

# Designing engaging online behaviour change interventions: A proposed model of user engagement

**Camille E. Short**

University of Adelaide

Central Queensland

University

**Amanda L. Rebar**

Central Queensland

University

**Ronald C.  
Plotnikoff**

University of Newcastle

**Corneel**

**Vandelanotte**

Central Queensland

University

## Background

The potential of online behaviour change interventions for improving public health in both a primary and tertiary prevention setting is well recognised (Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012; Kuijpers, Groen, Aaronson, & van Harten, 2013). Due to this, and the growing popularity of the

Internet, the last decade has seen a substantial increase in the number of online behaviour change interventions developed and evaluated. Several well-conducted systematic reviews and meta-analyses have synthesised the literature regarding this research, providing insight into the effectiveness of these interventions, as well as the factors associated with intervention success (e.g., Brouwer et al., 2011; Davies et al., 2012; Kuijpers et al., 2013; Webb, Joseph, Yardley & Michie, 2010). In general, these reviews have shown that online interventions can be effective (albeit effect sizes are in general small), and that effectiveness is mediated by factors related to health behaviour change (e.g., the use of behaviour change theory and the type and number of behaviour change techniques employed) as well as intervention characteristics related to user engagement in the intervention (e.g., whether intervention content is tailored to match individual characteristics, website interactivity, frequency of website updates and reminders and the use of supplementary delivery

modes).

Engagement in this context refers to a quality of user experience, characterised by increased attention, positive affect, sensory and intellectual satisfaction and mastery (O'Brien & Toms, 2008). Whilst there have been calls as early as 2009 (Ritterband & Tate, 2009) to consider determinants of user engagement when designing online interventions, very few studies have incorporated this into their conceptual framework. Rather, the development of online interventions has been guided predominantly by theories of behaviour change, which focus on the psychosocial determinants of behaviour (e.g., self-efficacy, intentions). Theories offering insight into how to foster user engagement in online interventions have been largely ignored, an oversight which may explain why issues with user engagement, such as low use of intervention features, few logins, and poor retention rates are consistently reported in the literature (Davies et al., 2012; Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012).

A notable exception is research investigating the efficacy of computer-tailored interventions. Computer-tailoring is a technique that utilises expert-system technology and individual assessments to provide individuals with customised health behaviour advice and feedback via an automated process (Kreuter, Farrell, & Olevitch, 2000). The Elaboration Likelihood Model (ELM; Petty, Barden, & Wheeler, 2009), an information processing theory, is often cited as the theoretical rationale for computer-tailoring (Kreuter et al., 2000; Short, James, & Plotnikoff, 2013). According to the ELM, people process information elaborately (i.e., in an active and deliberate manner) if they are motivated and have the resources (e.g., time), tendency and capabilities

to do so. Otherwise, information is processed with little or no consideration of central information and attitudes are formed or reinforced based on simple periphery cues (e.g., number of arguments made, credibility of the source) and heuristics (e.g., presumptions that experts are generally correct) rather than thoughtful consideration of the message content. Information processed in either way can lead to persuasion, however for long-lasting effects, thoughtful processing of the message is necessary (Petty et al., 2009). In a behaviour change context, this means that intervention strategies that increase an individual's motivation, tendency and ability to elaborately process intervention content are more likely to result in actual and sustained attitudinal changes (Petty et al., 2009). According to the ELM, a key factor that influences motivation to process information elaborately is the perceived personal relevance of the message (Petty et al., 2009). Whereby, motivation is heightened when the message is perceived as personally relevant. Since computer-tailored interventions provide customised advice, likely to be perceived as personally relevant, pioneers in this technique asserted that individual's receiving computer-tailored interventions would be more motivated to process them elaborately than if they received a generic 'one size-fits all' intervention.

Previous evaluations of computer-tailored interventions have provided support for this, showing that computer-tailored intervention materials are more likely to be read, remembered, discussed, and perceived by the reader as interesting compared to non-tailored (i.e. generic) intervention materials (Kreuter et al., 2000). Furthermore, personal relevance has been found to enhance the persuasiveness of messages when perceived personal relevance is high (Dijkstra & Ballast, 2012) and at least partially mediate intervention effects on behaviour (Oenema, Tan, & Brug, 2005; Jensen, King, Carcioppolo & Davis, 2012).

Taken together, these studies support the notion that intervention techniques directed at influencing user engagement have an impact on intervention

efficacy and should therefore be considered when designing and evaluating online interventions. In line with best practice, these factors should be considered within a conceptual framework that is both evidence-based and guided by theory (Michie, Johnston, Francis, Hardeman & Eccles, 2008). While this has been done to some extent in computer-tailoring studies, it should be noted that even in these studies the ELM has not been operationalized in full. Other factors thought to impact on whether information is processed elaborately, such as an individual's resources (e.g., time), tendency and capability to process information have not yet been considered. Nor have factors that may influence motivation (e.g., expectations and goals of the program) or the role of peripheral cues (e.g., aesthetic appeal) that may help to enhance engagement in the initial stages of the intervention. The purpose of this paper is to propose a new model that can be used to guide the consideration of these factors when developing and evaluating online behaviour change interventions.

## Model of user engagement in online interventions

Research stemming from multiple disciplines, including social psychology, information science and marketing, suggests that factors relating to the individual's environment, the individual and the intervention interact to influence how users engage with the intervention program and how persuasive it is (Petty, Wheeler & Tormala, 2003; O'Brien & Toms, 2008; Petty et al., 2009; Ritterband & Tate, 2009; Kelders et al., 2012; Short et al., 2014; Crutzen, Ruiters & de Vries, 2014). Our model based on this research is presented in Figure 1. The pathways of influence depicted for each hypothesised determinant of user engagement are based on information drawn from existing models, including the ELM (Petty et al., 2009), O'Brien and Toms' conceptual model of user engagement with technology (O'Brien & Toms, 2008),

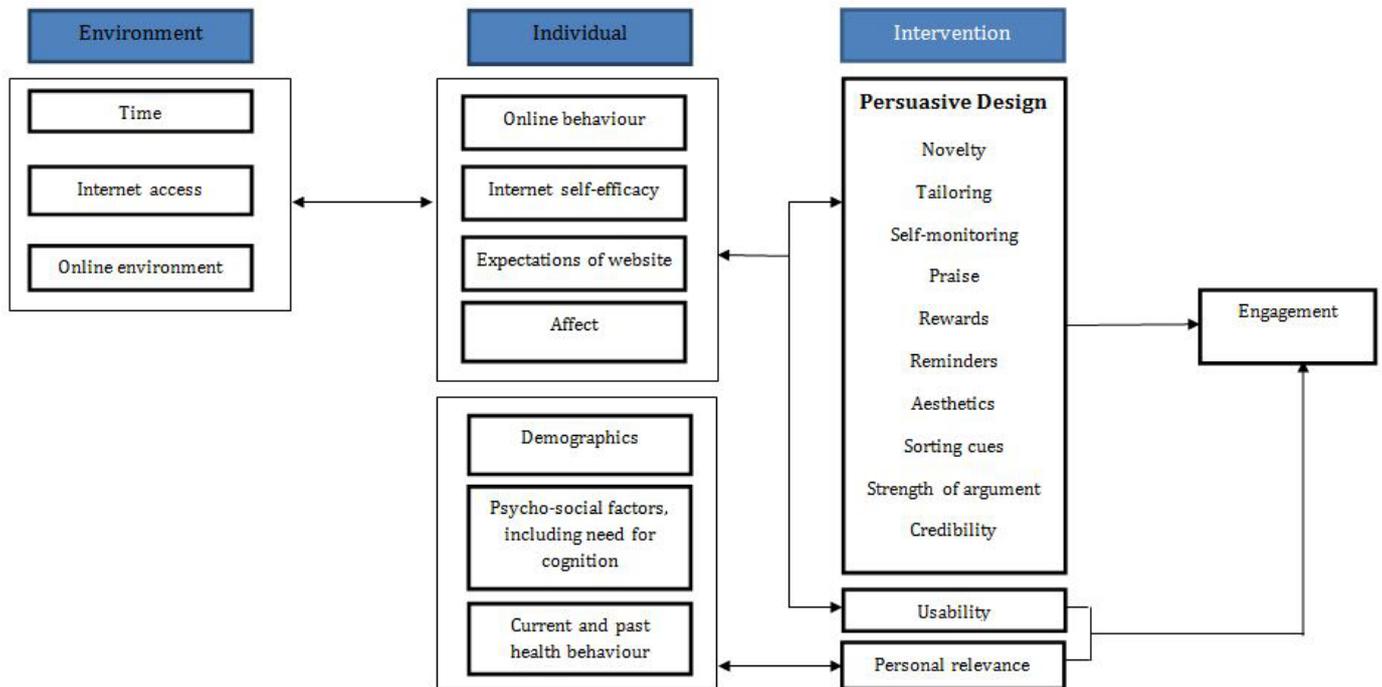


Figure 1. Model of user engagement in online interventions.

Ritterband and Tate's (2009) model of internet interventions, as well as the Persuasive Systems Design Model (Oinas-Kukkonen & Harjumaa, 2009) as applied by Kelders and colleagues (Kelders et al., 2012).

In this model, the environment is composed of external factors that impede or facilitate intervention use, such as the length of time available to the user and the user's access to the Internet. The online environment, relating to the tone, feel and function of what is currently accessible online, also fits within this domain. These environmental determinants influence engagement indirectly by shaping a user's expectations of the intervention, internet self-efficacy and internet behaviour, which in turn influences the user's perception of intervention usability and how persuasive it is to them (Ritterband et al., 2009).

The user's individual characteristics are related to perceived personal relevance of the intervention, the

tendency to process information elaborately (need for cognition), user expectations and the perceived usability of the intervention (Crutzen et al., 2014; O'Brien & Toms, 2008; Petty et al., 2003; Petty et al., 2009). When intervention content is matched to the user's demographic, psychosocial and behavioural characteristics the intervention content is perceived as personally relevant by the user, who is then motivated to consider the intervention content elaborately and engage in the intervention (Petty et al., 2003; Petty et al., 2009). Increased motivation to engage in the intervention also occurs when intervention content and the way information is presented is matched to the participants need for cognition (i.e., the extent to which people enjoy in depth thinking) and encourages a positive affect. For individuals with low need for cognition, the presence of motivating periphery cues (e.g., several arguments presented, the website is published by a credible source) and information presented in an accessible

and visual manner (e.g., via video or graphics) is likely to initiate engagement in the intervention. For individuals with a high need for cognition, in depth information that can be read at the users' own pace may be more appreciated (Petty et al., 2003; Petty et al., 2009). Disengagement can be motivated by the experience of negative emotions, resulting from incongruence between the user's expectations of the website and the website itself (Crutzen et al., 2014) or the intervention being perceived as irrelevant, cumbersome (i.e. low usability) or unlikely to be effective in terms of the user's personal goals (O'Brien & Toms, 2008). Importantly, disengagement in the intervention can also occur due to the experience of positive emotions, such as satisfaction with the program due to the achievement of personal goals (O'Brien & Toms, 2008).

Intervention features, such as the aesthetics, interactivity, intended frequency of use, delivery mode of intervention content (e.g., video or text) and the content itself, exert a strong influence on user engagement. Engagement is most likely to be initiated when the intervention is perceived as relevant, novel, and aesthetically appealing. Sustained engagement is likely when the intervention proves usable and offers ongoing learning and interacting opportunities that are relevant and motivating to the user (O'Brien & Toms, 2008). This can be achieved using persuasive design features, such as interaction with a counsellor and by frequently updating content (Kelders et al., 2012). Disengagement occurs when the user experiences negative emotions relating to intervention features, such as frustration or boredom.

Importantly, these factors operate within a feedback loop, whereby they influence each other and engagement reciprocally (Figure 1).

## Operationalization of the proposed model alongside health behaviour change theory

The proposed model is congruent with current psycho-social and ecological models of health behaviour change. As in these models, multiple and interacting levels of influence on the individual are recognised, including individual, social and environmental factors. Indeed, intervention developers may wish to utilise health behaviour change models to determine which psycho-social and environmental factors may be important to consider in the context of engagement as well as behaviour change. Overall, these models can be operationalised alongside each other to inform a more comprehensive approach to intervention development. That is, one that focuses not only on what psychosocial and ecological factors to target in order to influence behaviour, but on how these factors are likely to influence engagement and which intervention features are likely to be effective in the target population. As is recommended for the operationalization of behaviour change theory, the proposed model should be operationalised by mapping the proposed determinants of engagement to intervention strategies, preferably with known efficacy (Michie, Fixsen, Grimshaw & Eccles, 2009). To inform this process, experimental studies focusing on the impact of intervention strategies on determinants of user engagement and engagement itself are needed (Crutzen et al., 2014). While little work has been done in this area within the behaviour change field, there are some notable exceptions. For example, Crutzen and colleagues (2014) have recently conducted experiments investigating user perceptions as determinants of engagement in online interventions. These studies show that altering the users affect (by arousing interest) is a promising intervention strategy for enhancing engagement in online interventions and provide important insights into how to manipulate intervention features to

achieve this aim.

## Implications for Future research

Overall, the presented model suggests that online interventions are likely to be most engaging when they are well matched to the user's characteristics (demographics, behaviour, psycho-social profile), needs (need for cognition), skill level (internet self-efficacy) and expectations (related to goals and previous internet experience). The use of persuasive design characteristics helps to sustain engagement, especially when techniques promote patterns of use that reflect the users' available resources (in terms of time and internet access), meet or exceed the users' expectations for the program, and create a positive user experience.

While this model may be an oversimplification of the processes involved with engagement in online interventions (Ritterband et al., 2009), it provides a useful foundation to help intervention developers identify and map their assumptions about how the intervention will work against each of the model's domains. In doing so, intervention developers can identify which environmental, individual and intervention features related to engagement have not yet been considered, and which should be addressed, examined and measured in the context of their intervention.

As the model is utilised and tested by researchers in the future, it can be adapted to better explain and predict engagement in online interventions. To this end, key steps for future research are to test whether the relationship between the proposed determinants and engagement are causal, if the determinants interact with each other as suggested and what moderating and/or mediating effects these determinants have on behaviour change. This will need to be done with the same rigor that is applied for tests of behaviour change theory. This means that experimental designs must allow for causal inferences, reliable and valid measures must be used

to assess both determinants and outcomes, and clear links between the determinants of engagement targeted and the techniques selected to address them must be made (Michie et al., 2009). Furthermore, in accordance with Crutzen and colleagues (2014), we agree that experimental studies examining the impact of specific intervention features on user engagement is an essential next step for building 'a science of user engagement' in our field.

## Conclusion

Evidence from systematic reviews and meta-analyses suggests that the effectiveness of online interventions is mediated by factors associated with user engagement in interventions and psychosocial health behaviour change determinants. However, current intervention approaches strongly focus on influencing determinants of health behaviour change and fail to address determinants of engagement. This is due to a reliance on behaviour change theories to guide the development and evaluation of online interventions, which provide little or no insight into how to deliver intervention content in an engaging way. If we are to fully understand the active mechanisms of online interventions, future studies need to consider both sets of determinants and their interactive effects. The model presented in this paper can be operationalised alongside behaviour change theory to help guide this research.

## References

- Brouwer, W., Kroeze, W., Crutzen, R., de Nooijer, J., de Vries, N. K., Brug, J., & Oenema, A. (2011). Which intervention characteristics are related to more exposure to Internet-delivered healthy lifestyle promotion interventions? A systematic review. *Journal of Medical Internet Research*, *13*(1), e2. doi:10.2196/jmir.1639
- Crutzen, R. (2014). The Behavioral Intervention

- Technology Model and Intervention Mapping: The best of both worlds. *Journal of Medical Internet Research*, 16(8), e188. doi:10.2196/jmir.3620
- Crutzen, R., Ruiter, R. A. C., & de Vries, N. K. (2014). Can interest and enjoyment help to increase use of Internet-delivered interventions? *Psychology & Health*, 29(11), 1227-1244. doi:10.1080/08870446.2014.921300
- Davies, C., Spence, J., Vandelanotte, C., Caperchione, C., & Mummery, W. (2012). Meta-analysis of internet-delivered interventions to increase physical activity levels. *International Journal of Behavioral Nutrition and Physical Activity*, 9(1), 52. doi:10.1186/1479-5868-9-52
- Dijkstra, A., & Ballast, K. (2012). Personalization and perceived personal relevance in computer-tailored persuasion in smoking cessation. *British Journal of Health Psychology*, 17(1), 60-73. doi:10.1111/j.2044-8287.2011.02029.x
- Jensen, J. D., King, A. J., Carcioppolo, N., & Davis, L. (2012). Why are tailored messages more effective? A multiple mediation analysis of a breast cancer screening intervention. *Journal of Communication*, 62(5), 851-868. doi:10.1111/j.1460-2466.2012.01668.x
- Joseph, R. P., Durant, N. H., Benitez, T. J., & Pekmezi, D. W. (2014). Internet-based physical activity interventions. *American Journal of Lifestyle Medicine*, 8(1), 42-68. doi:10.1177/1559827613498059
- Kelders, S. M., Kok, R. N., Ossebaard, H. C., & Van Gemert-Pijnen, J. E. (2012). Persuasive system design does matter: A systematic review of adherence to web-based interventions. *Journal of Medical Internet Research*, 14(6), e152. doi:10.2196/jmir.2104
- Kreuter, M., Farrell, D., Olevitch L., & L. Brennan (2000). *Tailoring health messages: Customizing communication with computer technology*. Mahwah, New Jersey: Lawrence Erlbaum Associates
- Kuijpers, W., Groen, W. G., Aaronson, N. K., & van Harten, W. H. (2013). A systematic review of web-based interventions for patient empowerment and physical activity in chronic diseases: Relevance for cancer survivors. *Journal of Medical Internet Research*, 15(2), e37. doi:10.2196/jmir.2281
- Michie, S., Fixsen, D., Grimshaw, J., & Eccles, M. (2009). Specifying and reporting complex behaviour change interventions: The need for a scientific method. *Implementation Science*, 4(1), 40. doi:10.1186/1748-5908-4-40
- Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: Mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology*, 57(4), 660-680. doi:10.1111/j.1464-0597.2008.00341.x
- O'Brien, H. L., & Toms, E. G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. *Journal of The American Society for Information Science and Technology*, 59(6), 938-955. doi:10.1002/asi.v59:6
- Oenema, A., Tan, F., & Brug, J. (2005). Short-term efficacy of a web-based computer-tailored nutrition intervention: Main Effects and Mediators. *Annals of Behavioral Medicine*, 29(1), 54-63. doi:10.1207/s15324796abm2901\_8
- Oinas-Kukkonen H & Harjumaa M. (2009). Persuasive Systems Design: Key Issues, Process Model, and System Features. *Communication of the Association for Information System*, 24, 28. Retrieved from <http://aisel.aisnet.org/cais/vol24/iss1/28>
- Petty, R. E., Barden, J., & Wheeler, S. C. (2009). The elaboration likelihood model of persuasion: Health prompts that yield sustainable behavioral change. In R. J. DiClemente, R. A. Crosby, & M. C. Kegler (Eds), *Emerging theories in health promotion practice and research* (pp. 185-214). San Francisco: Josey-Bass.
- Petty, R. E., S. C. Wheeler and Z. L. Tormala (2003). Persuasion and attitude change. In T. Mellon, & M. J. Learner (Eds), *Handbook of psychology: Vol. 5: Personality and social psychology* (pp.282-353). Hoboken, NJ: Wiley.
- Ritterband, L. M., & Tate, D. F. (2009). The science of internet interventions. *Annals of Behavioral Medicine*, 38(1), 1-3. doi:10.1007/s12160-009-9132-5

Short, C. E., James, E. L., & Plotnikoff, R. C. (2013). Theory-and evidence-based development and process evaluation of the Move More for Life program: A tailored-print intervention designed to promote physical activity among post-treatment breast cancer survivors. *International Journal of Behavioral Nutrition and Physical Activity*, *10*, 124. doi:10.1186/1479-5868-10-124



Camille E. Short is a National Health and Medical Research Early Career Fellow at the School of Medicine, University of Adelaide, Australia  
camille.short@adelaide.edu.au

Short, C. E., Vandelanotte, C., Dixon, M. W., Rosenkranz, R., Caperchione, C., Hooker, C., . . . Duncan, M. J. (2014). Examining participant engagement in an information technology-based physical activity and nutrition intervention for men: the manup randomized controlled trial. *JMIR Research Protocols*, *3*(1), e2. doi:10.2196/resprot.2776



Amanda L. Rebar is a Post-Doctoral Research Fellow at the School of Human, Health, and Social Sciences Central Queensland University, Rockhampton, Australia  
a.rebar@cqu.edu.au

Webb, T. L., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research*, *12*(1), e4. doi: 10.2196/jmir.1376



Ronald C. Plotnikoff Professor and founding director of the Priority Research Centre for Physical Activity and Nutrition, University of Newcastle, Newcastle, Australia  
Ron.plotnikoff@newcastle.edu.au



Corneel Vandelanotte is an Associate Professor at the School of Human, Health, and Social Sciences, Central Queensland University, Rockhampton, Australia  
c.vandelanotte@cqu.edu.au