-regulation across behaviors (Mata et al., 2009) are some examples. Anecdotally, we have frequently witnessed participants in our obesity treatment studies implementing broader changes in their lives as a whole, apparently "inspired" by what and how they were changing in the weight management

program. The participant that did not enjoy walking and later became a near-professional organizer of walking trips in nature; and the women who divorced her husband during the program (who did not support her losing weight and being away from the kitchen so often), exceptional as they may be, became symbolic of this phenomenon.

A second related issue raised by the application of SDT in health contexts is that it provides an alternative "criterion" by which to evaluate many of the processes that take place during behavior change interventions. In fact, the autonomous vs. controlled dichotomy can also be used to characterize and qualify many of the *constructs* defined by other theories as mediators of behavior change, as well as the *techniques* used to target them. Two examples of the former are attitudes and goals, common constructs in many health behavior change theories. It should be apparent that people can express positive attitudes about a given behavior rooted in deeply reflected personal beliefs about the value of the behavior or its consequences (the "autonomous route") or, alternatively, based on more or less coercive persuasion or effective "convincing" by others (the "controlling route"). Notably, while the latter may be never fully self-endorsed, clients will still report that the behavior is important for them or a "good thing" (i.e. report positive attitudes). Similarly, goal selection (e.g., losing weight) and related expectations can be linked to aspects viewed by SDT as reflective of "intrinsic" motives such as improved functional health or being a positive role model for the children; or to motives not leading to need satisfaction and personal growth, such as impressing others or protecting one's self-esteem. Thus, a SDT analysis of these determinants provides a nuanced understanding of their psychological functional significance and potentially of their impact in actual behavior change and well-being (Ng et al., 2012).

A similar exercise can be applied to *behavior change techniques* or practical strategies currently applied in behavior change interventions (e.g. Michie et al., 2013). As pointed out in other contributions in this issue (Knittle, 2014; Kok, 2014) when selecting and evaluating behavior change techniques it is important to consider the theoretical parameters for its effectiveness and to look at *how* techniques are delivered as this can have a differential impact on results. According to SDT, these techniques can be employed within a need-supportive "motivational climate" or, by contrast, a controlling climate. As an example, one of us (PJT) was recently involved in a debate (Teixeira & Volpp, personal communication, April 24, 2014) where the use of financial incentives (a behavior change method) was discussed as to its potential to control individuals into behavior change versus contribute to their self-determination (c.f. Kullgren, Williams, & An, 2013). Briefly, the degree to which a particular technique is autonomy-promoting versus controlling is thought to result from aspects of its *content* (e.g., in the case of financial incentives, was the incentive or the incentive schedule chosen by the individual or imposed?) or its *delivery*. From an SDT view, emphasis falls on the prevailing *interpersonal style* involved in the communication between professionals and clients/patients. For instance, different use of language (e.g. avoiding "shoulds" and "musts") and other interpersonal features such as warmth vs. coldness are expected to meet the need for personal relatedness quite differently. As another example, prompting self-monitoring, one of the most evidence-based BCT, can be achieved with a more or less authoritarian stance; according to SDT, variability in interpersonal style would yield different psychological and behavioral outcomes from its use. As we have indicated before, less "shoulding" and more "wanting" is expected to bring about the best outcomes, especially when evaluated in the long run. This issue was recently addressed in more detail elsewhere (Hagger & Hardcastle, 2014) using SDT and MI as examples.

We recognize that the development of a "taxonomy of intervention styles" may represent a challenging endeavor, with several perils. Interpersonal style encompasses "ways of being"

which may resist being reduced to a group of techniques. For instance, results from a meta-analysis in the field of Motivational Interviewing revealed that excessive coding and manualization of interventions actually detracted from outcomes (Lundhal, Brownell, Tollefson, & Burke, 2010). Although manualization should encourage fidelity to the MI approach, fidelity showed no significant correlations with MI outcome. The authors pointed out that in humanistic, client-centered approaches manualization may interfere with truly centering on the client by causing pressure on practitioners to focus on specified items or indicators. This notwithstanding, a process leading to the clarification of what best describes a need-supportive, need-thwarting, and a controlling style is needed and is underway (e.g. Su & Reeve, 2011). This should contribute to better describe what takes place between interventionists and clients/patients, how (theory/SDT-based) interventions can be tested scientifically, and how can those methods be taught when training health professionals. Ultimately, success in using SDT-based health behavior change interventions requires prior success at all three of these processes.

As a final note, and going back to our title – "from theory to practice" –, health behavior researchers and practitioners involved in interpersonal interventions should be reminded that theories have within them particular meta-theoretical (ontological) premises about human beings and how they function in the world. Given its humanistic origins, this is perhaps more evident in SDT than in other frameworks (a topic we will not expand on here). Regardless, if understood and endorsed by researchers and practitioners, these views can permeate the entire behavior change process, from the first contact (note: we are reminded of the famous movie line "you had me at 'hello'"!), to implementation of behavior change techniques. Importantly, some of these fundamental premises may not be fully compatible with "competing" positions from other theories, a contrast which could impinge on the internal coherence and possibly the effectiveness of an intervention. Just as an example, in SCT, autonomy is equated with independence and dismissed as a largely irrelevant process in motivated behaviors (Bandura, 1989). This represents a fundamental difference that could be hard to harmonize when intervening from *both* SCT and SDT perspectives. Another example concerns goal selection. From an SDT perspective, not all goals "are created equal" in the sense that some are more likely than others to satisfy basic psychological needs. By being "agnostic" on the nature of the goals, a health professional may find him/herself at odds with the prospect that promoting the psychological well-being of the client may not be served if SDT-extrinsic goals are being pursued and (especially) if they are met. Although there is surely overlap among health behavior change theories, and very few of them have been designed as truly integrative models to explain all aspects of behavioral regulation (Davis, Campbell, Hildon, Hobbs, & Michie, 2014), we believe that reflecting on deeper-level assumptions embedded within each theory is a step forward in designing future theory-based interventions. Whether interventionists would be more effective by learning not only how to select and employ behavior change techniques *but also* learning the key tenets of the theories underlying those techniques – and made aware of potential inconsistencies – is largely an empirical question.

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