

Social Cognition Models

Stephen Sutton

The term '**social cognition models**' (SCMs) is used to refer to theories that specify the **proximal cognitive determinants of behaviour**. These theories include, among others, social cognitive theory (SCT) (Bandura, 1986, 1997), the theory of reasoned action (TRA) (Ajzen & Fishbein, 1980), the theory of planned behaviour (TPB) (Ajzen, 1991), the health belief model (HBM) (Becker, 1974; Strecher & Rosenstock, 2002), protection motivation theory (Rogers, 1983), the 'continuum' version of the health action process approach (HAPA-C; Schwarzer, 2008; Sutton, 2008) and the information-motivation-behavioural skills model (Fisher & Fisher, 1992). SCMs are widely used in health psychology to predict and explain health behaviours such as condom use, physical activity, smoking cessation and medication adherence. Increasingly, they are being used to underpin the development of interventions to change health behaviours.

PREDICTION VERSUS EXPLANATION

It is important to distinguish between prediction and explanation (Sutton, 1998). A key aim of research on health behaviours

is to identify the determinants (causes) of particular health behaviours. Researchers do this by developing theories that identify potentially important determinants of behaviour and specify the causal pathways by which they influence behaviour and by conducting empirical studies that enable the **effect sizes** to be estimated, usually in the form of **regression coefficients**. Ideally, we want to obtain *unbiased* and *precise* estimates of the causal effects of the putative determinants of a particular health behaviour in a given target population. If the aim is prediction rather than explanation, we do not need to concern ourselves with identifying the determinants of behaviour or with specifying causal processes (although a causal model may suggest suitable predictor variables). We are free to choose convenient predictors and weights. Any predictor that 'works' can be included in the regression model. Past behaviour, for instance, is often a strong predictor of future behaviour, even though its theoretical status as a determinant of behaviour is contentious (Sutton, 1994). Similarly, when the aim is prediction, it does not matter if relevant causal variables are omitted from the model. Prediction can be useful without explanation, particularly when the time interval allows

interventions to be applied. For example, it would be useful to be able to predict who is at risk for becoming a problem drinker. Identification of high-risk individuals may enable an early intervention to be made. Thus, prediction enables interventions to be targeted to high-risk groups. However, an understanding of the factors that lead some people but not others to develop a drinking problem (explanation) would be even more useful because it would have implications for the nature and content of an intervention programme. Although prediction and explanation are not the same, the first is necessary for the second; models that do not enable us to predict behaviour are unlikely to be useful as explanatory models.

SCMs can be classified by range of application (general, health-specific and domain- or behaviour-specific) and formal structure (**stage versus non-stage theories**) (Sutton, 2015; see Armitage & Conner, 2000, for a related classification scheme). General theories, such as the TPB (Ajzen, 1991) and its predecessor the TRA (Fishbein & Ajzen, 1975), are those that, in principle, can be applied to a wide range of behaviours, not simply health-related ones. Health-specific theories like the HBM (Strecher & Rosenstock, 1997) are specific to health-related behaviours. Behaviour- or domain-specific models have a still narrower range of application. For example, the AIDS risk reduction model (Catania et al., 1990) was developed to understand STD-preventive behaviour such as condom use.

Stroebe argues that general models should be preferred on the grounds of parsimony: 'it is not very economical to continue to entertain specific theories of health behaviour unless the predictive success of these models is greater than that of general models of behaviour' (2000, p. 27). If we can use a single theory to explain why some young people use condoms consistently with new sexual partners while others do not, why some people engage in regular exercise more often than others, and why some people recycle their newspapers whereas others throw them away, this is much

more useful and economical than developing different theories for each of these three behaviours. The argument, then, is that general theories should be preferred to health- or behaviour-specific theories unless the latter can be shown to be better in some important way. This suggests a strategy of always starting with a general theory and only modifying it if absolutely necessary when applying it to a new behaviour or behavioural domain.

The second important distinction is between stage and non-stage (or *continuum*) theories (Sutton, 2005; Weinstein et al., 1998). These two types of theories have different formal structures and different implications for intervention. Stage theories assume that behaviour change involves movement through a sequence of discrete stages, that different factors are important at different stages, and therefore that different (*stage-matched*) interventions should be used for people in different stages. Examples of stage theories include the transtheoretical model (Prochaska & Velicer, 1997) and the precaution adoption process model (Weinstein & Sandman, 1992).

Stage theories are discussed by Armitage in Chapter 10 of this volume. The present chapter focuses on continuum or non-stage theories. Each of these theories specifies a small set of proximal cognitive determinants of behaviour. (Note that some theories also include variables that, strictly speaking, cannot be described as cognitive determinants, for example, skills and actual behavioural control.) The causal relationships specified by such theories can be represented in the form of a path diagram with behaviour on the far right. Figure 9.1 shows three prototypical representations. The variables *X*, *Y* and *Z* are the hypothesised cognitive determinants; *B* is behaviour. In Figure 9.1a, both *X* and *Y* are assumed to influence behaviour directly. In Figure 9.1b, the effect of *X* and part of the effect of *Y* are mediated by *Z*; *Z* is a *mediator* or *intervening variable* (Baron & Kenny, 1986). Thus, *Y* has direct and indirect effects on behaviour, whereas *X* has only an indirect effect. In Figure 9.1a and b, the variables combine *additively*.

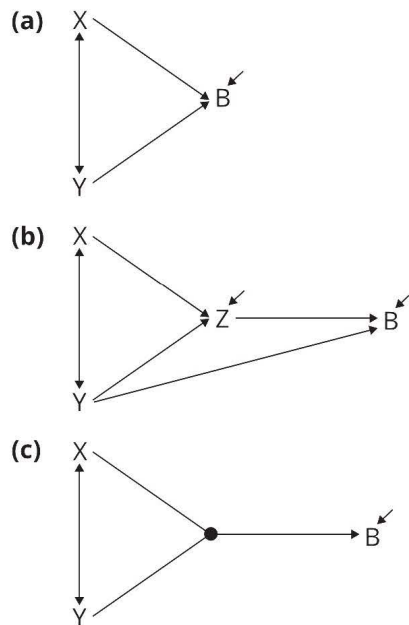


Figure 9.1 Three Prototypical Representations of the Causal Relationships Specified by Social Cognition Models (*X*, *Y* and *Z* are Explanatory Variables; *B* is Behaviour)

By contrast, in Figure 9.1c, *X* and *Y* interact to influence behaviour. The effect of *Y* on behaviour depends on the level of *X*, that is, *X* is a **moderator** of the relationship between *Y* and *B*. (Interactions are symmetric, so, alternatively, *Y* can be regarded as the moderating variable.) Figure 9.1c does not show the nature of the interaction. Where SCMs specify interactions, they are nearly always of the multiplicative or synergistic type, in which, put simply, the effect of two variables together is hypothesised to be greater than their sum.

In Figure 9.1, the small unlabelled arrows pointing to *B* represent the aggregate of all other causes of behaviour apart from those specified in the model. This is referred to as the **error** or **disturbance** term. The disturbance term can be thought of as comprising two components: a systematic component consisting of other important causes of behaviour; and a random component consisting of tens, hundreds or even thousands of minor,

independent and unstable causes of behaviour. The latter causes would be impossible to specify in practice. (An alternative justification for assuming a random component is that 'there is a basic and unpredictable element of randomness in human responses which can be characterised only by the inclusion of a random variable term': Johnston, 1984, p. 14.) Although, individually, the effects of these 'random shocks' are assumed to be small, in aggregate their effect may be quite large. Conceivably, the majority of the variance in behaviour could be explained by the random component and only a minority by the major causal factors. Thus, SCMs may not necessarily be expected to explain a large proportion of variance in behaviour.

Algebraic equations can be used as an alternative to the diagrammatic representation. Figures 1a and c can each be represented by a single equation, but Figure 9.1b requires two equations because there are two **endogenous** (dependent) variables.

Although SCMs are sometimes described as 'static' models, they are in fact dynamic in the sense that they specify causal relationships between variables whose values may change over time and may be deliberately changed through interventions. For example, the theory depicted in Figure 9.1b says that, if *Y* is held constant, a change in *X* will produce a change in *Z*, which in turn will produce a change in behaviour. However, with the exception of Bandura's (1986, 1997) SCT, the theories do not tell us how to change the variables on the far left (the **exogenous variables**) (Sutton, 2002).

In Figure 9.1, the exogenous variables *X* and *Y* are linked by a two-headed arrow. This indicates that these two variables may be correlated with each other but that this correlation is not explained by the theory; it is treated as given. The implicit assumption is that the correlation must be due to other variables external to the theory (common causes). If it seems plausible that the

correlation is due to one variable influencing the other, then the two-headed arrow should be replaced by a single-headed arrow, thus making one of the exogenous variables endogenous. This apparently minor change can have major implications for estimates of effect size and for interventions (Sutton, 2002).

Ideally, SCMs should specify the causal lag for each of the causal relationships in the model. The causal lag is the time it takes for a change in an antecedent variable to produce a change in a dependent variable. For example, if a person's attitude towards performing a particular behaviour changes as a result of receiving a persuasive communication, how long does it take for this to produce a change in their intention and then in their subsequent behaviour? Causal lag is an important consideration in deciding on an appropriate research design (Finkel, 1995). It is common practice in research on SCMs to measure all the presumed proximal cognitive determinants of behaviour at the same time but to measure behaviour several days, weeks or months later. This implicitly assumes a very brief causal lag between all the variables in the model apart from behaviour but a longer causal lag between these variables and behaviour, which sounds plausible (Sutton, 2002). However, there are exceptions to this view. For example, Liska, in the context of the TRA, suggested that '... as information processing takes time, changes in attitudes may lag behind changes in beliefs, perhaps in some cases by months or even years...' (1984, p. 66). Ideally, researchers should make explicit and justify the assumptions that underpin the research designs they select for investigating SCMs, including those that relate to causal lag. An alternative or complementary approach is to estimate the causal lag empirically (Finkel, 1995).

Table 9.1 shows the SCMs that have been most cited in the last five years. Before outlining these, it is important to consider how to define and measure the behaviour of interest.

DEFINING AND MEASURING BEHAVIOUR

In any study of the determinants of health behaviour, it is important to start by defining the behaviour of interest as clearly as possible. Following Ajzen and Fishbein (1980), behaviours can be defined in terms of four components: action, target, time and context. The action component is a necessary part of the definition of any behaviour. The target component is usually necessary, though not always. Time and context are optional; they enable the definition of behaviour to be as specific as required. For example, consider the definition 'eat breakfast tomorrow'. Here, 'eat' is the action, 'breakfast' is the target (alternative targets would be 'a bowl of cereal' or 'lunch'), and 'tomorrow' is the time component. No context is specified in this definition, but it could include 'at work' or 'in the kitchen with my family' for example. As an illustration of the importance of context, consider the following definitions:

1. using a condom the next time I have sex
2. using a condom the next time I have sex with my regular partner
3. using a condom the next time I have sex with a new sexual partner

The first definition omits a potentially important contextual factor, namely type of partner, and is therefore probably too general for most purposes. The other definitions each specify a context.

Table 9.1 Most Cited Social Cognition Models 2019–2024

<i>Model</i>	<i>Number of Hits</i>
Self-Determination Theory	2,797
Theory of Planned Behaviour	1,953
Theory of Reasoned Action	1,743
Social Cognitive Theory	1,653
Health Belief Model	744

Note: Searches for the occurrence of the name of the model (or common abbreviations e.g. TPB) in the title or abstract of outputs published in 2019–2024 were conducted in PsycINFO (University of Cambridge library database) on June 09, 2024.

These may be considered to be quite different behaviours both from a public health viewpoint and from the viewpoint of an individual who has both types of sexual partner.

Such behaviours are often measured as dichotomies: for example, 'Did you use a condom? Yes/No'. This implies that the person has a choice between two mutually exclusive and exhaustive alternatives: performing the behaviour or not performing it. This approach enables the simplest possible application of a given SCM: participants' cognitions are assessed with respect to performing the behaviour. Occasionally, their cognitions with respect to *not* performing the behaviour are measured as well, but the usual assumption is that these will be the complement of the first set of cognitions and therefore provide no additional information. For example, if a person states that they are extremely likely to perform a given behaviour, it is assumed that, if asked, they would say that they were extremely unlikely not to perform it. This *complementarity assumption* seems plausible for intentions but is questionable in the case of other cognitive variables. For example, a smoker may believe that his chances of developing lung cancer are 'quite high' if he continues to smoke. If we only had this information, we might assume that he would be motivated to quit smoking. However, he may also believe that his chances of developing lung cancer are 'quite high' if he stops smoking (because 'the damage has already been done'). Ideally, then, relevant cognitions should be measured with respect to *both* alternatives (performing and not performing the behaviour). An alternative approach is to phrase measures explicitly in terms of changes or differences (Weinstein, 1993). For example, participants could be asked 'How much less likely would you be to develop lung cancer if you stopped smoking compared with if you continued to smoke?'.

In some cases, it is more realistic to specify more than two alternatives. For example, in a

study of contraceptive use, one could ask: 'The last time you had sex, did you use (a) a condom, (b) the pill, (c) another method of contraception, or (d) no method of contraception?'. As an alternative to this multiple-choice format, respondents could be asked a series of separate questions (e.g. 'Did you use a condom? Yes/No', 'Did you use the pill? Yes/No' etc.). In this example, it is possible for respondents to have used more than one method, for example, a condom and the pill; the alternatives are not strictly mutually exclusive.

Some behaviours are defined so generally that they are best thought of as *behavioural categories*. Behavioural categories cannot be directly observed. Instead, they are inferred from single actions assumed to be instances of the general behavioural category. Ajzen and Fishbein (1980) give the example of dieting. Dieting may be inferred from specific behaviours such as eating two instead of three meals a day, eating smaller portions, not eating desserts, drinking tea and coffee without adding sugar, taking diet pills and so on. There are two approaches to assessing behavioural categories. The first is simply to ask respondents questions like 'Are you currently dieting?'. In this case, a definition of 'dieting' should be provided, unless the aim is to explore different interpretations of this term. The second approach is to ask about a number of specific behaviours and use these to create an index of dieting. These approaches have different implications for the measurement of intention and other proximal cognitive determinants.

In many situations, we may be interested not in whether or not a behaviour is performed but in the quantity and/or frequency of a behaviour. For example, in a study of drinking, we could ask people how often they have an alcoholic drink (frequency) and how much they usually drink on such occasions (quantity). Such behavioural criteria pose problems for applications of SCMs because they imply multiple alternatives, and it is not practicable to assess relevant cognitions with respect to all possible values of frequency and/or quantity.

A common strategy is to convert the behaviour into a dichotomy. For example, one could use the official definition of 'safe' drinking and ask respondents about their cognitions with respect to exceeding the safe drinking limit. For further discussion of the problems created by magnitude and frequency measures, see Courneya (1994; Courneya & McAuley, 1993).

It is also important to distinguish between behaviours and *outcomes* of behaviours. Losing weight, for example, is an outcome not a behaviour. Achieving this outcome may be influenced in part by behaviours such as eating low-fat foods or jogging two miles every day. But achievement of outcomes may be influenced by factors other than the person's behaviour. Losing weight depends on physiological factors such as metabolic rate, as well as on behavioural factors. If the aims are to predict and explain a behavioural outcome, the actions that lead to this outcome have to be identified and measured along with other, non-behavioural factors.

Most studies of health behaviours use self-report measures of behaviour. The limitations of self-reports are well known (Sutton, 2004), but in many cases, there will be no feasible alternative. Sometimes it may be possible to use 'objective' measures of behaviour, but these usually have limitations too. For example, records of attendance for breast screening may be inaccurate and may miss women who go to other centres; electronic monitoring of tablet use may not only measure but also increase adherence (Sutton et al., 2014); and biochemical measures of tobacco smoke intake are sensitive only to recent intake. Nevertheless, objective measures of behaviour may be more predictive of relevant health outcomes than are self-report measures. It is conceivable that SCMs may predict self-reported behaviour quite well but may be less effective in predicting objective behavioural measures that are most strongly related to important health outcomes.

The *principle of correspondence* (Ajzen & Fishbein, 1977; Fishbein & Ajzen, 1975) or *principle of compatibility* (as it was

renamed by Ajzen, 1988) states that, in order to maximise predictive power, all variables in an SCM should be measured at the same level of specificity or generality. This means that the measures should be matched with respect to the four components of action, target, time and context. To draw on the example used above, in order to predict intention to use a condom the next time one has sex with a new sexual partner, the measures of the predictor variables should use the same wording (e.g. Subjective norm: 'Most people who are important to me would think that I should use a condom the next time I have sex with a new sexual partner'). The rationale given for the principle is a pragmatic one: it improves prediction. Presumably, however, there is also a *theoretical* rationale for the principle, namely that, by measuring all variables at the same level of specificity, we are matching cause and effect (Sutton, 1998). Note that, although this principle was developed to apply to the TRA/TPB, it applies equally well to other SCMs.

OUTLINE DESCRIPTION OF THE MOST WIDELY USED SOCIAL COGNITION MODELS

This section briefly outlines the most widely used SCMs. For a more detailed exposition of these and other models, see the book by Conner and Norman (2015).

The Health Belief Model

The HBM (Becker, 1974) was developed in the 1950s by a group of social psychologists working in the field of public health who were seeking to explain why some people do not use health services such as immunisation and screening. The model is still in common use. There are four core constructs: the first two refer to a particular disease, whereas the second two refer to a possible course of action that may reduce the risk or severity of that disease. Perceived susceptibility

(or perceived vulnerability) is the individual's perceived risk of contracting the disease if he or she were to continue with the current course of action. Perceived severity refers to the seriousness of the disease and its consequences as perceived by the individual. Perceived benefits refer to the perceived advantages of the alternative course of action including the extent to which it reduces the risk of the disease or the severity of its consequences. Perceived barriers (or perceived costs) refer to the perceived disadvantages of adopting the recommended action as well as perceived obstacles that may prevent or hinder its successful performance. These factors are commonly assumed to combine additively to influence the likelihood of performing the behaviour. Thus, high susceptibility, high severity, high benefits and low barriers are assumed to lead to a high probability of adopting the recommended action. Another factor that is frequently mentioned in connection with the HBM is cues to action (events that trigger behaviour), but little empirical work has been conducted on this construct. Some versions of the HBM include **self-efficacy** (see below) as an additional determinant of behaviour.

There have been several meta-analyses of research using the HBM. Carpenter (2010) analysed the findings from 18 studies that used a longitudinal design in which the HBM variables were measured at time 1 and behaviour at time 2. Benefits and barriers were consistently the strongest predictors of behaviour, with mean correlations of 0.27 and 0.30, compared with 0.15 for severity and only 0.05 for susceptibility. Several moderators were identified, including the length of time between the measurement of beliefs and behaviour (the longer the time, the lower the correlation) and prevention versus treatment behaviours (higher correlations for prevention). Carpenter recommended that researchers should abandon the simple four-variable additive model and instead examine possible mediation and moderation among the variables. Consistent with the latter suggestion, Sheeran et al. (2014),

in a meta-analysis of experimental studies (not specifically on the HBM), found that increases in risk perceptions (perceived susceptibility) led to increases in intentions and behaviour and that the effects were larger when perceived severity was also increased.

The HBM has been used as a basis for health behaviour change interventions (e.g. Jones et al., 2014).

Social Cognitive Theory

According to SCT (Bandura, 1986, 1997), behaviour is influenced directly by goals and self-efficacy expectations and indirectly by self-efficacy, outcome expectations and socio-structural factors. Goals are similar to intentions in other theories of health behaviour; they determine the amount of effort that the individual invests in changing their behaviour and serve as guides to action. Self-efficacy refers to a person's belief in their ability to perform a specific action in a particular situation. Outcome expectations are beliefs regarding the consequences (positive and negative) of performing the behaviour. The theory distinguishes between different kinds of outcome expectation. For example, social outcome expectations might include anticipated approval or disapproval from one's partner, whereas self-evaluative outcome expectations refer to anticipated feelings arising from internal standards such as pride in having achieved a change in one's behaviour. Finally, the theory incorporates perceived opportunities and barriers, which are assumed to influence goals.

Although SCT includes a number of constructs, the majority of empirical applications of the theory focus on self-efficacy. There is a large body of evidence from observational studies showing that self-efficacy expectations consistently predict behaviour (Luszczynska & Schwarzer, 2015). The theory has also been used as the basis for behaviour change interventions, again focusing almost exclusively on self-efficacy. According to Bandura (1997), there are several ways of enhancing self-efficacy.

These include: mastery experiences, in which the person gains confidence by achieving a modest goal; observation of someone similar to themselves successfully performing a behaviour, known as modelling or vicarious learning; and verbal persuasion.

Theory of Planned Behaviour

The TPB (Ajzen, 1991; 2019b), an extension of the TRA, developed out of social-psychological research on attitudes and the attitude-behaviour relationship. According to the theory, behaviour is determined by the strength of the person's intention to perform that behaviour and the amount of actual control that the person has over performing the behaviour. Perceived behavioural control, similar to Bandura's construct of self-efficacy, refers to the person's perceptions of their ability to perform the behaviour and is assumed to reflect actual behavioural control more or less accurately. To the extent that perceived behavioural control is an accurate reflection of actual behavioural control, it can, together with intention, be used to predict behaviour.

The strength of a person's intention is determined by three factors: their attitude toward the behaviour (their overall evaluation of performing the behaviour); their subjective norm (the extent to which they think that important others would want them to perform it); and their perceived behavioural control. Attitude, subjective norm and perceived behavioural control are each held to be determined by sets of salient (readily accessible) beliefs about the behaviour. Attitude toward the behaviour is determined by behavioural beliefs about the personal consequences of performing the behaviour; subjective norm by normative beliefs about the views of important others and perceived behavioural control by control beliefs about the presence of factors that may facilitate or impede performance of the behaviour. In the current version of the theory, perceived behavioural control is shown as interacting with attitude and subjective norm to

influence intention; specifically, attitude and subjective norm will influence intention to the extent that people believe that they are capable of performing the behaviour in question (Ajzen, 2020).

The TPB has been widely used in observational studies to predict and explain intentions and behaviour. Meta-analyses of these studies show that, on average, the TPB explains between 35 and 50% of the variance in intentions and between 26 and 35% of the variance in behaviour (Sutton, 2004). The theory is being increasingly used to develop behaviour change interventions (Steinmetz et al., 2016).

Self-determination Theory

Self-determination theory (SDT; Ryan & Deci, 2000) is a general theory of motivation. It is a complex theory comprising six mini-theories and multiple constructs. In this summary, we focus on those aspects of the theory that have been most widely used in studies of health behaviours, namely types of motivation and psychological needs.

In SDT, several different types of motivation (or behavioural regulation) are distinguished, lying on a continuum of relative autonomy or self-determination. In this section, the different types of motivation are defined and illustrated by items from the Behavioural Regulation in Exercise Questionnaire (BREQ-3; <http://exercise-motivation.ban.gor.ac.uk/breq/breqdown.php> accessed June 09, 2024). At the self-determined end of this continuum is **intrinsic motivation** in which an action is performed for its inherent interest, enjoyment or satisfaction ('I exercise because it's fun'). The four different types of extrinsic motivation vary in the extent to which their regulation is autonomous. Integrated and identified regulation are highly self-determined. **Integrated regulation** refers to motivation deriving from congruence with one's identity and core values ('I exercise because it is consistent with my life goals'). **Identified regulation** refers to motivation stemming from the

belief that the action is personally important ('It's important to me to exercise regularly'). The other two types of extrinsic motivation have more controlled forms of regulation. **Introjected regulation** involves being motivated by contingent self-esteem, including avoidance of guilt or anxiety and the attainment of pride ('I feel guilty when I don't exercise'). The second controlled type, **external regulation**, is the least self-determined as motivation derives from external pressures or contingent rewards ('I exercise because other people say I should'). Finally, at the non-self-determined end of the continuum is **amotivation**, the state of lacking the intention to act ('I don't see why I should have to exercise'). The theory predicts that types of motivation and regulatory style that are more self-determined will be associated with a higher probability of engaging in and sustaining (presumably, health-enhancing) behaviour.

In SDT, three basic psychological needs are specified: **autonomy** (the need to self-regulate one's experiences and actions); **competence** (the need to feel effectance and mastery) and **relatedness** (the need to feel socially connected). In the health domain, satisfaction of these needs is proposed to facilitate the adoption and maintenance of health-conducive behaviours and to lead to improved physical and mental health. Ng et al. (2012) proposed that these effects were mediated by behavioural regulations (autonomous self-regulation, controlled regulation and amotivation). According to SDT, satisfaction of psychological needs is facilitated by exposure to an autonomy-supportive environment. SDT has been most commonly applied to exercise/physical activity and dietary change.

CRITERIA FOR SELECTING A SOCIAL COGNITION MODEL

In general, in research on health behaviours, researchers select an SCM on the basis of personal preference. Usually, there is little discussion of the advantages of the selected model compared with other models that

could have been selected instead. The criteria for what is a 'good' model have not been considered in detail. As mentioned above, it can be argued that general models should be preferred to health-specific models. In addition, the constructs should be clearly defined and the causal relationships between the constructs clearly specified, and there should exist clear recommendations for how the constructs should be operationalised. In addition, the model should have been shown to have performed well in previous studies.

The last criterion warrants further comment. The performance of a model is usually assessed in terms of the percentage of variance it explains in behaviour. However, there are a number of important methodological and measurement reasons why models may have low predictive power; for example, random measurement error, violation of the principle of compatibility and lack of stability in the predictor variables (Sutton, 1998). Furthermore, it can be argued that undue emphasis is placed on the amount of variance explained (Sutton, 2004). A model that explains more variance in behaviour is not necessarily more valid than one that explains less variance. The validity of a model depends on the validity of its underlying assumptions, not on the proportion of variance it explains. Sutton (2002) gives several hypothetical examples, including one in which close to 100% of the variance is explained, but the estimates of the causal effects of the predictor variables are seriously biased, and another showing that unbiased estimates of causal effects can be obtained even if the regression model does not explain a large proportion of variance in the criterion.

USING SOCIAL COGNITION MODELS TO DEVELOP HEALTH BEHAVIOUR INTERVENTIONS

In recent years, SCMs have been increasingly used to develop interventions that aim to change behaviour by targeting its presumed cognitive determinants. Here we use the TPB as an example of how to use an SCM to develop an intervention.

Applications of the TPB to developing behaviour change interventions have focused on changing attitude, subjective norm and perceived behavioural control by changing the salient beliefs that are assumed to determine these constructs. There are three strategies for achieving this aim: change existing salient beliefs; make existing non-salient beliefs salient or create new salient beliefs. The following section summarises the steps involved in developing an intervention to change existing salient beliefs and presents an example. See Sutton (2010) for a more detailed exposition.

Steps in the Development of a TPB-Based Intervention

1. Decide on the target behaviour and the target population
These are crucial decisions regardless of the theory that is being used to inform the intervention. However, as noted above, in the TPB, the definition of the target behaviour determines the definition of the constructs to be targeted in the intervention and the wording of the items used to assess these constructs.
2. Identify the modal salient beliefs
The second step is to conduct an elicitation study to identify those salient behavioural, normative and control beliefs with respect to the target behaviour that are most common in a sample of people drawn from the target population. Those beliefs that are elicited first in response to open-ended questions such as 'What do you see as the advantages for you of [performing behaviour X]?' are assumed to be salient for the individual. Those elicited most frequently in the sample are designated the modal salient beliefs.
3. Decide which TPB components to target in the intervention
This decision can be informed by conducting a quantitative study in a second sample from the target population in which the TPB variables are measured using a structured questionnaire. In the analysis, intention is regressed on attitude, subjective norm and perceived behavioural control; and behaviour is regressed on intention and perceived behavioural control. The findings are used to decide whether the intervention should target one, two or all three components.

4. Decide which specific beliefs to target
The same dataset can be used to identify the beliefs that best discriminate between intenders and non-intenders (or between those who subsequently engage in the behaviour and those who do not). This is usually done by dividing the sample into two groups on the basis of intention or behaviour responses and examining differences in scores between groups on each of the belief measures in turn, for example, by conducting a series of t-tests.
5. Develop and pre-test the intervention materials
The next step is to develop an intervention designed to change these key beliefs. As well as the content of the intervention, decisions will need to be made about the mode of delivery, duration, frequency and so on at this stage if not before; but the TPB and other SCMs provide little guidance about these aspects. With regard to content, Table 9.2 lists the possible ways of changing existing behavioural, normative and control beliefs, using 'walking for more than 20 minutes a day' as the example target behaviour. It is advisable to pre-test intervention materials and messages and/or to co-produce them in a sample of participants from the target population; this may involve several cycles of pre-testing and modification.
6. Evaluate the intervention
The final step is to assess the efficacy of the intervention in another sample drawn from the target population. This is typically done in a randomised controlled trial in which participants are randomly assigned to the intervention or to one or more comparison conditions (e.g. a no-intervention control condition) and the TPB variables are measured. More than one study may be conducted at this stage; for example, a relatively small trial focusing on acceptability and feasibility followed by a larger trial to estimate effectiveness and possibly also cost-effectiveness.

Of course, variations on this six-step procedure are possible. Relevant prior studies may already exist which may obviate the need for collecting new data for Steps 2–4. In addition to changing existing salient beliefs, the intervention may aim to create new salient beliefs by presenting novel information. For example, an intervention to encourage smokers to quit may present evidence that smoking is a risk factor for osteoporosis.

Table 9.2 Ways of Changing Existing Beliefs in the Theory of Planned Behaviour, Using 'Walking for More Than 20 Minutes a Day' as the Example Target Behaviour

Behavioural Beliefs

- a. Increase belief strength
(e.g. increase the perceived likelihood that walking for more than 20 minutes a day will improve fitness)
- b. Increase outcome evaluation
(e.g. increase the perceived desirability of the outcome 'will improve my physical fitness')

Normative Beliefs

- c. Increase belief strength
(e.g. increase the recipient's perceived likelihood that his/her parents – or other significant referents – would approve if he/she walked for more than 20 minutes a day)
- d. Increase motivation to comply
(e.g. persuade the recipient that he/she wants to do what his/her parents want them to do)

Control Beliefs

- e. Increase belief strength
(e.g. increase the recipient's perceived likelihood that they will have more time in the future)
- f. Increase perceived power
(e.g. persuade the recipient that having more time in the future will make it easier to walk for more than 20 minutes a day)

Note: These strategies assume the use, and validity, of a particular scoring scheme: unipolar scales for all six belief components, for example 1–7, where 1 means extremely unlikely (belief strength), extremely undesirable (outcome evaluation), extremely low (motivation to comply) and much more difficult (control belief power), and 7 means extremely likely (belief strength), extremely desirable (outcome evaluation), extremely high (motivation to comply) and much easier (control belief power).

A TPB-based intervention may also attempt to increase participants' actual control over the behaviour, for example, by increasing the local availability of fruit and vegetables.

A limitation of the TPB and similar theories is that it does not specify how to change beliefs, only that belief change requires exposure to 'information', broadly conceived to include not just written information from leaflets and web pages, for example, and verbal information, such as advice from a health professional, but also direct experience with the target behaviour, observation of others performing the behaviour and other behaviour change techniques (Michie et al., 2013). For example, offering an incentive for behaviour change may work by creating a new salient belief ('If I perform behaviour X, I will receive a reward').

An Example of a TPB-Based Intervention Study

Elliott and Armitage (2009) developed and tested a TPB-based intervention to promote car drivers' compliance with speed limits.

The target behaviour was compliance with 30 mph speed limits, which was selected because most accidents in Britain occur on 30 mph roads. Participants were sampled from a database of drivers residing in the South East of England. Participants were randomly assigned to a control group ($N = 159$) who were sent a baseline questionnaire or to an experimental group ($N = 141$) who were also sent an eight-page intervention booklet to be read after completing the questionnaire. Both groups were followed up by postal questionnaire at one month. The booklet included information about the risks of speeding in 30 mph areas and persuasive messages targeting behavioural, normative and control beliefs associated with complying with 30 mph speed limits. The beliefs to be targeted were those that predicted drivers' attitudes, subjective norms, perceived behavioural control and/or intentions to comply with speed limits in a previous study (Elliott et al., 2005). The messages targeting behavioural beliefs focused on five positive outcomes (that complying with 30 mph speed limits would put pedestrians at less risk, reduce the chances

of an accident, use less fuel, make it easier to detect hazards and make driving more relaxing) and one negative outcome (that complying with 30 mph speed limits would make it difficult to keep up with the traffic). Table 9.3 shows the message that was used to target the negative outcome. The normative message targeted three groups of referents (friends, spouses/partners, parents/children). Finally, messages targeting control beliefs consisted of strategies that drivers can use to help them to avoid speeding when late or in a rush, when other drivers are exceeding the speed limit, when the speed limit is not clearly signed and when driving on long straight roads.

The TPB measures used in this study were closely in line with Ajzen's recommendations (Ajzen, 2019a). The measure of speeding behaviour was the mean of two items: 'How often have you kept within 30 mph speed limits when driving over the last month? (never-nearly all the time)'; and

'I have kept within 30 mph speed limits when driving over the last month' (strongly disagree-strongly agree).

The intervention had effects on some of the cognitions. It influenced one of the control power items: compared with those in the control group, participants in the intervention group were significantly more likely to say that if they were to drive on long straight roads this would make it more likely that they would keep within the speed limit. Intervention participants also had higher perceived behavioural control at follow up. Finally, there was a significant effect on the behaviour measure: intervention participants reported greater compliance with speed limits compared with controls. The effect size was small (0.19). Mediation analysis supported a model in which the effect of the intervention on behaviour was mediated by change in perceived behavioural control which was in turn mediated by change in control power for 'long straight roads'.

Table 9.3 Examples of Messages Used by Elliott and Armitage (2009) to Target Behavioural, Normative and Control Beliefs With Respect to Complying With 30 mph Speed Limits

Behavioural Beliefs

Keeping to 30 mph speed limits will not make it difficult to keep up with the traffic

Many drivers think that if they keep to the speed limit, they will have difficulty keeping up with the traffic. However, this is a perception rather than a reality for the most part. Consider what driving in a 30 mph area is typically like. Even on larger 30 mph roads, there are roundabouts, traffic lights, pedestrian crossings and other things that make it necessary for traffic to slow down or stop. If a vehicle in front starts to pull away from you, you will often find that by maintaining a speed of 30 mph you will catch up with that vehicle further up the road, because they have had to stop or slow down. They will have saved no significant amount of time and they will have gained little or no advantage.

Normative Beliefs

Do the people important to you really want you or themselves to be involved in an accident?

Many drivers say that a reason why they sometimes drive faster than the speed limit is because they think other people would want them to do so. Drivers may think that people who are important to them, or people whose views they respect, would approve of them driving faster than the speed limit. However, is this really the case? It is a fact that increases in driving speed will increase the risk of a road traffic accident. It is also a fact that increases in driving speed will increase the severity of an accident, were it to occur. Ask yourself: *Do the people who are important to me really want me, or themselves, to be involved in a road accident? Do my friends really want this to happen? Does my girl/boyfriend, or my wife/husband want this to happen? Do my parents or my children want this to happen?*

Control Beliefs

Driving in a hurry?

It's actually very easy to keep within the speed limit. Keeping to 30 mph speed limits is something everyone should, and can, do. Many drivers say that they speed because they are late or in a hurry. However, as mentioned above, driving faster than the speed limit does not actually save you that much time when driving in 30 mph areas. You are more likely to make your appointment on time and find it easier to keep to 30 mph speed limits if you plan ahead and make sure you leave plenty of time to reach your destination.

Several limitations of this study should be mentioned. The first concerns the target group. Ideally, the target population for such an intervention would be drivers who do not consistently comply with 30 mph speed limits. However, at baseline, the study sample had on average strongly positive attitudes, subjective norms and perceived behavioural control with respect to the target behaviour and scored just over 5 on the 7-point self-report measure of compliance with the 30 mph speed limit. The authors comment that there was limited scope for changing many of the TPB variables. Second, regarding the content of the intervention, note that the normative message (Table 9.3) included information that increases in driving speed increase the risk and severity of accidents, which is relevant to behavioural beliefs, part of the attitude component of the theory. This illustrates a potential difficulty in TPB-based interventions, namely that it is challenging to design a message that targets a single component of the theory. Also, the normative message asked 'Do the people important to you really want you or themselves to be involved in an accident?'. This is not the same as asking participants whether the people important to them would want them to drive faster than the speed limit, which directly references the target behaviour as required by the theory.

A BROADER THEORETICAL FRAMEWORK

SCMs specify the proximal determinants of behaviour, but they do not rule out other causes. Many other factors such as social, cultural and geographical factors may influence behaviour, but these are assumed to be distal causes, in other words to be further removed from the behaviour than the proximal causes specified by the theory. It is often assumed that the effects of distal factors on behaviour are mediated by the specified proximal factors.

An important subset of such distal factors can be summarised by the broad label 'social'. Several different classifications of such social factors have been proposed by theorists who have contributed to the development of what is known in the fields of health promotion and public health as the '**social ecological framework**'. For example, McLeroy and colleagues distinguished the following sets of determinants of health behaviour:

1. Intrapersonal factors – characteristics of the individual such as knowledge, attitudes, behaviour, self-concept, skills, etc. This includes the developmental history of the individual.
2. Interpersonal processes and primary groups – formal and informal social network and social support systems, including the family, work group, and friendship networks.
3. Institutional factors – social institutions with organizational characteristics, and formal (and informal) rules and regulations for operation.
4. Community factors – relationships among organizations, institutions, and informal networks within defined boundaries.
5. Public policy – local, state, and national laws and policies. (1988, p. 355)

To many psychologists, the social ecological framework may seem vague and difficult to operationalise. However, multi-level modelling (Bryk & Raudenbush, 1992; Duncan et al., 1998; Hox, 2002) provides a way of operationalising the framework and of organising the social causes of health behaviours. From this perspective, the last four items on the above list refer to higher-level units or entities of which the individual is a 'member' and whose characteristics may influence the individual's health-related behaviours either directly or indirectly.

To give a simple example, an adolescent's smoking behaviour (an individual-level or level 1 variable) may be influenced by the characteristics of the school they attend as well as by individual factors. For instance, the age of the student (level 1) may influence the likelihood that he or she smokes.

However, smoking may also be influenced by characteristics of the school, for example, whether the school has a strict non-smoking policy, whether it is an independent (fee-paying) or a state school, and the proportion of students who receive free school meals (an index of deprivation); all these are level 2 variables.

School characteristics may be correlated with individual characteristics. In this example, type of school may be correlated with age. In other words, students who attend one type of school may be older, on average, than those who attend another type of school. In a multi-level analysis, the effect of type of school on smoking can be estimated, controlling for possible differences in age between different types of school. This can be labelled a *contextual* effect, meaning an effect that cannot be accounted for by the *compositional* effect of different types of schools having different kinds of students (in this case, students of different ages).

Some causal effects of level 2 variables on the individual-level dependent variable may be mediated by other individual-level variables. For example, whether or not a school has a strict non-smoking policy may influence an individual student's attitudes to smoking which in turn influences the likelihood that they smoke. Causal pathways may involve more than one variable at level 2 and more than one variable at level 1. One school-level variable may influence another school-level variable which influences one individual-level variable which in turn influences another individual-level variable.

Level 2 variables may also interact with level 1 variables to influence the dependent variable. For example, the effect of age on smoking may differ in different types of school (e.g. there may be a weaker effect of age on smoking in schools that have a strict non-smoking policy). This is a *cross-level interaction*.

This approach can be extended to three or more levels. For example, a student's smoking may be influenced by characteristics of the class of which they are a member as

well as the school that they attend. Individual, class and school form three hierarchical levels. School-level variables may influence individual-level variables directly or through class-level variables.

CONCLUSIONS AND RECOMMENDATIONS

SCMs will continue to be widely used in health psychology and increasingly as the basis for behaviour change interventions. Researchers should carefully consider the selection of an SCM for a particular application, whether the aim of the study is prediction, explanation or behaviour change – and it is important to distinguish between these three different aims. More attention should be paid to the criteria for selecting a 'good' model. It has been argued that general models should be preferred to health-specific models. In addition, the constructs should be clearly defined and the causal relationships between the constructs clearly specified, and there should exist clear recommendations for how the constructs should be operationalised. In addition, the model should have been shown to have performed well in previous studies. In relation to this last criterion, researchers should note that SCMs may not necessarily be expected to explain a large proportion of variance in behaviour.

Although SCMs show overlap of constructs, there are important differences between them. For example, unlike other theories in common use, the TPB emphasises the importance of salient (readily accessible) beliefs as key determinants of intentions and behaviour. This has important implications: different subsets of beliefs may be salient in different situations, which implies that a person's attitude, subjective norm, perceived control and intention may vary depending on the context. More generally, it is important to appreciate that, although SCMs are sometimes described as 'static' models, they are in fact dynamic in that they specify causal relationships between variables whose values

may change over time and may be deliberately changed through interventions.

In any study using an SCM, it is important to start by defining the behaviour of interest as clearly as possible and to make sure that the theoretical determinants are assessed at the same level of specificity or generality.

Finally, to properly investigate the effects of what we have called 'social' variables requires a broad multilevel framework and a multilevel design in which the target health behaviour and its presumed proximal determinants, as specified by an SCM, are conceptualised as level 1 variables, and the various presumed social causes are conceptualised as higher-level variables. Ideally, in a particular investigation, the selection of social factors to be included and the presumed causal pathways from social to individual (as well as those operating within each level) should be informed by theory and existing evidence.

REFERENCES

- Ajzen, I. (1988). *Attitudes, personality, and behavior*. Open University Press.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Ajzen, I. (2019a). *Constructing a theory of planned behavior questionnaire*. <https://www.people.umass.edu/ajzen/tpb.measurement.pdf>. Accessed on June 09, 2024.
- Ajzen, I. (2019b). *Theory of planned behavior*. <http://www.people.umass.edu/ajzen/tpb.html>. Accessed on June 09, 2024.
- Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, 2, 3–24.
- Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, 84, 888–918.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Prentice-Hall.
- Armitage, C. J., & Conner, M. (2000). Social cognition models and health behaviour: A structured review. *Psychology and Health*, 15, 173–189.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. Freeman.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51, 1173–1182.
- Becker, M. H. (Ed.). (1974). *The health belief model and personal health behavior*. Slack.
- Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models*. Sage.
- Carpenter, C. J. (2010). A meta-analysis of the effectiveness of the health belief model variables in predicting behavior. *Health Communication*, 25, 661–669.
- Catania, J. A., Kegeles, S. M., & Coates, T. J. (1990). Towards an understanding of risk behavior: An AIDS risk reduction model (ARRM). *Health Education Quarterly*, 17, 53–72.
- Conner, M., & Norman, P. (Eds.). (2015). *Predicting and changing health behaviour: Research and practice with social cognition models* (3rd ed.). Open University Press.
- Courneya, K. S. (1994). Predicting repeated behavior from intention: The issue of scale correspondence. *Journal of Applied Social Psychology*, 24, 580–594.
- Courneya, K. S., & McAuley, E. (1993). Predicting physical activity from intention: Conceptual and methodological issues. *Journal of Sport and Exercise Psychology*, 15, 50–62.
- Duncan, C., Jones, K., & Moon, G. (1998). Context, composition and heterogeneity: Using multilevel models in health research. *Social Science and Medicine*, 46, 97–117.
- Elliott, M. A., & Armitage, C. J. (2009). Promoting drivers' compliance with speed limits: Testing an intervention based on the theory of planned behaviour. *British Journal of Health Psychology*, 100, 111–132.
- Elliott, M. A., Armitage, C. J., & Baughan, C. J. (2005). Exploring the beliefs underpinning drivers' intentions to comply with speed limits. *Transportation Research Part F*, 8, 459–479.

- Finkel, S. E. (1995). *Causal analysis with panel data*. Sage.
- Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Addison-Wesley.
- Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS-risk behavior. *Psychological Bulletin*, 111, 455–474.
- Hox, J. (2002). *Multilevel analysis: Techniques and applications*. Erlbaum.
- Johnston, J. (1984). *Econometric methods* (2nd ed.). McGraw-Hill.
- Jones, C. J., Smith, H., & Llewellyn, C. (2014). Evaluating the effectiveness of health belief model interventions in improving adherence: A systematic review. *Health Psychology Review*, 8, 253–269.
- Liska, A. E. (1984). A critical examination of the causal structure of the Fishbein/Ajzen attitude-behavior model. *Social Psychology Quarterly*, 47, 61–74.
- Luszczynska, A., & Schwarzer, R. (2015). Social cognitive theory. In M. Conner, & P. Norman (Eds.), *Predicting and changing health behaviour: Research and practice with social cognition models* (3rd ed., pp. 225–251). Open University Press.
- McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, 15, 351–377.
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J., & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine*, 46, 81–95.
- Ng, J. Y. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J. L., & Williams, G. C. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science*, 7, 325–340.
- Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12, 38–48.
- Rogers, R. W. (1983). Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In J. T. Cacioppo, R. E. Petty, & D. Shapiro (Eds.), *Social psychophysiology: A sourcebook* (pp. 153–176). Guilford Press.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68–78.
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1–29.
- Sheeran, P., Harris, P. R., & Epton, T. (2014). Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychological Bulletin*, 140, 511–543.
- Steinmetz, H., Knappstein, M., Ajzen, I., Schmidt, P., & Kabst, R. (2016). How effective are behavior change interventions based on the theory of planned behavior? A three-level meta-analysis. *Zeitschrift für Psychologie*, 224, 216–233.
- Strecher, V., & Rosenstock, I. M. (1997). The health belief model. In K. Glanz, F. M. Lewis, & B. K. Rimer (Eds.), *Health behavior and health education: Theory, research and practice*. Jossey-Bass.
- Strecher, V. J., & Rosenstock, I. M. (2002). The health belief model. In A. Baum, S. Newman, J. Weinman, R. West, & C. McManus (Eds.), *Cambridge handbook of psychology, health and medicine* (pp. 113–117). Cambridge University Press.
- Stroebe, W. (2000). *Social psychology and health* (2nd ed.). Open University Press.
- Sutton, S. (1994). The past predicts the future: Interpreting behaviour-behaviour relationships in social psychological models of health behaviour. In D. R. Rutter, & L. Quine (Eds.), *Social psychology and health: European perspectives* (pp. 71–88). Avebury.
- Sutton, S. (1998). Predicting and explaining intentions and behaviour: How well are we doing? *Journal of Applied Social Psychology*, 28, 1317–1328.
- Sutton, S. (2002). Testing attitude-behaviour theories using non-experimental data: An examination of some hidden assumptions. *European Review of Social Psychology*, 13, 293–323.
- Sutton, S. (2004). Determinants of health-related behaviours: Theoretical and methodological issues. In S. Sutton, A. Baum, & M. Johnston

- (Eds.), *The Sage handbook of health psychology* (1st ed., pp. 94–126). Sage.
- Sutton, S. (2005). Stage theories. In M. Conner, & P. Norman (Eds.), *Predicting and changing health behaviour: Research and practice with social cognition models* (2nd ed., pp. 223–275). Open University Press.
- Sutton, S. (2008). How does the health action process approach (HAPA) bridge the intention-behavior gap? An examination of the model's causal structure. *Applied Psychology: An International Review*, 57, 66–74.
- Sutton, S. (2010). Using social cognition models to develop health behaviour interventions: The theory of planned behaviour as an example. In D. French, K. Vedhara, A. A. Kaptein, & J. Weinman (Eds.), *Health psychology* (2nd ed., pp. 122–134). BPS Blackwell.
- Sutton, S. (2015). Stage theories. In M. Conner, & P. Norman (Eds.), *Predicting and changing health behaviour: Research and practice with social cognition models* (3rd ed., pp. 279–320). Open University Press.
- Sutton, S., Kinmonth, A. -L., Hardeman, W., Hughes, D., Boase, S., Prevost, A. T., Kellar, I., Graffy, J., Griffin, S., & Farmer, A. (2014). Does electronic monitoring influence adherence to medication? Randomized controlled trial of measurement reactivity. *Annals of Behavioral Medicine*, 48, 293–299.
- Weinstein, N. D. (1993). Testing four competing theories of health protective behavior. *Health Psychology*, 12, 324–333.
- Weinstein, N. D., Rothman, A. J., & Sutton, S. R. (1998). Stage theories of health behavior: Conceptual and methodological issues. *Health Psychology*, 17, 290–299.
- Weinstein, N. D., & Sandman, P. M. (1992). A model of the precaution adoption process: Evidence from home radon testing. *Health Psychology*, 11, 170–180.