

The ‘scientific’ approach for the physical activity behavior change

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Published online: June 30, 2017

(Accepted for publication June 17, 2017)

DOI:10.7752/jpes.2017.02109

Abstract:

Interventions promoting various health enhancing behaviours such as physical activity and exercise have tended to lack the rigorous use of theory in both their design and implementation. The purpose of this review paper is to outline the stages involved in the development of a theory-based intervention. The paper highlights how the field has evolved to meet its ultimate goal; a solid scientific base. Steps including theory use, intervention techniques and technique taxonomies are outlined. The paper also addresses various considerations that have to be taken into account for valid interventions to be achieved.

Key words: interventions; promotion; exercise.

A ‘theoretical’ approach to behaviour change

Underpinning behaviour change interventions with a theoretical base significantly improves the effectiveness of such interventions in comparison to those that do not utilise theory to inform intervention design (Taylor, Conner, & Lawton, 2012). As such, interventions should be developed using theoretical insights from behavioural psychology. Atheoretical interventions tend to focus on the techniques to be utilised whereas theoretical approaches initially target the processes involved in change and then identify suitable techniques to achieve the change (Gourlan et al., 2015). When processes are highlighted using non-theoretical designs, an intuitive or ‘logical’ approach is taken to identify potential targets (i.e., the group lack sufficient efficacy beliefs to engage in exercise). Although appropriate determinants should be identified prior to intervention development, the selection and application of theory to achieve this feat is challenging for those within health psychology. In addition to theory selection, there are several other considerations that must be accounted for to develop and undertake a sound scientific intervention. Taking into account the number of limitations encountered within each consideration, the striving for a science of behaviour change is rather difficult. The purpose of this article is to provide a summary of the scientific approach to changing health behaviours, such as physical activity (PA) and exercise. The paper will first highlight the various stages involved in the development and evaluation of a behaviour change intervention. Problems addressed within these stages will then be discussed. It is hoped that this commentary will provide an insight into how to develop and deliver effective theory-based interventions to promote health enhancing behaviours.

Intervention development

Despite the longevity of behaviour change theories, an explicit call for theoretically informed interventions was only made relatively recently. The Medical Research Council provide robust guidelines on the development of interventions (Craig et al., 2008). Such stages include; theory, modelling, exploratory, randomised control trial, and long term implementation. For example, the designer should first select, amongst many, an appropriate theoretical base for the intervention. Once selected, the relevant determinants should be identified as well as the strategies to target such determinants. Although vigorous, these guidelines do not identify *how* to navigate through the initial stages (Michie, Johnston, Francis, Hardeman, & Eccles, 2008). For example, it is not clear how a suitable theory should be selected nor how change strategies should be identified. This leaves the question; how should the theory be applied? In addition to these guidelines, Intervention Mapping (Bartholomew, Parcel, Kok, Gottlieb, & Fernández 2011) and the ‘RE-AIM’ framework (Reach, Efficacy/Adoption, Implementation, Maintenance model) (Glasgow, Klesges, Dziewaltowski, Bull, & Estabrooks, 2004) have also been developed to facilitate intervention planning. One again, however, the process that intervention designers should undertake lack specificity. Nevertheless, the appeal for a theoretical approach to intervention design offers a starting point for intervention development.

The psychological processes of change

The selection of an appropriate behaviour change theory is important for promoting change. Psychological behaviour change theories attempt to identify the determinants and beliefs associated to behaviour and to therefore target within interventions. For example, the Theory of Planned Behaviour (TPB; Ajzen, 1985)

states attitude, subjective norms and perceived behavioural control formulate a behavioural intention and, if under volitional control, this intention will lead to subsequent behaviour. An individual may perceive PA to have many benefits, perceive friends to want them to engage in the behaviour and also have the confidence to undertake the activity. Thus, in this example, it is more likely that behaviour will be performed. Despite the number of theories, there are striking similarities amongst them. For example, the Health Action Process Approach (Schwarzer, 1992) identifies similar determinants to the TPB with the addition of planning strategies and volitional efficacy beliefs. Such ‘cafeteria-style theorizing’ (Bandura, 1998) has led to the proliferation of theories comprising of similar psychological constructs with different names (i.e., self-efficacy and perceived behavioural control being one example). In fact, there are over 1700 constructs and at least 83 theories (Michie, West, Campbell, Brown, & Gainforth, 2014).

The number of constructs have been narrowed down to identify those important (Fishbein et al., 2001; Michie et al., 2005). Within the Theoretical Domains Framework, Michie et al. (2005) organised 128 identified constructs into 12 domains including ‘Knowledge’, ‘Skills’ and ‘Beliefs about Capabilities’. This work provided the base for the COM-B model and the Behaviour Change Wheel (Michie, van Stralen, & West, 2011). As a macro approach to behaviour, these frameworks are applicable to a number of contexts. The COM-B model states that behaviour is influenced by capability, opportunity, and motivation. Capability refers to whether an individual has the skills and psychological capabilities. Opportunity refers to both the social and physical opportunity, and motivation concerns both the reflective and automatic processes. Note that some of the sources of behaviour include components that popular theories do not. The addition of automatic processes, which is a recently integrated idea within health psychology, posits behaviour to be influenced by processes beyond the realm of consciousness (Sheeran, Gollwitzer, & Bargh, 2013). For example, although an individual may consciously decide to engage in exercise, prior bad experiences may override this decision. The identification of what to target shares similarities with the belief elicitation procedure outlined within the TPB (Ajzen, 1985). Once the crucial processes are identified, whether this is a mixture of motivation, opportunity, or capability, the Behaviour Change Wheel offers formative guidance on how to alter them. In addition to the inclusion of the COM-B, the wheel includes intervention functions and policy categories. Intervention functions are broad categories of means by which an intervention can change behaviour and includes nine categories such as *Modelling* and *Education*. To increase rates of exercise, an intervention may provide knowledge of the behavioural benefits or a model of those undertaking the behaviour. Seven categories relate to the policy decisions made by authorities to implement interventions. Exercise can be targeted, for example, by reducing costs (Fiscal Measures) or attending to laws (Legislation). These share similarities with ecological approaches which criticise dominant theories of change for not accounting for environmental factors (Sallis, Owen, & Fisher, 2008).

In summary, identifying the determinants of change and the most appropriate ways to instigate such change are the initial steps in intervention development. Although there are a number of theories that can be used to conduct this, doing so is important in selecting specific change targets. The techniques, which are discussed next, are then selected to actually bring about this change.

The ‘active ingredients’

Behaviour change techniques (BCTs) are the ‘active ingredients’ involved in changing behaviour (Michie et al., 2015). The number of available psychological determinants coupled with the utilisation of atheoretical approaches has led to confusion amongst the reporting of such techniques within interventions. For example, some techniques are reported using similar labels to others when they are different and, conversely, similar techniques are reported under different labels when they are the same. Without a standardisation of what BCTs comprise of, it is quite difficult to identify those that are effective. To address this problem, the taxonomies of BCTs have been developed to provide a common language for interventionists in reporting techniques (Abraham & Michie, 2008). These classifications are agnostic in terms of the theoretical base but provide clear definitions of techniques. The taxonomies of BCTs have been applied to both specific (Abraham & Michie, 2008; Abraham, Good, Warren, Huedo-Medina, & Johnson 2011) and multiple behaviours (Michie et al., 2013). For example, Abraham and Michie (2008) identified 26 BCTs commonly used to change PA and dietary behaviours whereas the BCT taxonomy v1 (Michie et al., 2013), which was not behaviour specific, resulted in 93 distinct BCTs organised into 16 groupings. These taxonomies have also evolved; 26 techniques was extended to 40 within the CALO-RE taxonomy (Michie et al., 2011b). Similar techniques do, as would be expected, apply to multiple behaviours. Michie et al. (2011b) identified 12 BCTs relating to smoking behaviour to be the same as PA.

To summarise, the standardisation of technique descriptions provides a common language amongst intervention designers. Such taxonomies thus provide another development in the scientific approach to behaviour change.

Mapping techniques to constructs

Upon establishing clear definitions of techniques, there is a need to link the active ingredients with the psychological processes of change (Michie et al., 2016). That is, establishing knowledge of the BCTs that could influence certain psychological processes. Michie et al. (2008) linked techniques with constructs to gain an

understanding of the techniques were appropriate for changing specific processes. Although there was a clear agreement as to techniques that would and would not change certain constructs, as would be expected, the applicability of the techniques varied. For example, self-monitoring was outlined to be appropriate for changing four constructs whilst self-talk was judged to be appropriate for only one. Although useful, the authors acknowledge the subjectivity involved within this process.

Effective ‘behavioural’ techniques

After gaining an understanding of what BCTs consist of and how they could potentially link with psychological constructs, it is then important to identify the utility of techniques and whether they can be combined to increase effectiveness. Michie, Abraham, Whittington, McAteer and Gupta (2009) found techniques such as self-monitoring, prompting intention formation, goal setting, and feedback to be most effective in promoting PA. For French, Olander, Chisholm and McSharry (2014), however, self-monitoring and goal setting were shown to be less effective. Similar findings were shared recently by Warner, Wolff, Ziegelmann, Schwarzer and Wurm (2016) who found participants to not engage in planning and self-monitoring. With regards to the quantity of techniques, it has been found that interventions including more than one technique are more effective than those utilising just one strategy (Gilinsky et al., 2015; Michie et al., 2009; Williams & French, 2011). Michie et al. (2009) found that combining self-monitoring with at least one other technique from control theory was significantly more effective in promoting PA than other interventions. The inclusion of more techniques may allow participants to discover their own way to change (Dombrowski et al., 2012). One should be cautious in using too many, however, as the quality of the intervention, issues of fidelity, confusion, and an overall decrease in technique effectiveness may arise when more are included (Michie et al., 2009). The optimal number of techniques is thus unclear (Dombrowski et al., 2012). Moreover, technique interaction could play a significant role, particularly as one technique may work in combination with the other, may provide additional support to the other, or may hinder the other (Dusseldorf, Van Genugten, van Buuren, Verheijden, & van Empelen, 2014). The equivocal results of both technique effectiveness and technique quantity could be due to a number of other issues involved. For example, success depends, amongst other things, on how the techniques are used and then reported. Some of these issues will be discussed later. The ambiguous findings above consequently lead to ‘informative’ conclusions rather than ‘definitive’ (Williams & French, 2011).

Effective ‘determinant’ techniques

The mapping of theoretical constructs by Michie et al. (2008) was done using a consensus approach, albeit from experts within the field. Failure to link techniques to determinants using an evidence base is problematic (de Bruin, Crutzen, & Peters, 2015). There could be techniques that do not necessarily alter the theorised determinants as well as techniques that are effective but not included. The research described above also focuses on those techniques influencing behaviour, rather than the psychological determinants. A technique not changing behaviour would therefore be classified as ineffective despite successfully altering its targeted process. This is troublesome, particularly as there is a well-established gap between intention and behaviour (Webb & Sheeran, 2006). As such, there is a need to understand the techniques capable of successfully changing theorised determinants. Self-efficacy is a determinant that has received attention concerning PA (e.g., Ashford, Edmunds & French, 2010; Olander et al., 2013; Williams & French, 2011). Ashford et al. (2010) found feedback on performance and vicarious experience to be most effective. The use of action plans have also demonstrated utility in altering PA related self-efficacy (Olander et al., 2013; Williams & French, 2011).

In summary, empirical work establishing the effectiveness of precise techniques and their corresponding determinants is important. Despite this, there has been a considerable lack of empirical research highlighting such techniques.

Intervention delivery

In addition to understanding the content of the intervention, it is also important to consider ‘how’ they are delivered. The mode of delivery relates to the way that the intervention is communicated in practice. For example, an intervention could comprise of daily client-based sessions, visual posters or printed manuals. Interventions may also consider the *Form of Delivery* which includes ‘the provider, format, materials, setting, intensity, tailoring, and style’ (Dombrowski, O’Carroll, & Williams, 2016, p. 734). Thus, although encompassing aspects of the mode of the delivery, *Form of Delivery* offers additional, specific considerations. For example, Hagger and Hardcastle (2014) suggest *interpersonal style* should be accounted for which includes the language used. PA can be improved using language conveying autonomous motivation (Deci & Ryan, 2000). It is therefore important to consider the delivery of the intervention as well as the content.

Intervention reporting

The development of psychological practice can only be achieved with correct reporting of interventions. Properly reporting the use of interventions and the theory within them can help intervention designers and intervention reviewers. CONSORT (Consolidated Standards of Reporting Trials) guidelines identifies 25 items

crucial to intervention reporting (Schulz, Altman, Moher, 2010). For example, developers should include trial design, how randomisation was achieved and a justification for the sample size. Michie and Prestwich (2010) have also developed a theory coding scheme which provides clarification as to whether theory was used within intervention design. This coding scheme can also be used as a checklist for developers. Time can be wasted developing interventions if their implementation is not accurately reported. If intervention reporting is conducted correctly, the internal validity of psychological interventions should be ensured. If not, however, both Type I and Type II errors can occur. Incorrectly stating that an intervention was effective when it wasn't or that the intervention wasn't effective when it was may not only damage the validity of the intervention, but the following meta-analyses. The evolution of intervention success becomes stagnated whilst limiting our understanding of what is influential in change.

Problems

As can be seen, the development of a scientific approach to behaviour change has progressed rapidly within the past couple of decades. Indeed, precise specifications for inducing change can be dated way back to the methods employed within behaviourism. Skinner (1953) offered specific guidelines on when behaviour would and would not succumb to reinforcements. Despite recent progress, there are still a number of issues that have to be accounted for to achieve a scientific position. First, a number of variables can confound intervention influence, thus will have a profound impact on technique and intervention effectiveness (Abraham, 2016). Second, the information gained from the type of design used needs to be accounted for. Finally, it could be questioned whether such aspirations actually provide benefit to the field. These issues will now be discussed.

Confounding variables

Intervention fidelity

An appropriate test of intervention effectiveness can only take place when the intervention has been implemented according to the description. Intervention fidelity refers to discrepancies between intervention protocol and intervention delivery (Hardeman et al., 2008). Thus, a distinction can be made between what should be delivered and what is actually delivered (Knittle, 2014). When fidelity is unaccounted for, it is unclear whether an ineffective intervention is a resultant of the ingredients involved or the delivery of such ingredients. Similarly, an intervention could be delivered correctly, but not *completely*. One could conceivably undertake the rigorous formative work, yet fail to conduct the stages outlined within the protocol. Failing to do so not only wastes time, resources and finances, but the evolution of behaviour change is impeded as the internal validity is questioned. Checklists and questionnaires can be used to try and ensure the delivery of interventions are actually undertaken (Knittle, 2014).

Participant fidelity

It is important that the participant's pay significant attention to the intervention and engage in the specified protocol. For example, the success of the popular self-regulatory strategy Implementation Intentions (Gollwitzer, 1999) can only be measured with those who correctly develop the relevant planning strategies. Research examining why participants do not perform the relevant planning activities is different to research examining the efficacy of such strategies. Thus, encouraging participants to engage in the intervention, which is different from both the intervention itself and the motivation to actually change behaviour, is important for assessing effectiveness (Crutzen & Ruiter, 2015). Failing to account for participant fidelity could provide an incorrect assumption of the technique, potentially leading to a Type II error.

Control groups

The confounding role of control groups should also be taken into consideration as it can exert substantial influence over the intervention effect size. Although it is difficult to separate the control and experimental groups (if that is what is required within the intervention), contamination of the two can result in inaccurate findings. For example, effect sizes from a control receiving a portion of the intervention are likely to be lower compared to effect sizes comprising of a control group not receiving this influence (Williams, 2010). Thus, it is questionable whether intervention success (or lack of) is a consequence of the intervention or the control. Furthermore, if a comparison group is used, similar considerations should be undertaken with this group as that undergoing manipulation. Using an 'active' control requires the same attention as the experimental condition (Freedland, Mohr, Davidson, & Schwartz, 2011). It is important that such care is then standardised as effect sizes will vary dependent of the level of care provided. For example, a weaker standard group would show greater effect sizes than a stronger group (Ayling, Brierley, Johnson, Heller, & Eiser, 2015; Williams, 2010). Finally, differentiations should be made between studies that provide interventions to both groups and those that use the intervention condition only (Michie, Prestwich, & De Bruijn, 2010). Effect sizes will be considerably greater for the latter than the former. Findings thus depend not only on the intervention, but also the quality of standard care given. The attention paid to the control group is just as important as that given to those undergoing experiment.

Techniques

To properly ascertain the influence of BCTs, it is also important to consider the confounding role of techniques and other outside influences. As interventions often comprise of multiple techniques, there may be confusion as to the technique causing change. Method co-occurrence can lead to ineffective techniques classified as being effective due to its combination with the other technique (French et al., 2014; Peters, de Bruijn, & Crutzen, 2015). In terms of outside influences, it has been found that measuring cognitions can lead to a change in behaviour (the mere-measurement effect). For example, Godin, Sheeran, Conner and Germain (2008) found participants' blood donation rates to increase upon given a questionnaire. One explanation for such effects is that increasing the accessibility of thoughts from measuring instruments leads to behavioural performance (Morwitz, Johnson, & Schmittlein, 1993). Although such findings may provide alternative and useful ways to change, attributing change to a technique within the intervention rather than measurement impacts on the efficacy of effectiveness. Similarly, content within the Form of Delivery may influence intervention effect size. Finding that intervention frequency influences significance levels provides conditions for success, although these parameters occur outside the experimental technique. The 'Hawthorne effect' (French, 1953) and demand characteristics (Orne, 1962) are other examples of masked techniques influencing outcome variance.

Theory designs

Correlational research has predominantly been used to validate theories of behaviour change. Although this is no fault of the authors, such data cannot prove causality. As Weinstein (2007) points out and as is highlighted within the Social Cognitive Theory (Bandura, 1986), the reciprocal nature of human functioning acknowledges perceptions can cause behaviour, but perceptions can also be a resultant of behaviour. Put simply, an individual demonstrating high levels of self-efficacy to engage in exercise may have developed such perceptions *during* the behaviour rather than *a priori*. Thus, perceptions may not be the causal role in behaviour. What can demonstrate causality, however, is well planned randomised control trials (Coates, 2010). The most widely used experimental method within health psychology has adopted between-subject designs. However, such designs cannot be applied specifically at the individual level (Johnston & Johnston, 2013). For example, a trial highlighting the influential effect of an intervention within the experimental group may not necessarily be applicable to every participant within that group. Although this is an issue with the design used rather than the theories per se, the conclusions derived from such experimental studies cannot account for both inter-individual and intra-individual variability. There may not only be variability between subjects (inter-individual), fluctuations may also occur within an individual (intra-individual). To address this problem, N-of-1 designs have recently been used where participants experience both the control and experimental conditions. An intervention can be tailored to the individual and behaviour can be tracked over a period of time. N-of-1 randomised control trials can thus be useful for establishing which technique or combination of techniques are useful for individual change (Sniehotta, Presseau, Hobbs, & Araujo-Soares, 2012).

Summary

In summary, intervention success (or lack of) and reported effect sizes significantly influenced by that other than the ingredients involved within the intervention has significant implications for the internal validity of such interventions. Taking into consideration such confounding factors would not only improve the validity of interventions but the inferences made from the resulting systematic reviews and meta-analyses would also be credible. For example, a standardisation of control groups would provide less bias at the individual level and, as a consequence, provide valid reviews of intervention (in)effectiveness. Similar to the issues discussed within intervention reporting, this would also prevent both Type I and Type II errors concerning the efficacy of techniques too. For example, a technique demonstrating less influence due to indifferent control groups may incorrectly lead to the assumption of technique ineffectiveness. Similarly, a technique demonstrating significant influence due to the mere-measurement effect can incorrectly lead to the assumption of technique effectiveness. The types of designs used to identify the influence of technique should also be taken into consideration, particularly as the most widely used designs to date cannot apply to each individual.

Constraining psychological practice?

In accounting for some (if not all) of the above influences, the internal validity of behaviour change interventions would certainly be increased. Rigorous and meticulous planning and implementation of well-developed trials would enable the identification of relevant processes in change. Despite the presence of internal validity, however, the external validity could be questioned. The messy reality of social life and the infinite number of influences on human behaviour outside the laboratory setting, of which cannot be controlled, certainly limits the applicability of such findings. Moreover, if behavioural scientists struggle to change behaviour in well-controlled experiments, what hope is there for less-informed practitioners implementing these ideas? Trials striving for *efficacy* rather than *effectiveness* limits its applicability to real world scenarios. Rather than restricting and limiting variability, Ogden (2016) suggests it should be embraced. With psychologists creating problems rather than solving them, she calls for a paradigm shift away from the systemisation of techniques. Although some of the points raised are valid, one has to be careful to not undo the good work already conducted.

With the scientific practice starting to take shape, it could well be too early to begin a departure (Teixeira, 2016). Thus, one should not simply give up on achieving a scientific approach to behaviour change and bring the field to mere speculation (Michie et al., 2011a). Rigorous scientific study can unravel the effective avenues for change and the field can then continuously evolve from such findings (Johnston, 2016). Understanding the parameters of success would certainly help (Peters & Kok, 2016). For example, the application of specific techniques (i.e., Implementation Intentions) can only demonstrate success when certain parameters are met (i.e., participants are already motivated). An unmotivated individual is unlikely to engage in planning strategies. Although such parameters are not accounted for within BCT taxonomies (Schaalma & Kok, 2009), an understanding of the conditions of effectiveness would enable better validity (Peters et al., 2015). The limitations of such controlled designs may also be seen as a positive. As intervention fidelity, for example, is something difficult to account for in experimental research, this difficulty may perfectly reflect issues in the outside world and thus be equally valid (Knittle, 2014).

Conclusions

Theory-based approaches to changing PA and exercise have long been used. It is not until recently that a proper scientific base has been developed to bring the mass of research together. Broadly speaking, there are three main factors influencing intervention effectiveness; the underpinning theory, the techniques used, and the mode of delivery (Webb, Sniehotta, & Michie, 2010). Psychology has long focused on the first factor; however, a recent striving for a scientific practice has led to a focus on the latter two. Despite the inherent simplicity in changing PA, and as demonstrated above, there are still many issues that must be overcome. If done correctly, an increase in health enhancing behaviours may be achieved.

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