Towards the usage of persuasive strategies in a virtual sleep coach

Corine Horsch[1], Willem-Paul Brinkman[1], Rogier van Eijk,[2] Mark Neerincx[13]
[1]Delft University of Technology, [2]Utrecht University, [3]TNO Human Factor Soesterberg
{c.h.g.horsch, w.p.brinkman, m.a.neerincx}@tudelft.nl {r.m.vaneijk}@uu.nl

Smart phones could become a great support technology for several behavioural therapies. In order to support target behaviour whenever the therapist is not available, build-in persuasive strategies can motivate users to adhere to their therapy. Several scholars have described persuasive strategies and how to implement them in different degrees. This paper gives an overview of the most important persuasive strategies and maps them on Cognitive Behaviour Therapy for Insomnia principles to derive some first high-level requirements of a virtual sleep coach.

Persuasive technology. Virtual sleep coach. Mental health computing.

1. INTRODUCTION

The functionalities of smart phones and how they are used in daily life provide all kind of opportunities in mental healthcare. Especially during the time therapists are not there with their patients, behaviour change can be difficult to accomplish.

People with insomnia could benefit from Cognitive Behaviour Therapy for Insomnia (CBT-I). Four main behavioural treatments within CBT-I are: sleep hygiene, relaxation training, sleep restriction, and stimulus control (Bemmel, Beersma, Groen, Hofman, 2001). *Sleep hygiene* encompasses creating a comfortable, inviting bedroom (clean, dark, pleasant temperature, silent etc.) and taking into account the effects of caffeine intake, exercising, alcohol etc. on sleep. *Relaxation training* consists of different exercises to relax body and mind. *Sleep restriction* adapts the amount of time spend in bed to the actual sleep time. So, if a coachee (the person who follows the therapy) sleeps on average five hours a night, the coachee is only allowed to spend five hours in bed. When sleep efficiency (actual sleeping time divided by time in bed) starts increasing, coachees are allowed to lengthen their time in bed. This treatment increases sleep deprivation and eventually lead to better and longer nights. *Stimulus control* prescribes that coachees need to get out of bed when they are awake in their bed for more than 20 minutes in order to learn to associate the bed with sleep. Imagine, the coachees' beds are warm and cosy and they have to get out to the dark, cold, boring living room while the coachees are grumpy and tired. This might be difficult to accomplish. Besides these four behavioural treatments, cognitive therapy deals with dysfunctional beliefs about sleep and sleep education. The bases for cognitive therapy are a sleep diary in which sleep patterns are recorded and questionnaires to detect the existing dysbeliefs of the coachee (Bemmel, Beersma, Groen, Hofman, 2001). Lastly, the relationship between the coach and coachee has been hypothesized to be a key component for successful behaviour changes (Bickmore, & Picard, 2005).

A virtual sleep coach might be a helpful support tool for CBT-I. Smart phones are there at the right time; when people need to get out of bed or get in bed. A possible first step for a virtual sleep coach to become effective in supporting behaviour change might be to build in some persuasive strategies. Therefore, this paper investigates to what extent it is possible to contrive some first ideas about how to apply persuasive strategies in a virtual sleep coach.

2. PERSUASIVE STRATEGIES

Fogg (2003) defines persuasion as *an attempt to change attitudes or behaviours or both (without using coercion or deception)* (Fogg, 2003, p.15). Fogg can be seen as one of the 'founders' of the persuasive technology field and in his book he identified fifteen persuasion strategies suitable for computers (Fogg, 2003). His research is rather comprehensive and has been (partly) worked out in numerous research and development projects (e.g., Connelly et al., 2006).

2.1 The first basic persuasive strategies

Persuasive strategies can be categorized along 'the functional triad' which is based on how a technology is functioning (Fogg, 2003).

Table 1: *Persuasive strategies defined by Fogg (2003) and related examples for our envisioned virtual sleep coach*
HE=sleep hygiene and education, RX=relaxation, SR=sleep restriction, SC=stimulus control, C=cognitive therapy,
RCC= relationship coach-coachee

Technology as a tool

Persuasive strategy	Potential ways of applying the persuasive strategies in the sleep domain	CBT-I part
Reduction (Simplifying)	*By giving a format for a sleeping diary it is simpler to fill it out, the benefit/cost ratio for coachees increases*	*SR, SC*
Tunnelling (Guidance through a process)	*The coach can guide the coachee through calming down at the end of the day step-by-step, e.g. turn off the TV, read some pages in a book, put on your pyjamas, brush your teeth, lie in your bed*	*RX*
Tailoring (Personalisation)	*The treatments, like wake up time, or a specific relaxation exercise are tailored to the coachee*	*SR, RX*
Suggestion (Intervene at right time)	*An alarm to indicate bedtime and wake up time is given at the right time*	*SR*
Self-monitoring (Track coachee)	*From the sleep diary averages are calculated so the coachees can monitor how well they are performing*	*SR*
Surveillance (Be observed by others)	*Sleep measures (e.g. bed time, sleep efficiency, wake up time) are shared with a therapist*	*SR*
Conditioning (Reinforcing behaviour)	*The virtual coach rewards the coachee when the sleep diary is filled out e.g. with a compliment*	*SR, SC*

Technology as social actor

Persuasive strategy	Potential ways of applying the persuasive strategies in the sleep domain	CBT-I part
Physical cues (Looks of coach)	*The virtual coach should suit the coachee. So the coachee might choose between different characters. Two options could be: a female or a male coach*	*RCC*
Psychological cues (Personality of coach)	*The coach can for example display a dominant or submissive personality style*	*RCC*
Language cues (How something is communicated)	*The coach could give feedback on sleep efficiency by saying: you almost reached the sleep efficiency goal of 85%, good job! About the same event the coach could also say: you only accomplished a sleep efficiency of 75%, this is not enough.*	*SR*
Social dynamics (Unwritten rules of interacting with others)	*The coach can use reciprocity to persuade the coachee to adhere to a treatment. For example, [bed partner] has helped you to stick to your bedtimes by going to bed at the same time as you, do your relaxation exercise to increase the chance of sleep, so you both can go to bed earlier next week.*	*SR*
Social roles (Impersonalisation)	*The coach can have multiple roles and characters, for example one motivator for motivational support and a sleep therapist as authority to teach the coachee about sleep and sleep hygiene*	*HE*

The functional triad distinguishes three technology functions: technology as a tool, medium, or social actor, which all have different underlying persuasive mechanisms. For example, tools may be persuasive because they can make target behaviour like filling in a sleep diary easier, whereas social actors might give positive feedback when a coachee gets out of bed while still sleepy. In table 1 the persuasive strategies from Fogg are mapped to possible CBT-I implementations and some first functions for a sleep coach are deduced. The strategies in which technology functions as a medium are not mentioned in table 1. These strategies could persuade coachees by predicting or simulating how a treatment could work out for them in the future.

2.2 The Persuasive Systems Design model

Oinas-Kukkonen and Harjumaa (2008) state that the strategies of Fogg are not directly usable for software implementations. Therefore, they proposed a systematic method to develop persuasive systems based on Fogg's strategies. Their Persuasive Systems Design (PSD) model contains three steps: designers should understand the key issues behind persuasive systems (step 1), designers should analyse the persuasion context (step 2), and designers should consider the system qualities (step 3). The system qualities (step 3) are described comprehensively; the underlying principles of the system qualities are described, and the belonging software requirements and examples of implementation are given. The system qualities are divided into four categories: task-, dialogue-, credibility-, and social support. The strategies within the first two categories (task and dialogue support) are based on the strategies of Fogg (2003). There are no fundamental differences; the descriptions deviate in the level of details. The underlying idea of credibility, the third category, is that a system that is more credible is more persuasive. Fogg (2003) discussed credibility as well, however not in his functional triad.

Table 2: Persuasive strategies defined by Oinas-Kukkonen and Harjumaa (2008) and related examples for our envisioned virtual sleep coach.

Persuasive strategy	Potential ways of applying the persuasive strategies in the sleep domain	CBT-I part
Social learning (Observe others doing it)	*The coach can show how peers in the coachee's community are adhering to their therapy*	*C*
Social comparison (Compare with others)	*Coachees can compare their own sleep behaviour and therapy performance to that of their peers*	*C*
Normative influence (Peer pressure)	*Peers can influence each other by telling each other it is really important to do relaxation exercises (or any other treatment) every day (peer pressure)*	*RX, C*
Social facilitation (Not the only one)	*The coach can show the coachees they are not the only one dealing with sleep problems and adherence to the sleep therapy by bringing them into contact with peers*	*C*
Cooperation	*The coach can stimulate coachees to ask for help from roommates*	*C*
Competition	*Through a reward system (e.g. get points when the coachees cleaned their bedroom, did a relaxation exercise) the peers can be involved in a competition*	*HE, RX*
Recognition (Public recognition)	*By giving the coachees the possibility to share their experiences on a social network, public recognition for their problems could be generated*	*C*

Table 3: Persuasive strategies defined by Cialdini (1993) and related examples for our envisioned virtual sleep coach.

Persuasive strategy	Potential ways of applying the persuasive strategies in the sleep domain	CBT-I part
Reciprocity (Pay back a favour)	*The coach could communicate that peers have already given good tips, you should share your experience with the community to help your peers (see also table 1 social dynamics)*	*C*
Liking (Someone you like)	*Let coachees choose a coach/character they like, so they are inclined to be persuaded (see also table 1 psychological cues)*	*RCC*
Authority (People with status)	*The coach says that the therapist states a bedroom should be clean (see also table 1 social roles)*	*HE*
Consensus (Adjust to majority)	*The coach says: most peers benefit from progressive relaxation training, try that exercise*	*RX*
Scarcity (Only a few left)	*The coach says: there is only one chance a day to go to bed at the right time. Take that chance today!*	*SR*
Consistency and commit-ment (Consistent beliefs and act accordingly)	*Coachees can set their own bedtime and therewith implicitly commit to that goal*	*SR*

For the virtual sleep coach credibility might be assured by developing the coach in narrow cooperation with sleep therapists for credible treatments and with coachees for perceived surface credibility. The last category is social support, which describes how to use social influence strategies to persuade the coachee. These social strategies could be used in a virtual sleep coach by connecting the coachees with peers. Table 2 shows how the connection with peers mediated by the virtual sleep coach might be beneficial per social persuasion strategy.

2.3 Persuasion from a marketing perspective

From a marketing perspective six persuasive strategies were identified: reciprocity, liking, authority, consensus, scarcity, and consistency & commitment (Cialdini, 1993). An example of how these strategies can be used in a sleep coach can be found in table 3. Recently, these six strategies were used to emphasize the importance of tailoring in persuasion by means of persuasion profiles (Kaptein, 2011). A persuasion profile indicates how susceptible an individual is to a specific persuasion strategy. Based on the persuasion profile of a person a system can select and use the most effective persuasion strategy for that person. A virtual sleep coach could for example use an authority argument or a consensus argument to persuade coachees to optimize their bedroom environment depending on the persuasion profile of the coachee.

2.4 Eight guidelines from practice

Consolvo, McDonald, and Landay (2009) derived guidelines for technologies that support behaviour change from implementations and the learned 'best practices'. Table 4 shows some ideas for the implementations of these guidelines into a virtual sleep coach. The method to base guidelines on prior examples is in line with the 8-step design approach of Fogg (2009), which states that designers should consider successful prior examples and imitate and expand on that success. Although these guidelines are not all about persuasion, they seem relevant 'learned lessons', since these guidelines also aim at increasing the probability that the technology will actually be used.

Table 4: *Persuasive strategies defined by Consolvo and colleagues (2009) and related examples for our envisioned virtual sleep coach.*

Persuasive strategy	Potential ways of applying the persuasive strategies in the sleep domain	CBT-I part
Data abstraction and reflection (Show only relevant data)	*Based on a sleep diary the coach can give insights into sleeping patterns of the coachee*	*SR, SC*
Unobtrusiveness (Present and collect discrete)	*Alarms and reminders can be adapted to different profiles, e.g. in a meeting, at home etc. To coach should 'sense' when the coachee can be disturbed.*	*RCC*
Public (Be sensitive with personal info)	*The sleep diary is only accessible to the coachee, maybe with a security code*	*C, RCC*
Aesthetic (Be attractive)	*The virtual coach should suit the coachee, so the coachee can choose between different styles of the interfaces: e.g. a playful or business-like appearance (see also table 1 physical cues)*	*RCC*
Positive (Use positive reinforcement)	*The coach rewards the coachee when the coachee get out of bed in the middle of the night by points or something like that*	*SC*
Controllable (Coachee can control data)	*The coachee can adjust the data provided to and elicited by the coach. So at any time the coachee can adjust the sleep diary, or adjust his or her location elicited via GPS.*	*SR, SC, RX*
Credibility (Be accurate)	*The coach provides accurate sleep efficiency data to the coachee along with an indication of the precision of the calculated sleep efficiency*	*SR, SC*
Historical (Show past behaviour)	*The coach shows an overview of the sleep performance of last week and month*	*C*
Comprehensive (Do not limit data, account for a range of behaviour)	*The coach is coupled to the digital agenda of the coachee, all activities in that agenda are categorized in relaxation, sleep time, sports, work, etc. The coachee can also create his or her own categories.*	*C*

3. DISCUSSION

Recently, Beun (2012) identified three persuasive strategies that may influence the motivation of a coachee in CBT-I: alignment, adaptation, and motivational support. These three strategies and underlying persuasive mechanisms are not gathered into a framework or into guidelines. However, most of the suggested ideas correspond to strategies already mentioned in this paper.

In conclusion, there are many persuasion strategies depending on the exhaustiveness, exclusivity, emphasis, and granularity of the 'search' (Kaptein, 2011). The described frameworks take a different perspective which can inspire designers and make them think about their own application and context in different ways.

As can be seen in the tables, almost all persuasive strategies can be used in a virtual sleep coach. The challenge for the virtual sleep coach will be how to combine or choose between all these persuasive strategies and when to apply which strategy. This paper provided a first overview of the theoretical foundation and derived support functions of our envisioned virtual sleep coach.

4. ACKNOWLEDGEMENT

5. REFERENCES

Bemmel, A., Beersma, D., de Groen, J., Hofman, W. (2001) *Handboek slaap en slaapstoornissen*. Elsevier gezondheidszorg, Maarssen.

Bickmore, T. W., & Picard, R. W. (2005) Establishing and maintaining long-term human-computer relationships. *ACM Transactions on Computer-Human Interaction*, *12*(2), 293-327.

Cialdini, R. (1993) *Influence, Science and Practice*. HarperCollings College, New York.

Beun, R. (2012) Persuasive strategies in mobile insomnia therapy: alignment, adaptation and motivational support. Personal and Ubiquitous Computing Journal, In Press.

Connelly, K., Faber, A., Rogers, Y., Siek, K., Toscos, T. (2006) Mobile applications that empower people to monitor their personal health. *Elektrotechnik und informationstechnik*, 123, 124-128.

Consolvo, S., McDonalde, D., Landay, J. (2009) Theory-Driven Design Strategies for Technologies that Support Behavior Change in Everyday Life. *CHI 2009 - Creative Thought and Self-Improvement*, April 6th, 2009, 405-414.

Fogg, B. (2003) *Persuasive Technology, Using computers to change what we think and do*. Morgan Kaufmann, San Fransico.

Fogg, B. (2009) Creating persuasive technologies: an eight-step design process. Persuasive, Claremont, April 26-29. ACM, New York.

Kaptein, M. (2011) *Personalized Persuasion in Ambient Intelligence*. PhD Thesis, Eindhoven University of Technology, The Netherlands.

Oinas-Kukkonen, H., Harjumaa, M. (2008) A Systematic Framework for Designing and Evaluating Persuasive Systems. *Persuasive 2008*, Oulu, Finland, June 4-6. Springer-Verlag, Berlin.