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Designing Information Systems to Break Habits and Promote Preventive Behaviours During Large-Scale Disease Outbreaks

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Abstract

Adhering to preventive behaviours, like social distancing and wearing a mask, can help reduce the spread of some transmissible diseases; however, doing so can be a challenge as it requires people to break established habits. This challenge will be most evident for organisations as they need to ensure that all stakeholders adhere to preventive behaviours to resume in-person business operations. While various information systems (IS) have emerged to address this challenge, they remain limited in scope and fall short of helping users navigate the evolving practices and guidelines of a pandemic. To address this shortcoming, we adopt the design science research approach to derive design principles for IS supporting the breaking of established habits and promotion of preventive behaviours. The design principles are rigorously anchored in the habit alteration knowledge base and the Health Belief Model. We demonstrate how the design principles can be applied using an illustrative case.

1. Introduction

The novel coronavirus disease (COVID-19) that emerged in late 2019 has threatened the health and livelihood of millions of people. Hundreds of thousands have succumbed to the disease, millions of people are in lockdown, and many businesses will not survive [1]. Great uncertainties remain about the virus and its consequences; however, it is clear that individual and collective public behaviour changes can help contain the spread of the virus [2]. Such preventive behaviours include, among others, social distancing, increased handwashing, reduced face touching, and mask wearing [3, 4]. Adopting these behaviours is widely acknowledged as a means to successfully slow the spread of the virus and relieve some of the stress on the health care system [5]. Furthermore, such behaviours should be maintained in order to resume in-person business operations while ensuring that the threat of a new wave of infections is reduced. Yet, adherence to the new behaviours can be a challenge [4], as it requires people to alter pre-established behaviours that they act on automatically, known as habits [6, 7].

Habits are defined as "memory-based propensities to respond automatically to specific cues, which are acquired by the repetition of cue-specific behaviours in stable contexts" [8 p. 4]. As an example, many of us will shake hands to greet someone without consciously thinking about it and infringe on social distancing guidelines during a pandemic. Verplanken and Wood [9] noted that education and information campaigns (e.g., posted signs, flyers, radio ads) can help, but are not sufficient to change behaviours, especially once they have been established as a habit. Instead, interventions that are specific to the alteration of habits, like disrupting the cues that prompt the habitual behaviour, should be used.

With plans for lifting lockdown restrictions and reopening businesses being discussed, many organisations will face the challenge of making sure all stakeholders adhere to preventive behaviours. Organisations will need to abide by relevant public health recommendations and requirements regarding a safe return to work [e.g., 10], while also addressing issues that are specific to their own physical and organisational context [11]. This will result in a significant number of new behaviours to be adopted by employees, partners, clients, and other stakeholders to reduce the likelihood of the disease being transmitted.

Promisingly, information systems (IS) that are designed to facilitate and motivate people to form, alter, or reinforce attitudes, behaviours, or acts of compliance that are more beneficial for them can address this issue

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[12]. Such systems are known as behaviour change support systems [12]. Moreover, a number of solutions have emerged in the last few months and they include apps promoting social distancing [e.g., 13], increased hand washing [e.g., 14], and reduced face touching [e.g., 15]. While such solutions can be very useful, they are limited in scope and fall short of helping users navigate the often-complex web of rules and guidelines that they need to adhere to within a given environment [16-18]. There are models that can help the design of such systems [e.g., 19, 20]; however, they are not health-specific, nor do they explicitly address habitual behaviours. The health-specific context and the techniques to alter habits should both be considered for more comprehensive solutions to be developed.

Accordingly, our work aims to *derive theory-driven design principles for IS supporting the breaking of established habits and promotion of preventive behaviours.* The goals of such system will be (1) to help users invoke conscious decision making as a means to inhibit the undesired automatic behaviour (e.g., entering an establishment without wearing a mask) and (2) promote the uptake of the desired preventive behaviour (e.g., putting on a mask).

We refer to behaviours that can reduce the likelihood of disease transmission among individuals (e.g., social distancing, wearing a mask, handwashing) as preventive behaviours. Design principles are "statements that prescribe what and how to build an artefact in order to achieve a predefined design goal" [21 p. 4040]. Thus, our design principles are intended for systems designers helping organisations develop IS solutions for their stakeholders to break established habits and adhere to new preventive behaviours for the current and future contexts of large-scale disease outbreaks.

We adopt the design science research approach and literature on theorising design artefacts to derive design principles from kernel theories [22]. Kernel theories are explanatory/predictive theories borrowed from the natural or social sciences to help govern the design requirements of a system [23]. We propose to anchor the design of IS supporting preventive behaviours in two kernel theories: the habit alteration knowledge base [24] and the Health Belief Model [25]. We then derive design principles from these kernel theories and demonstrate its applicability by using an illustrative case that examines IS promoting preventive behaviours for students, faculty, and staff members in a university setting. The contribution of this paper is conceptual in nature and focuses on the rigorous development of design principles that can be used to develop new systems or expand the scope of existing systems for preventive behaviours. The development of such comprehensive solutions will undoubtedly continue to be required in this "new normal".

2. Theoretical background

It is natural for human behaviours to tend towards automaticity as we try to adapt to the environment [26] and nearly half of the behaviours we perform everyday are done automatically as habits [6]. Habits are created to relieve the cognitive stress of having to make a volitional decision towards performing specific behaviours. However, habits can be difficult to change because they bypass conscious decision-making [9]. For this reason, we propose to anchor the design principles in the habit alteration knowledge base and specifically the techniques that can help alter pre-established habits in favour of desired ones. These techniques are widely used in psychological interventions where they have shown their effectiveness [24]. Furthermore, we propose to integrate the Health Belief Model as a kernel theory because it identifies specific factors to address in relation to the individuals' need to believe in prescribed interventions in order to participate in them [27]. The Health Belief Model is key to mitigating user resistance to the habit alteration interventions.

In the following sections we present a brief account of the theoretical background for the two kernel theories and the concepts that are mapped to design principles are shown in bold.

2.1. Habit alteration knowledge base

Habits are behavioural routines carried out automatically given specific cues and are acquired through repetition of the cue-routine association in a stable context [8]. For example, approaching someone you know can act as a cue that triggers a routine behaviour that is a handshake. Through **repetition** of the cue-routine association, the behaviour becomes automatic – no longer requiring intention or motivation to initiate [28].

A number of techniques have been developed in the field of psychology to alter established habits in favour of a more desirable alternative behaviour. To facilitate the discussion, we organised the techniques into four different types: (1) techniques targeting planning activities, (2) those centred around self-monitoring, (3) those aiming to use rewards, and (4) those focused on managing the context of the behaviour.

There are four prominent techniques that target **planning** activities to alter established habits: action planning, coping planning, decomposing the desired behaviour, and stacking behaviours. Action planning requires individuals to specify what goal-directed behaviours will be performed and link them to the situational cues that they should be performed under [29]. Coping planning on the other hand accounts for the barriers that may hinder action plans and is a self-regulation strategy that requires for individuals to form "if-then" statements [30]. Both action and coping planning can help individuals anticipate how they will behave in different situations and environments; hence these activities are conducive to help alter the cue-routine associations of a habit [31]. The third planning technique focuses on decomposing the desired behaviour into a sequence of simple actions – as complex behaviours are less likely to become automatic [32]. The decomposed actions can be used in the fourth planning technique known as stacking behaviours. Stacking allows for the decomposed actions to be positioned at the end of already established behaviours. In this situation, the completion of an already established behaviour will prompt the initiation of the desired action. We are more likely to perform the desired behaviour when it is stacked because our brains are cognitively free after the completion of the preceding behaviour and can easily be triggered by another cue [33].

The second type of techniques stresses **self-monitoring** of the target behaviour. If we are trying to alter an established habit and promote preventive behaviours, then it may be worthwhile to consider using a technique like logging the number of times we successfully avoided the undesired behaviour or engaged in the desired behaviour [34]. Self-monitoring techniques like tracking or recording can be important in disrupting habits because the feedback from these techniques draws attention to when we have reverted back to an undesired behaviour. Self-monitoring also allows individuals to see that they are performing the action in the same manner every time thereby inciting contextual stability, which leads to cue-routine associations. Finally, the results can highlight the progress made towards the overall goal and bring about a sense of accomplishment [35].

The third type of techniques to alter habits integrates the **use of rewards** to help promote repetition of the cue-routine behaviour association [36, 37]. When rewards are integrated, habits start with a cue, that triggers a routine behaviour, in order to achieve a reward. When the reward is perceived as worthwhile, the brain is more likely to notice the cues going forward and repeat the routine. This loop has been popularised in the grey literature by Duhigg [38] as the habit loop. During the early stages, behaviours that are considered satisfying can bolster repetition of the habit loop while ones that prompt negative affect are abandoned [24, 39]. Thus, it is worthwhile to highlight the consequences of the now-undesired behaviour, and the benefits of the now-desired behaviour. A distinction should be made between extrinsic (e.g., financial) and intrinsic (e.g., pleasure) rewards. Extrinsic rewards can initially spur the action [40], but they can lose their effects over time as an expectation for the reward is formed [41]. Thus, it is useful to identify intrinsic rewards that align with people's identity – allowing them to internalise the desired behaviour and repeat it [42].

The last type of techniques aims to **manage the context** of the undesired behaviour to disrupt it while promoting the desired behaviour. Repetition of a routine in a stable context allows for a consistent pairing of the surrounding cues with the routine behaviour [28]. Thus, techniques focusing on disrupting the environmental or social cues that prompt the undesired behaviours can be used to alter a habit [9]. The disruption prompts the conscious decision-making process and may be enough for people to consciously shift towards performing the desired behaviour. Alternatively, by stabilising the context under which the desired behaviour is performed, we can help establish the cue-routine associations.

2.2. Health Belief Model

The core assumption of the Health Belief Model is based on the understanding that a person will change their health behaviour if they feel that a negative health condition can be avoided; have a positive expectation that the target behaviour will reduce the risk of the negative health conditions; and believe that they can successfully carry out the target behaviour [25, 43, 44]. The model has evolved over the years and the latest conceptualisation has the following concepts for individual beliefs, as shown in Figure 1.

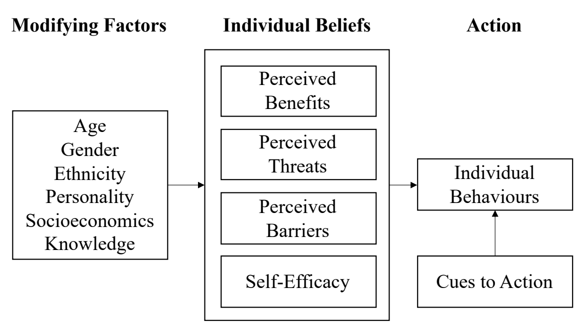

Figure 1. Health Belief Model concepts and their relationships [adapted from 27]

Perceived benefits is a person's belief that the target action will reduce the risk of an adverse health condition. **Perceived threats** is based on a person's perception of the chances they will experience an adverse health condition if they do not change their behaviour (susceptibility) and how serious the condition is (severity) [27]. Third is **perceived barriers** and it refers to a person's opinion about the tangible and psychological costs associated with performing the target action. Finally, **self-efficacy** captures a person's perception of their competence to perform the behaviour [44]. Aside from the four individual beliefs, **cues to action** can activate individual behaviours and can come in the form of internal cues like debilitating pain or an external cue like media publicity. Finally, modifying factors such as age, gender, and ethnicity may influence individual beliefs. These concepts and their relationships thus explain the factors that can influence an individual's health-specific behaviours.

3. Methodology

The overarching aim of this paper is to derive theory-driven design principles for IS supporting the breaking of established habits and promotion of preventive behaviours. As such, we focus on the rigour cycle of design science research [45] as shown in Figure 2. The rigour cycle draws from the habit alteration knowledge base and the Health Belief Model to derive design principles for systems design.

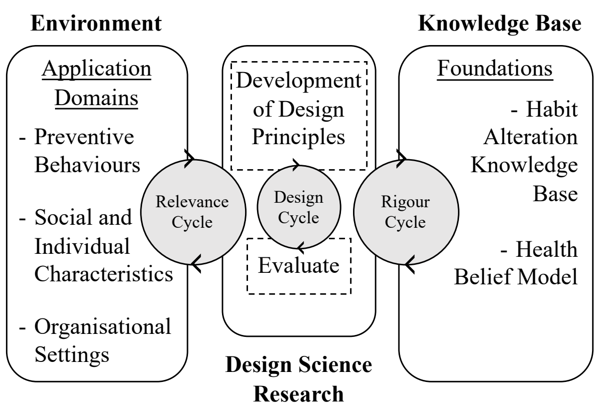

Figure 2. Design science research cycles [adapted from 45]

To complete the rigour cycle, we adopt the Design Science Research Process Model, which has been developed to guide the development of IS artefacts in a manner that also generates new knowledge for a particular class of systems [22]. The process model contains five steps and we discuss how they are addressed in our work below.

The first step calls for awareness of the problem and the problem was derived from literature as presented in the introduction of our paper. There are challenges associated with altering established habits in order to follow preventive behaviours during large scale disease outbreaks.

The second step requires that a suggestion for a tentative design be made. In this research, the suggestion for a tentative design is to anchor the design of systems aiming to break established habits and promote preventive behaviours in two well-known and relevant kernel theories: the habit alteration knowledge base and the Health Belief Model.

The third step focuses on the development of the artefact. In this research, development is achieved through the specification of design principles derived from the selected kernel theories. Design principles are theory-anchored prescriptive knowledge that can guide the development of instantiated artefacts such as systems [21]. In design science research, design principles can act as stand-alone artefacts subject to the same development and evaluation cycles as tangible systems [46]. Thus, the design principles stand as the designed artefact in this research. Specifically, we derived the design principles from the explanatory statements of the selected kernel theories [22]. Explanatory statements provide a cause and effect relationship that can be mapped to prescriptive design knowledge by way of abductive logical reasoning as shown in Figure 3 [22]. All of the explanatory concepts boldened in the theoretical background section were thus mapped to one or more design principles. Some concepts require more than one prescriptive statement and in situations where the prescriptive statements overlap, the concepts were addressed together to avoid repetition.

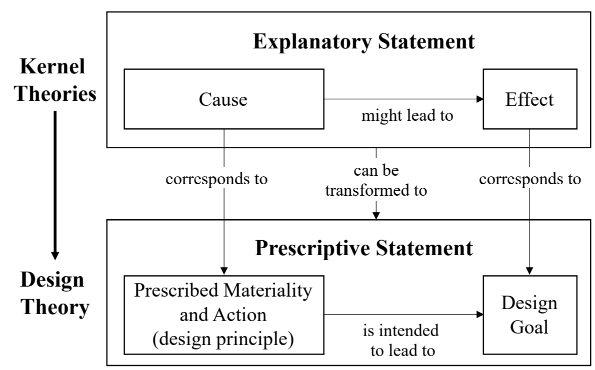

Figure 3. Deriving design principles from kernel theories [adapted from 22]

The fourth step is to evaluate the designed artefact. We address this by using an illustrative case in the context-specific demonstration section of the paper. There can be ambiguity in implementing prescriptive design knowledge and to overcome this challenge, researchers recommend providing rich contextual descriptions of the implementation based on the design principles [47]. Thus, for the evaluation step, we demonstrate the implementation of the design principles using an illustrative case of IS supporting preventive behaviours for students, faculty, and staff returning to a university setting once lockdown restrictions are eased.

The context-specific demonstration will also allow for researchers to trace design decisions back to the proposed design principles and supporting kernel theory concepts, thereby establishing instantiation validity [48].

The fifth and final step of the Design Science Research Process Model is a conclusion, provided at the end of the paper.

4. Design principles

In this section, we present the design principles derived from concepts in the habit alteration knowledge base [24] and the Health Belief Model [25]. Such design principles guide the development of system specific features and functionalities by establishing core design goals for the class of systems [21, 23]. As such, design principles do not embody specific preventive behaviours, but rather focus on the features that a system should provide to facilitate the uptake of preventive behaviours.

For each kernel theory concept, we examined the explanatory cause and effect relationships and asked what prescribed actions from an IS perspective are intended to lead to the goal of the designed system (breaking the established habit and promoting the preventive behaviour). Furthermore, we followed the action and materiality orientation of formulating design principles [21]. This format prescribes what an artefact should enable users to do (action) and how it should be built to achieve the action (materiality).

To demonstrate the mapping process, we take the concept of repetition from the habit alteration knowledge base and its cause and effect relationship. Repetition (cause) of the cue-routine association in a stable context leads to the development of automaticity (effect) for the routine behaviour [28]. Thus, to alter a habit, disruption of repetition (cause) leads to breaking the habitual routine (effect) by way of conscious decision-making. We map this cause and effect to a prescribed action and goal for the system. We propose that the system shall provide features to disrupt repetition of the undesired behaviour (prescribed materiality) in order to invoke this feature when users are about to perform the undesired behaviour (prescribed action). This design principle is intended to lead to breaking the established habit (design goal) by way of conscious decision-making. An example of such feature is the use of sensors to trigger an alarm on a wearable device when someone is about to shake hands to disrupt the automatic behaviour and make users consciously aware of the need to practice preventive behaviours.

This approach led to the derivation of nine design principles. A summary of the mappings from kernel theory concepts to the design principles are shown in Figure 4 and a summary of the design principles and their associated design goals are shown in Table 1. The design principles (DP) state that **the system shall provide features to…**

> ***DP1.*** *Disrupt repetition of the undesired behaviour in order to invoke this feature when users are about to perform the undesired behaviour.*

This design principle is mapped from the concept of repetition leading to automaticity as discussed in the habit alteration knowledge base. A decrease in repetition of a behaviour in a stable context will likely lower the automaticity of the behaviour. Thus, systems aiming to thwart undesired habitual behaviours should have the features to disrupt repetition of undesired established habits when they are about to be performed.

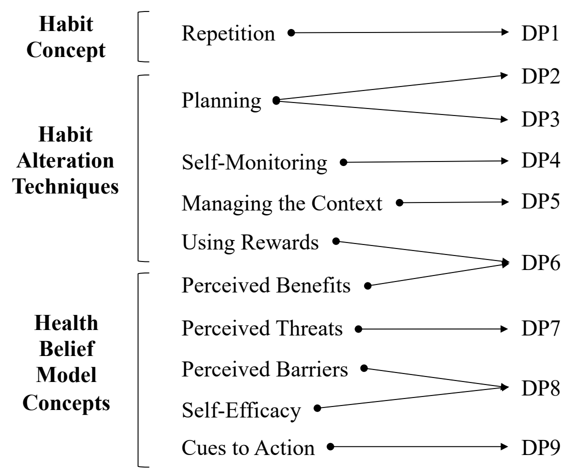

Figure 4. Mapping from kernel theory concepts to design principles (DP)

> ***DP2.*** *Draw recommended preventive behaviours from recognised guidelines in order to communicate the recommended preventive behaviour to users.*

The habit alteration techniques that support planning are mapped to two design principles. The first one (DP2) focuses on what actions are required based on users' capabilities and the situation they are in. Thus, the design principle addresses the concepts of action planning and decomposing by suggesting simplified preventive actions for users in place of their established habits. Furthermore, by recommending actions for different (if-then) situations the design principle addresses coping planning. Such recommendations are drawn from recognised public health guidelines and adapted for users' capabilities and situations.

DP3. Identify when and how to behave in order to communicate when and how to perform the preventive behaviour to users.

The second design principle derived from planning techniques (DP3) links preventive behaviours to cues that help define when and specifies how for a given instance. Systems can achieve this through the use of context-awareness capabilities and associate the preventive actions with context to prompt it. Additionally, systems can refer to public health guidelines stating how actions should be performed and recommend it for users. Thus, action planning, coping planning, and stacking behaviours map to when actions should be performed, while action and coping planning also map to how actions are performed.

DP4. Track preventive behaviours and display progress in order to help users visualise their progress.

This design principle is derived from the self-monitoring technique. It requires systems to provide features allowing users to track and visualise their own preventive behaviours relative to established guidelines. The tracking feature can focus on the number of times users perform the undesired behaviour to motivate users to improve their adherence to preventive behaviours. Alternatively, tracking can also focus on users' adherence to preventive behaviours as a form of reward.

DP5. Be aware of the context in order to stabilise or disrupt the context for users.

A change in the environmental or social context in which the habitual behaviour is performed can disrupt an automatic process, while stabilising the context for preventive behaviours can help promote them. The fifth design principle is derived from this concept and we propose for systems to have the capabilities to identify the context and make recommendations that can change or stabilise the context for users. Beyond simply making a recommendation, systems can also autonomously alter the social or environmental context for users. As an example, the system may turn on the bathroom light when users come home as a form of changing the environmental context such that it prompts users to go to the bathroom and wash their hands.

DP6. Seek out new rewards in order to help identify and provide rewards that consistently bring satisfaction for users.

This design principle is derived from two concepts: techniques for using rewards to drive the habit loop and perceived benefits. These two concepts overlap conceptually because both require positive aspects of performing preventive behaviours to be defined. By constantly seeking out new rewards that bring about satisfaction for users, the system can facilitate uptake of the preventive behaviour. By having this feature, systems may also help overcome desensitisation to the satisfaction of rewards over time.

Table 1. Summary of design principles and their intended design goals

	Materiality	**Action**	**Design Goals**
	The system shall provide features to…	**In order to…**	**This design principle is intended to lead to…**
1	Disrupt repetition of the undesired behaviour	Invoke this feature when users are about to perform the undesired behaviour	Breaking the habit
2	Draw recommended preventive behaviours from recognised guidelines	Communicate the recommended preventive behaviour to users	Promoting the preventive behaviour
3	Identify when and how to behave	Communicate when and how to perform the preventive behaviour to users	Promoting the preventive behaviour
4	Track preventive behaviours and display progress	Help users visualise their progress	Promoting the preventive behaviour
5	Be aware of the context	Stabilise or disrupt the context for users	Breaking the habit Promoting the preventive behaviour
6	Seek out new rewards	Help identify and provide rewards that consistently bring satisfaction for users	Promoting the preventive behaviour
7	Identify personalised risks and consequences	Make users aware of the risks and consequences that are specific to their situation	Breaking the habit Promoting the preventive behaviour
8	Demonstrate and teach the preventive behaviour	Educate users on how to overcome the barriers that may prevent them from performing the desired behaviour	Promoting the preventive behaviour
9	Alert users of when preventive behaviours should be practiced	Alert users when needed	Breaking the habit Promoting the preventive behaviour

DP7. Identify personalised risks and consequences in order to make users aware of the risks and consequences that are specific to their situation.

The concept of perceived threat is a combination of users' perceived susceptibility and perceived severity as defined in the kernel theory. Thus, the system should specify the risk users face (susceptibility), the risk they pose to others, and the consequences (severity) associated with these risks based on their individual profile. Systems can identify this information by referring to public health guidelines related to specific population groups. Through this design feature, users' perception of threats may be influenced more than by generic threats.

***DP8.** Demonstrate and teach the preventive behaviour in order to educate users on how to overcome the barriers that may prevent them from performing the desired behaviour.*

The concepts of perceived barriers and self-efficacy from the Heath Belief Model both map to this design principle because they overlap conceptually. We propose for systems to provide training and guidance based on recognised health guidelines to promote the preventive behaviour. Through this educational approach, users can overcome psychological barriers and increase their self-belief that they are capable of performing the preventive behaviour.

***DP9.** Alert users of when preventive behaviours should be practiced in order to alert users when needed.*

The last design principle is derived from the concept of cues to action. The cues being referred to in this concept are events emphasising the need for preventive behaviours (e.g., declaration of a pandemic), not cues that act as a trigger for automatic behaviours as discussed in the habit alteration literature. Thus, this design principle focuses on the need for systems to alert users that preventive behaviours should be practiced at a given time. While such cues are likely to come from users' environments prior to system use, for example through media outlets, they need to be reinforced through the system.

5. Context-specific demonstration

To demonstrate how the design principles can be implemented, we present an illustrative case similar to the approach used by Müller-Wienbergen et al. [49]. The case follows a third-year university student, by the name of Casey, returning to campus after her university has resumed in-person classes. As part of her university's reopening policies, strict social distancing behaviours among other preventive behaviours will be required on campus. Social distancing, also known as physical distancing, is an action taken to minimise contact with other individuals in order to reduce disease transmissions [50]. The university has developed a mobile application, named "SafeCampus", that can be connected to users' wearable devices to help students, faculty, and staff adopt and adhere to the new social distancing policies and other preventive behaviours.

Prior to arriving on campus, Casey checks her class schedule on the university website and learns that the university highly recommends the SafeCampus app for any students returning to campus. Casey installs the app on her mobile phone and is alerted by the app that the university has imposed strict social distancing policies on campus (DP9), and she remembers reading about this in a university sent email.

To help with adherence to the new preventive behaviours, SafeCampus specifies a personalised risk profile for Casey based on information in the university's student database and additional information provided by Casey. Casey is 21 years old, has no prior health conditions, but lives at home with her grandparents who are in their 70s, including her grandfather who has diabetes type II. Using this information, the system specifies the threat that others pose to Casey (medium – young and healthy) and the threat that Casey poses to others (high – living with her grandparents) based on recognised health guidelines and at-risk profiles set out by the local municipality (DP7).

Casey has always enjoyed the social atmosphere at school and is excited to see her friends again after the extended summer break. Thus, SafeCampus offers a short questionnaire for Casey to answer to better understand what rewards bring her satisfaction. Through the questionnaire, the system identifies that Casey is a social learner and suggests that benefits for her include the opportunity for face-to-face learning and the sense of belonging to a community. Casey agrees and also realises that preventive behaviours will keep her family safe (DP6).

Nevertheless, Casey feels that the new changes and policies are overwhelming because she has a full course load and a new job on campus to worry about. Thus, SafeCampus provides instructional videos created by other students working on campus to share their stories of how they plan to get through the semester (DP8).

Once Casey arrives on campus, she encounters a friend that she has not seen for a few months and goes in for a hug. Through Bluetooth-enabled sensors, SafeCampus detects that Casey is within two metres of her friend and triggers a vibration on her wearable device to disrupt the habit of hugging (DP1).

As lunch time arrives, SafeCampus proceeds to support Casey in devising a plan for how to practice preventive behaviours while she is in the cafeteria. SafeCampus recommends that she maintains a two-metre distance, wipes down the table, and sanitises her hands before eating as these are public health guidelines, they suit Casey's capabilities, and apply to the dining situation (DP2). The system also recommends for Casey to have lunch at 1:30 p.m. as there is less traffic at that time and it fits her schedule (DP3). To help Casey plan how she will perform such preventive behaviours, the system displays a map of the cafeteria with one-way traffic flow, the location of sanitisation stations, and a menu for the day (DP3).

After lunch, Casey has to head to her next class and usually takes a path that is quite busy and will likely violate social distancing guidelines. Appropriately, SafeCampus recognises through sensors that the usual route to her next class is too busy at this time of day and recommends an alternative route for her with lower traffic volumes (DP5). By suggesting a different route, SafeCampus is recommending a change to the environmental context that could otherwise prompt Casey to violate social distancing guidelines.

Casey's successful social distancing behaviours throughout the day are tracked by the system using sensors and visualised on a dashboard that she can access (DP4). The dashboard shows that she has successfully maintained her distance from others for the past two hours and has washed her hands four times.

6. Discussion

As the current COVID-19 pandemic develops organisations are starting to recognise the potential that technologies have to facilitate the uptake and adherence to preventive behaviours, as seen in emerging solutions. Such solutions can help organisations promote preventive behaviours for their stakeholders once in-person business resumes. The nine design principles we derived act as a form of prescriptive knowledge that can guide organisations to effectively develop systems that can harness the potential of behaviour change support systems in this situation. Furthermore, the principles address the calls for improvement in current solutions by providing a more comprehensive approach [16-18] that integrates theory grounded features.

Our theory-anchored design principles can be used in parallel with the existing behaviour change support systems knowledge base. For example, the Persuasive Systems Design model outlines seven postulates of persuasive systems, details the contextual factors to consider as a designer, and provides features that are known to persuade users [19]; however, it does not take into account the unique contextual factors of breaking habits during a pandemic. The same can be said for the 28 propositions for designing ePsychology interventions [20]. Thus, our contribution seeks to address the limitations of existing approaches and theories by guiding practitioners on which features to select, when they should be delivered, and how they should be delivered for preventive behaviours.

Within the wider body of literature on health behaviour change support systems, interest in designing specifically for habit alteration is growing. Recently published studies have demonstrated the potential that IS have in altering habits [e.g., 51, 52]. For instance, Karppinen et al. [51] demonstrated how a web-based behaviour change support system developed following the Persuasive Systems Design model can help break unwanted habits and foster a healthier lifestyle. Our contributions extend this notion by providing actionable recommendations that are specific to preventive behaviours. In doing so, we also address an issue commonly raised about the lack of transparency in translating behaviour change theories to design decisions [53]. By transparently anchoring design principles in kernel theories, we can justify why certain features are selected for a comprehensive solution while increasing the credibility of the principles for practitioners.

Nevertheless, this research is limited in terms of validation and instantiation. In terms of validation, the applicability [54] and actionability [55] of the proposed design principles remain to be validated. We demonstrated the applicability using an illustrative case, but further research should empirically validate the proposed principles. Finally, there is a need to instantiate the design principles in different contexts to assess their generalisability. It is important to ensure that solutions derived from the design principles can support the breaking of established habits and promotion of preventive behaviours.

7. Conclusion

We adopt the design science research approach [21, 22] to derive design principles for IS supporting the breaking of established habits and promotion of preventive behaviours. The design principles are anchored in the habit alteration knowledge base and the Health Belief Model. Thus, they can be used to design new systems or expand the scope of existing systems to provide a comprehensive approach for users. The contributions extend the current knowledge on the design of IS to support behaviour change by introducing prescriptive knowledge for breaking habits and situate it within the preventive behaviour context. From the practical perspective, the contributions can guide organisations to develop effective IS solutions to help their stakeholders adopt and adhere to preventive behaviours.

8. Acknowledgements

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