Developing Interventions to Change Recycling Behaviors: A Case Study of Applying Behavioral Science

Abstract

Background: The Theoretical Domains Framework (TDF) and the Behaviour Change Wheel (BCW) are frameworks that can be used to develop recycling interventions. **Purpose:** Demonstrate the utility of these frameworks for developing recycling interventions. **Method:** 20 semi-structured interviews with university building users were analyzed using the TDF and BCW. **Results:** Environmental context and resources, beliefs about consequences, knowledge and intention were identified as the key theoretical domains influencing recycling behaviors. The BCW was used to develop recommendations for intervention. **Discussion:** This is the first case study to demonstrate how the TDF and the BCW can be used to develop recycling interventions.

Words: 100/100

Keywords: behavior change; recycling; waste-related behaviors; intervention development; Behaviour Change Wheel; Theoretical Domains Framework

Introduction

To reduce waste, interventions that draw on the science of behavior change are needed (DEFRA, 2011). Developing, implementing and evaluating such interventions can be challenging, especially when one is working against a strong psychological, social and/or environmental gradient(s) (Michie, Atkins, & West, 2014b; Michie, van Stralen, & West, 2011). Interventions to change behavior, and specifically waste-related behaviors such as reycling, are often developed without a systematic method and without drawing on evidence and theories produced in the behavioral and social sciences (McKenzie-Mohr, 2000; Michie, West, Campbell, Brown, & Gainforth, 2014).

Theory provides an important and evidence-based starting point for intervention development. It provides a summary of accumulated knowledge and a framework for understanding current behavior and identifying targets for change (Michie, West, et al., 2014). Theory guides the evaluation of the process of change as well as outcomes, and facilitates the synthesis of empirical findings across studies. Accordingly, theory is recommended practice for the development of complex interventions that aim to change behavior (Craig et al., 2008).

Various behavior change theories have been used to explain and promote waste-related behaviors, with Schwartz's (1975; 1970, 1973) norm-activation model and Ajzen's (1985, 1991) theory of planned behavior being frequently applied in the literature (Bamberg & Möser, 2007). Norm-activation model conceptualizes behavior as being primarily pro-social and motivated by the activation of personal and/or moral norms. Conversely, the theory of planned behavior states that behaviors are motivated by a person's attitudes, belief in his/her ability to perform the behavior, and perceived social norms. While other theories have been applied to understand waste-

related behaviors (e.g., value-attitude-behavior model, operant conditioning theories, self-regulation), the theories applied to date are not linked to a systematic method for designing interventions and do not cover the full range of intervention options available. To address these limitations, this paper aims to present two evidence- and theory-based frameworks that can be applied to understand waste-related behaviors and develop interventions: the Behaviour Change Wheel and the Theoretical Domains Framework (Cane, O'Connor, & Michie, 2012; Michie, Atkins, et al., 2014b; Michie et al., 2005; Michie, van Stralen, et al., 2011).

The Behaviour Change Wheel (BCW) is a synthesis of 19 frameworks of behavior change identified in a systematic literature review (Michie, Atkins, et al., 2014b; Michie, van Stralen, et al., 2011). The BCW consists of three layers (Figure 1). Using the COM-B model, the hub of the wheel identifies sources of the behavior that could prove fruitful targets for intervention. The COM-B model provides a simple framework for understanding behavior (i.e. behavioral analysis), in which 'capability' (physical and psychological), 'opportunity' (physical and social) and 'motivation' (automatic and reflective) are conceptualised as three essential conditions for behavior (Michie, van Stralen, & West, 2011). Surrounding the COM-B model is a layer of nine intervention functions to choose from that can be used to address deficits in one or more of capability, opportunity or motivation. These intervention functions can then be linked to the behavior change techniques (BCTs; i.e. the active components of an intervention) described in published taxonomies of BCTs (Abraham, Good, Huedo-Medina, Warren, & Johnson, 2012; Abraham & Michie, 2008; Michie, Ashford, et al., 2011; Michie, Hyder, Walia, & West, 2011; Michie et al., 2013; Michie et al., 2012). Finally, the outer layer, identifies seven types of policy that one can use to deliver the intervention functions. The BCW can be applied across levels from

individuals to groups, sub-populations and populations, and within different organizational structures and systems.

The Theoretical Domains Framework (TDF) can be used alongside the BCW and provides a method for conducting a more elaborate behavioral analysis than is possible using either individual theories or the COM-B model (TDF; Cane et al., 2012; Michie et al., 2005) The TDF is a synthesis of behavior change theories and was developed with the aim of making the existing range of numerous, overlapping theories of behavior more accessible to intervention developers (Michie et al., 2005). Importantly, its 14 domains can be mapped onto the Capability, Opportunity and Motivation components of COM-B (see Figure 1).

Since their introduction both the BCW and the TDF have been used to understand and design interventions in a wide range of contexts. For example, BCW has been successfully used to understand and design behavior change interventions in a wide range of contexts including improving paediatric services in Kenyan hospitals (English, 2013); providing contraception to adolescents (Rubin, Davis, & McKee, 2013); and understanding general practitioners' use of different cardiovascular risk assessment strategies (Bonner et al., 2013). Likewise, the TDF has been used to identify factors influencing a range of behaviors such as clinical management of illness (Tavender et al., 2014), hand hygiene amongst health care professionals (Boscart, Fernie, Lee, & Jaglal, 2012) and prescription errors (Duncan et al., 2012). To our knowledge, the BCW and TDF have not been applied to systematically develop evidence-based interventions to change waste-related behaviors in any setting.

The current case study aimed to demonstrate how the BCW and the TDF can be used to develop a theoretical understanding of waste-related behaviors and design effective behavior

change interventions. The paper reports results of a TDF behavioral analysis of recycling behaviors amongst building users in a London university and subsequently demonstrates how the BCW can be used to develop recommendations for intervention. Of note, recycling behavior was specified as using the bin system as intended (i.e. avoidance of contamination of recyclable waste and lost opportunities for recycling).

Methods

Ethical approval for the study was granted by the *Removed for Blind Review* Research Ethics Committee.

Context

The case study was conducted at a London University where a previous recycling intervention had been implemented. The intervention involved changes in bin positioning, the addition of informational signage, and incentives to give up individual under-desk waste bins. Whilst this intervention was found to have a small effect on the contamination of recyclable waste (i.e. with non-recyclable materials) it had little effect on lost opportunities for recycling (i.e. the disposal of recyclable materials into general waste containers), and as such was only marginally effective (Beard et al., Submitted).

Participants

Twenty staff and student users of the building where the previous recycling intervention was implemented. Eleven were students (five undergraduate, six postgraduate) and nine were staff members (five administrative staff and four academic staff). Just over half (n = 11) were female, and ages ranged from 18-53 (mean = 30.75; SD=11.39; see Table 3 for participant characteristics).

Participants were recruited by on-site opportunistic invitations, posters placed around the building, e-mails advertising participation and pre-advertised 'drop-in' sessions. A £50 prize draw (with two prizes of £50 each available) was offered as an incentive for participation. Efforts were made to ensure that the sample was representative of the range of building users at the intervention site (i.e. students, academic staff, administrative and support staff).

<Table 1 here>

Design and Procedure

The study was cross-sectional interview study. Participants gave informed consent to be interviewed and audio-recorded. Semi-structured interviews were conducted face-to-face in the intervention building by four researchers (KS/HG/HR/UE). Interviews lasted for approximately 20 minutes, were audiotaped and subsequently transcribed verbatim. Demographic information was also gathered from each participant (e.g. age, gender, job title/degree level). The interview schedule was informed by the COM-B model (Michie, Atkins, & West, 2014; Michie, van Stralen, et al., 2011) and the TDF (Cane et al., 2012; Michie et al., 2005) (see Table 2).

<Table 2 here>

Behavioral Analysis

A content analysis was conducted to identify theoretical domains within the interview data. A thematic analysis was conducted to identify, analyse and report sub-themes within each TDF domain. For questions 5 and 13 (see Table 2), responses were recorded quantitatively as descriptive variables, whilst any further discussion prompted by these questions was subjected to content and thematic analysis. Two researchers (KS/HG) independently coded the transcripts using

the COM-B model (Michie, Atkins, et al., 2014; Michie, van Stralen, et al., 2011) and the TDF (Cane et al., 2012) to structure the themes identified. The fourteen domains of the TDF, structured according to the COM-B model are outlined in the Supplementary File. After coding the first two interviews, and after coding the seventh interview, the researchers compared their coding, discussed discrepancies until a consensus was reached, and refined sub-themes.

Consistent with approach used by Tavender and colleagues (2014) The importance of domains and sub-themes, was determined by (1) the frequency with which each was mentioned across the 20 interviews and (2) the number of interviewees mentioning each domain. TDF domains and sub-themes were judged to be important if they were mentioned by the majority of participants. Quotes were selected from the transcripts to illustrate each sub-theme; selected quotes are presented in Table 3. Quotes are reported verbatim except for minor additions (in square brackets) to improve the readability.

Developing Recommendations Using the Behaviour Change Wheel

Using the results of the behavioral analysis and a matrix of COM-B components mapped against intervention functions (Michie, Atkins, et al., 2014b), the intervention functions likely to be effective for changing recycling behaviors in their context were identified. A second matrix mapping intervention functions against policy categories were used to identify relevant policy categories. Both matrices are provided in the Supplementary File (Table 2 and 3).

Having identified general intervention functions, the final step for intervention development is to select one or more functions and determine the policy categories and the behavior change techniques best placed to deliver these functions, given the intervention context. This requires a judgement informed by local knowledge as well as scientific evidence taking into account criteria

such as **a**ffordability, **p**racticality, **e**ffectiveness and cost-**e**ffectiveness, **a**cceptability, **s**ide-effects/safety, and **e**quity (i.e. the APEASE criteria Michie, Atkins, et al., 2014).

Results

Domains Influencing Recycling Behaviors

The key TDF domains identified as influences on recycling behaviors were: environmental context and resources; beliefs about consequences; knowledge; and intentions. Social/professional role and identity were also mentioned by more than half of the participants (see Figure 2). Sub-themes and illustrative quotes identified in these domains are summarised in Table 3.

<Figure 2 here>

Environmental context and resources. This domain was most frequently mentioned, and was mentioned by all of the participants. The key sub-theme within this domain, mentioned by all of the participants, was the availability of an accessible bin in close proximity at the time that they had a recyclable material to dispose of (see Table 3 and Figure 2).

Beliefs about consequences. Beliefs about the consequences of recycling were important influences on all participants, most notably beliefs about the environmental benefits of recycling (mentioned by 19 participants), beliefs about other benefits of recycling (mentioned by 15 participants) and uncertainty about the consequences of recycling (mentioned by 19 participants). Whilst the majority of participants spoke positively about recycling and the positive impact it could have not only on the environment but also upon other factors (e.g. reducing financial costs, purchasing decisions), many also spoke about their uncertainty of whether these benefits would be realised (e.g. whether materials placed into a recycling bin are actually recycled and uncertainty about the environmental impact) (see Table 3). For nearly half the participants, the possible negative consequences of contaminating a bin of recyclable materials deterred them from putting non-recyclable materials into recycling bins (see Table 3).

Knowledge. Participants had a relatively good knowledge of which materials could be recycled using the building's facilities (70-100% correct) but fewer (5-60% correct) were able to correctly identify which items were non-recyclable (see Table 1). Eighteen participants indicated that knowing or not knowing how to recycle correctly (i.e. knowing which materials can be recycled and which cannot) influenced their recycling behavior (see Table 3). Knowledge appeared to interact with environmental influences in that fourteen participants indicated that the major barrier to recycling was the lack of or inadequate informational signage to inform them of how to dispose of different materials correctly (i.e. which receptacles to use for different items) (see Table 3).

Intentions. All but one participant intended to recycle in general and thirteen participants indicated strong intentions (e.g. 'going the extra mile' or 'putting the effort in'). However, seven participants mentioned that laziness or lack of priority were reasons for not recycling (see Table 3). An interaction between intentions and the environment was also evident, in that 13 participants reported that they intended to recycle only if the environment at the time made it easy (e.g. bins in close proximity), but would not go out of their way to recycle (see Table 3).

Social/professional role and identity. A personal responsibility to recycle was expressed by eight participants (see Table 3).

<Table 3 here>

Relevant Intervention Functions and Policy Categories

Behavioral Analysis. These findings showed that, in terms of the COM-B model, psychological capability and physical opportunity were the factors that needed to be changed in order for recycling behavior to improve.

Intervention Functions. Intervention functions relevant to psychological capability include education (i.e. increasing knowledge or understanding), training (i.e. imparting skills) and enablement (i.e. increasing means/reducing barriers to increase capability and opportunity). Intervention functions relevant to physical opportunity include training, restriction (i.e. using rules to increase the target behavior by reducing the opportunity to engage in competing behaviors), environmental restructuring (i.e. changing the physical or social context) and enablement.

Policy Categories. Intervention functions can be implemented several different ways, as illustrated by the policy categories of the BCW. For example, an intervention aiming to educate individuals about how to recycle could be delivered through signage (communication/marketing) or through establishing voluntary agreements that outline rules for recycling in the workplace (regulation). An intervention aiming to restructure the environment by providing bins may achieve this by creating mandatory workplace guidelines.

Selecting Intervention Functions and Policy Categories. Relevant intervention functions and policy categories were presented to the buildings' management team. The team was encouraged to use the APEASE criteria to improve their existing intervention.

Discussion

This case study demonstrates the utility of the TDF and the BCW for developing interventions to change waste-related behaviors, specifically recycling behaviors. The behavioral analysis revealed that majority of participants were generally motivated to recycle. However, their motivation fluctuated depending on the physical opportunity to recycle (i.e. availability and proximity of resources for recycling) and their psychological capability to recycle in the present context (i.e. knowing which items can be recycled and where). Using the BCW led to identifying intervention functions of training, restriction, environmental restructuring and enablement which could be delivered through several types of policy. Thus, rather than focusing on motivating individuals to recycle, interventions aiming to promote recycling in this context should provide appropriate opportunities to recycle (i.e. access to bins) as well as education and training to ensure that individuals possess the knowledge necessary to use the recycling facilities provided in their workplace.

Results point to an intention-behavior gap amongst building users. Consistent with prior research reporting differences between waste-management intentions and actions (Barr, Gilg, & Ford, 2005; Robinson & Read, 2005; Tudor, Barr, & Gilg, 2007), participants were motivated to engage in recycling but their motivation was not strong enough to overcome barriers to recycling. Accordingly, intervention functions linked to promoting motivation to engage in recycling such as persuasion, incentivisation and coercion were *not* identified as functions to include in subsequent interventions. Persuasion, incentivisation and coercion have been recommended by researchers, intervention developers and policy makers who favour motivational approaches to encouraging recycling behaviors (Guagnano, Stern, & Dietz, 1995; Thøgersen, 2003; Tudor, Barr, & Gilg, 2007). However, our results indicate that interventions aimed at capability and opportunity rather

than motivation are likely to be the most effective. This recommendation highlights the strength of conducting a behavioral analysis using the TDF and BCW. This approach allows intervention developers to consider the full range of intervention options rather than using singular theoretical frameworks that primarily focus on increasing motivation such as the norm-activation model or the theory of planned behavior.

To our knowledge, this is the first case study that has used the TDF and BCW to analyze current recycling behaviors as a basis for designing interventions. The systematic approach allowed us to identify internal and external influences on the behaviors (i.e. psychological capability and physical opportunity). This finding is consistent with previous research highlighting the interactional influence of capability, opportunity and motivation on recycling behaviors in other contexts (Barr, Gilg, & Ford, 2001; Ölander & Thøgersen, 1995; Ölander & Thøgersen, 2006). By using these frameworks to understand recycling behavior and collecting data in a real-world context, our approach addresses limitations of single theoretical frameworks that may not be broad enough to cover the full range of intervention options and may lack external validity.

The value of this study lies in demonstrating a method as interviews were only conducted with a small sample of building users in *one* building on *one* university campus. Thus, our findings may not be generalizable to other waste-management settings. The strength of the research lies in its theory- and evidence-based systematic method of analysing behavior in its context and guiding intervention development. To our knowledge this is the first empirical study to use the TDF, the COM-B model and the BCW to conduct a behavioral analysis and develop recommendations for interventions to promote waste-related or recycling behaviors.

In summary, the results of our behavioral analysis highlight the interactional influence of capability, opportunity and motivation on recycling behaviors. Creating more opportunities to recycle as well as education and training to use recycling facilities are necessary to make the most of existing motivations to recycle. The TDF and BCW provide a theory-based and systematic method for designing interventions to change waste-related behaviors.

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