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Health Behaviour Theory in Health Informatics: Support for Positive Change

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Abstract. The rising use of the Internet and information technology has made computerized interventions an attractive channel for providing advice and support for behaviour change. Health behaviour and behaviour change theories are a family of theories which aim to explain the mechanisms by which human behaviours change and use that knowledge to promote change. Among the best-known of these theories are the Social Learning and Social Cognitive theories, the Health Belief Model, the Theory of Reasoned Action and its successors the Theory of Planned Behaviour and the Reasoned Action Approach, and the Transtheoretical model. We discuss three examples of how behaviour change theories have been applied in computer-based interventions: a system to aid users to quit smoking, a decision aid for choice of breast cancer therapy, and an internet-based exercise program for reducing cardiovascular risk. We also discuss misapplication of theory, and reflect on how these theories can best be used. Behaviour change theory can be applied in health informatics interventions in several ways; for example, to select participants for a particular intervention, to shape the content of the intervention to effectively influence behaviour, or to tailor content to individual needs. Application of these theories to provide personalized advice ("decision support") is a young but promising area of research, and could inform other decision support interventions, including those that provide support for clinicians.

Keywords. Health behavior; Health psychology; Behaviour change theory; Theory-based design; Decision support systems, clinical

Learning objectives

After reading this chapter, the reader will be able to:
1. List some health behaviour and behaviour change theories and understand their relevance to system design and participant selection.
2. Understand the association of these models with technology adoption models and organizational change models.
3. Understand how these models relate to behaviour change techniques, and have been applied in technology-based interventions for smoking, breast cancer, and exercise to reduce cardiovascular risk.
4. Apply these models to designing an intervention for changing behaviour.

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1. Introduction to behaviour change theories

Health behaviour and behaviour change theories aim to explain the mechanisms by which (health) behaviours change, with a focus on harnessing those mechanisms to promote change [1]. These theories trace their roots to early work in the field of psychology, and B.F. Skinner's work in operant conditioning. Miller and Dollard's 1941 work on "social learning and imitation" can be considered the first behaviour change theory, asserting that people develop behavioural patterns through social interaction and reinforcement, including observing the actions and consequences experienced by others. This work formed the basis of the modern Social Learning and Social Cognitive theories.

1.1. Social Learning and Social Cognitive Theory

Social Learning Theory sought to combine the behaviourist and cognitive theories of learning, by positing that people learn through an interaction between cognitive factors, environmental influences, and behaviour. Observational learning occurs with four processes: attention (observing the modelled behaviour), retention (remembering the modelled behaviour), reproduction (attempting to imitate the behaviour), and motivation (anticipating the consequences of performing the behaviour, including social consequences). Reinforcement (external consequences) and self-control also play a role. In 1986 the theory was extended into the Social Cognitive Theory, an extensive theory of human motivation and action. In this theory, cognitive, environmental, and behavioural determinants all interact and influence one another [2]. People live and act within a social structure, which is in turn influenced by its members. Human agency can be exercised by taking action, directing others, or acting as part of a group. It encompasses intention and forethought, self-regulatory, and self-reflective mechanisms. The latter includes the important psychological construct of self-efficacy – an individual's belief that their actions can effect the desired change; that is, that they are capable of being effective in a particular task.

The Social Cognitive Theory is a general theory of behaviour, not specific to health or behaviour change. Nonetheless, it is one of the most-used theories in behaviour-change interventions, including internet-based interventions [3]. A shortcoming of the model is that it ignores the role of emotions, neurology, and physiology on behaviour. For example, behaviour often shifts as people age, without any corresponding shift in social, cognitive, or environmental influences.

1.2. The Health Belief Model

Work in the field progressed in the 1950's, as researchers sought to understand why tuberculosis screening programs had failed. The factors they elucidated formed the basis of the Health Belief Model (Figure 1).

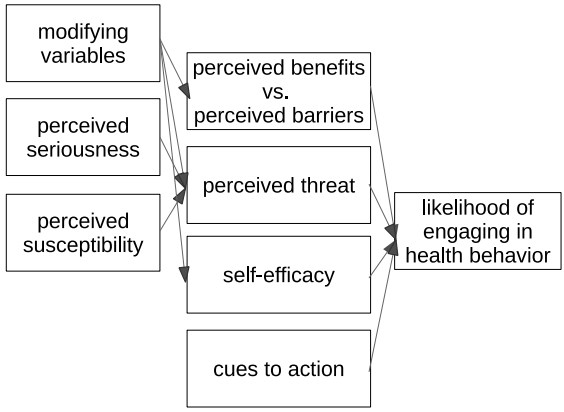

Figure 1: The Health Belief Model [4]

The authors aimed to better understand why, and under what conditions, people take action to prevent, detect and diagnose disease [4], which they termed "health behaviours" (in contrast to "illness behaviours:" the behaviours a person who perceives themselves as ill may engage in to manage or treat their condition). In the case of tuberculosis screening, most people understood that the disease was serious (perceived seriousness), but many people did not believe they were likely to catch it (perceived susceptibility). Another factor which influenced the likelihood of undergoing screening for tuberculosis was the belief that screening was effective, or the benefit of early detection – the perceived benefit of engaging in the behaviour. This was weighed against the perceived barriers, such as fear of exposure to x-rays. All of these variables were likely influenced by modifying variables such as age and social norms. The authors observed that the act of finally deciding to engage in the health behaviour is prompted by a cue – an external event that causes the behaviour to change. This could be an event that changes the perceived threat (e.g. experiencing worrying symptoms or a friend developing tuberculosis) or a public health intervention, such as a screening campaign.

Although originally intended to be a descriptive model, the Health Belief Model has also been applied both to design interventions and to predict health behaviours. The model construct "Perceived benefits and perceived barriers" has been shown to be the strongest predictor from this model [5]. A shortcoming of the Health Belief Model is its focus on individual choice, with no explicit mention of social influences or other external factors. It also assumes that health choices will be deliberate, thus ignoring unconscious choices (e.g. habit). The original model was formulated for relatively simple behaviours, such as getting a test or an inoculation. For more complex behaviours, perceived ability to perform the action (self-efficacy) is an issue. Self-efficacy was added to the model later, drawing from social cognitive theory [6].

1.3. Theory of Reasoned Action, Theory of Planned Behaviour, and Reasoned Action Approach

Shortly after publication of the Health Belief Model, Fishbein and Ajzen introduced the Theory of Reasoned Action (1967). While the Health Belief Model arose from the public health discipline, the Theory of Reasoned Action arose from social psychology

and theories of attitude, particularly the Theory of Propositional Control. It asserts that *behavioural intention* (the intention to engage in a behaviour) can be predicted by the person's attitude toward that behaviour and the *subjective norm* (perceived social pressure). Attitudes about performing an act are composed of beliefs about the consequences of the act, and the subjective evaluation of (or weight given to) these consequences. The model assumes, perhaps unwisely, that behavioural intention is strongly correlated with actual behaviour [7].

The Theory of Reasoned Action is probably best known in the field of health informatics for its influence on the development of the Technology Acceptance Model (TAM)[8], which asserts that the behavioural intention of using a particular technology is predicted mainly by the user's attitude toward the technology (Reasoned Action construct "attitude"), which is in turn predicted by perceived usability and usefulness[2].

The Theory of Reasoned Action was succeeded in 1985 by the Theory of Planned Behaviour, developed by Ajzen to improve the predictive accuracy of the model by adding *perceived behavioural control* (self-efficacy), again drawn from social cognitive theory, as a construct [9]. The authors note that perceived behavioural control can influence all of the other factors in the model, including actually performing the behaviour (i.e. the individual may intend to perform the behaviour, but ultimately does not do so because they feel they cannot.)

The most recent version is the Reasoned Action Approach, an attempt to integrate the work of Fishbein, Ajzen, and several other models of behaviour change (Figure 2) [10]. It added beliefs about behaviour, norms, and control as formative constructs, and acknowledged the influence of external factors on shaping these beliefs.

Like the Health Belief Model, the Reasoned Action family of models are limited to *reasoned* action, implicitly a conscious process. It also posits that intention leads directly to action. This is often not the case; people sometimes engage in behaviours without conscious choice (e.g. habits) and frequently do not engage in a behaviour despite good intentions.

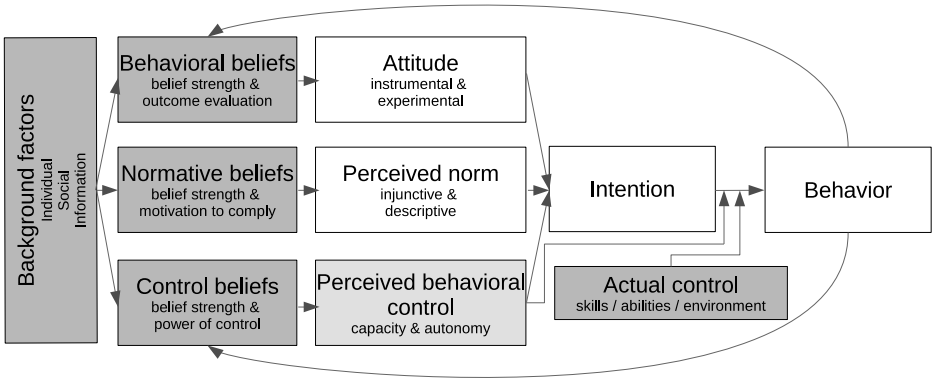

Figure 2: Reasoned Action Approach [10], showing constructs inherited from the Theory of Reasoned Action (white) and Theory of Planned Behaviour (light gray), as well as those new to the Reasoned Action Approach (dark gray).

[2] See also Chapter 6, "Technology Acceptance Models in health informatics: TAM and UTAUT".

1.4. Transtheoretical model

In 1982, shortly before the publication of Ajzen's Theory of Planned Behaviour, another highly influential model was introduced: the Transtheoretical or "stages of change" model. As the name implies, the model was developed through the integration of several behavioural and psychological models, and proposed that behavioural change occurs in five stages [11] (Box 1). A final stage, *termination*, was added later.

The authors also recognized 10 processes of change, and noted that particular cognitive processes tend to be used at different stages of change (Box 1). The verbal processes tend to play a large role in the early states of change. *Self-reevaluation* and *self-liberation* tend to come into the action phase, and *counterconditioning* and *stimulus control* bridge the action and maintenance phases. *Social liberation* plays a role in all phases. Self-efficacy and *temptation* (the strength of the desire to engage in the old behaviour) were added in later revisions of the model. The transtheoretical model has also been applied to and influenced research on organizational change – the study of preparing individuals and organizations for changes in the workplace [12]. "Resistance to change" is modelled as a mismatch between the readiness of the leadership for change and the stage of change of the employees. Studies across a range of behaviours show that before an action is taken, about 40% of people are in the pre-contemplation stage, and thus will likely resist change if the organization leadership proposes it. This can be addressed by assessing the employees' readiness to change, and taking action (individualized or collectively) according to their stage of change, for example by activities which raise awareness of the need for change for employees in the pre-contemplation phase.

Like the Health Belief Model, the Transtheoretical model portrays behaviour as mainly individual, with social influences playing only a minor role. It also assumes that people plan changes before making them. Armitage has suggested that the "five stages" can be better modelled as only two: a motivational phase (where a person prepares to change) and a volitional phase (where a person executes the change) [13] (Figure 3).

Stages of change
Precontemplation: Not yet thinking about change, may not be aware that change is needed
Contemplation: Thinking about the change
Preparation: Becoming determined to change
Action: Taking action to change
Maintenance: Maintaining the new habit
Termination: The new behaviour no longer requires active maintenance

Processes of change
Consciousness-raising: Seeking information about the behaviour
Self-liberation: Belief in the ability to change
Social liberation: Seeking and recognizing social support for the new behaviour
Self-reevaluation: Changing one's self-image in line with the new behaviour
Environmental reevaluation: Seeking and recognizing the effect of the old and new behaviour on others
Counter-conditioning: Substituting new, healthier behaviours for old habits
Stimulus control: Removing cues that trigger the old behaviour
Reinforcement management: Recognizing rewards from others and creating rewards for the new behaviour
Helping relationships: Seeking and recognizing support from others for the new behaviour

Figure 3. Armitage's two-stage model of change [13].

1.5. Translating theories to interventions

Although the above theories are among the best-known, there are many other behaviour change theories – 83 according to Davis et al [14]. Often more than one is used when designing an intervention. Michie et al. have worked extensively to aid the application of these theories by mapping elements of each theory ("constructs") to behaviour change techniques. Their group has identified 93 distinct behaviour change techniques, such as goal-setting (setting a concrete and achievable behavioural goal), and mapped these to 14 theoretical domains [15]. These insights have been organized into the Behaviour Change Wheel and the Theoretical Domains Framework [16]. At the centre of the Behaviour Change Wheel is the COM-B model, a general model of behaviour which states that an individual will engage in a Behaviour if they have the Capability, Opportunity, and Motivation to do so. The next level of the wheel maps these to nine intervention functions (high-level techniques) and seven policy categories (reflecting policies that can facilitate the techniques). Thus, for example, "goal setting" would be classified under Motivation in the COM-B model.

A practical example of applying this framework to design an intervention is given by Mangurian et al. [17]. Their goal was to increase the rate of screening for cardiovascular disease by primary care providers in patients with severe mental illness. They followed the eight steps outlined in the Behaviour Change Wheel framework. First, focus groups were formed with providers, patients, and managers to identify barriers and potential target behaviours, to identify potential targets and select the target behaviour: ordering of metabolic screening tests (e.g. HbA1c) by primary care providers at community mental health clinics. The behaviour was then described in detail, including its place in the providers' workflow, to identify what change was needed. The researchers identified barriers in 10 behavioural constructs, e.g. "Screening for diabetes is low on the priority list for these patients" (constructs: goal setting, motivation, attitudes [Reasoned Action]) and "I don't know exactly what the guidelines recommend" (constructs: knowledge, perceived behavioural control [Reasoned Action]). These problems were then mapped to 18 intervention functions. For example, lack of knowledge could be addressed through education, or through environmental restructuring so that the knowledge is available when it is needed, e.g. through a decision support system. They also identified 8 policy strategies to support the interventions, e.g. providing training on the content of the guidelines, and 7 behaviour change techniques applicable to this situation, e.g. self-regulation (Social Cognitive Theory) in the form of feedback on their individual screening rates. Finally, they defined the mode of delivery for each intervention. The authors reported that using the framework helped them in applying the underlying behaviour change theories to their intervention.

As noted by Kok et al., designing an effective behaviour change intervention is not simple [18]. Success depends on ensuring that changing the selected determinants will result in the desired behaviour, choosing behaviour change methods that affect these determinants, and executing the methods correctly so that they can be effective. The authors propose an Intervention Mapping taxonomy and protocol. The taxonomy consists of 13 behavioural determinants with methods for changing each, the theories on which these methods are based, and evidence of their effectiveness by specifying the theoretical parameters under which the method is effective or not. The taxonomy is not limited to the individual level, but also identifies methods of change at higher ecological

Box 1: Stages and Processes of change in the transtheoretical model [10]

levels. For example, the determinant "environmental conditions" can be affected by

offering technical assistance (according to the Diffusion of Innovations theory, among others). Also, change methods at the individual level can be directed toward agents at higher levels (e.g., consciousness raising), in combination with change methods for higher levels (e.g., agenda setting). The protocol for designing theory- and evidence-based behaviour change interventions consists of six steps: (1) conducting a needs assessment; (2) creating a matrix of change objectives by mapping behaviours to behavioural determinants to determine intervention targets; (3) select theory-based intervention methods that can influence the determinants, and translate these to practical interventions; (4) integrate the interventions into a programme; (5) organize adoption, implementation and maintenance of the program by identifying program users and supporters and addressing their needs; (6) create an evaluation plan to measure the effect.

2. Usage of health behaviour and behaviour change theories in health informatics

As computers and the internet have become more integrated into our lives, they have become increasingly attractive platforms for behaviour change interventions [3]. Many computer-based interventions simply provide information, with theory guiding what information is presented, to whom and in what ways. More complex interventions use specific data about the user to tailor the information that is presented or guide the user in making choices about their health, and thus can be considered a type of decision support system. Likewise, the goal of decision support is often to change behaviour – either the behaviour of health professionals on behalf of their patients, or the behaviour of patients themselves in self-management systems. Apparently well-designed decision support systems often go unused, or fail to deliver the expected effect on health or health care [19]. One possible path toward improving the success of systems is to draw from existing cognitive and behavioural theories, to determine how the system's advice should be presented to be most persuasive and most helpful to the end user.

Examples of theory-based systems described below that provide patient- or situation-specific advice to aid in making a health-related decision are the Tailored Print Smoking Cessation system, the BresDex decision aid for women with breast cancer, and the Active Living Every Day internet-based intervention for reducing cardiovascular risk.

2.1. Smoking cessation

The Tailored Print Smoking Cessation system generated person-specific advice based on the transtheoretical model. [20] The system asked the user questions based on the constructs of the transtheoretical model, including the 10 processes of change, temptations, and self-efficacy. For example, the system might ask the user to rate the statement, "I tell myself I can choose to smoke or not" (construct Self-Liberation). The system then compared the user's answers to relevant norms and used decision rules to determine which written interventional materials were appropriate for the user. The user's stage of change was determined, and then materials were selected to help move the user to the next stage. The person was reassessed every 3-6 months, and the system also incorporated data from previous assessments, and generated a feedback report. This report included a comparison of the individual's progress to a set of norms derived from data on people who ultimately were and were not successful at quitting smoking, as well

as to the person's own past responses. The underlying rule base was complex, resulting in around 20,000 possible unique reports.

The system proved to be considerably more effective than providing non-tailored materials or simply allowing people to answer the questions and draw their own conclusions. Use of the system resulted in a self-reported 22-26% smoking-cessation point-prevalence (people who said they had not smoked in the last 24 hours; an intermediary outcome associated with long-term cessation) [20]. This means the system was nearly as effective at helping people quit smoking as intensive clinic-based interventions.

2.2. Choice of therapy for breast cancer

The BresDex decision aid provided a variety of different forms of information to help women with breast cancer in deciding between breast-conserving surgery with radiotherapy or mastectomy [21]. The Theory of Planned Behaviour has also been shown to predict behaviour in decisions such as choice of cancer therapy. As with other decision aids, the goal of this system was to help the patient come to a decision that is in line with her values. The authors used an extended version of the theory which included the construct "anticipated regret." The decision aid consisted of video clips of enacted patient experiences (all constructs), patient photos (attitudes and anticipated regret), videos of health professionals (attitudes, subjective norms, and perceived behavioural control), information on further treatment (attitudes and anticipated regret), a Your Surgery Options section (attitudes and anticipated regret), an It's Your Choice section (subjective norms and perceived behavioural control), a What's Next section (behavioural control), and a "decision support" tool which visually summarized the patient's responses to other items as a tally of pros and cons for each option (subjective norms and perceived behavioural control). The decision aid also offered information on the causes, types, and consequences of breast cancer, in line with the Common Sense Model of Illness Representations (a model of coping behaviour in disease). The effect of the decision aid was studied in a sample of 54 women using questionnaires administered before and after using the system. "Readiness to make a decision" improved significantly after using the system, as measured by the DelibeRATE score (increase from a mean score of 65 to 76, $p < 0.001$). However, knowledge of breast cancer did not change, as measured by a 10-point breast cancer knowledge scale (mean score = 8.3 before and 8.5 after; $p = 0.202$). Most women preferred breast-conserving surgery both before and after using the system, although slightly more preferred it after (27/54 participants before and 30/54 participants after).

2.3. Exercise

Active Living Every Day is an internet-delivered program designed to encourage exercise and reduce cardiovascular disease risk factors in sedentary adults [22]. Participants are screened for their level of readiness to change based on the Transtheoretical model. They are then matched to a (fictional) virtual participant at the same level of readiness to change. They can read about their virtual partner's progress, and receive reading material tailored to their state of change. The material includes activities such as Setting Goals (consciousness-raising), Scouting Physical Activity in Your Community (environmental re-evaluation, helping relationships), and Mall Walking (counter-conditioning, reinforcement management). Participants also keep a

journal of their own activities and goals, and are periodically re-evaluated for their stage of change.

The intervention was tested in a controlled study with 32 participants, where the control group received a delayed intervention (started after the study outcomes were measured). In the 16-week program, activity increased by 1384 steps/day ($p=0.03$) in the intervention group, compared to 816 steps/day ($p=0.14$) for the control group. Waist circumference decreased in the intervention group but not in the control group (a change of -4.0 cm vs +0.6 cm; $p < 0.05$) and Coronary Risk Ratio reduced in the intervention group (from 5.1 to 4.7; $p=0.04$) while remaining constant in the control group (3.7; $p=0.94$).

3. Explanation of the success or failure of use of health behaviour and behaviour change theory in health IT systems

In a review of internet-based behaviour change interventions, Webb et al. found that use of theory was positively associated with effect size [3]. Three theories were used most often: the Theory of Planned Behaviour, Transtheoretical model, and Social-Cognitive theory. Figure 4 shows the effect sizes for studies that used these theories, as well as the effect for studies that used behaviour change theories in different ways. Using theory or predictors for participant selection was associated with a larger increase in effect size than using it for intervention design, and using it for both purposes had the greatest effect [3].

All three of the interventions described above made use of theory to develop the content of their interventions. Presenting tailored information (in other words, incorporating specific data about the user/patient to determine what kind of support should be provided) also showed a small positive effect. The Tailored Print application and the Active Living Every Day intervention are examples of this application of theory. Theory can also be applied to explain or predict observed behaviour. For example, clinicians' intention to use each of seven information sources to learn about a new drug was examined in a survey based on the Reasoned Action Approach. In this study, attitudes were shown to have a greater influence than subjective norms for this behaviour [23].

Theory can also be misapplied, e.g. by applying it out of the context in which it was developed and tested. An example of this is an attempt to use "credibility cues", based on Fogg's work on credibility, persuasion, and behaviour change, to encourage people to register as an organ donor via a website [24]. Fogg’s theory, based on many empirical studies of eCommerce websites, states that website credibility is based on the user's perception that the people behind a website are trustworthy and have relevant expertise. This means a site design should be: professional; make it easy to verify the information it contains; show that behind the site is a real organisation with people who have relevant expertise, are honest and trustworthy and can be contacted if need be; easy to use, useful and frequently updated; and that the site design avoids errors of all kinds and promotional content.

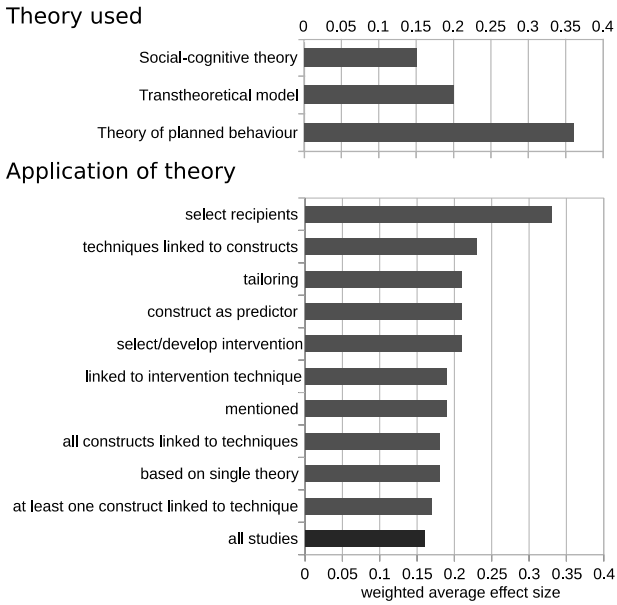

Figure 4. Effect of use of theory in internet-based behaviour change interventions. Based on data from Webb et al. [3]

To test if Fogg's theory improved sign-up rates for the NHS organ donation website, an online study was conducted in which 889 participants were randomized to use one of two versions of the website over a 3 week period, one with characteristics previously identified as signalling credibility (University logo, privacy statement, references, etc.) and one with characteristics of low credibility (advertisements, broken links, non-secure site for entering form data). This study showed no difference in the number of participants registering as an organ donor (176/466 or 37.8% in the "credible" variant, 160/423, again 37.8% in the "low credibility" variant). However, the kind of decision being made in this study – whether to allow your organs to be harvested for transplant after death – was very different from the kind of decision targeted by Fogg's persuasive technology theory – whether to purchase an item on an eCommerce website. Thus, perhaps not surprisingly, the theory was simply not valid in this context.

Another example of an intervention which did not go as planned was the Personally Controlled Health Management System for Asthma [25]. This was a web-based self-management system for asthma, with the primary goal of helping patients develop a written Asthma Action Plan. The system contained three "patient journeys," which were designed around the Health Belief Model. The first journey aimed to increase perceived susceptibility and emphasizes the importance of having a written plan in the event of an asthma attack, the second addressed perceived barriers by providing the information needed to formulate a plan, and the third addressed self-efficacy by providing encouraging tips in monthly emails. They also provided a "cue to action" by allowing patients to book a consultation online. The system was also informed by the Transtheoretical model, in that the three journeys can be viewed as appropriate for different stages of change and the social cognitive theory by incorporating social features such as polls and forums. However, only 20% of eligible participants ever logged in more

than once. The primary goal of the system was to encourage developing a written Asthma Action Plan, and at the end of the study only 18% of intervention group participants had one (compared to 22% of the control group). Based on a follow-up survey, the authors cite unrecognized and unaddressed barriers as the primary reason for the poor effect of the system: for example, believing that a written plan was not necessary in their situation, being discouraged from getting one by a health care professional or by a previous negative experience with trying to create a plan, or feeling that it was unimportant compared to other priorities in their life.

Research using these theories, or theories in general, falls into two categories: studies which test a theory in an applied setting to determine if the theory applies to that setting, or studies which aim to solve a practical problem and make use of the theory to formulate a better solution [26]. The attempt to apply Fogg's theory to the NHS organ donation website can be viewed as a study of the first type. However, the outcome might be considered predictable: the target behaviour was very different than the behaviours in the studies from which the theory was derived. Once the decision has been made to become an organ donor, the user may not be deterred by being required to use an unprofessional-looking website – unlike the decision to purchase a book or music, which can always be purchased later or from another vendor. This also explains why self-efficacy needed to be added to the Health Belief Model; it was originally developed to explain simple behaviours like getting a vaccination, and needed an additional construct to be applied to more complex behaviours where the person might doubt their own ability to engage in the behaviour. Likewise, a theory may not apply if the target group is very different from the original target group or if the target behaviour is influenced by forces not accounted for in the model. For example, clinicians' behaviour is usually regulated in part by law and reimbursement policy, so it is unlikely that any behaviour change intervention would cause clinicians to behave in a way that substantially contradicted these policies. Likewise, interventions to change a health behaviour in school children or in military personnel might be quite different, since many choices in these groups are not made by the individuals themselves. A thorough review of the literature may be informative to determine if a theory has been successfully applied for that behaviour, type of person and context of interest. Several of the models discussed above have the shortcoming that they consider the behaviour of a person in isolation, disregarding social influences. These models are unlikely to apply in situations where social interaction plays a large role, or when the decision is made by a team rather than an individual. Finally, as mentioned above, correct operationalization of the theory is critical. This is likely the reason for underuse of the asthma website mentioned above: although barriers are a construct in the Health Belief Model, the investigation of barriers prior to developing the system failed to identify the barriers, which ultimately led to the system not being used. Use of a guide such as that proposed by Kok et al. can help assure that the theory is applied correctly [18].

4. Discussion

Health behaviour and behaviour change theories are widely applied in the field of psychology and have now been classified and translated into a taxonomy of practical techniques. Many health informatics interventions, particularly those directed toward healthcare professionals and patients, aim to change user behaviour in some way, and use of a behaviour change theory in intervention design or participant selection is

associated with increased effectiveness in internet-based behaviour change interventions [3]. Some behaviour change theories have even been developed specifically for use in technology-based interventions [27] However, because many people working in health informatics focus on technology not psychology, the use of behaviour change theory in online or mobile interventions originates mainly from another discipline: psychologists and public health workers familiar with behaviour change theory, who are moving toward using computers and mobile devices as affordable, scalable channels to reach their patients. Many interventions developed by people working in health informatics also aim to help patients stop smoking, provide a tailored decision aid, or influence other health behaviours or health professionals, but do not report using a health behaviour or behaviour change theory. The goal of many systems designed to support clinicians could also be characterized as "behaviour change" - for example, aiming to increase screening for a particular problem, reduce ordering of unnecessary tests, or changing from the use of one medication to another [28]. One of the reasons given for failure to incorporate new evidence into practice is "habit," implying that behaviour change theory has potential application in this area as well. There is a clear opportunity for greater collaboration and multidisciplinary cooperation between the fields of health psychology, health promotion and health informatics, and an urgent need to apply health behaviour and behaviour change theories in designing and evaluating health IT interventions. One way to promote this is to include insights from psychology and behaviour change theories in health informatics education programmes.

Teaching questions for reflection

1. What do people working in health informatics need to know about behaviour change theory and techniques?
2. Does basing the design of an intervention on Behaviour Change Theory always lead to a more effective intervention? If not, why not?
3. How else can people working in health informatics make use of behaviour change theory to improve the impact of our work?
4. How can we help the field move forward and understand which Behaviour Change Theories work best in specific contexts?

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