Attribute-centred theorizing to address behavioural changes
Rajiv N Rimal & Maria Knight Lapinskib

Abstract Despite the importance of behaviours in promoting health and wellness, persuading people to adopt and sustain healthy behaviours remains a significant public health challenge. Considerable progress has been made in developing and testing theories about the personal, social, environmental and structural drivers of behaviours. However, theorizing about behaviours themselves has remained elusive, as evidenced by the absence of a widely accepted taxonomy of behaviours. By carefully examining the nature of behaviours, practitioners and researchers can identify the most effective ways to promote behavioural change. We propose attribute-centred theorizing as an approach for defining behaviours based on their relevant properties, which can then assist in developing a taxonomy of behaviours and theorizing about them. Behaviours differ because of their underlying properties; for example, some behaviours are addictive, others are publicly observable and others are expensive. Addictiveness, privacy and cost are therefore three (of the many) attributes relevant for theorizing about behaviours. We describe a framework for operationalizing attribute-centred theorizing, which includes generating behavioural attributes, verifying and testing those attributes, and constructing a behavioural matrix to inform campaigns or interventions. We illustrate this framework using the examples of Guinea-worm disease and cardiovascular diseases. The benefits of our approach include the ability to inform intervention development and the ability to generalize across different behaviours; however, more research on converting the behavioural matrix into actual policy is needed.

Introduction
Health behaviours are critically important over a wide range of diseases and risk factors such as obesity, cancer, hypertension, unwanted pregnancy and human immunodeficiency virus (HIV) infection. Human actions underlie even seemingly intractable problems such as climate change and watershed protection. The current coronavirus disease 2019 pandemic has highlighted the importance of behavioural change in public health; minimizing infections to reduce transmission has only been possible as a result of the widespread adoption of face mask wearing, regular hand washing, physical distancing, testing and vaccination.

Despite the substantial literature on behavioural drivers (i.e. the predictors of behaviour, which are not part of the behaviour itself), relatively little research has been conducted on the actual behaviours. Seminal behavioural theories predict behaviours based on the characteristics of individuals, social networks, social factors, environments and public policies. However, none of these perspectives provide guidance on how to promote behavioural change based on the characteristics of the focal behaviour itself. Because behaviours vary over multiple dimensions, efforts to change them must be adaptive to the underlying characteristics, that is, the attributes of the behaviour, distinct from behavioural drivers.

Smoking cigarettes is an example of behaviour in which addictiveness is a key attribute. In many parts of the world, it is also an expensive behaviour and involves a restricted product. The three relevant attributes of smoking cigarettes are therefore addictiveness, cost and restrictiveness. However, addictiveness and cost are not attributes that define the wearing of face masks; in this case, availability and public visibility may be important attributes. Conversely, privacy considerations may be key for certain behaviours (e.g. contraception use), but not for others (e.g. physical activity).

Behavioural attributes can also be categorized according to (i) temporality: some behaviours have immediate consequences (e.g. applying a bandage to an open wound) and others have more long-term effects (e.g. recycling household waste); (ii) the recipient of the benefits of the behaviour (e.g. satisfying cravings by eating high-sugar foods, or registering as an organ donor); and (iii) the required frequency of the behaviour (e.g. annual influenza vaccinations versus a single smallpox vaccination).

Attribute-centred theorizing defines behaviour in terms of a unique configuration of its underlying behavioural attributes and the relative importance of these attributes. In this paper, we describe a framework for using attribute-centred theorizing in the development of public health interventions. We illustrate this framework using the case studies of Guinea-worm disease and cardiovascular diseases, and discuss the strengths and limitations of the technique.

Attribute-centred theorizing
We first introduced attribute-centred theorizing in 2011 (originally referred to as the attribute-centred approach). Several researchers have since used the approach to theorize about behaviours, in particular to model the conditions under which social norms drive people’s behavioural choices. For example, Manning identified four key behavioural attributes (social approval, social motivation, pleasantness and “interpersonal-ness”) to model the influence of social norms across 31 behaviours. Other researchers used attribute-centred theorizing to explain when and how behaviours are guided by social norms to identify promising interventions across a variety of behaviours and to build behavioural theory. Using attribute-centred theorizing to guide public health interventions is a three-stage approach: (i) attribute generation, (ii) attribute testing and verification, and (iii) behavioural matrix construction.

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Attribute generation

The first stage is the generation of a list of relevant behavioural attributes using qualitative and mixed-method techniques. We recommend beginning by consulting key source documents – newspaper reports, journal articles, government briefs, social media feeds and other channels – for descriptions of the behaviours in question, noting the manifest attributes. In the case of vaccination against severe acute respiratory syndrome coronavirus 2, such preliminary searches could yield the information that vaccines require government approval and are in short supply, and that complete vaccination requires two injections; the key attributes are therefore scarcity, the requirement of approval and repetitiveness.

Attributes can also be generated through thought-listing exercises, or asking participants key questions that are designed to elicit important properties of the behaviour. For example, participants might be asked to (i) list thoughts that come to mind when you hear the word vaccination; (ii) say what happened when you received your last vaccine; or (iii) describe what you remember reading about vaccines recently. Responses to these prompts are used to delineate the key attributes pertaining to vaccination.

Attribute testing and verification

Attributes generated in the first step then undergo testing and verification. In surveys, participants can rate the importance of each attribute identified in the first step for different behaviours through scaled responses. For example, if the attribute is addictiveness, participants can be asked how important it is for smoking, exercising, wearing a mask, vaccination, screening and any number of other behaviours of interest. Similarly, participants can be asked to rate the attribute’s relevance, usefulness or salience for each focal behaviour. This method can be done across a variety of behaviours and attributes, or for a single behaviour and attribute believed to be very important (e.g. hand washing visibility). The results are averaged to determine how various attributes cluster. For example, regular hand washing and social distancing are both behavioural clusters. For example, regular hand washing and social distancing are both behaviours that are visible to others, low in cost and repetitive; a campaign emphasizing the social norms supportive of the behaviour, easy access and the ritualistic nature of the behaviours might therefore be a useful approach when used in combination with structural and environmental changes to facilitate these behaviours.

For sensitive or stigmatizing behaviours.

To increase accuracy, this method can be supplemented with other unobtrusive methods such as the approach-avoidance task (Box 1). The approach-avoidance task proposes that it is cognitively easier to process attributes consonant with the underlying behaviour than attributes discordant with the behaviour.21

**Box 1. The approach-avoidance task and its relevance to attribute-centred theorizing**

Human brains process certain kinds of information more easily than others, and the speed with which information is processed is often taken as an indication of this ease (or difficulty). When information is easy to process, cognitive burden is low and people’s reaction time (often measured in milliseconds), or the time needed to process that information, is shorter; conversely, when tasks are more complex, reaction time is longer because the cognitive burden is greater.

Cognitive burden, in turn, is greater when the stimulus is characterized by conflict or if it inspires negative emotions such as fear.22

The approach-avoidance task can be done across a variety of sensitive or stigmatizing behaviours. Typically, people are asked to pull a lever (or press a particular button) as soon as they see something specific as instructed. For example, people might be asked to pull the lever as soon as they see the colour green or the letters g-r-e-e-n. The reaction time is typically longer when there is conflict (e.g. if the word “green” is written in red ink) than when there is no conflict (e.g. the word “green” is written in green ink). This disagreement is known as stimulus conflict, which typically garners a longer response time.23

This example illustrates the idea that concordant information (green colour to spell the word “green”) garners shorter reaction time than discordant information (red colour to spell “green”). Extending this notion to attribute-centred theorizing leads to the proposition that when people process an attribute that is concordant with the behaviour in question (e.g. need for privacy as an attribute of HIV testing), their reaction time, as measured through an approach-avoidance task, would be shorter than when they process a discordant attribute (e.g. testing for HIV in a public setting).

**Table 1. The behavioural matrix in attribute-centred theorizing: strength of relationship between attributes and behaviours for control of coronavirus disease transmission**

| Attribute   | Wearing masks | Washing hands | Physical distancing | Testing | Vaccination |
|-------------|---------------|---------------|---------------------|---------|-------------|
| Repetitiveness | High          | High          | High                | Medium  | Low         |
| Cost         | Medium        | Low           | Low                 | Low     | Medium      |
| Public visibility | High     | Low/high*     | High                | Medium  | Medium      |

* The matrix could also provide empirically derived weights, describing the relationship between each attribute and the focal behaviour. Values may also differ by context. For example, vigilance of washing hands may be ranked high in public facilities, but not always in private.

**Illustrations**

We illustrate attribute-centred theorizing using the examples of Guinea-worm disease and cardiovascular diseases. These examples were chosen because of their...
behavioural foci and range of behavioural attributes.

Guinea-worm disease is caused by the parasitic worm Dracunculus medinensis. The disease is endemic in Guinea and in several countries across the world; however, this disease can be eliminated by changing human behaviour, and it is on the verge of being eradicated without the use of drugs.26–29 Indeed, it has been noted that the demise of Guinea-worm disease “will be proof that people can be persuaded to change their behaviour through innovative health education.”30

The World Health Organization defines cardiovascular diseases as “a group of disorders of the heart and blood vessels,” for which the leading behavioural risk factors are unhealthy diet, physical inactivity, tobacco use and harmful levels of alcohol consumption.31 Although pharmacological interventions can be a part of the treatment, both prevention and risk reduction involve significant individual lifestyle changes.32

Because Guinea-worm disease is a neglected tropical disease, there may be relatively few popular press articles or published studies on related behaviours; it may therefore be necessary to research other similar behaviours for different diseases for clues to the attributes. In contrast, cardiovascular diseases are more common and discussions of underlying behaviours, and hence the salient attributes, may be more readily discernible (Table 2).

Observations of people enacting the behaviours and discussions with community members about the behaviours themselves are other means of generating relevant attributes. The goal of these activities is to understand how the behaviours are enacted and understood by people in the community, which helps to identify relevant attributes. Visibility could be an important attribute in both examples (tethering animals for Guinea-worm disease or conducting physical exercise for cardiovascular disease), whereas the requirement for technical knowledge may be greater for treating water than for eating fruit and vegetables. Similarly, the extent to which the behaviour confers benefits collectively (e.g. improving the health of the community by providing access to treated water) or individually (e.g. improving health by not smoking), the frequency with which the behaviour needs to be conducted (the regular and continuous containment and care of animals or engagement in physical activity) and whether the behaviour is associated with addiction (not relevant for tethering animals but relevant for smoking) are other attributes for consideration (Table 2).

Once attributes have been identified, their relevance for the behaviour at hand needs to be tested. In this step, the goal may be to determine the extent to which people perceive the behaviour in question as comprising the attributes or the extent to which the attributes are salient or relevant. Surveys of community members in areas in which Guinea-worm disease is endemic could be undertaken. Likewise, searching social media for content from groups of people with heart disease (e.g. the social networking website PatientsLikeMe®)33 can provide evidence for the salience of attributes. One of the qualitative methods available for testing and verification includes the free-listing exercise, which can identify barriers to particular behaviours.28 “Tell me what comes to mind when you think about tethering your animals before you head out to the fields,” for example, can serve as an open-ended question designed to determine whether the attributes identified by the researchers or programme planners also match those emerging in people’s conversations. Another qualitative method is a pile-sorting exercise,34 in which participants categorize different attributes in terms of their importance or relevance.

Finally, the behavioural matrix is constructed to describe the strength of the relationship between the attribute and the behaviour. Table 2 lists the strengths of the relationships between: (i) the attributes of requirement of technical knowledge, collective benefit and requirement of resources, and the behavioural example of disposal of aquatic animal waste (Guinea-worm disease); and (ii) the attributes of visibility, individual benefit and addictiveness, and the behavioural example of daily consumption of fruit and vegetables (cardiovascular diseases).

Analysis of behavioural attributes using this technique can identify the extent to which potential interventions to influence behaviours related to the prevalence of Guinea-worm disease or cardiovascular diseases are likely to be effective. For example, if an intervention under consideration includes a communication campaign to describe the social norms associated with a behaviour, an action that is visible to others in the community, undertaken collectively and simple to implement is more likely to be adopted.35

Table 2. Illustration of attribute-centred theorizing for the development of behavioural change interventions to reduce prevalence of Guinea-worm disease and cardiovascular diseases

| Attribute-centred theorizing stage | Guinea-worm disease | Cardiovascular diseases |
|-----------------------------------|---------------------|------------------------|
| Attribute generation | Required risk reduction behaviours: treating water sources, appropriately disposing of aquatic animal waste, tethering or containment of animals, and identifying and treating infections in humans and animals30 | Required risk reduction behaviours: regular fruit and vegetable consumption, regular physical activity, smoking cessation and reduction of salt intake27 |
| Associated attributes: requirement of technical knowledge, collective benefit, requirement of resources and complexity | Associated attributes: visibility, individual benefit, addictiveness |
| Attribute testing and verification | Surveys of community members | Social media search |
| Behavioural matrix construction | e.g. Treatment of water sources may be high for requirement of technical knowledge, high for collective benefit and high for requirement of resources | e.g. Daily consumption of fruits and vegetables may be low for visibility to others, high for individual benefit and low for addictiveness |

Discussion

The attribute-centred theorizing approach has several benefits for public health interventions. First, aligning relevant behavioural attributes with theoretical assumptions provides guidance on which theory to adopt in the promotion of behavioural change. For example, if a particular theory is based on an assumption of individual desire in enacting change,36 then its use for behaviours defined by addictiveness.
ملخص

وضع النظريات المرتكزة على السمات لتناول التغيرات السلوكية

على الرغم من أهمية السلوكيات في تعزيز الصحة والسلامة، فإن إقء الناس بعض السلوكيات الصحية والحفاظ عليها يظل من الصعوبات الكبيرة في مجال الصحة العامة. لقد تحقق تقدم كبير في وضع نظريات واختبارها بشأن الدوافع الشخصية والاجتماعية والبيئية والمكملة للسلوكيات. إلا أن وضع النظريات التي تتناول السلوكيات نفسها قد يظل خادعًا كما يظهر في غياب تصنيف مقبول للفئات السلوكية. لا يزال التحيز المتشابك للسلوكيات يتطلب تحليلًا دقيقًا في تطبيقات التصميم، حيث تكون النظريات المرتكزة على السمات تنبأ بها عن السلوكيات ذات الصلة، وهو الأمر الذي يستدعي الحاجة إلى وضع نظريات للسلوكيات والملاحظات المرتبطة بها. تختلف النظريات السلوكية حسب خصائصها ذات الصلة.

أقتراض

BUILDING A THEORY CENTERED ON ATTRIBUTES TO UNDERSTAND BEHAVIORAL CHANGE

Attribute-centred theorizing for behavioural change

Rajiv N Rimal & Maria Knight Lapinski

As social norms play a role in the development of individual behavior, it may be more relevant for changing behaviors defined by high public visibility. However, this variable can be confused with behavioral attributes. The second limitation is the difficulty in translating the behavioral matrix into interventions. Nevertheless, we anticipate that this is a function of the novelty of the approach, and it is hoped that future researchers and practitioners can contribute to this effort in a significant way.

To conclude, attribute-centred theorizing is an empirically based practical tool for behavioral change. Its adoption can focus interventions, reduce redundancy across health domains, and better leverage existing public health research and practice. It can be applied formally when the time, resources and capacity exist to do so, or informally; in either case, it provides a structured method of carefully examining the nature of behavior when behavioral change interventions are being considered.

Competing interests: None declared.

Summary

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would be unwise. Conversely, theories about social norms (typically based on people's observations and perceptions about others' behaviors) might be more relevant for changing behaviors defined by high public visibility. However, this variable can be confused with behavioral attributes. The second limitation is the difficulty in translating the behavioral matrix into interventions. Nevertheless, we anticipate that this is a function of the novelty of the approach, and it is hoped that future researchers and practitioners can contribute to this effort in a significant way.

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Summary

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A pesar de la importancia de los comportamientos en la promoción de la salud y el bienestar, persuadir a las personas para que adopten y mantengan comportamientos saludables sigue siendo un importante reto para la salud pública. Se ha avanzado considerablemente en el desarrollo y la comprobación de teorías sobre los factores personales, sociales, ambientales y estructurales que impulsan los comportamientos. Sin embargo, teorizar sobre los comportamientos en función de su naturaleza sigue siendo un reto para la salud pública. Se ha avanzado considerablemente en el desarrollo y la comprobación de teorías sobre la naturaleza de los comportamientos, los profesionales de la salud y los investigadores pueden identificar las formas más eficaces de promover la naturaleza de los comportamientos, los profesionales de la salud y los investigadores pueden identificar las formas más eficaces de promover.

Los comportamientos difieren por sus propiedades subyacentes; por ejemplo, algunos comportamientos son adictivos, otros son observables públicamente y otros son costosos. La adicción, la privacidad y el coste son, por tanto, tres (de los muchos) atributos relevantes para teorizar sobre los comportamientos. Describimos un marco que permite identificar las formas más eficaces de promover el cambio de comportamiento. Proponemos una teoría centrada en los atributos de comportamiento y una teoría centrada en el comportamiento.

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