

Chapter 14

Safety and Behaviour Change

Paul M. Chadwick

Abstract Promoting industrial safety is a complex field requiring collaboration between academia and industry across a range of professional and academic disciplines. Whilst human factors are recognized as being key modifiable determinants of risk across all professional groups and disciplines the variety and type of theories, methodologies and practices can make it difficult to identify commonalities and integrate findings into a conceptually coherent framework for research and intervention. The science of behaviour change offers possibilities for integrating cross-disciplinary understandings of the contributions of human behaviour to industrial safety through the use of models and frameworks like the Behaviour Change Wheel (BCW). This chapter describes the principles and processes involved in designing behaviour change interventions using the BCW illustrating this with examples drawn specifically from the industrial safety sector. The potential applications of the approach in the areas of workforce development and research are highlighted.

Keywords Capability · Opportunity · Motivation

14.1 Introduction

Whilst increasing amounts of resource are ploughed into initiatives to improve industrial safety there appears not to be a corresponding return on this investment as manifest by outcomes such as a reduced frequency of accidents or major hazards. Human behaviour has been identified as a major modifiable determinant of exposure to risks and hazards and is widely agreed to be a legitimate target of interventions to improve safety. Whilst numerous theories and frameworks have been used to understand and intervene with the behavioural determinants of risk the field

P.M. Chadwick (✉)
Centre for Behaviour Change, University College, London, UK
e-mail: p.chadwick@ucl.ac.uk

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suffers from a proliferation of models which are difficult to compare and contrast. This limits the accumulation of a coherent body of knowledge and expertise about what works, in what situations, for what problems, both within and across sectors. Furthermore, practices in the field may or may not reflect what is known scientifically, and the rise of the ‘safety industry’ and ‘safety professional’ means that the theories and techniques behind methodologies may be obscured by commercial interests.

This chapter examines the potential contributions of the emerging science of behaviour change to the field of industrial safety. It will outline the principles of understanding and changing behaviour using the Behaviour Change Wheel (BCW); a theory and evidence-based framework for designing behaviour change interventions that is gaining traction in cross-disciplinary research (Michie et al. 2014).

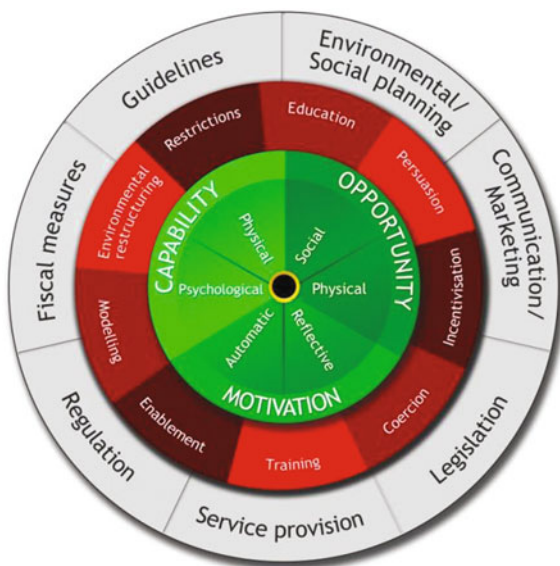
14.2 The Emerging Science of Behaviour Change and the Behaviour Change Wheel

The study of behaviour change has its roots in experimental psychology. As such, the tools of the scientific method—theory, hypotheses, experimentation, evaluation—are at the heart of the approach. Whilst there has been a great deal of empirical research into behaviour change across a range of sectors—including industrial safety—the field has lacked a unifying framework by which findings from studies employing different theories and methodologies can be integrated. In many areas, this has resulted in a fragmented research literature that can be difficult to pull into a coherent body of knowledge for the purpose of designing interventions.

One recent approach to reducing this muddle and providing coherence is the Behaviour Change Wheel (Michie et al. 2014). The Behaviour Change Wheel is a synthesis of 19 frameworks of behaviour change identified across a range of behavioural and social sciences (Michie et al. 2011). The BCW consists of three layers (Fig. 14.1).

The approach begins at the hub of the wheel where the sources of the behaviour that could prove fruitful targets for intervention are identified (i.e. a behavioural analysis). A simple model of behaviour, COM-B, is used to conduct the behavioural analysis. COM-B is an acronym for ‘Capability’ (physical and psychological), ‘Opportunity’ (physical and social) and ‘Motivation’ (automatic and reflective), conceptualised as the three essential conditions for behaviour. Surrounding the COM-B model is a layer of nine intervention functions 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 behaviour change techniques (BCT’s; i.e. the active components of an intervention) described in published taxonomies of BCTs (Abraham and Michie. 2008; Michie et al. 2013). Finally, the outer layer, the rim of the wheel, identifies seven types of policy that one can use to deliver the intervention functions.

Fig. 14.1 The behaviour change wheel (Michie et al. 2011)



In order to translate general intervention functions identified using the Behaviour Change Wheel into a practical intervention for the given context, relevant behaviour change techniques are subsequently identified (for more information about behaviour change techniques, see Michie and Johnston 2011). Further consideration as to how the behaviour change techniques will be delivered within organisations or communities is taken into account by considering criteria such as the **affordability**, **practicality**, **effectiveness** and **cost-effectiveness**, **acceptability**, **side-effects/safety**, and **equity** of the intervention (i.e. the APEASE criteria; Michie et al. 2014). The BCW is designed to be a pragmatic framework that can be used to systematically design and support the evaluation of behaviour change interventions (see Michie et al. (2014) for more details).

14.3 Behaviour Change Versus Behavioural Safety Approaches

The behaviour change approach described in this paper should be differentiated from the ‘safe behaviour,’ ‘behaviour modification’ or ‘behavioural safety’ approaches described by Hopkins (2006). Whilst behaviour and how to change it is at the heart of both approaches, ‘behavioural safety’ programmes are more narrow in focus and deal primarily with downstream causes of accidents. Theorists have criticized the behavioural safety approaches for falling foul of the ‘fallacy of monocausality’, which is the idea that there is often a single root cause—in this case, behaviour—of an event. Since human factors are often implicated at some point during the causal chain of events leading up to an industrial accident,

behavioural safety programmes focus on understanding and modifying the associated behaviours. This approach has been heavily criticized by unions and academics alike because of the perception that it unfairly blame workers for the accidents that befall them, misdirecting attention from other factors that may play a role in the complex causal chain of events that leads up to an accident. In contrast, a *behaviour change* approach acknowledges that whilst unsafe behaviour may trigger an accident, the behaviour itself may be better viewed as something requiring an explanation rather than itself being the explanation (Hopkins 2006). As such, the behaviour change approach outlined in the BCW acknowledges that changing individuals' behaviour requires making changes to the contextual influences on that behaviour. This may include the way people are organized, managed, motivated and rewarded, as well as their physical environment and the tools that are available to them (Fleming and Lardner 2002).

14.4 Specifying Outcomes and Their Behavioural Determinants

The starting point for any attempt to change behaviour is to determine what it is that needs to be different (the outcome) and then identify the behavioural determinants of that outcome. For example, if a company wishes to have fewer on-site accidents then it would need to specify the specific types of accidents (e.g. fewer machine tool injuries) and the behaviours that are related to this (e.g. using tools correctly, wearing personal protective equipment). Specificity is important since all behaviour is context dependent. The behavioural determinants of one type of machine tool injury may or may not translate to a different machine because different machines require different types of complex motor movements to operate them. Similarly, the behavioural determinants of a particular type of machine tool injury on the same machine may be different between sites because the context in which the machine and the worker interact may be different. There may be commonalities across contexts but one should always be open to the possibility that the behavioural determinants of outcomes could vary in important ways between them.

14.5 Behaviour Change, Safety-I and Safety-II

Accidents caused by deviations to established protocols for routine tasks are different to accidents caused by workers' behavioural responses to unexpected events that have never happened before, or cannot be foreseen. Interventions to prevent accidents arising from the former are referred to as Safety-I approaches, whilst interventions directed towards limiting the damage caused by the unexpected and unforeseen are termed Safety-II approaches (Hollnagel et al. 2015). A behaviour change approach can be applied within both approaches since they share an

emphasis on understanding behaviour in context. For example, being able to specify the behavioural determinants of effective responses to unexpected events can inform how organisations train individuals to respond to similar circumstances. In both cases the behaviour change approach is based on an understanding of how people actually carry out their work (work as done) as opposed to how they are supposed to do it (work as imagined). Interventions developed with the BCW always start from examining the behaviour in context and in many cases this requires changing the context to enable the behaviour rather than changing behaviour to fit the context. Within the industrial safety sector, an intervention based on behaviour change principles may well involve restructuring the nature of work itself in order to bring it in line with the known limits and constraints on human performance, rather than attempt to modify human performance in order to bring it in line with unattainable production targets.

Whilst behaviour change principles are amenable to looking at safety through both Safety-I and Safety-II perspectives, the BCW may at first seem more aligned with Safety-I approaches on the basis that the primary unit of analysis is behaviour. Nevertheless, by understanding behaviour as context-dependent, and broadening the definition of context to include the organisational, cultural and linguistic determinants on behaviour, models such as the Behaviour Change Wheel have the potential to be applied within Safety-II frameworks. Safety-I looks at why things go wrong and tries to identify and eliminate the causes of error, whereas Safety-II looks at why things go right and tries to ensure that they happen again, often by promoting organisational resilience. In both cases a focus upon describing the situation in behavioural terms and identifying the determinants of what goes wrong, or what goes right, is likely to generate helpful new insights for targeted interventions.

14.6 Specifying What Needs to Change—Behavioural Diagnosis

Once the behavioural targets have been identified the next step in designing a behaviour change intervention is to identify the determinants of the behaviour(s). The Behaviour Change Wheel uses a simple model of behaviour, COM-B (Michie et al. 2011) as a framework to categorise the various influences on the behaviour. COM-B is an acronym for the three essential conditions for behaviour; ‘Capability’ (physical and psychological), ‘Opportunity’ (physical and social) and ‘Motivation’ (automatic and reflective).

14.6.1 Capability

Capability refers to an individual’s ability to carry out the required behaviour. The model distinguishes between physical and psychological capability, the former

being the physical skills, strengths and stamina to behave in a certain way, for example, being fit enough to continue handling well at the end of a long shift, the latter being the necessary mental process required to carry out a behaviour, such as being able to reliably make the right decision in the face of a barrage of complex information.

14.6.2 Opportunity

Opportunity refers to those influences on behaviour that are largely external to the individual and are found in the physical and social environment (e.g. productivity targets). Physical opportunity refers to the time, resources, locations and cues that trigger behaviour or enable it. Social opportunity refers to the interpersonal influences on behaviour such as behavioural norms, peer influences, role models, as well as broader aspects such as the linguistic and cultural concepts that shape behaviour and its expression (e.g. safety and management culture).

14.6.3 Motivation

Motivation refers to all those processes, conscious and unconscious, that energise and direct behaviour. The model distinguishes between reflective and automatic processes. Reflective motivation refers to the conscious plans, beliefs, desires and intentions that influence behaviour, such as the specific intentions to behave in ways that are consistent with an individual's beliefs about their identity. Automatic motivation refers to the largely unconscious influences that shape behaviour, such as emotional reactions (e.g. the experience of guilt or shame if found to be doing an unsafe behaviour), impulses, inhibitions and drive states such as hunger and thirst, and habits (e.g. reaching for a lever that is typically on a certain side).

14.6.4 Pulling Together the Behavioural Diagnosis

Capability, opportunity and motivation all act to influence the expression of behaviour in a reiterative way. For example, an organisational culture characterized by high levels of trust between workers and management (social opportunity) may lead to greater engagement with initiatives to improve behavioural safety (reflective motivation) leading to workers who have the acquired physical and psychological skills to behave in ways that are less likely to lead to injury (physical and psychological capability). Conversely, pressures on productivity (physical opportunity) may reduce willingness of workers to take proper precautions (reflective motivation) thereby creating a community of unsafe practice that spreads through the

processes of peer to peer role modelling (social opportunity) that means that new members of staff do not adequately acquire the competencies to do their job safely (psychological capability).

Deriving a behavioural diagnosis using the COM-B model has the potential to provide a comprehensive explanation of behaviours related to safety since it encompasses automatic processes as well as conscious deliberative processes, practical influences such as time and resources upon behaviour, as well as the complex web of social influences (e.g. what's normative), and the physical and psychological capabilities such as knowing why a behaviour is important and knowing how and possessing the skills to do it. It also specifically includes system level influences and emphasizes that behaviour is the product of, and therefore potentially influenced by, interventions at multiple levels of influence.

14.7 Intervention Design Using Intervention Functions

Once a behavioural diagnosis has been identified, the next stage is to design an intervention to influence the behaviour in the desired direction. The BCW describes nine categories of intervention classified by their function. These intervention functions and their definitions are described in Table 14.1. When designing intervention using the BCW the designer is encouraged to think about the entire range of possible ways to influence behaviour, not just the obvious ones or those with which they are most familiar as a result of professional training or experience. Nevertheless, it is clear that different intervention functions are more suited to influencing different forms of behavioural influence (e.g. training is an appropriate way to help people acquire the physical capability to perform a behaviour whereas persuasion will be ineffective). More information on the relationship between the COM-B domains and the interventions functions can be found in Michie et al. (2014).

Williams (2015) describes how the BCW was used to understand the positive impact of an environmental restructuring intervention on the incidence of road traffic accidents in a manufacturing company. The company fitted vehicles with driver-performance trackers as a means to increase productivity. Driver performance measures included 'fuel efficiency' and 'sympathetic braking/accelerating' and each driver's performance was visible to their co-workers on a live display screen in the transport office. The unintended impact of this was a dramatic reduction in the occurrence of road traffic incidents. Interviews with the drivers in the company revealed that this change to the work environment (an environmental restructure intervention) changed the norms by which drivers judged their driving (tackling social opportunity) as well as providing motivation to be the 'best driver' (boosting reflective motivation) as well as providing feedback to drivers about their performance which they used to improve their performance (improving capability).

Table 14.1 BCW intervention function definitions and examples [adapted with permission from Michie et al. (2014) and Williams (2015)]

Intervention function	Definition	Example of intervention function
Education	Increasing knowledge or understanding	Providing information on risks associated with non-compliance with machine operating instructions
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using images or stories drawn from real life accidents to induce the desire for compliance
Incentivisation	Creating an expectation of reward	Scheme to acquire benefits in return for compliance with behaviours related to safety
Coercion	Creating an expectation of punishment or cost	Loss of in-work benefits if found to be violating safety principles
Training	Imparting skills	Dynamic risk assessment skills
Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	Prohibiting entry to certain areas of the plant.
Environmental restructuring	Changing the physical or social context	Changing work teams to provide social influences
Modelling	Providing an example for people to aspire to or imitate	Using shopfloor, peer coaches as part of manual handling training
Enablement	Increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)	Behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity

14.8 Using Policy to Change Behaviour

Organisational context is a powerful determinant of safety culture and decisions made by those in power will have an important influence on the expression of safety-related behaviour. The BCW identifies seven distinct types of influence which can be leveraged by authorities to influence behaviour. These include:

- ‘communication/marketing’ (using print, electronic, telephonic or broadcast media);
- ‘guidelines’ (creating documents that recommend or mandate practice);
- ‘fiscal’ (using the tax system to reduce or increase the financial cost);
- ‘regulation’ (establishing rules or principles or behaviour and practice);
- ‘legislation’ (making or changing laws);
- ‘environmental/social planning’ (designing and/or controlling the social environment);

- and ‘service provision’ (delivering a service).

As with intervention functions, the relevance of each different policy function will vary according to the nature of the behaviour to be changed and the context in which it occurs. Nevertheless, the inclusion of a policy level of influence is an important differentiator for the BCW compared to other behaviour change frameworks, especially when applied to a sector where organisational culture has been shown to have such an important influence on the uptake and spread of initiatives to improve safe practices.

14.9 Using Behaviour Change Techniques Within Intervention Design

Intervention functions describe the different ways in which behaviour is influenced (e.g. through coercion and training) but they fall short of describing the specific techniques that are employed to bring about change. Behaviour Change Techniques (BCT’s) are the observable, replicable, irreducible components of an intervention designed to change behaviour, for example, goal setting and self-monitoring. It is possible to specify the content of behaviour change interventions by listing these active ingredients using a hierarchical taxonomy of behaviour change techniques that has been scientifically developed through a rigorous process of expert consensus review (Michie et al., 2015). The Behaviour Change Technique Taxonomy V1 (BCCTV.1) is available online as a web and app-based resource as well being described in Michie et al. (2014). Specifying behaviour change interventions at the level of BCT’s has the potential to allow researchers and practitioners to understand with more precision how different techniques may be related to outcomes. This may be useful for designing more cost-effective interventions since elements that are proven to be unrelated to outcomes can be discarded, or for identifying why similar interventions have different results in different contexts of delivery.

14.10 Potential Applications of the BCW Methodology for Industrial Safety

As a relatively new framework the utility and the effectiveness of the BCW is yet to be established in the field of industrial safety. Whilst it is for researchers and practitioners in this sector to decide for themselves the potential applications of this framework the following options may be useful starting points for further development based on its application to other areas:

- Using the BCW to design and develop curricula to embed safety considerations into the induction and training programmes for workforce development. For

example, the COM-B model could be used to audit or develop training programmes to ensure that workers are equipped with the three necessary conditions for working safely; having the skills to carry out task safely (capability); the physical and social resources to do work safely (opportunity), and the sense that working safely is a core part of what makes a ‘good’ worker (motivation).

- Adapting the BCW as a methodology for ‘safety professionals.’ The BCW provides a comprehensive behaviour change methodology that enables professionals tasked with safeguarding against risks to develop interventions in a systematic way, considering the entire range of possible influences on risk-related behaviour.
- Using the BCW as an organising framework for research into ‘what works and for whom’ in relation to interventions to improve industrial safety. The BCW and BCTTV.1 provide a methodology and tools to allow for greater precision in specifying the content of behaviour change interventions to improve safety in industrial contexts.

14.11 Conclusions

Like many other fields in applied behavioural science, the field of industrial safety is in danger of being overwhelmed by the proliferation of theories and frameworks that can be brought to bear on the perennial challenge of ensuring that workers behave in ways that minimize the risks to self, others and the environment. The emerging science of behaviour change, and specific frameworks such as the Behaviour Change Wheel, create opportunities to integrate the valuable insights from diverse disciplines using a single framework that has cross-disciplinary appeal.

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