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Behaviour change theory and evidence: a presentation to Government

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This review presents a case study of Government policy in relation to behaviour change and suggests ways of strengthening it by drawing on theoretical and empirical approaches from health psychology. It aims to inform policy-makers and politicians about the value of behavioural science, and to provide psychologists with an example of engagement with Government. It is based on two Health Psychology submissions to the 2010 UK House of Lords' Science and Technology Select Committee inquiry into Behaviour Change. The Inquiry examined current knowledge about what interventions can effectively influence behaviour, how behaviour change interventions can be used to achieve policy goals and what factors should be taken into account by government in determining whether a particular behaviour change intervention is appropriate. The review critiques current UK Government thinking about behaviour change and presents a number of linked frameworks for determining which behaviour change interventions and policies it would be sensible to research and implement. These include the COM-B system, a systems approach to understanding behaviour in context; the PRIME Theory of motivation; the Behaviour Change Wheel, including a comprehensive listing of intervention functions and policy levers; and behaviour change techniques. We end with considerations of intervention development, effectiveness and cost-effectiveness.

Keywords: behaviour change; behaviour change theory; behaviour change interventions; evidence-based policy; 'Nudge'; theory; government policy

Introduction

In 2010, the UK House of Lords' Science and Technology Select Committee launched a wide-ranging inquiry into Behaviour Change and called for evidence from the national and international scientific and policy communities and beyond (www.parliament.uk/documents/lords-committees/science-technology/behaviourchange/CfEBehaviourChange.pdf). To our knowledge, this is the first such exercise by any national legislative body. The evidence was received by a panel of 12 peers with expertise in science, ethics and policy; the expert advisor to the panel was a health psychologist. Whilst the submissions could be on any aspect of behaviour change, the great majority of the 150 or so submissions concerned health.

The context for the inquiry was as follows:

> To meet many of the societal challenges we are currently facing – such as achieving an 80 percent reduction in carbon emissions by 2050 or reducing the burden on the health

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> service as a result of smoking, drinking or the rise in obesity – individual and collective behaviour will need to change significantly .... The inquiry will examine our current state of knowledge about what interventions can effectively influence behaviour, how behaviour change interventions which have been designed on the basis of that knowledge can be used to achieve policy goals, and what factors should be taken into account by government in determining whether a particular behaviour change intervention is appropriate.

The select committee set out to investigate, amongst other things, the policy implications of recent developments in research on behaviour change, whether current UK government behaviour change interventions are evidence-based and subject to appropriate evaluation, the relationship between government, industry and the voluntary sector in promoting behaviour change and the social and ethical issues surrounding the use of behaviour change interventions by government. This article is based on two health psychology submissions (Michie & West, 2010; West & Michie, 2010) one of which was invited as part of expert witness evidence to the Inquiry. It addresses five of the 16 questions posed by the Inquiry: What is known about how behaviour can be influenced? What should be classified as a behaviour change intervention? How should different levels of intervention (individual, organisational, community and national) and different types of intervention (legislative, fiscal, educative) interact in order to achieve policy goals more effectively? Should behaviour change interventions be used in isolation or in combination with other policy interventions? What are the policy implications of recent developments in research on behaviour change?

We begin this review with a critique of current UK Government thinking about behaviour change and then propose an agenda for designing theory-based behaviour change interventions of interest to policy-makers and for systematically developing the science base and technology of behaviour change. This includes brief summaries of:

(1) The COM-B system: a systems approach to understanding behaviour in context.
(2) The PRIME Theory of motivation which draws together into a single coherent model the broad range of motivational processes, from drives and impulses to analysis and self-conscious decision making.
(3) The Behaviour Change Wheel (BCW) which includes a comprehensive listing of categories of intervention functions and the policy levers that may be used to enact these.
(4) Taxonomies of behaviour change techniques (BCTs) which form the components of behaviour change interventions.
(5) We end with considerations of intervention development, effectiveness and cost-effectiveness.

The UK Government's approach to behaviour change

The UK coalition Government has declared its intention of avoiding coercive interventions or those that impose 'bureaucratic restrictions' on individuals or industry, and has established a 'Behavioural Insight Team' to help them achieve this. Its work is illustrated in the following response to a House of Lords parliamentary question (emphases ours):

Asked by Lord Bassam of Brighton

> To ask Her Majesty's Government how many staff are employed in the Behavioural Insight Team in the Cabinet Office; what are their terms of reference; to whom they report; to whom they are accountable; and when they are expected to complete their work programme. [HL3958]
>
> Lord Taylor of Holbeach: 'The Behavioural Insights Team has seven full-time staff. Their terms of reference are to develop more cost-effective **and less bureaucratic ways** of changing behaviour in ways that give citizens and communities greater control of their own lives. They will achieve this in three ways. First, by proactively developing ideas for achieving behavioural change using **less bureaucratic methods** across a wide range of government policy and activity. In this mode the team will actively seek out areas where behavioural science applications could be usefully applied. Secondly, by pursuing **non-bureaucratic and non-coercive** alternatives to regulation. And thirdly, by creating and facilitating alliances and partnerships between government, business, media and the third sector to deliver and activate the ideas developed above.'

The emphasis on the virtue of 'non-bureaucratic' (rather than, say, 'effective') interventions reflects the Government's underlying philosophy that eschews explicit regulation and promotes behaviour change by more subtle means such as priming and framing, social norm feedback, default options, incentivisation and environmental cues. The Behavioural Insight Team draws heavily on a book called 'Nudge': Improving Decisions About Health, Wealth and Happiness' (Thaler & Sunstein, 2008). Common parlance includes 'nudge thinking', 'nudge interventions', 'nudge policies' and even 'nudge theory'. 'Nudge' is defined as 'any aspect of the 'choice architecture' that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives'. This is put forward as the 'third way' between libertarianism and paternalism. Libertarian paternalists 'want to make it easy for people to go their own way; they do not want to burden those who want to exercise their freedom' (p. 5). .... 'Libertarian paternalism is a relatively weak, soft, and nonintrusive type of paternalism because choices are not blocked, fenced off, or significantly burdened. If people want to smoke cigarettes, to eat a lot of candy, to choose an unsuitable health care plan, or to fail to save for retirement, libertarian paternalists will not force them to do otherwise – or even make things hard for them' (p. 6).

Eschewing other potentially more powerful interventions does not take into account the conflicting interests in society: one person's 'freedom' is another person's burden e.g. the 'freedom' to smoke extends the years of illness and disability for which the smoker requires others to care for them; the 'freedom' to make potentially harmful food attractive maximises profit for the food industry. Many large corporations have no qualms about using more directive, coercive and powerful methods of shaping our behaviours. The most striking example is cigarettes which besides containing an addictive drug, nicotine, are engineered to maximise the impact of this drug in terms of speed of delivery and potent conditioned stimuli (Rabinoff, Caskey, Rissling, & Park, 2007). Gaming machines use sophisticated operant conditioning techniques to maximise behaviour rate. The food industry engineers its products, for example with large amounts of hidden salt, to maximise immediate taste appeal (Magriplis et al., 2011). The alcohol industry uses sophisticated marketing techniques tapping into core aspects of identity to attract people to its products (Anderson, 2009).

The 'nudge' doctrine also discounts the duty of the state, in a democracy, to protect its citizens from the harmful effects of such manipulation; protection may require regulation, service provision, legislation and fiscal measures which research findings have shown the public happy to accept (Bassi, 2010; Maryon-Davis & Jolley, 2010; YouGov, 2010).

Advocates of 'nudge' argue for a collaboration between government and the market 'to steer people's choices in directions that will improve their lives'. Of note is reference to the notion of choice rather than to behaviour. This is based on the erroneous assumption that the behaviours that harm people's health are exclusively the result of choice, and that impulses driven by instinct and past associations that do not involve reflective analysis do not play a significant role in shaping behaviour. Thus, while the book makes much of cognitive biases, these are all considered to work through a process of reflective option selection and not as part of the flow of behaviour that is undertaken without self-awareness. Due weight is not given to the powerful associative learning influences that interact with drives and emotions. An example of the lack of attention to the role of context and impulse-driven motivation in shaping behaviour is 'in many cases, people make pretty bad decisions – decisions they would not have made if they had paid full attention and possessed complete information, unlimited cognitive abilities, and complete self-control' (p. 6). Even if people had all these resources and had made a decision to behave in a healthy fashion, influences such as associative learning, widely used by the advertising industry, will serve to push people off their chosen path.

A consideration of the effectiveness of 'nudge interventions' within the existing UK public health environment that is shaped largely by industry suggests that the evidence, where it exists, shows little or no effect (Marteau, Ogilvie, Roland, Suhrcke, & Kelly, 2011).

The 'nudge' approach pre-judges the key issues that should be considered in designing intervention strategy. Interventions need to be affordable, practicable and publicly acceptable but if they are not effective these count for nothing. There is no substitute for a rigorous evaluation of the evidence and a systematic analysis of the behaviour in context in the light of that evidence. If a government turns its back on interventions that evidence clearly shows are likely to be effective and which are affordable, practicable and carry public support, and instead they back interventions that derive from inconclusive evidence that is tangentially related to the behaviour at issue but fits with a particular doctrine, human lives may be lost in their thousands.

Also missing is a consideration of the context of the harm posed by behaviour; the central role that the notion of harm should play in intervention selection is articulated by the Nuffield Council on Bioethics in its Ladder of Interventions and stewardship model (Nuffield Council on Bioethics, 2007). The 'nudge' approach forswears 'banning' activities and yet no rational thinker could imagine that, were cigarettes to be invented today, they should be permitted for sale. The fact that the harms they cause were only discovered recently has led to an anomalous situation in which governments concerned about public health have been forced to use other interventions such as education and persuasion to limit that harm, and every attempt to go further has been vigorously opposed by a hugely influential and wealthy industry that uses the fact that its products are legal as a key defence.

The 'nudge' doctrine is not adequate to deal with the behaviour change challenges facing society. It does not engage in a systematic analysis to determine likely

intervention effectiveness, and allows political values to influence judgements about other criteria such as effectiveness and public acceptability. The political values underpinning adoption of the 'nudge' doctrine are revealed by the fact it is favoured in cases where major industries, such as the alcohol and food industries, fear they may lose business, but not in cases where there are no major industry stakeholders. For example, the new stimulant drug 'mephedrone' was quickly banned even though the harms to users and society appear to be substantially less than from tobacco or alcohol. Coercive policies are also favoured with regard to getting people off sickness and unemployment benefit and forcing drug-users by court order into treatment programmes.

The arena of behaviour change where the Government favours 'nudge' is one that does not involve a level playing field. Since industry can and does use interventions that go well beyond 'nudge' to influence the behaviour of consumers, a socially responsible behaviour change strategy needs to take account of the fact that all our behaviours are subject to powerful manipulation by companies through marketing and product design. The tobacco, gambling, 'fast food' and alcohol industries spend many millions of pounds and dollars exploiting our psychology to sell their products. If governments eschew interventions that protect us against this, 'choices' are not free – they are dictated by commercial exploitation. An example of how industry uses the vast resources at its disposal to influence consumer behaviour is Coca Cola's spend on advertising, estimated at $2.44 billion in 2009 (http://www.adbrands.net/us/cocacola_us.htm).

It may be noted that, like Odysseus who instructed the crew of his ship to tie him to the mast and to block their own ears with wax so that they would not be lured by the song of the sirens to steer the ship on to the rocks, the public will often support coercive or restrictive interventions that prevent them succumbing to temptation. For example, a large-scale survey of adults in Britain found that 77% supported getting rid of cigarette vending machines completely, 73% wanted tobacco put out of sight in shops and 67% supported banning TV advertising of junk food before 9 pm (YouGov, 2010). There is also widespread approval even among smokers of the use of tax increases as a way of curtailing smoking behaviour (Gardner & West, 2011) and almost half the adult population of England would even support a total ban on sale of cigarettes (Shahab & West, 2011).

'Nudge' is an ideologically driven doctrine, the application of which will result in poor policy decisions with respect to health behaviour change. It should be replaced with a systematic evidence-based approach to selecting interventions and determining policy. It is recognised that values should shape and constrain behavioural interventions. The criticism of the 'nudge' doctrine is that it does so from a narrow political perspective rather than a broader societal one. Thus it rules out interventions that most members of society would be happy to accept if they were explained. Rather than starting from a restricted range of intervention options, Government should give systematic and comprehensive consideration to the range of interventions that may be applicable to determine its behaviour change strategies. We present such an approach aimed to be usable by psychologists and policy-makers alike. The starting point is an analysis of the behaviour to be changed which conceptualises behaviour as a system incorporating context (the COM-B system). For example, understanding physical activity must take into account weather, local geography and availability of facilities, and GP advice to stop smoking is very

different in contexts where GPs can provide free medication or refer to a behavioural support programme than when these options are not available.

This analysis is linked to an evidence-based method for selecting amongst a comprehensive, systematically organised and theoretically grounded range of intervention options (the BCW). The selected interventions can, in turn, be linked to specific BCTs and general policies to support their delivery in a way that is sensitive to specific contexts.

A model of behaviour in context: the COM-B System

Applying the principle of parsimony, we sought to identify the simplest overarching model needed to account for change in a behaviour. By behaviour, we mean 'anything a person does in response to internal or external events. Actions may be overt (motor or verbal) and directly measurable, or covert (activities not viewable e.g. physiological responses) and indirectly measurable; behaviours are physical events that occur in the body and are controlled by the brain' (Hobbs, Campbell, Hildon, & Michie, 2011). We drew on two sources representing very different traditions: a US consensus meeting of behavioural theorists in 1991 (Fishbein et al., 2001), and a principle of US criminal law dating back many centuries. The former identified three factors that were necessary and sufficient conditions for the performance of a specified volitional behaviour: the skills necessary to perform the behaviour, a strong intention to perform the behaviour and no environmental constraints that make it impossible to perform the behaviour. In US criminal law, it is recognised that for a defendant to be found guilty of a criminal act three conditions must be present: means/capability, motive and opportunity (Means, motive, and opportunity, 2011). Logic dictates that this can be extended to any action. This provides the starting point for a comprehensive framework for understanding behaviour: as a system of interacting elements as shown in Figure 1. The arrows represent potential for causal inference. Thus, capability, motivation and opportunity are all necessary conditions for a given behaviour, the behaviour can influence all three of these and capability and opportunity can both influence motivation.

We can divide each of the sources of behaviour into two types. Capability can be either physical (in the case of physical skills, physical strength, etc.) or psychological (in the case of psychological resources and skills, knowledge, capacity for understanding

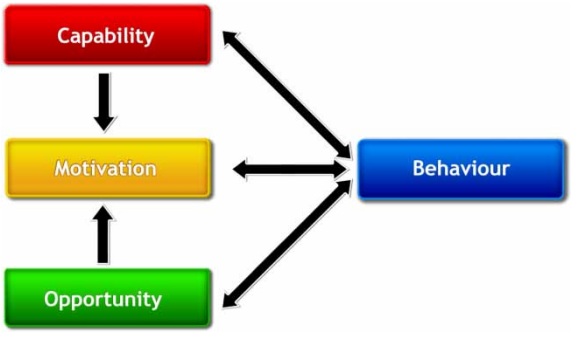

Figure 1. The COM-B system: a framework for understanding behaviour.

etc.). For motivation, reflective (involving self-conscious planning, analysis and decision-making) and automatic processes (involving emotional reactions, drives and habits) play a role. In the case of opportunity, it is possible to distinguish between what is afforded by the physical environment (resources, locations, physical barriers, etc.) and the social environment (concepts available in language, exposure to ideas, etc.).

This model provides a basis for specifying what drives and enables behaviour patterns and individual behaviours. It is thus a model of behaviour *per se*, and provides the basis for a model of behaviour change. It puts the nature of the behaviour to be changed at its core: a COM-B analysis of the behaviour has direct implications for the types of intervention likely to be effective. A systematic, theory-based approach to intervention design would be to identify the nature of the desired change and then systematically consider each of the components that would be necessary, practicable and acceptable to achieve that change.

In the case of health-related behaviour, it is apparent that motivation in its broadest sense lies at its heart. Thus smokers are physically capable of not lighting up, excessive drinkers are physically able to abstain and so on. Motivation is not simply a matter of reflective choice; a COM-B analysis requires an understanding of how reflective and automatic motivation interact to determine behaviour. There are a number of models that have begun to explore this (e.g. Strack & Deutsch, 2004) but one in particular explicitly seeks to bring together the full range of motivational constructs into a single coherent model.

PRIME Theory of motivation

Motivation is central to the generation of behaviour. Given all the things that we are capable of doing and that we have the opportunity to do, motivation determines what we actually do and how we do it. Motivation goes beyond reason and choice to all the psychological and physiological processes that energise and direct our behaviour, including biological drives, emotions and habits (Mook, 1995). There has been a tendency in recent years to focus on reflective aspects of motivation at the expense of automatic aspects that have long been known to be important (Mook, 1995). Those that have focused on automatic processes have often not recognised important distinctions within these processes (Keren & Schul, 2009). For example, within operant conditioning there is evidence of an important distinction between the learning of stimulus-impulse associations (habit) and associations between stimuli and anticipation of pleasure or avoidance of discomfort (goal-directed behaviour)(Skinner, 1953).

A comprehensive theory that represents the structure of human motivation as a number of levels is PRIME Theory (West, 2006) (see Figure 2), with PRIME standing for Plans, Responses, Impulses/inhibition, Motives and Evaluations. According to this theory, 'higher' levels of motivation have evolved later than lower levels and provide greater flexibility of response, but crucially are only able to influence behaviour by acting as stimuli to lower levels. Higher levels of motivation permit both greater flexibility of responding and anticipation of future events. Thus reflex responses are the lowest level and simply involve organisation of a response in response to a stimulus. Impulses and counter-impulses allow for immediate stimuli with the strongest motivational force to control behaviour. Motives/desires allow for goal-directed behaviour to the extent that possible futures can be imagined.

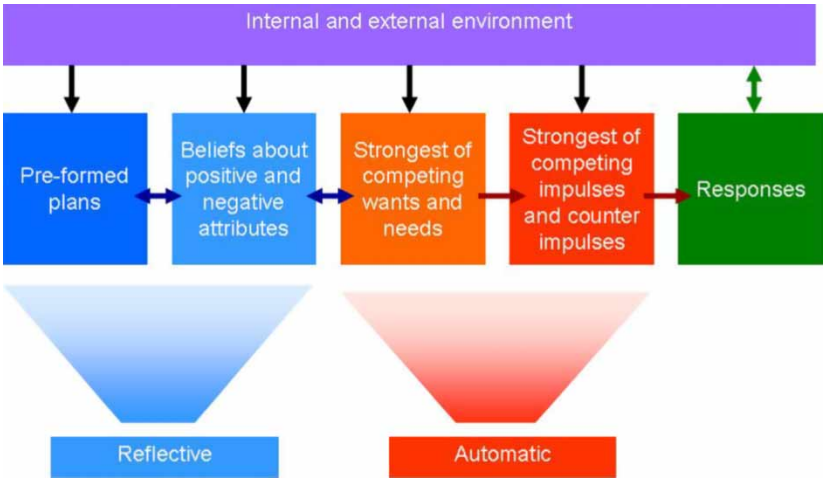

Figure 2. The structure of human motivation in PRIME Theory.
Note: Plans are self-conscious intentions to perform an action in the future. Beliefs are propositions that are held to be true. Wants and needs are imagined futures to which are attached anticipated pleasure/satisfaction and relief from mental or physical discomfort respectively. Impulses are organised action schemas, and counter impulses are inhibitory countervailing processes. Responses involve initiating, modifying or stopping an action. The internal environment involves an ever-changing flux of emotional states, drive states, images and cognitive schemata. The external environment involves stimuli impacting on the sense organs. Reflective processes involve self-conscious information processing. Automatic processes do not require conscious awareness although their results may be the object of reflection and form part of ongoing experience.

Evaluations allow for goal-directed behaviour where goals can be communicated through language and derived from inference and analysis. Plans allow for behaviours to be deferred according to priorities or anticipated opportunity or threat.

Thus what we believe to be good or bad can only influence our actions if our beliefs make us want or need things at the relevant moment. Similarly, what we intend to do at one time can only direct what we actually do if the intention is remembered and generates sufficiently strong wants or needs in the moment to overcome competing wants and needs from the immediate environment. In summary, wants and needs compete at each moment for control over our actions and these are under strong stimulus control as a result of past associative learning, and current drives and emotional states.

Previous models of health-related behaviour have considered only a limited number of ways in which change occurs. A great deal of attention is focused on communication and inferential reasoning but associative learning is also crucial, as are many other processes (see Table 1).

PRIME Theory notes that the motivational system is fundamentally 'chaotic' which means that small triggers can have large effects, and change can be sudden or gradual or involve a long period of apparently random switching between states. Approaches such as the 'stages of change' model that propose an orderly transition in behaviour change, only account for a small proportion of instances of behaviour

Table 1. Elementary processes of change in human motivation; items 1–12 may be thought of as 'automatic' while items 13–15 form part of 'reflective' information processing.

1. Maturation: Changes associated with growing older
2. Habituation: Decrease in response with exposure
3. Sensitisation: Increase in response with exposure
4. Chemical 'Insult': Pharmacological responses
5. Physical 'Insult': Brain lesions
6. Associative learning: Operant and classical conditioning
7. Imitation: Direct copying
8. Perception: Acquiring information from the senses
9. Identification: Forming one's own identity from perceptions of others
10. Consistency disposition: Generation of motives, ideas from similar ones
11. Dissonance avoidance: Negating or blocking uncomfortable thoughts
12. Objectification: Generating evaluations from likes and dislikes
13. Assimilation: Acquiring information via communication
14. Inference: Induction and deduction
15. Analysis: Formal and informal calculation

change and can lead to inappropriate interventions (West, 2005). In the field of smoking, for example, many smokers who appear not to be ready to stop will respond favourably to an offer of help and will go on to become ex-smokers, contrary to what would be expected from the 'stages of change' model (Pisinger, Vestbo, Borch-Johnsen, & Jorgensen, 2005).

PRIME Theory further notes that, as a result of self-awareness, we as humans develop mental representations of ourselves about which we have strong feelings. These 'identities' are a very important source of wants and needs which give stability to behaviour patterns; in many cases, a change in identity is a fundamental driver of behaviour change. This has been cited as important in recovery from drug addiction (White, 2004), and is cited as a major factor underlying spontaneous recovery and forms part of the treatment approach offered by organisations such as Alcoholics Anonymous which is widely used in many countries (Kaskutas, 2009). Self-control involves a domination of reflective over automatic processes and this requires psychological skills, mental energy (a finite resource) and efficient downward connections between parts of the brain involved in reflective processes and the automatic channels through which they must operate.

Thus, fundamental tenets of PRIME Theory are, first, that at every moment we act in pursuit of what we most 'want' (anticipating pleasure or satisfaction) or 'need' (anticipating relief from mental or physical discomfort) at that moment. Second, these are feelings and we do not have to verbalise them (even internally) for them to influence our actions. Also, third, beliefs about what is good or bad and preformed plans (reflective processes) can only influence our actions if they generate sufficiently strong wants or needs at the relevant moment to overcome competing wants or needs arising from more direct sources such as past associations and drive states. Our identities are a very important source of wants and needs and can often be key to achieving lasting behaviour change. Self-control is fundamental to much behaviour change and to facilitate this it is necessary to develop psychological capabilities as well as motivation to change, and to provide an environment conducive to this. Stress and other psychological demands deplete reserves of mental energy and make it

harder for individuals to exercise self-control. The concept of mental energy has been operationalised and studied, but as yet does not have a clear physiological substrate and so can best be considered as a 'metaphor'.

PRIME Theory provides a broad conceptualisation of motivation and its influences that can help to develop interventions designed to change health-related behaviours. Concepts developed in COM-B and PRIME Theory have been linked with a comprehensive classification of intervention functions and policy categories to form a theoretically based system for developing behaviour change interventions. This is discussed in the following section.

A system for classifying interventions: the Behaviour Change Wheel (BCW)

A behaviour change intervention is a co-ordinated set of activities designed to change specified behaviour patterns. Usually these behaviour patterns are measured in terms of the prevalence or incidence of particular behaviours in specified populations (e.g. prevalence of tobacco smoking or incidence of delivery of brief advice from a physician to stop smoking).

When designing or evaluating behaviour change interventions, one needs to begin with a *comprehensive* analysis of what is driving the current behaviour pattern and the available intervention and policy options. This requires an overarching model of behaviour, and within that of human motivation, and a way of linking this to make a selection from among the full panoply of intervention and policy options. This approach contrasts with one which takes an idea, such as 'nudge' (Thaler & Sunstein, 2008) and attempts to apply it as a doctrine, thus neglecting all those intervention strategies that come from a different perspective. It also contrasts with frameworks in common use by the UK Government, such as MINDSPACE (Institute for Government, 2010), that are not comprehensive in that they do not cover all possible intervention types. Neither are they coherent in the sense of using categories that are mutually exclusive and at similar conceptual levels.

We describe a classification system developed on the basis of a systematic review of previous frameworks, with a clear goal of being (1) comprehensive, (2) coherent and (3) based on an overarching model of behaviour (Michie, van Stralen, & West, 2011). It is a starting point for systematically developing the science base in this area and a behaviour change technology.

The BCW takes the concepts developed in PRIME Theory and COM-B and applies them to directing the choice of intervention functions and from there to policy categories needed to enact those interventions. The distinction between intervention functions and policy categories is illustrated by examples. A COM-B analysis may determine that there is a requirement to educate particular sectors of the population about the substantially increased risk of Type-II diabetes with even moderate overweight. Thus, the intervention function is 'education'. It then has to determine what policies would be appropriate to deliver this. It may be 'Communications/marketing' (for example with a TV campaign), or 'Service delivery' (for example, by primary healthcare staff giving brief advice to all patients who are overweight). In a second example, consider that it is decided that an important intervention function to reduce excessive alcohol consumption would be 'environmental restructuring' in which there was reduced exposure to certain kinds of manipulative promotion by alcohol producers. Depending on the circumstances, it

may be decided that this could be achieved through voluntary 'regulation' or it may require 'legislation'. A striking example of the difference between governmental policies that have been largely evidence-based and derived from a comprehensive analysis of the options and those that have been dominated by political ideology or pandering to commercial interests is tobacco versus alcohol.

The BCW is marked out from other intervention classifications by its explicit linkage to a comprehensive understanding of behaviour and motivation. It is also marked out by the fact that the identification of intervention functions and policy categories was arrived at by a systematic literature search for pre-existing classification systems. This identified 19 frameworks of behaviour change (Michie, van Stralen, & West, 2011). Such a comprehensive list is crucial because, unless intervention designers and policy-makers can see the full set of options available for achieving behaviour change, they are likely to overlook some that could be particularly effective. An analysis of these frameworks revealed nine broad functions of interventions and seven categories of supporting policies.

Merely listing the intervention and policy options can be useful as a reminder of ones that would otherwise be missed. However, the BCW goes beyond that. It forms the basis for a scientific analysis of how to make the selection. This is based on a COM-B analysis of the target behaviour, along with key principles of likely effectiveness, affordability, ethical acceptability, public acceptability and capacity to be implemented within the current context.

The BCW classification system shows where doctrines such as 'nudge' fit within the broad framework of behaviour change and the a-priori limits they impose on intervention options. It also provides an analysis of the behaviour itself in relation to the potential interventions and policies for change. The BCW is illustrated diagrammatically in Figure 3 and definitions with examples are listed in Table 2.

An intervention strategy is a selection of intervention functions and policies to enact or support these. Choice of intervention strategy only takes one so far in attempting to change behaviour. Even the appropriate mix of intervention functions is no guarantee of success. It is necessary to go to a more fine grained analysis of the specific BCTs that make up the interventions.

Delivering interventions: behaviour change techniques (BCTs)

Each intervention function involves one or more specific BCTs. BCTs are irreducible activities designed to achieve behaviour change (Michie, Abraham et al., 2011; Michie, Johnston, Francis, Hardeman, & Eccles, 2008). Taxonomies of such techniques that can be reliably used for specifying interventions have been developed in relation to key behaviours related to health: smoking (Michie, Churchill, & West, 2011; Michie, Hyder, Walia, & West, 2011; West, Walia, Hyder, Shahab, & Michie, 2010), excessive alcohol use (Michie et al., in press), physical inactivity and unhealthy eating (Abraham & Michie, 2008; Michie, Ashford et al., 2011; Michie et al., 2008). Interventions may comprise many individual BCTs and the same BCT may be evident across several interventions.

An example of applying an analysis of interventions based on BCTs comes from the UK's NHS Centre for Smoking Cessation and Training (NCSCT: www.ncsct.co.uk), an academic-health service partnership. Analysing the enabling function of the Stop-Smoking Services by BCT has identified the specific activities of its service

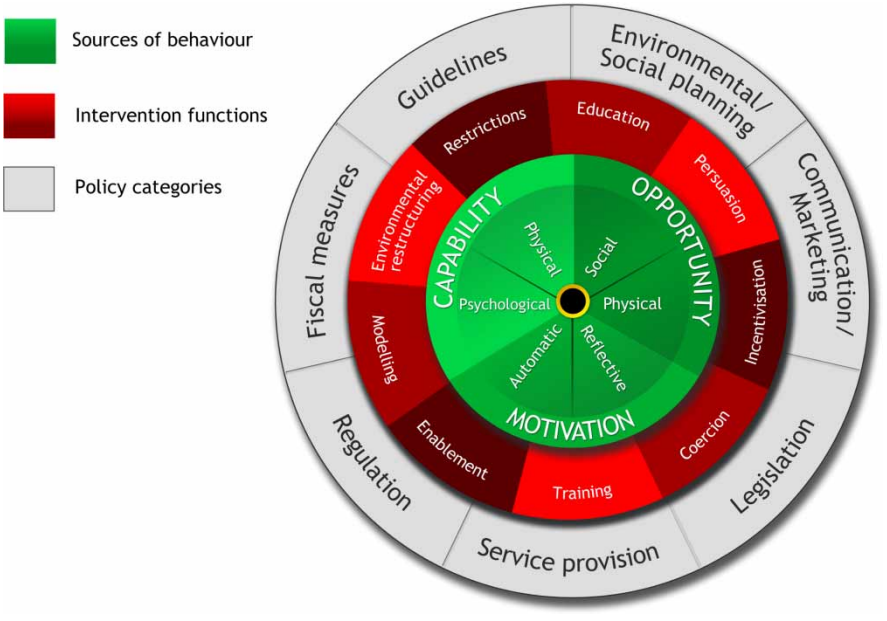

Figure 3. The Behaviour Change Wheel: a system for selecting interventions and policies from an analysis of behaviour.

provision that are associated with better success rates in their clients (West et al., 2010). Out of 43 BCTs identified, a set of core ones were found to differentiate more successful from less successful services (see Table 3). These cover the range of processes described in PRIME Theory. For example, advising smokers on changing their routines helps to avoid impulses to smoke in the presence of smoking cues. Measuring expired-air carbon monoxide concentrations provides a strong image to smokers of the harm from smoking and the immediate gains from stopping that makes smokers feel positive about abstinence. Advising on stop smoking medications allows smokers to make best use of those medications and so reduce the acquired drive to smoke when nicotine concentrations in the brain are depleted and they experience learned impulses to smoke. Helping smokers achieve an ex-smoker identity enables them to put firm barriers around their behaviour so that smoking is 'not an option' at any time, just as it would be if they were in a supermarket. There is much more work to be done on BCTs and their links with interventions and the nature of the target behaviour, but a start has been made.

The BCW is currently being developed into a theory- and evidence-based tool allowing a range of users to design and select interventions and policies according to an analysis of the nature of the behaviour, the mechanisms that need to be changed in order to bring about behaviour change, the interventions and policies required to change those mechanisms and the BCTs required to deliver them.

Developing an effective intervention strategy

An effective 'intervention strategy' will involve a combination of intervention functions, enacted using policies identified using criteria such as effectiveness, cost,

Table 2. The Behaviour Change Wheel: interventions and policies.

Level within BCW	Definition of intervention/policy	Examples
Interventions		
Education	Increasing knowledge or understanding	Providing information to promote healthy eating
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Using imagery to motivate increases in physical activity
Incentivisation	Creating expectation of reward	Using vouchers to motivate smoking cessation
Coercion	Creating expectation of punishment or cost	Raising the financial cost to reduce excessive alcohol consumption
Training	Imparting skills	Advanced driver training to increase safe driving
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 sales of solvents to people under 18 to reduce use for intoxication
Environmental restructuring	Changing the physical or social context	Providing on-screen prompts for GPs to ask about smoking behaviour
Modelling	Providing an example for people to aspire to or imitate	Using TV drama scenes involving safe-sex practices to increase condom use
Enablement	Increasing means/reducing barriers to increase capability beyond education and training	Behavioural support for smoking cessation, medication for cognitive deficits, surgery to reduce obesity, prostheses to promote physical activity
Policies		
Communication/ marketing	Using print, electronic, telephonic or broadcast media	Conducting mass media campaigns
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision	Producing and disseminating treatment protocols
Fiscal	Using the tax system to reduce or increase the financial cost	Increasing duty or increasing anti-smuggling activities
Regulation	Establishing rules or principles of behaviour or practice	Establishing voluntary agreements on advertising
Legislation	Making or changing laws	Prohibiting sale or use
Environmental/ social planning	Designing and/or controlling the physical or social environment	'Traffic-calming' measures; use of prompts and reminders
Service provision	Delivering a service	Establishing support services in workplaces, communities etc.

Table 3. Behaviour change techniques found to be associated with higher carbon-monoxide[a] verified success rates in the NHS Stop Smoking Services.

Addressing capability
Facilitate relapse prevention and coping
Advise on stop-smoking medication
Ask about experiences of stop smoking medication that the client is using
Advise on conserving mental resources
Addressing motivation
Strengthen ex-smoker identity
Measure expired-air CO (and use as a motivational tool)
Provide reward (e.g. praise) contingent on abstinence
Boost motivation and self-efficacy
Provide reassurance
Addressing opportunity
Advise on changing routine
Advise on/facilitate use of social support
Supporting other behaviour change techniques
Elicit client views
Give options for additional or later support
Summarise information/confirm client decisions
Use reflective listening

[a]Carbon monoxide testing is used to check smokers' reports of abstinence. The concentration in expired air, as with a breathalyser, give an accurate indication of the concentration in the blood which in turn gives a good index of cigarette smoke intake over preceding hours.

practicability and acceptability. Of these criteria, effectiveness is clearly a necessary condition.

A crucial lesson from the accumulated evidence in many different areas is that what is effective for a given behaviour, delivered in a particular way, in a given target group and a given context may not be effective for other behaviours, target groups, etc. The only way to be sure that a proposed intervention strategy in a given context will be effective is to try it and evaluate it. The choice of strategy to implement and evaluate should be based on the best available relevant evidence coupled with a sound understanding of the underlying principles. A theoretical understanding of behaviour and behaviour change, and previous research evaluating specific interventions are crucial in designing intervention strategies that stand a better chance of success, or in ruling out strategies that are unlikely to be effective (Craig et al., 2008).

Using theory to design an intervention strategy is helpful and recommended (Craig et al., 2008; Michie et al., 2008). This requires:

(1) an understanding of the nature of the behaviour to be changed and the context. We have proposed a model that analyses the behaviour in terms of 'capability', 'motivation' and 'opportunity'; these are necessary conditions for the new behaviour pattern to emerge and point to where the deficiency currently lies. This allows one to determine what needs to change in order for the behavioural target to be achieved;
(2) a system for considering the full panoply of possible intervention functions and identifying which are likely to be effective to bring about the necessary

change identified above. Further details of this approach are available in Michie et al. (2011b).;

(3) a method for designing the intervention strategy. Candidate intervention functions are selected on the basis of the analysis at (i), and relevant evidence of effective interventions and component BCTs. Relevant evidence should be searched systematically rather than 'cherry picked'.

When it comes to using previous research to design an intervention strategy, the best starting point is to look for relevant systematic reviews. Two very good sources for these in domains related to health are the Cochrane Library (www.thecochranelibrary.com) and National Institute for Health and Clinical Excellence (NICE) guidance documents (www.nice.org.uk). NICE has written generic guidance on behaviour change interventions (Abraham, Kelly, West, & Michie, 2009; National Institute of Health and Clinical Excellence, 2007). Because it was constrained by its brief not to go into specific examples, the guidance was necessarily general and could be seen as promoting 'motherhood and apple pie'. However, careful inspection of the guidance will reveal important guiding principles that are rarely adopted in practice; if they were, a great deal of public money would be saved on repeated promulgation of ineffective intervention strategies.

There were 11 key psychological targets (which address both 'reflective' and 'automatic' aspects of human motivation) identified:

(1) Knowledge and outcome expectancies (helping people to develop accurate knowledge about the health consequences of their behaviours).
(2) Personal relevance (emphasising the personal salience of health behaviours, that is, what the consequences mean for individuals).
(3) Positive affective attitudes (promoting positive feelings towards the outcomes of behaviour change).
(4) Descriptive norms (promoting the visibility of positive health behaviours in people's reference groups – that is, the groups they compare themselves with, or aspire to).
(5) Subjective norms (enhancing social approval for positive health behaviours in significant others and reference groups).
(6) Personal and moral norms (promoting personal and moral commitments to behaviour change).
(7) Self-efficacy (enhancing people's belief in their ability to change).
(8) Intention/goal setting and the formation of concrete plans (helping people to form plans and goals in graded steps, over time and in specific contexts, including making if-then plans and developing appropriate coping strategies).
(9) Behavioural contracts (inviting people to commit to their plans with others)
(10) Social relationships (helping people recognise how their social contexts and relationships may affect their behaviour).
(11) Relapse prevention (helping people to develop skills to cope with difficult situations and conflicting goals once they have initiated change).

A general conclusion of this NICE guidance was that the most effective interventions were those that acted simultaneously at several levels. An example of integrating

different levels and types of intervention in relation to a policy goal following the outbreak of the 2009 H1N1 pandemic influenza is shown in Box 1.

Box 1: An example of interacting intervention levels

A systematic review of interventions to increase vaccination amongst health care workers (Lam, Chambers, MacDougall, & McCarthy, 2010) investigated interventions in 12 randomised controlled trials and controlled before-and-after studies published from 1992 to 2009. The interventions included education or promotion (efforts to raise awareness and increase knowledge about influenza and vaccination); improved access to vaccination (e.g. extended opening hours, mobile vaccination); legislation or regulation (e.g. mandatory vaccination); measurement and feedback where rates are tracked and then publicised; and role model work where senior staff encourage vaccination.

The study found that in hospital settings, education campaigns and interventions to improve access resulted in only small increases in rates of uptake. Campaigns involving more coercive components achieved higher rates of uptake. In non-hospital health care settings, they concluded that a combination of educational campaigns and improved access yielded greatest increases in uptake. This nicely illustrates the importance of context in intervention effectiveness.

Evidence of effectiveness and cost-effectiveness: importance to policy-makers

The House of Lords Inquiry asked for evidence of effective and ineffective behaviour change interventions. It was evident from SM's experience of being called as a witness to the Inquiry that the members were dissatisfied with the quantity and quality of the evidence contained within the large number of submissions they received. They wanted 'hard evidence' of effective interventions that could be recommended to Government. We used the BCW to structure the identification and presentation of examples, emphasising that they are a small selection derived from a very extensive evidence base. They address broad questions concerning the types of intervention that can be effective; it must be stressed that the same type of intervention can be delivered in many different ways and this would influence its effectiveness. Implementation of evidence-based interventions across behaviour, population and setting is not a mechanistic process and is underpinned by a recent but rapidly developing science (see the journal *Implementation Science*).

There is an extensive evidence base on specific BCTs to apply within each of the intervention functions specified in the BCW, and we provide a selection by way of illustration:

(1) Education: provision of educational materials can increase uptake of cervical cancer screening (Forbes, Jepson, & Martin-Hirsch, 2002).
(2) Persuasion: hard-hitting mass media campaigns can increase smoking cessation rates (Bala, Strzeszynski, & Cahill, 2008); brief GP advice increases smoking cessation rates (Stead, Bergson, & Lancaster, 2008); mass media campaigns can have an immediate effect in increasing rate of HIV testing (Vidanapathirana, Abramson, Forbes, & Fairley, 2005).

(3) Incentives: vouchers for pregnant smokers to stop can increase smoking cessation rates for the duration of the pregnancy (Heil et al., 2008; Higgins et al., 2010).
(4) Coercion: increasing the price of alcohol and tobacco reduces consumption (Babor et al., 2003); speed cameras and speeding fines reduce speeding and vehicle crash rates (Wilson, Willis, Hendrikz, Le Brocque, & Bellamy, 2010); random breath testing and driving bans reduce drink-driving and alcohol-related death rates (Babor et al., 2003).
(5) Training: social skills training can reduce antisocial behaviour (Losel & Beelmann, 2010); parenting training can reduce unintentional injury rates in children (Kendrick, Barlow, Hampshire, Polnay, & Stewart-Brown, 2007).
(6) Restrictions: restricting availability, for example by reducing outlet density, has been found to reduce excessive alcohol consumption and alcohol related harm (Babor et al., 2003).
(7) Enablement: behavioural support and medications such as nicotine replacement therapy, bupropion and varenicline are effective in helping smokers to stop (Cahill, Stead, & Lancaster, 2007; Hughes, Stead, & Lancaster, 2007; Lancaster & Stead, 2005; Stead, Perera, Bullen, Mant, & Lancaster, 2008); methadone maintenance treatment is effective in reducing criminal activity to fund heroin use (Drugs and Public Policy Group, 2010); gastric banding surgery reduces calorie intake and therefore obesity (Colquitt, Picot, Loveman, & Clegg, 2009).
(8) Modelling: hand-washing by senior role models can increase hand hygiene behaviour of healthcare workers (Lankford et al., 2003).
(9) Environmental restructuring: prompts and reminders can improve health professional management of diabetic patients (Renders et al., 2001).

The following examples of ineffective interventions are a small selection from a very extensive evidence base. It must be remembered, however, that proving a negative is impossible and when it comes to conclusions about intervention effectiveness with regard to behaviour change it is more common to encounter statements of the kind 'the evidence is too weak to support any firm conclusions'. Where the negative evidence is strong we simply state the finding but where it is weaker we use phrases such as 'does not appear to'.

(1) Education: drug and alcohol education in schools has been found to be ineffective (Babor et al., 2003; Drugs and Public Policy Group, 2010).
(2) Persuasion: school-based programmes including attempts at persuasion have not been effective in reducing overeating in children (Summerbell et al., 2005); public service announcements have proved ineffective in reducing excessive alcohol consumption (Babor et al., 2003).
(3) Incentives: financial incentives have not proved effective in promoting long-term smoking cessation (Cahill & Perera, 2011); the current form of financial incentives through Quality Outcome Framework payments to record smoking status and raise the topic of smoking with patients does not appear to have increased rates of prescribing stop-smoking medications as an objective marker of smoking-cessation activity (Coleman, 2010).

(4) Coercion: criminalisation and decriminalisation of use of psychoactive drugs appear to have little or no effect on prevalence of drug use (Drugs and Public Policy Group, 2010).
(5) Training: advanced driver training does not appear to promote safer driving or reduce traffic accident rates (Ker, Roberts, Collier, Renton, & Bunn, 2003).
(6) Restrictions: residency restrictions on sex-offenders do not appear to be effective in reducing reoffending (Durling, 2006).
(7) Enablement: relatively brief physician counselling does not appear to be effective in helping obese individuals reduce calorie intake (Tsai & Wadden, 2009).
(8) Modelling: The widely adopted Drug Abuse Resistance Education project which included use of role modelling was ineffective in preventing later illicit drug use in adolescents (Vincus, Ringwalt, Harris, & Shamblen, 2010).
(9) Environmental restructuring: prompts and reminders have been found to be ineffective in increasing the rate of physician prescribing of antihypertensive medication (Heidenreich, 2003).

Recent developments in research on behaviour change have identified highly cost-effective interventions tackling unhealthy diets, physical inactivity, obesity, smoking and salt reduction (Asaria, Chisholm, Mathers, Ezzati, & Beaglehole, 2007; Cecchini et al., 2010; WHO, 2003). In collaboration with WHO and other partners, The Lancet convened some of the world's leading scientists working in chronic diseases and commissioned a series of reviews to examine the evidence for behavioural interventions aimed at disease prevention. This is summarised below, with BCW policies and intervention functions signalled in brackets.

A modelling analysis of behavioural interventions combining the health and economic outcomes of interventions targeting unhealthy diets, physical inactivity and obesity showed the following to be cost-effective (Cecchini et al., 2010):

(1) Fiscal measures [policy] that increase the price of unhealthy food content [coercion] or reduce the cost of healthy foods rich in fibre [incentivisation] were found to produce the largest health gains in the shortest timeframe, being consistently cost-saving and generating the largest health effects in both 20 years and 50 years.
(2) Regulation [policy] of food advertising to children that improves nutritional information [education] or restricts the marketing of unhealthy foods to children [environmental restructuring] were found to have very favourable cost effectiveness ratios, as do mass media [policy] and worksite health promotion [persuasion, education] campaigns.
(3) Service delivery [policy]: Physician counselling of individuals at risk in primary care [enablement] is one of the most effective interventions, but its health effect is greatest and cost-effectiveness best in countries where a larger proportion of the population has regular access to primary-care physicians and facilities.
(4) Communication/marketing [policy]: School-based health promotion interventions [persuasion, education] consistently have unfavourable cost-effectiveness ratios up to 50 years from their initial implementation. However, the cost-effectiveness of interventions targeting young children tends to improve

substantially in a longer timeframe (greater than 50 years), as these interventions realise their full potential in improving health.

This review also found that, consistent with NICE's review of behaviour change interventions, multiple-intervention strategies achieved substantially larger health gains than individual interventions, and often more cost effectively.

A review of interventions to reduce tobacco and salt intake over 10 years (2006–2015) found they could avert 13.8 million deaths at a cost of less than US$0.40 per person per year in low-income and lower middle-income countries, and US$0.50–1.00 per person per year in upper middle-income countries (as of 2005) (Asaria et al., 2007). The tobacco control interventions were:

(1) Fiscal measures [policy]: increased taxes on tobacco products [coercion] to reduce smoking prevalence.
(2) Legislation [policy] to enforce smoke-free workplaces [environmental restructuring].
(3) Legislation [policy] requirements for FCTC-compliant packaging and labelling of tobacco products [environmental restructuring] combined with public awareness campaigns [policy] about the health risks of smoking [education/persuasion], and
(4) A comprehensive ban [policy] on tobacco advertising, promotion and sponsorship [environmental restructuring].

Conclusions

Governments have a duty of care to protect citizens from external and internal threats. They seek approval from electorates in part on the basis of promises to enact policies that will benefit health and wellbeing and that the public will accept. If they limit the options they are willing to consider on the basis of doctrines such as 'nudge' they will fail in that responsibility and will directly contribute to unnecessary death and suffering. Part of the reason why this doctrine has gained currency is a lack of a clear comprehensive framework for analysing behaviour and determining an intervention strategy. Such frameworks as have been used, such as MINDSPACE, are partial and lack coherence. This article presents a system for analysing behaviour in context (the COM-B system), a theory of motivation that encompasses both reflective and automatic processes and how they interact (PRIME), and a framework for classifying interventions and policies (the BCW) which can be linked to the analysis of behaviour. This systematic, comprehensive and theory-based approach to intervention development should help policy makers to select intervention strategies that have a reasonable chance of being effective. Only within this context should the issues of public acceptability and practicability be considered; they are key to the success of interventions but should not be the starting point.

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