With Me – The European Platform to Promote Healthy Lifestyle and improve care through a Personal Persuasive Assistant

WITH-ME (332885)

D2-1 SOTA on human motivation theory and coaching strategies.

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Abstract	Theories and determinants that motivate behavioral change are described, as well as the techniques to influence these determinants (i.e., coaching strategies). A systematic approach to design cognitive systems, like With-Me, is provided to link these theories to practical applications in the with-Me system (see wiki.scetool.nl and www.scetool.nl). This approach is illustrated with concrete applications.
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	0.1	Joke Kort (TNO)	2013-09-16	First draft: table of content
	0.2	Hanne Van Overloop (R2i)	2013-10-23	Second draft
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	0.9	Wilma Otten (TNO), Hanne Van Overloop (R2i)	2013-11-28	Final version for Final version submitted to the European Commission - Section 4.1 'Framework' and figure 7: 'Relationships between theory and models, determinants, BCT, boundary conditions and behaviour', were moved to the beginning of the document. - In the 'selected theories' section (3.3) a summary of all selected theories and selected BCTs was added.

				- More detailed comments in the text were taken into account.
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	Pierre Barralon (TEC)	2013-11-26	This first deliverable of WP2 contains relevant information and will serve as a solid basis for the tasks within this WP. -In order to be more accessible for non-experts I would suggest to move sub-section 4.1 and figure 7 at the beginning of the document as it helps to have a general view and definitions of some terms. - It might be useful to have a summary table that would list the 6 selected theories and their associated BCTs - Details comments and suggestions made in the document.	

1   Executive summary

The With-Me system aims to have an impact on people's lifestyle and health, providing both health prevention and health care. The aim of task T2-1 is to identify and extract a set of behaviour change techniques (coaching strategies) that could be effectively implemented in the With-Me system. A state of the art on motivation theories (that are the foundation of behaviour change techniques) was started in the form of a mind map in which a diverse array of theories and behaviour change techniques were gathered. From this gathering several theories were selected, and explored in more detail. For each theory several behaviour change techniques were selected that could be used to promote motivation in behaviour change.

Several motivational theories can be used to increase motivation. Self-regulation theory provides insight into how people regulate their behaviour to reach a goal. Self-determination theory handles the basic psychological needs that all people strive for. Dual process theory states that there is an unconscious, fast way of thinking that is automatic and a conscious, slow way of thinking that requires more effort. Since most of the time we use the fast way of thinking, we should take this into account when trying to motivate people to change their behaviour. Theory of planned behaviour handles the slow way of thinking, and stresses the importance of the social norm: the behaviour that is normal in a certain situation. The use of emotions is important because people's behaviour is also motivated by emotions experienced in performing the behaviours and the anticipated emotions when reaching their goal. Lastly, social cognitive learning theory stresses the importance of self-efficacy and outcome expectations. Based on these theories several behaviour change techniques are described. The theories and behaviour change techniques are published in a public accessible online wiki, which makes the information easily accessible for longer periods of time.

As an example, for the Belgium pilot it is shown for various behaviour change techniques how these can be applied. The persona Peter (see With-me D1-1) who needs to improve his lifestyle is the start to apply behaviour change techniques. A performance objective is specified (e.g., to motivate Peter to change his breakfast habits). A determinant is chosen that produces this behavioural change (e.g., changing the way he feels about having breakfast and the goals it fulfils). A behaviour change technique (e.g., 'narratives') is chosen to change the determinant (e.g., his feelings). The technique is translated into a concrete application for the pilot (e.g., a video based narrative testimonial). In applying the technique one considers the boundary condition under which a technique especially applies (e.g., for persons low in need for cognition).

In parallel, this task provided the pilots in With-Me with a framework for the design of cognitive systems that are designed to support behaviour, or behaviour change. The framework is based on Intervention Mapping, a roadmap to design a well-founded intervention, and on situational Cognitive Engineering, a method to support human centred design. To conclude, a gap analysis shows that most devices on the market that promote health do not make use of behaviour change techniques, besides providing feedback in graphs or number. Some use a form of goal setting. Combining more behaviour change techniques (in this project) and therefore focusing on different aspects of motivation and behaviour change, will enlarge the impact of such a system on the habits of a user.

2 Introduction

2.1 Purpose, context: Why this task?

The With-Me system aims to have an impact at people's lifestyle and health, providing both health prevention and health care. The system will provide and support safe and secure seamless monitoring and persuasive guidance anytime and anywhere for healthier behaviours (e.g. a balanced diet every day, exercising for prevention but also during care). Earlier studies show that once people stick to a schedule or work plan that supports them in creating new healthy habits, their health will improve. A broad overview of which health problems exist and how healthy habits (e.g., being more physical active) can have an impact on health was created within task T1-1 and T1-2 (DT1-2 State-of-the art report on health prevention).

Fact is that changing behaviour is a process. It takes time and practice to change unhealthy behaviour and create new, healthy habits. Therefore, it is crucial that people are motivated and stay motivated. Two different types of motivation exist regarding With-Me: (1) the With-Me system itself should motivate people to stick to their work plan and keep on working on healthy habits (leading to the actual behaviour change), and (2) people should be motivated to keep on using the With-Me system.

Within this task we focus on the first type of motivation: motivating and supporting a user to stick to his work plan, to keep working on creating healthy habits and eventually to make stable and durable changes to their behaviour. To accomplish this aim, the With-Me system should use well-considered motivational coaching strategies, further in the text referred to as **behaviour change techniques (BCTs)**, adjusted to the different types of users and the contexts in which they use the system. These behaviour change techniques (e.g. self-logging, positive feedback on results, etc.) should be considered while designing the core system. They are not just an extra that could be added later on in the design process. The aim of task T2-1 is to identify and extract a set of behaviour change techniques that could be effectively implemented in the With-Me system. Many theories exist on motivation and behaviour change. Task T2-1 should ensure suitable behaviour change techniques are selected for further implementation in With-Me.

The second type of motivation: motivating people to use the device in a regular way and for a longer period of time (long enough to make durable changes to their lifestyle), will be addressed in task 'T2-4: Persuasive technology' and task T2-5 'Engaging Serious Game Design'. In task T2-4 the selection of behaviour change techniques from task T2-1 will be extended with advise on which persuasive technology could work for the With-Me system. Also, in this stage specific theory on user experience design will become important. Task T2-5 will investigate the use Game Design and Gamification.

Finally, in task 'T2-8: Reference Coaching Module', all advice will be converted into more practical design concepts & guidelines to be implemented in a demonstrator.

2.2 Process: How did we do this?

Within task T2-1 we identified a set of behaviour change techniques that should be effectively implemented in the With-Me system. This was done in three important steps:

1. First, a state of the art analysis (SOTA) was performed focusing on the most relevant theories in motivation and behaviour change, including an evaluation of their most important advantages for With-Me in terms of applicability, proven results in behavioural change and motivation when applied in practice (e.g., applied to system design). Findings were kept in a mind map (section 3.2 Exploration: Mindmap). From the mind map, we selected a set of theories, that we consider important to apply to the With-Me system (3.3 Selected theories). Next steps in task T2-1 were based on this selection of theories. Following from the theories, several behaviour change techniques (i.e., coaching strategies) were selected (5.5 Behavior change techniques and application to Belgium pilot) and short scenarios were written for the Belgium pilot.

2. Second, we looked at the role motivation plays in behaviour change. We developed a framework (2.3 Framework: the bigger picture) to gain communal understanding of how we see behaviour change. We further shared knowledge about the situated Cognitive engineering Tool (sCET, paragraph 4.). This is a tool that supports the development of behaviour supporting systems and technical solutions. We gathered information to fill the first steps of the tool in an offline version of the tool. These documents were shared with the pilot holders.

3. Finally, a gap analysis was performed comparing SOTA theory and applications used in practice (section 6. 'Gap analysis'). This analysis indicated there is still a need for a system that applies a good combination of behaviour change techniques. This gap should be addressed by the With-Me system.

2.3   Framework: the bigger picture

Besides the various theories that describe processes involved in explaining and changing behaviour (see Section 3 'State of the art analysis'), behavioural change in itself occurs in several phases (Gollwitzer, 1996; Prochaska & Diclemente, 1984; Rothman et al., 2011; Schwarzer & Luszczynska, 2008; Weinstein et al. 1998). In the present framework we discern the following phases: (a) Intention, in which a person develops an intention (or goal) to act; (b) Initiation, in which the actions are planned and a person starts acting toward goal achievement; and (c) Continuation, in which the initiated behaviour is maintained in order to achieve the end-state successfully. Depending on the specific phase of behaviour change different determinants are effective. Figure 1 illustrates this framework.

Figure 1: Framework behavioural change and questions to ask
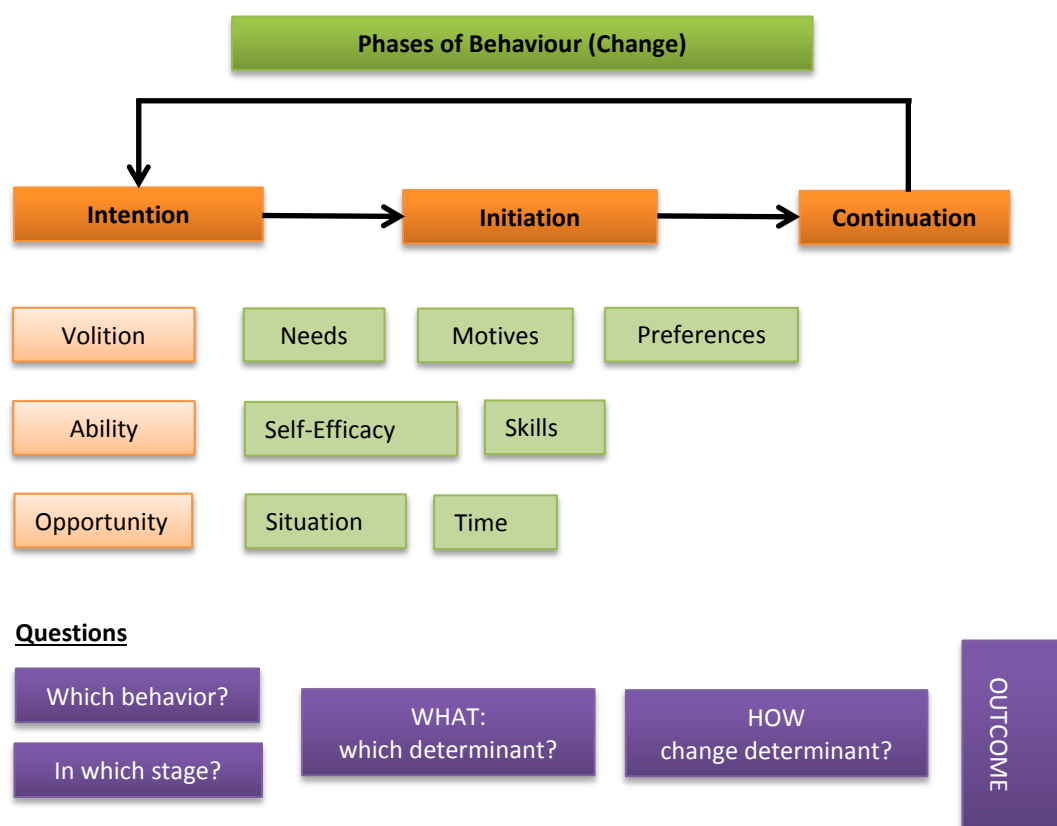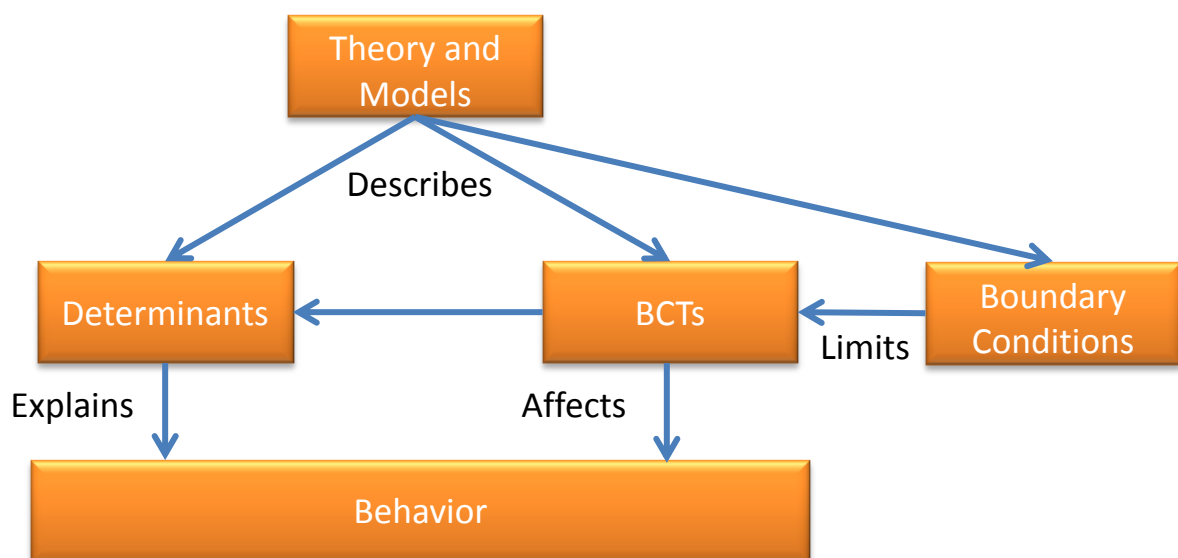
Figure 1 depicts the phases of behavioural change and that for each phase different determinants may apply. These determinants may be related to 'Volition', 'Ability' or 'Opportunity'. 'Volition' describes all processes dealing with setting goals, intentions, striving for, wanting something, and is more applicable to the Intention phase of behaviour change. 'Ability' deals with being able to perform a behaviour and is more linked to the Initiation phase of behaviour change. However, volitional aspects are still important to initiate the behaviour, and ability aspects also influence whether one wants to execute a behaviour. Volition and Ability are focused at the individual person, and are also described in section 3.2 'Exploration: the mind map' and in the selected theories (section 3.3). 'Opportunity' focuses on the situational aspects that influence behavioural change, like situational cues and time constraints. Situational aspects are more related to habitual behaviour and the unconscious, implicit route to change behaviour (see section 3.3.3. Dual processes).

At the bottom of Figure 1 the questions are summarized that this framework poses when designing cognitive systems or interventions to support behavioural change. The first question is which behaviour in which phase of change needs to be addressed. Secondly, an important distinction is

between the **what** and **how** of behavioural change. What refers to the specific determinants that influence the behaviour, whereas how reflects the behaviour change techniques to use in order to change the determinant, so that the behaviour is changed and the wanted outcome is achieved.

As illustrated in Figure 2, theory and models lay at the base of behaviour change. On the one hand, theory and models describe personal and environmental determinants, which explain individual's behaviour. On the other hand, theory and models describe behavioural change techniques (BCTs), which can address these determinants and affect behaviour accordingly. Also, they describe boundary conditions; the BCTs' limitations.

Figure 2: Relationships between theory and models, determinants, BCT, boundary conditions and behaviour

The questions at the bottom of figure 1 are more elaborated in the situated Cognitive Engineering Tool, described in section 4.

3   State of the art analysis (SOTA)

3.1   Scope

The **state of the art analysis** (SOTA) on motivation and behaviour change was initiated by a broad literature 'exploration'. Much research exists on the topic of motivation, in different research domains and contexts. Therefore, many theories on motivation exist next to each other: some of them are complementary, many are overlapping.

Since motivation and behaviour change is a broad research topic, we did not aim to create a complete overview of all existing theory. During the SOTA we focused on these theories that are relevant for With-Me, by applicability and/or proven results in behavioural change and motivation when applied in practice.

This exploration helped us to scope the theoretical framework for the list of behaviour change techniques. The first boundaries of this scope were the different **use cases**, related to the pilot studies that will be executed later in this project (D1-1: Personalized With-Me Use Case Scenarios). While reading and selecting possible interesting theories, we always kept these use cases in mind.

A second important choice that we made was to focus on **individuals** only. While reading through documentation from PREVE (www.preve-eu.org), a project that was funded by the European Commission in the 4th ICT Call of the 7th FP and coordinated by VTT (a partner in the With-Me project), we came across a division in theories and behaviour change techniques focused on individuals vs. theories focused on organizations (PREVE 2013). Since the aim of With-Me is to help individual users, we excluded organization-focused theories (e.g., organizational development theory (ODT), model of community organization (MCO)) and focused on individual coaching.

3.2   Exploration: the mind map

The SOTA was started by looking at behaviour change techniques and theories about motivation, from two domains: **HCI** (human computer interaction) and **motivational psychology**. In the domain of HCI psychological theories and techniques are applied to situations where people are using devices (e.g., self-logging on a mobile device). An example of a theory from the domain of motivational psychology is Self-Determination Theory.

Due to contributions of all partners involved in task T2-1, the exploration was extended to several other domains: **Health and social psychology** (e.g. dual processes theory), **Communication** (e.g. Persuasion-Communication Matrix), **Emotion and motivation** (e.g. Extended Elaboration Likelihood Model (ELM)). Theories on emotion and motivation were included on behalf of task 'T2-7: Emotion detection and classification technology'. This task will focus on analysing the relationship and/or interaction between physical activity (lifestyle) and human emotional states through physical emotional detection (PED). Insights were needed on how emotion plays a role in human motivation and behaviour change. In the mind map, all theories that focus on emotion are indicated with a smiley.

During the exploration, findings were kept in a mind map (see Figure 3). This mind map gives an overview of all relevant theories and behaviour change techniques that we came across during our literature study, and it indicates the relations between these different theories and techniques. A more detailed view of the mind map can be found in Appendix 1.

Figure 3: The mind map
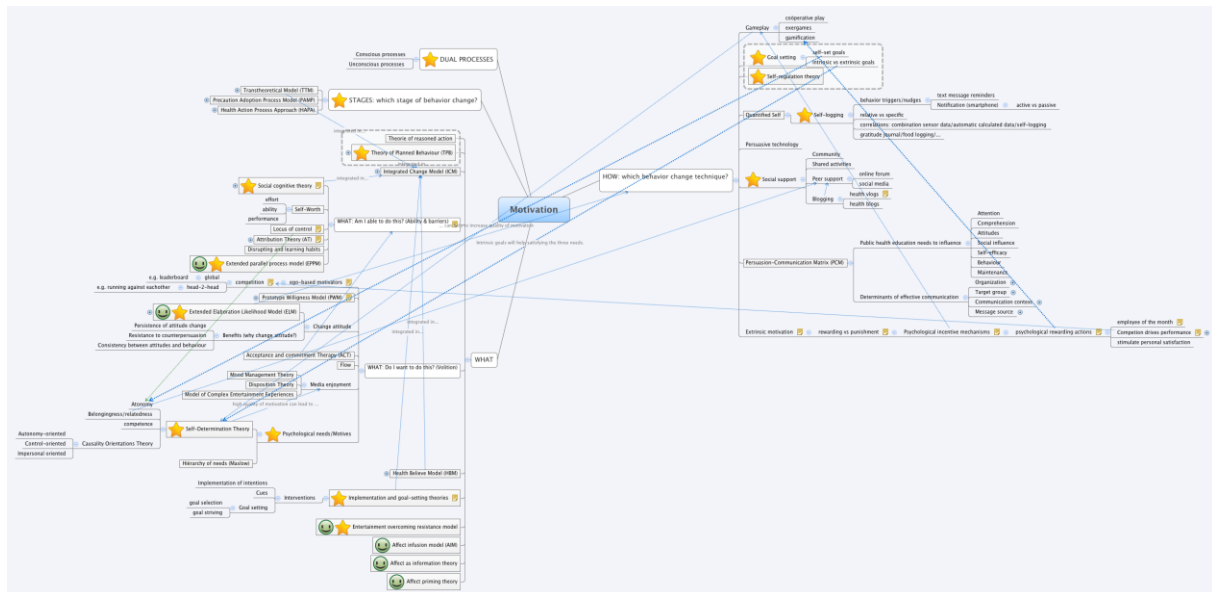
Initial structure

The mind map was initially structured around three questions:

- Can I do this? (ability)

- Do I want to do this? (volition)

- How can I succeed? (skills)

Broussard and Garrison (2004) observed that contemporary motivation research tends to be organized around these three questions. Therefore, it seemed a good initial structure for the mind map. It helped us to keep in mind the different aspects of motivation:

- **The belief of a person that he can succeed** in changing his behaviour. This aspect is about belief in one's own **ability** to complete tasks and reach goals, about being confident in succeeding.

- The will or **volition** of a person to complete tasks, reach goals and change his behaviour. This aspect relates to the value a certain task or goals fulfils for a person. Does a person believe it is worth the effort?

- The **skills** of a person to actually change his behaviour. Although a person could believe he can change and could be ready to start, he still needs to learn how he can make these changes. A person needs skills to start creating new, healthy habits and to follow up his progression.

Since all these aspects play an important role in the motivation of a person, the With-Me system should combine behaviour change techniques linked to each of these aspects.

Developing our own view

As the mind map evolved, we developed a better insight in which aspects of motivation are important and how motivation could be implemented in the With-Me system (section 2.3 Framework: the bigger picture). Therefore, some adjustments were made to the structure of the mind map (Figure 4):

- 'Can I do this?' (Ability) and 'Do I want to do this?' (Volition) were combined together in **WHAT**. The branch WHAT contains theories that describe what exactly influences the behaviour of a person. Ability and volition were combined in one branch since several theories have an impact on both aspects, what makes it difficult to place them under only one of these categories.

- 'How can I succeed' (skills) became: **"HOW: which behaviour change technique**?". This branch complements the WHAT branch by enlisting techniques that explain how we can have an impact on aspects that influence behaviour change. It contains behaviour change techniques through which theories can be implemented in a system like With-Me. We added the behaviour change techniques that we came across during the exploration, however, we did not complete it

afterwards by adding all techniques related to the theories in the mind map. As soon as we made a choice about the theories to focus on, we enlisted all relevant behaviour change techniques on a wiki page that formed the basis of our next steps within this task (see section 3.3 selected theories).

- Two new branches were added. One branch adds **dual processes**, focusing on the difference between conscious and unconscious processes within a person. Unconscious processes and barriers have been identified as a strategic element/lever to be included in With-Me and are studied in task 2.3 *Identification of unconscious motivators and barriers in users.* In the present task 2.1 the dual process approach is included to present a comprehensive overview of theories on human motivation. A concise description will be presented of unconscious processes, because task 2.3 will provide an elaborate description of these processes. The other branch focuses on theories about **'stages of behaviour change'**. Behavior change is a process consisting of different stages: starting with the intention to change, then initiating the change, and finally continuing the change. Each stadium has different appropriate behaviour change techniques.

Figure 4: The four branches of the mind map

It should be clear that this exploration does not aim to provide a complete overview on existing literature on motivation and behaviour change. It was a 'quick scan' of domains and theories that could be interesting for the With-Me project and it helped us to make choices about the theories we should focus on and take with us during the next steps in the state of the art analysis. The selected theories on motivation and behavioural change, and the insight they provide, should be applied in the design of With-Me products and services as well as in the evaluation of these products and services in laboratory situations or field studies to guarantee a match with end users. In the mind map, the selected theories were indicated with a star.

3.3   Selected theories

The theories, that we selected from the mind map will be used for the design of the With-Me system. Therefore, an explanation of these theories should be available for all partners. We choose to make this information available through a public, online wiki (online encyclopaedia). This way, the information is accessible for everyone and a wiki-structure allows us to connect different theories, for example by indicating which theories make use of the same behaviour change techniques.

Since TNO already created a wiki on theories about behaviour change, we decided to extend this existing wiki and directly add the selected theories to their database. The TNO wiki was created to provide input for TNO's sCE-tool, an online tool based on Intervention Mapping (IM) and situational Cognitive Engineering (sCE). The sCE-tool was used later on in task T2-1 (4. sCET: from theory to behaviour change). In this section on selected theories, we will give a short description of all selected theories. More information on the theories (and the related determinants and behaviour change techniques) can be found in the wiki: http://wiki.scetool.nl/index.php?title=Hoofdpagina.

The selected theories and selected BCTs are:

Theory	BCT	Determinants
Self-Determination Theory (section 3.3.1)	Self-Monitoring	Competence
	Making own choices / motivational interviewing	Autonomy
	providing an interpersonal environment and social support	Relatedness
Theory of planned behaviour (section	Creating a different norm	Subjective norm

3.3.2)		
Dual processes (section 3.3.3)	Approach-avoidance training	Automatic approach, Avoidance tendencies, Attitude, Automatic affective reactions
Social Cognitive Learning theory (section 3.3.4)	Modelling	Subjective norms, Skills, Outcome expectancies
Self-regulation theory (section 3.3.5)	Providing feedback on outcomes of behaviour	Self-regulatory strength, Goal persistence, Disengagement, Goal change, Self-efficacy
	Implementation Intentions	Accessibility, Environment, Habits
Theories on emotion (section 3.3.6)	Narrative persuasion	Affective attitude, Emotion, Behavioural intention, Perceived risk, Perceived severity, Perceived vulnerability, Behavioural beliefs

Table 1: Overview of the selected theories and BCTs

3.3.1   Self-Determination Theory

http://wiki.scetool.nl/index.php?title=Self-Determination_Theory

The Self-Determination Theory of Deci & Ryan focuses on the degree to which human behaviour is self-determined. In other words, it focuses on the question whether human behaviour is a result of a decision that was taken autonomous or that was rather imposed on a person.

An **autonomous decision** is one taken by the person himself. E.g. a person goes to the gym each day, just because he enjoys it. However, not all autonomous decisions are fully taken by the person. A decision influenced by others could be autonomous, as long as the person agrees to this influence. E.g. letting your coach decide which work plan is best for you. If a decision was taken by others and a person does not agree, he will feel a **pressure from his environment**. This will result in a low degree of self-determination. E.g. a person goes to the gym, only because his doctor told him to.

The degree to which behaviour is self-determined will have an impact on the quality of the motivation (Ryan & Deci, 2000). Deci en Ryan divided motivation in three qualitative types: amotivation, extrinsic motivation and intrinsic motivation. Although all types of motivation (except amotivation, the absence of motivation) will lead to behaviour change, intrinsic motivation will have a larger impact. When a person's will to change comes from within himself, the motivation will be more durable. The chances are high that the new behaviour will becomes a part of his life, a habit. Extrinsic motivation is likely to lead to a temporary change that will disappear when the external pressure stops. Figure 5 shows that these three categories can be placed on a continuum. Most activities are not either completely extrinsic or intrinsic. They fall somewhere in between.

Figure 5: The quality of motivation (Deci & Ryan, 2000)
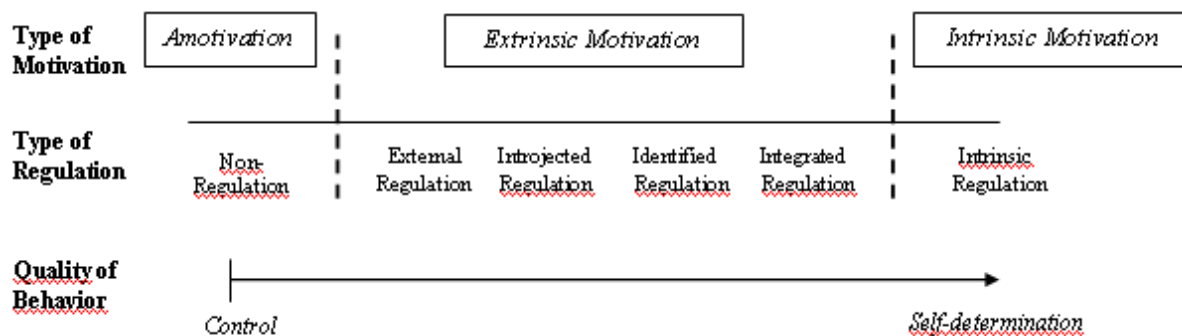
The process that makes it possible that the quality of motivation for a certain activity can increase, is called internalization. It is a natural process in which people tend to turn socially imposed moral into personal values. Internalization is what happens when people start seeing the importance of a certain external rule or moral (e.g., the idea of being slim by sporting) and try to add value to this activity. The more strongly a rule/behaviour is internalized, the higher the quality of the motivation of the person will be.

How self-determined behaviour is, depends on how well it satisfies the internal psychological needs of a person (Deci & Ryan, 2000). SDT determines three needs that are essential for optimal functioning and the personal growth of a person:

- **Competence** is the ability of a person to accomplish challenging tasks and having the feeling that he can reach his goal (Skinner, 1995; White, 1959). Social context events, like positive feedback or rewards, can increase the perceived competence of a person. Negative feedback can decrease it.

- **Autonomy** is the feeling of a person to be in control. This, either by taking his own decisions or by consciously deciding to let the opinion of others leads him in taking decisions (Ryan & Deci, 2000). Autonomy must accompany competence in order to let people see their behaviour as self-determined by intrinsic motivation.

- **Relatedness** is the need of a person to feel attached to others around them. A person needs interpersonal relations and social support, since this creates a safe and secure feeling (Deci & Ryan, 2000).

The more certain behaviour satisfies each of these needs, the more self-determined the behaviour is. And the more a person will be motivated to show (and keep showing) the behaviour. A high quality of motivation (highly self-determined) will increase the chances on long-term motivation and durable success/behaviour change.

Strengths and Limitations

- This theory provides three determinants (autonomy, competence, relatedness), three concrete aspects on motivation, the With-Me system can focus on.

- These three determinants are universal: they exist in each individual, regardless of culture.

- SDT is already applied in several domains (e.g., health coaching, learning, work environment, digital games)

- A limitation of SDT is that it mainly focuses on the theory and less on specific techniques that can be applied in practice. However, over the years research has proven the effectiveness of certain techniques within SDT. Recent research suggests that Motivational Interviewing, which provides a range of techniques, is consistent with the concept of SDT;

3.3.2   Theory of planned behaviour

http://wiki.scetool.nl/index.php?title=Theory_of_planned_behavior
http://wiki.scetool.nl/index.php?title=Theory_of_reasoned_action_II

The Theory of Reasoned Action (TRA) was formulated first by Fishbein and Ajzen (1975) and described that the intention to perform a behaviour is determined by the attitude towards that behaviour and the subjective norm regarding that behaviour. In the Theory of Planned Behavior (TPB) (Ajzen & Madden, 1986) a third determinant was added, namely perceived behavioural control that strongly resembled the concept of self-efficacy (Bandura, 1986). Recently the TRA is reformulated (Fishbein & Ajzen, 2010) by specifying that behaviour is determined by intention, as far as people have actual control over their behaviour. Actual control is determined by environmental factors and skills to deal with these factors. Intention is determined by attitude, perceived norm, and perceived behavioural control, which in turn are all determined by salient beliefs: behavioural beliefs, normative beliefs and control beliefs. Attitudes are based on the expected positive and negative consequences of a behaviour. A subjective norm is the person's perception that most people that are important to him think whether he should or should not perform the behaviour in question. Finally, perceived behavioural control reflects the idea of how much one can influence behaviour. These three factors provide insights in what influences the behaviour, and thus which determinants should be changed.

Strengths and limitations

- Helps to understand the specific variables that need to be changed.

- The theory in itself provides specific methods to measure the separate determinants of the theory, but not techniques how to change these determinants. However, TPB is applied in interventions to change behaviour, and therefore several BCTs are available.

- Can be applied in situations in which people are aware of the negative consequence of their behaviour. If people are not aware of their risk they must become aware of the problem before determinants can be explored. The theory is relevant for designing health education and health behaviour programs.

3.3.3   Dual processes

http://wiki.scetool.nl/index.php?title=Reflective_Impulsive_Model_(RIM)

Dual process models specify two routes to explain behaviour: an effortful rational route and an effortless automatic route. Such models further specify under which circumstances the two routes are most likely to operate. Although dual-process models can be traced back to the work of William James in 1890, recent formulations are the Reflective-Impulsive Model (Strack & Deutsch, 2004) and the System1-System 2 approach (Kahneman, 2003). In accordance with the dual process models, research has shown that human behaviour, including health behaviour, is not only determined by explicit, conscious processes, but also by automatic, non-conscious processes. Moreover, in the past decade, various behaviour change techniques (BCT) have been developed to change behaviour by addressing these implicit non-conscious processes (Sheeran, Gollwitzer, & Bargh, 2013).

In the social and health psychology domains, the effects of BCTs addressing automatic processes are often described in terms of the reflective-impulsive model (RIM; e.g., Sheeran et al., 2013; Friese, Hofmann & Wiers, 2011). The RIM distinguishes two modes of information processing. The reflective mode is slow and based on reasoning. It is accessed intentionally and draws upon the person's knowledge on the probability of consequences of a decision. The impulsive mode, on the other hand, is fast and occurs outside of awareness. It draws upon the person's associative network; a stimulus observed by the person activates elements in the associative network, which in turn activate other related elements. The two systems mainly differ in their way of thinking (analytic vs. associative), the effort it requires (much vs. none), and the awareness of the process (conscious vs. unconscious). Emotions and affect are usually placed in the impulsive part of the model, but some argue that people can also reason about their emotions and forecast their affect, implying that emotions and affect can also be part of the reflective process. Although dual process models specify two routes to explain behaviour (an effortful rational route and an effortless automatic route), those models rarely identify specific determinants that influence behaviour through automatic processes. Such determinants are sometimes identified (e.g., attentional bias, implicit approach response), but they are not integrated into a single theory. Perhaps a first step toward organizing automatic processes is made by Sheeran et al (2013), who categorized them into implicit cognition (e.g., attentional bias), implicit affect (e.g., implicit attitude), and implicit motivation (e.g., non-conscious goal pursuit). Further research and theorizing are needed to get a firmer grasp on the various automatic determinants and the inter-relationships between them.

Strengths and Limitations

- It is a strength that automatic and impulsive tendencies are recognized, and thus the strong effects of situational cues and habits on behaviour are acknowledged.

- To date most research only addressed a specific health problem (e.g., alcohol abuse and overeating) or population (e.g., students, teenagers) in mind. Future research has to examine the broader applications.

- Need for more studies on the effectiveness of these techniques, both replicating previous findings and exploring the extent to which those findings can be generalized to a wider range of behaviours and populations.

3.3.4   Social Cognitive Learning theory

http://wiki.scetool.nl/index.php?title=Social_cognitive_theory

In his Social Cognitive Learning theory (Bandura, 1986; Bandura, 1997), Bandura distinguishes between two behavioural expectations: efficacy expectations and outcome expectations.

- **Outcome expectations** refer to beliefs that a behaviour will generate a certain consequence. For instance, performing more physical activity will enhance one's physical health.

- **Efficacy expectations** reflect the belief that one has the capability to produce certain behaviour. It is about how confident a person is that he can do something, not about his actual competence. E.g. a person could still belief that he is not able to run for half an hour, even though he is perfectly capable of doing so.

   These **self-efficacy** beliefs are behaviour specific, and differ on various dimensions like strength and generality. Usually they are assessed by asking whether someone is confident to produce a certain behaviour in various circumstances that increase in level of difficulty. For instance, how confident is someone not to smoke at work versus how confident is someone not to smoke at a party or when a cigarette is offered. Self-efficacy is the belief that

There are four behaviour change techniques to increase the determinant self-efficacy beliefs:

1. Skills mastery, where people actually practice the behaviour,

2. Modelling, that is learning through the observation of other's behaviour (i.e., vicarious learning),

3. Reinterpreting physiologic symptoms (i.e., forming alternative explanations for symptoms), and

4. Social persuasion which means that others show the specific behaviour.

Strengths and Limitations

- The social cognitive theory provides a dynamic interrelationship between an individual's personality, environment and behaviour.

- Concepts such as self-efficacy, observational learning and reciprocal determinism are applicable to real-world implementation.

- The Social Cognitive Theory is already applied in the public health sector and in general self-help. The theory is relevant for designing health education and health behaviour programs.

3.3.5   Self-regulation theory

http://wiki.scetool.nl/index.php?title=Self-regulation_theory

Self-regulation is an umbrella term used to describe the various processes by which people pursue and attain goals. These processes include both those that are initiated consciously and deliberately, as well as those that are more automatic and operate without conscious intent (Mann, Fujita & de Ridder, 2013). This means that self-regulation can be done consciously as well as unconsciously. Studies indicate that controlled (conscious) self-regulation is more difficult and more depleting limited self-regulatory resources (Moller, Deci, & Ryan, 2006; Carver & Scheier, 1981; Carver & Scheier, 2001; Leventhal, Leventhal, & Contrada,1998; Muraven & Baumeister, 2000).

Self-regulation refers to the capacity of organisms (here, human beings) to override and alter their responses. It is the process by which people attempt to constrain unwanted urges by gaining control over the impulsive response. This is necessary when short-term goals (such as enjoying food) are in conflict with longer term goals (such as staying healthy and slim; Baumeister & Vohs, 2007). It is

suggested that both kind of goals are set by different mental systems: the impulsive system, which works automatically without effort, and the reflective system, which is responsible for higher order mental operations and acts slower (Hofmann, Friese & Strack, 2009).

For regulating the self, different ingredients are essential. Some of each ingredient is necessary for effective self-regulation. However, it is possible that the four ingredients can compensate or substitute for each other to some degree (Baumeister & Vohs, 2007):

- Standards or goals: what does one want to accomplish or reach?

- Monitoring: reaching a standard or goal requires a feedback-loop (Carver & Scheier, 1982). The person performs a test by comparing the self (or the relevant aspect of the self) to the standard. If the self falls short then self-regulation requires initiating some operation to change the self in order to bring it up to what it should be.

- Willpower, or self-regulatory strength: Self-regulation as well as effortful choice and active initiative, depends on a limited resource that is consumed during such activities. Ego depletion refers to a state in which the self does not have all the resources it usually has. Ego depletion renders the self temporarily less able and less willing to function normally or optimally.

- Motivation: caring about reaching the standard or goal. Motivation may be especially effective in compensating for decreased willpower (when willpower is not entirely depleted).

An ingredient that has also been found important for successful self-regulation is self-efficacy (Locke & Latham, 2002).

Strengths and Limitations

- Models of self-regulation apply to three criteria: a) The explicit consideration of goals, b) a view of the person as an active agent in shaping his or her own behaviour, and c) an emphasis on volitional processes in goal striving (de Ridder & de Wit, 2006).

- However, as mentioned, it is suggested that self-regulation can have an unconscious and automatic nature (Hoffman, Friese & Strack, 2009).

3.3.6   Theories on emotion

This section is based on Keer, M. (2013). Targeting affect to change behaviour. Internal TNO-report.

http://wiki.scetool.nl/index.php?title=Extended_elaboration_likelihood_model_(extended_ELM)
http://wiki.scetool.nl/index.php?title=Extended_parallel_process_model_(EPPM)

It is important to distinguish between affect, emotion, and mood. Although these terms are sometimes used interchangeably, most academics agree that they do in fact represent different phenomena. Distinguishing between these concepts is important because they may differ in their causes and consequences, the way they interact with behaviour and its determinants, and subsequently in how they can be addressed to change behaviour.

Moods are diffuse feeling states that may result from a series of events, and typically do not have an easily identifiable cause (Frijda, 1993; Schwarz, 1990). Moods are relatively low intensity feelings which do not interrupt ongoing activities (Forgas, 1992). Compared to moods, **emotions** are briefer, intense, caused by a specific event, clearly defined, fleeting and volatile (Beedie, Terry, & Lane, 2005). Emotions demand attention, and interrupt cognitive processes and behaviours (Forgas, 1992; Morris & Schnurr, 1989). In 1975 Eckman distinguished six basic emotions that are universal throughout human cultures: fear, disgust, anger, surprise, happiness, and sadness, and in 1999 he added: embarrassment, excitement, contempt, shame, pride, satisfaction, and amusement. (Eckman 1999). Finally, the term **affective attitude** (sometimes called "affect" or "affective evaluation") is a judgment about the pleasantness or unpleasantness of performing a certain behaviour (Breckler & Wiggins, 1989; Crites, Fabrigar, & Petty, 1994; Trafimow & Sheeran, 1998). Within affective attitudes a further distinction has been made between anticipated affect and anticipatory affect. The first term refers to the affect one expects to experience after engaging (or not engaging) in a behaviour. A well-researched anticipated affect is anticipated regret, the sorrow one may expect to experience after behaving in an unhealthy manner (e.g., eating fatty foods). Anticipatory affect refers to the affect one expects to experience while engaging in a certain behaviour; for example, the boredom during flossing one's teeth, or the joy while eating fruits.

Affect has long been neglected in models of behaviour change and the behaviour change techniques (BCTs) based on them. However, a number of studies show that individuals' affect toward health behaviours has a great impact on health decisions (Keer, Van den Putte, & Neijens, 2010; Keer, Van den Putte, & Neijens, 2012; Kiviniemi, Voss-Humke, & Seifert, 2007; Lawton, Conner, & McEachan, 2009). Furthermore, research has shown that affect has a large influence on intention to perform health behaviours, and on behaviour itself, independent of other social cognitive determinants such as attitude (Eves, Hoppé, & McLaren, 2003; French et al., 2005; Lowe, Eves, & Carroll, 2002). In sum, there is extensive evidence that affect influences health behaviour, and that affect is a proximal determinant of it. This makes targeting people's affective associations with health-related behaviours a promising way to influence their health practices.

Two theories that provide behaviour change techniques addressing affect are (1) the Extended elaboration likelihood model (extended ELM), and (2) the Extended parallel process model.

The extended ELM is a theory that predicts the degree to which narrative messages are processed. Narratives are messages that present information like a story as opposed to an abstract format. For example, information regarding breast cancer may be presented as a narrative in which a breast cancer survivor tells her story or more abstract like a didactic exposition. According to the extended ELM, the degree to which narratives are processed depends on how well the narrative serves the needs and goals of the reader or viewer (i.e., the recipient). For example, if the recipient's needs and goals include a sense of social relationships and experiences, then predictors of message processing include the degree of identification with protagonists in the narrative (Slater, 2002).

Some narratives have a persuasive subtext aimed at changing recipients' beliefs, attitudes or behaviour with regard to a specific topic (e.g., exercise). According to the extended ELM the effectiveness of the persuasive subtext depends on identification with characters and engagement (i.e., absorption, transportation) with the storyline. That is, the more strongly a recipient can identify with a story character, and the more engaged the recipient is in the storyline, the more persuasive the message will be. In the case of narrative communication, no persuasive impact of the narrative is likely in the absence of absorption in the narrative.

The extended ELM states that the processing of narratives, to a great extent, precludes that people disagree with the story and its message. People are so involved in the story itself that they don't elaborately process the message in the story. They don't notice that in fact they disagree and have arguments to counter the message in the story. In fact, it is argued that absorption in a narrative and counterarguing are fundamentally incompatible (Slater, 1997). This implies that narratives, by blocking counterarguing, provide an extraordinary opportunity to influence individuals who would ordinarily be resistant to persuasion.

The intensity of attention of people engaged in a narrative is largely emotional, as the recipient experiences the story characters' joys and sorrows. By this empathizing with the story characters the recipient's affective attitude changes regarding the behaviours performed by the story characters. Although the recipient's cognitions are also engaged with the events of the story they are likely more receptive and less critical than when processing a message that is overtly aimed to persuade. Attitude and behaviour change resulting from narrative persuasion are likely due to having internalized the values and experiences embodied in the story, rather than to a direct acceptance of arguments presented (Slater, 2002).

The Extended parallel process model (EPPM) builds on Leventhal's parallel response model (later called parallel process model; Leventhal, Safer & Panagis, 1983). Leventhal (1970) argued that adaptive responses (e.g., attitude, behavioural intention, and behaviour change) resulted from attempts to control the threat of health risks, and that maladaptive responses (e.g., ignoring or denying the threat) resulted from attempts to control the fear. People attempting to reduce the threat were said to be engaging in danger control processes; those focusing on their feelings, trying to reduce their fear, were said to be engaging in fear control processes. The EPPM adds to this theory an explanation of why people engage in danger or fear control processes.

According to the EPPM, the evaluation of a fear appeal initiates two appraisals of the message, which results in one of three outcomes. First, individuals appraise the threat of an issue from a message. If the threat is perceived as irrelevant or insignificant (i.e., low perceived threat), then there is no motivation to process the message further, and people simply ignore the fear appeal. When individuals believe they are susceptible to a serious threat, they become scared, and their fear motivates them to take some sort of action to reduce their fear.

They begin the second appraisal, which is an evaluation of the efficacy of the recommended response. Perceived efficacy (composed of self-efficacy and response efficacy) determines whether people will become motivated to control the danger of the threat or control their fear about the threat. When people believe they are able to perform an effective recommended response against the threat (i.e., high perceived self-efficacy and response efficacy), they are motivated to control the danger and consciously think about ways to remove or lessen the threat. Typically, they think carefully about the recommended responses advocated in the persuasive message and adopt those as a means to control the danger. Alternatively, when people doubt whether the recommended response works (i.e., low perceived response efficacy) and or whether they are able to perform the recommended response (i.e., low perceived self-efficacy), they are motivated to control their fear (because they believe it's futile to control the danger), and focus on eliminating their fear through denial, defensive avoidance, or reactance.

The EPPM suggests that perceived threat contributes to the intensity of a response to a fear appeal (i.e., how strong the danger or fear control responses are) whereas perceived efficacy (or lack thereof) contributes to the nature of the response (i.e., whether danger or fear control responses are elicited). If no information with regard to the efficacy of the recommended response is provided, individuals will rely on past experiences and prior beliefs to determine perceived efficacy. In sum, fear appeals may work best when they provide efficacious ways to avert the threat.

3.4   Tailoring

This chapter is based on Van Keulen, H. & Otten, W. (2013). Tailoring. In: Otten, W., Blanson Henkemans, O.A., Van keulen, H., Janssen, J.B., van Nunen, A. (2013) ePartners supporting behaviour change. TNO Rapport TNO/LS 2013 R10844 . Leiden: TNO.

One of the advantages of the With-Me system is that it can adapt to the user and its situation, because it can take into account many variables. In this way, the system can be personalized, situated or tailored. The latter term is used within the health education domain, and within this domain, tailoring is recognized as one of the basic behaviour change methods, because it turned out to be useful for almost any determinant at the individual level (Bartholomew et al., 2011). Tailored communication is defined as any combination of information or change techniques intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest, and have been derived from an individual assessment (p.1; Kreuter & Skinner, 2000).

The individualization of health communication involves two processes:

A. **Segmentation** is the degree to which the audience is divided into increasingly more defined, homogenous groups (Hawkins et al., 2008). The higher degree of segmentation, the more information is needed from recipients to determine the segmentation variables. Therefore, Kreuter and Skinner (2000) describe this as the dimension *level of assessment*, which they define as the extent to which an individual's characteristics have been assessed in order to drive the communication.

B. **Customization** is the degree to which the messages (layout, channel, content, source etc.) reflect relevant individual characteristics (Hawkins et al., 2008). This is similar to the definition used by Kreuter and Skinner (2000) for the dimension *content of communication*, which is the degree of individualization in the communication itself.

Figure 6: Classification of health communication approaches (Kreuter and Skinner, 2000)
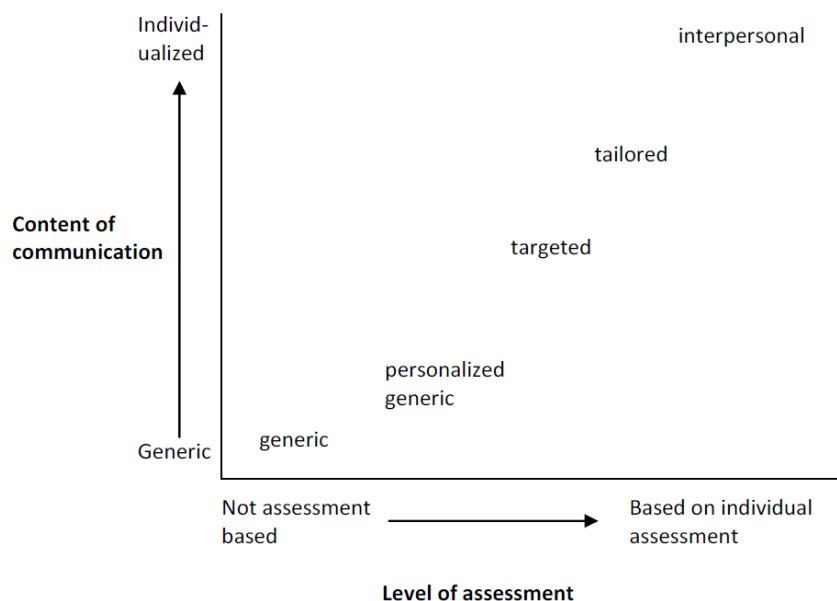
Both dimensions (i.e., the two processes 'segmentation' and 'customization') are linked to each other; the degree of individualization will increase as the level of assessment increases and vice versa (Kreuter & Skinner, 2000). On the continua of both processes or dimensions, communication strategies overlap (see Figure 6). In general, five health communication approaches have been identified: that is generic, targeted, personalized, tailored and interpersonal communication. The definitions of these communication methods are described below:

(1) Generic communication is information intended to reach groups of individuals by using a medium other than personal contact without taking into account the characteristics of those to whom the communication will be offered, and offers a means to reach large numbers of people (Kreuter & Skinner, 2000). The information is not individualized or based on any kind of individual assessment (Noar, Benac & Harris, 2007). An example of generic communication is a general brochure on the risks of smoking that one might read in a doctor's office.

(2) Targeted communication or targeting is an intervention approach for a defined population subgroup that takes into account characteristics shared by the subgroup's members. From a marketing perspective, targeting is also referred to as *market segmentation* (Kreuter & Skinner, 2000). An example of targeting is breast cancer screening material for older women.

(3) Personalized communication or personalization is a form of generic feedback, with the distinction that in personalized generic feedback, a personal characteristic, such as the name of the receiver, is used to personalize the message (Kreuter & Skinner, 2000; Noar et al., 2007). Personalization is generally used to draw attention to and enhance message processing of the generic message, but there is also some evidence that they affect behaviour directly (Dijkstra, 2005). An example of personalization is a mass mailing for the lottery ('Peter Jansen, you may have already won 2.500.000 euro').

Hawkins et al. (2008) state that personalization is one of the strategies (besides feedback and content matching) through which tailoring goals can be achieved. The three most common personalization tactics are:

(a) Identification, this involves identifying the receiver in the message, for example by mentioning the name, including pictures of the recipient or recognizing recipient's birthday.

(b) Raising expectation of customization, this involves overt claims of customization, for example 'the following health information has been created especially for you'.

(c) Contextualization, this involves framing the message in a context that is meaningful to the recipient, for example using demographic characteristics of patients to select age- and sex-matched images to include in mammography letters, or a message from which the source matches the receiver's demography or preferences. Other used contextualization variables were family structure (e.g., framing dietary messages differently for parents of children in different age categories), residential status (e.g., framing messages on home injury prevention differently for renters versus owners), ethnicity/culture and personal interests.

(4) Tailored communication or tailoring is any combination of information or change strategies intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest, and have been derived from an individual assessment (Kreuter & Skinner, 2000). Because the computer is often used to generate tailored feedback, tailoring is also referred to as *computer tailoring*. Tailoring can be applied once or multiple times. When tailoring is applied multiple times, it can be either *static* (providing one baseline assessment on which to base all successive feedback) or *dynamic* (assessing communication variables prior to each feedback) (Krebs, Prochaska & Rossi, 2010).

For each of the following types of tailoring examples are provided:

(a) Action tailored communication is information on how to change behaviours and what to do in difficult situations (Kroeze et al., 2008). Action tailored information is used to improve skills and self-efficacy expectations. An example of action tailored communication is feedback about how a receiver could change his diet based on an analysis of the contributing products to saturated fat intake of this participant, and suggestions for dealing with situations in which a receiver thought it would be difficult to reduce saturated fat intake.

(b) Descriptive tailored communication is defined by Hawkins et al. (2008) as information about what is known about the recipient (i.e., attitudes, beliefs, behaviours, etc.) based upon an assessment. This definition is similar to the first part (a) of *personalized tailored communication* (Kroeze et al., 2008), that is (a) information about the receiver's behaviour, (b) a comparison of (a) with the recommended behaviour, and (c) a comparison of (a+b) with the receiver's perception of his/her own behaviour (e.g., perceived as low fat intake compared to actual high fat intake). Because part (b) and (c) are also referred to as evaluative tailored communication and to facilitate future communication about these types of tailored communication, we will refer to personalized or descriptive tailored communication as defined by Hawkins et al. (2008; thus excluding part (b) and (c) from Kroeze et al., 2008). Hawkins et al. (2008) argue that this type of feedback influences behavioural determinants by stimulating self-referential thoughts about beliefs, behaviours or environmental constraints related to the outcome of interest. In addition, it could build rapport or lower resistance to persuasion through effects as 'feeling acknowledged' or 'feeling understood'. Personalized or descriptive tailored communication differs from personalized communication or personalization, in that the first is used to increase awareness, whereas the second is used to draw attention and enhance message processing. An example of personalized or descriptive tailored communication is feedback about the receiver's fat intake (e.g., 'Based on your answers on the questionnaire, we determined that you eat 24 grams of fat per day').

(c) Normative tailored communication is defined as messages based on a comparison of the receiver's responses to an assessment of the responses of their peers (Kroeze et al., 2008; Noar et al., 2007). This is also referred to as *comparative tailored communication* by Hawkins et al. (2008). Normative or comparative tailored communication may stimulate changes in perceived norms, attitudes or beliefs through effortful processing on self-evaluation and normative comparison (Hawkins et al., 2008). An example of normative tailored communication is feedback about the receiver's fruit and vegetable consumption compared to that of others of the same institution, age or sex (e.g., 'Compared to other women from this health center, you eat fewer servings of fruits and vegetables per day').

(d) Ipsative tailored communication are messages based on a comparison of the receiver's current responses to an assessment with their responses at a previous time point (Noar et al., 2007). This is also known as *iterative tailored communication* (De Vries & Brug, 1999). Ipsative or iterative tailored communication are a form of dynamic tailoring. Both are used to enhance self-monitoring, which may increase central information processing (Dijkstra & De Vries, 1999). An example of ipsative or iterative tailored communication is feedback about the receiver's current energy-saving behaviour compared to the previous year, for example whether the receiver has become more energy-saving, less energy-saving or shows stable energy-saving behaviour.

(e) Evaluative tailored communication involves feedback that makes interpretations, judgments or inferences based on what is known about the receiver's attitudes, beliefs or behaviours (Hawkins et al., 2008). This type of communication is used to change behavioural beliefs through providing new insights to a person's behavioural or psychological state, because the tailoring agent may be perceived credible (Hawkins et al., 2008). An example of evaluative tailored information is 'your physical activity level is well below the recommended level of 30 minutes of moderately intense activity on at least 5 days of the week' or 'you said you intend to start exercising regularly. That could be a good way to lower your blood pressure'. Evaluative tailored communication overlaps with the before mentioned types of tailoring, because all of them may contain evaluative information.

(5) Interpersonal communication is the most individualized form of communication, the communication is delivered by a real life person (Noar et al., 2007). An example of interpersonal communication is a counselling session of a nurse practitioner with a diabetic patient about the patient's lifestyle behaviours. Although interpersonal communication can be generic in nature, for example when the provider delivers general health information without taking into account the characteristics of the receiver, it has the greatest potential to be the most highly individualized due to its real life nature (Noar, Harrington & Aldrich, 2009). The level of individualization depends on the knowledge, skill and motivation of the provider (Spitzberg & Cupach, 1984).

In general, tailored communication has been found to be more effective than targeted or generic communication in promoting health behaviour change (Broekhuizen et al., 2012; Enwald & Huotari, 2010; Eyles & Mhurchu, 2009; Neville, O'Hara & Milat, 2009; Noar et al., 2007; Noar, Black & Pierce, 2009), because it improves exposure and information processing, is better appreciated, and more likely to be read and experienced as personally relevant (Brug, Oenema & Campbell, 2003; Hawkins et al., 2008; Ruiter, Kessels, Jansma & Brug, 2006). Because tailored information is often not delivered by a real life person, the strategy is suitable for reaching large groups of people (Neville, O'Hara & Milat, 2009). Due to their possibilities for a wide reach at relatively low costs, tailored interventions have substantial impact at a population level (Neville, Milat & O'Hara, 2009; Noar et al., 2007). Evidence for the cost-effectiveness of tailored interventions is scarce, however, a study showed that tailoring appeared more cost-effective than a person-delivered intervention (Van Keulen et al., 2010).

Purpose	Theories	Variables types	Specific variables	Outcomes
Match content to individual's information needs & interest	TTM, Stages of change, HBM, SCT, TRA, Extended Parallel Process Model	Psychosocial variables, past behaviour	Attitudes, beliefs, self-efficacy, social norms, perceived susceptibility, perceived severity, behavioural intentions, stage of change, previous behaviour	Persuasion (intervention convinced me)
Use design, production, and channel elements to capture and keep individual's attention	Activation Model Sensation-seeking Targeting limited Capacity Model	Message design variables ('look and feel')	Message sensation value	Attention (intervention kept my attention)
Place information in a meaningful context	Audience segmentation Personalization Culturally-oriented theories	Demographic, cultural variables	Gender, age, race, gender norms, cultural norms, ethnic identity, racial pride, religiosity, collectivism	Perceived relevance (intervention was designed for me and reflects my beliefs and values)
Present information in type and structure preferred by individual	Exemplification Theory Narratives Entertainment Education Message Framing Emotional appeals	Message structure variables (type of appeal)	Narrative versus statistical Gain versus loss framing Fear, guilt, warmth, and other appeals	Message processing (intervention made me thought, I am able to recall information, later on)

ELM = Elaboration Likelihood Model (Petty & Cacioppo, 1981); HBM = Health Belief Model (Janz & Becker, 1984); PAPM = Precaution Adoption Process Model (Weinstein, 1988); SCT = Social Cognitive Theory (Bandura, 1986); TPB = Theory of Planned Behavior (Ajzen & Madden, 1986); TTM = Transtheoretical model (Prochaska et al., 1992)

Table 2. Outcomes which can be achieved by tailoring (adapted from Noar, Harrington & Aldrich, 2009)

Summarizing: Tailoring is within the health education domain a well-defined approach, incorporating an elaborated ontology that positions tailoring on a dimension from generic, targeted, personalized, tailored to interpersonal communication. This dimension is defined by (a) segmentation (i.e., specifying the audience), and (b) customization (i.e., specifying the message). The term tailoring in itself encompasses five different ways of tailoring, like ipsative tailoring wherein current responses are compared to past responses of the receiver.

4   sCET: from theories to behaviour change

Various behaviour change techniques have been developed (e.g., Abraham & Michie, 2008). An application of BCT's may be to integrate these techniques into cognitive systems. Cognitive systems are personal, adaptive and intelligent systems that support human performance in close collaboration in complex task environments (Woods & Hollnagel, 2006). A cognitive system could also be seen as persuasive technology, which is designed to change attitudes or behaviours of the users through persuasion and social influence, but not through coercion (Fogg, 2002).

Within TNO the situated Cognitive Engineering Tool (sCET) has been worked out, so that cognitive systems can be developed that apply behaviour change techniques (BCT). In the sCET, Intervention mapping (IM) and sCE methods are integrated to facilitate (1) theory-based selection and application of BCTs and (2) translation of these behaviour change techniques to a requirements baseline for a cognitive system.

Here the steps are described that are required to select theoretically relevant behaviour change techniques and formalize them in the situated Cognitive Engineering tool. Finally, it provides an illustration of a requirements baseline for a cognitive system applying BCTs.

4.1   How does the sCE Tool work?

Behavior change techniques have been applied and evaluated by scientists in a research setting, but cognitive systems offer new application opportunities. Question is how can we translate BCTs to a cognitive system?

Two methods offer an interesting approach for this translation. These are the Intervention Mapping and the situated Cognitive Engineering. These two methods are integrated in the situated Cognitive Engineering Tool (sCET; http://scetool.nl/), a tool that formalizes the steps taken to design a cognitive system. We will describe these methods here. The two approaches have been applied in combination in the past to develop an eCoach stimulating health-promoting behaviour with people who are overweight (Blanson Henkemans et al., 2012).

4.2   Intervention Mapping

The Intervention mapping (IM) framework offers an approach to determine which technique or combination of techniques can be applied to stimulate healthy behaviour (Bartholomew et al., 2011). IM describes the process of health promotion programme development in six steps, which are:

1. Conducting a needs assessment: identify the population, their health problems and/or quality of life, distinguish environmental and behavioural causes and key determinants;

2. Develop program objective matrices: state expected changes of behaviour and environment, specify performance objectives and determinants, differentiate the target population and create matrices of objectives versus determinants;

3. Select theory-based intervention methods and practical strategies for behavioural and environmental change: brainstorm methods, translate methods into strategies influencing determinants, and organize strategies;

4. Produce program components and materials for behavioural and environmental change: operationalize strategies and pre-test program material with target groups and implementers;

5. Realize program adoption, implementation and sustainability: specify adoption and implementation performance objectives, create matrix or planning table, and write an implementation plan;

6. Evaluate the proposed program: develop an evaluation model, effect and process evaluation outcomes, indicators and measures, and write an evaluation plan.
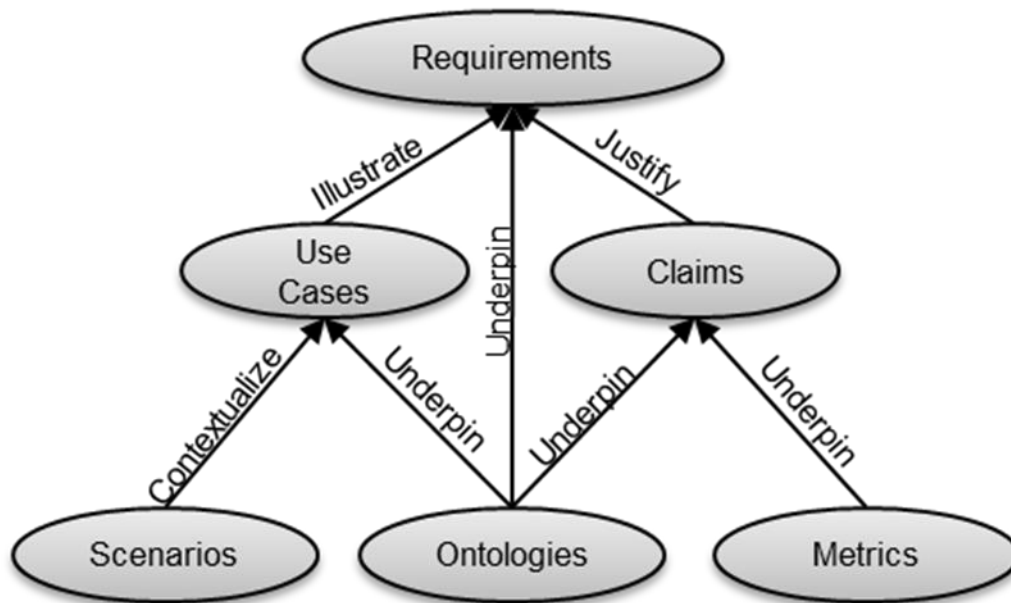
By applying IM, one can map the path from recognition of a need or problem to the identification of a solution on different levels (i.e., at risk population and intermediates).

4.2.1   Situated Cognitive Engineering

Situated Cognitive Engineering (sCE) is an approach for developing cognitive systems, which focuses on how humans cope with complexity, how work is accomplished by the use of artefacts, and how human-machine systems and socio-technical systems can be described as joint cognitive systems

(Neerincx & Lindenberg, 2008). The sCE method offers an approach to translate behaviour change techniques to a requirements baseline. A requirements baseline is a collection of requirements (e.g., "the system shall provide motivating feedback" and "the system shall guide the user to choose between multiple healthy options") that a particular cognitive system will fulfil through its functionalities (e.g., the system displays text messages, which compliment the user on realizing personal health goals, and the system offers a list of different healthy options, each with benefits and downfalls for the user). Figure 7 illustrates the specification phase of sCE, namely the development of requirements. The requirements jointly form the baseline for review, development and evaluation of a cognitive system.

Figure 7: Specification phase of the situated Cognitive Engineering and its core modules

The core of sCE consists of the following modules:

- Scenarios, which support reasoning about situations of use;

- Use cases, which provide the (formal) contextualization (conditions, scope);

- Requirements, which describe what the system should do;

- Claims, which provide the justification (why) ;

- Metrics, which enable the measurement of claims;

- Ontologies, which define the used concepts and their relationships

Previously, the situated Cognitive Engineering (sCE) method has been proven useful for developing cognitive systems supporting self-management (Blanson Henkemans, 2009).

4.2.2   Formalizing Behavior Change Techniques in sCET

Now, we discuss how to formalize BCTs within sCET. The first step is selecting appropriate BCTs. Second, the outcomes of the steps are entered in the different modules of sCET.

Selecting BCT

Following the IM framework, the selection of the BCT takes place during the first three steps:

1. Conduct a needs assessment:

    a. Determine the (health) issue (e.g., being overweight);

    b. Determine the risk factors, related to behaviour (e.g., overeating) and environment, (e.g., availability of food in the house);

     c. Describe the at risk population to which these risk factors apply (e.g., young women);

     d. Illustrate how risk factors lead to health issue (e.g., adolescent is alone, sitting depressed at home and falls back to eating);

     e. Choose theories and models which explain behaviour (of both the at risk population and actors of influence in the environment) and which indicate how to affect it (e.g., Elaboration Likelihood Model; Petty & Cacioppo, 1986);

2. Develop matrices of change objectives:

     a. Determine performance objectives for the at risk population and their environment to mitigate the health issue (e.g., develop an alternative response to feeling depressed besides eating);

     b. Assess, from theories and models, which determinants explain both risk behaviour (e.g., overeating) and behaviour to realize performance objectives (e.g., attention);

     c. Describe change objective, i.e., activity that shows that a determinant has changed and contributes to realizing performance objectives (e.g., girl focuses less on food);

3. Select theory-based BCTs and practical application:

     a. Assess, from theories and models, which BCTs have been proven effective in influencing determinants to realize performance objectives (e.g., attention bias modification treatment);

     b. Determine which boundary conditions apply to BCTs (e.g., effects have been found with regard to snacking attitudes and behaviour);

     c. Describe how BCT is applied for specific actor and determinants, considering relevant boundary conditions (e.g., girl plays cognitive bias modification game).

Step	Leaf in sCET (branch)	Comment	Example
1. Health issue	Problem Definition (Operational Demands)		Being overweight
2. Risk factors: behaviour and environment	Problem behaviour and Situational Factors (Operational Demands)		Overeating, being depressed, being alone, availability of food at home
3. At risk population	Actor (Operational demands)		Young woman
4. Illustration of risky situations	Problem scenarios (Operational Demands)	Illustration of how risk factors lead to health issue without system support. Design scenario shows how system helps tackle risk factors.	Adolescent girl is alone, sitting depressed at home and falls back to eating
5. Performance objectives	Performance objective (Operational demands)		Break behavioral patterns
6. Theories and models	Theories and models (Human Factors)	Theories and models lead to both the determinants that *explain* behaviour and the techniques to *affect* behaviour. Behavior relates to the population at risk and persons who can influence the environment (i.e., intermediates)	Reflective impulsive model
7. Determinants	Determinants (Human Factors)		Attentional bias
8. Change objectives	Change objectives (Specifications)	Change objectives are described as desired activity, displaying that determinant has changed.	The user will focus more on health stimuli and less on unhealthy stimuli
9. BCTs	Change techniques (Human Factors); Mapping (Specification)	Change techniques are entered in Change techniques and subsequently selected in Mapping if theoretically effective	Attention bias modification treatment (ABMT)
10. Boundary conditions	Boundary conditions (Human Factors); Mapping (Specification)	Boundary conditions are entered in Boundary conditions and subsequently selected in Mapping if theoretically relevant	Effects have been found with regard to snacking attitudes and behaviour
11. Application BCT	Mapping (Specification)	BCTs are mapped to determinants of actors and translated to application, while considering boundary conditions	Play cognitive bias modification game (CBMG)

Table 2: BCT section steps divided across leaves of sCET

Entering BCT in sCET

Table 2 lists the steps of selecting and applying behaviour change techniques and how they are formalized in sCET.

Translating BCT to a requirements baseline

The description of a BCT application provides direction for the requirements baseline, consisting of scenarios, uses cases, requirements, claims, metrics and ontologies. In this section we will focus on uses cases, requirements, and claims.

The first step is the description of use cases. Use cases describe how the system interacts with the user to apply the BCT (e.g., system invites user to play cognitive bias modification game).

Second, use cases determine what requirements the system has to fulfil. For example, the ePartner shall provide constructive feedback on performance in relation to personal goal. The collection of the requirements forms the requirements baseline.

Claims describe the hypothetical effect of the requirements and the potential benefits and drawbacks when these requirements are fulfilled. An example of a claim is that user decreases approach tendencies towards unhealthy stimuli.

In this description, we propose a chronological order of the specification phase (i.e., use case → requirement → claim), but in practice the application order can alternate. For example, one could start with defining the requirements, and then illustrate them in the use cases.

Once the requirements baseline is set, the review, development and evaluation of the cognitive system can begin (Figure 8). During the review, experts review the requirements baseline. During the development and evaluation, the different requirements are implemented in a prototype containing different functionalities. For example, to provide the user feedback on performance in relation to goal, the system could include the following functionalities:

- A Cognitive Bias Modification Game goal repository;
- A competence repository;
- A user model for user preference and performance data storage;
- Dialogue manager for constructive feedback.

Following, the prototype is tested by the target group in pilot and field settings.

During review and testing, the metrics are measured to validate and falsify the claims. Based on the outcomes, the requirements baseline is augmented and refined.

Figure 8: Evaluation phases of sCE.
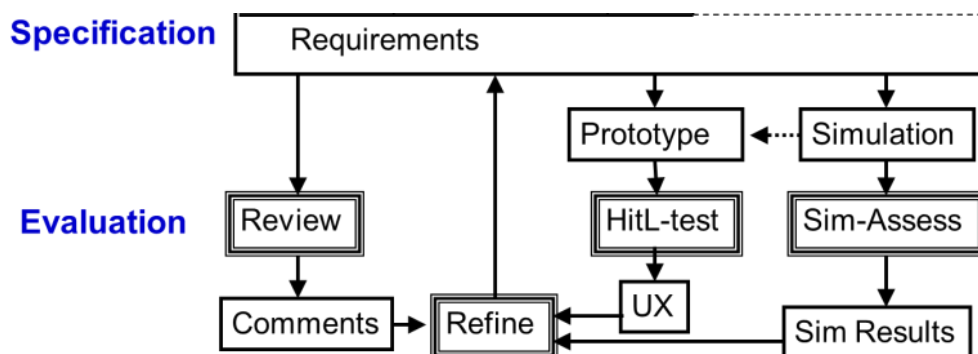
4.3   Use of the sCE Tool in With-Me

In the With-Me project the sCE Tool will be used to support the development of the cognitive systems that are being designed in the different pilots. All pilots have provided input for the first steps of the sCE-process. Therefore we used an offline version ('paper-and-pencil') of the Intervention Mapping-module in sCET. This module can be turned on in the tool-section of sCET. The module than functions

as a layer over the original sCE-steps. In Appendix 8.3. the first filled-in steps of the offline tool for the Belgium pilot is shown. The tool will be used in the next steps of the With-Me project.

5   Behavior change techniques and application to Belgium pilot

In this section we describe behaviour change techniques per motivational theory. In addition we have written a short scenario to illustrate how this could be applied in With-Me. We chose the Belgium pilot to do this, but the techniques can also be applied to other pilots.

We recommend that the application of behaviour change techniques into specific with-me cognitive systems is done in close collaboration between psychologist and designers. From experience we know it will take some time and effort to understand each other, and to design successful applications of the behaviour change techniques.

Figure 9. The knowledge and expertise of psychologist and that of designers comes together in writing scenarios: how does a person use the technology on a day to day basis.
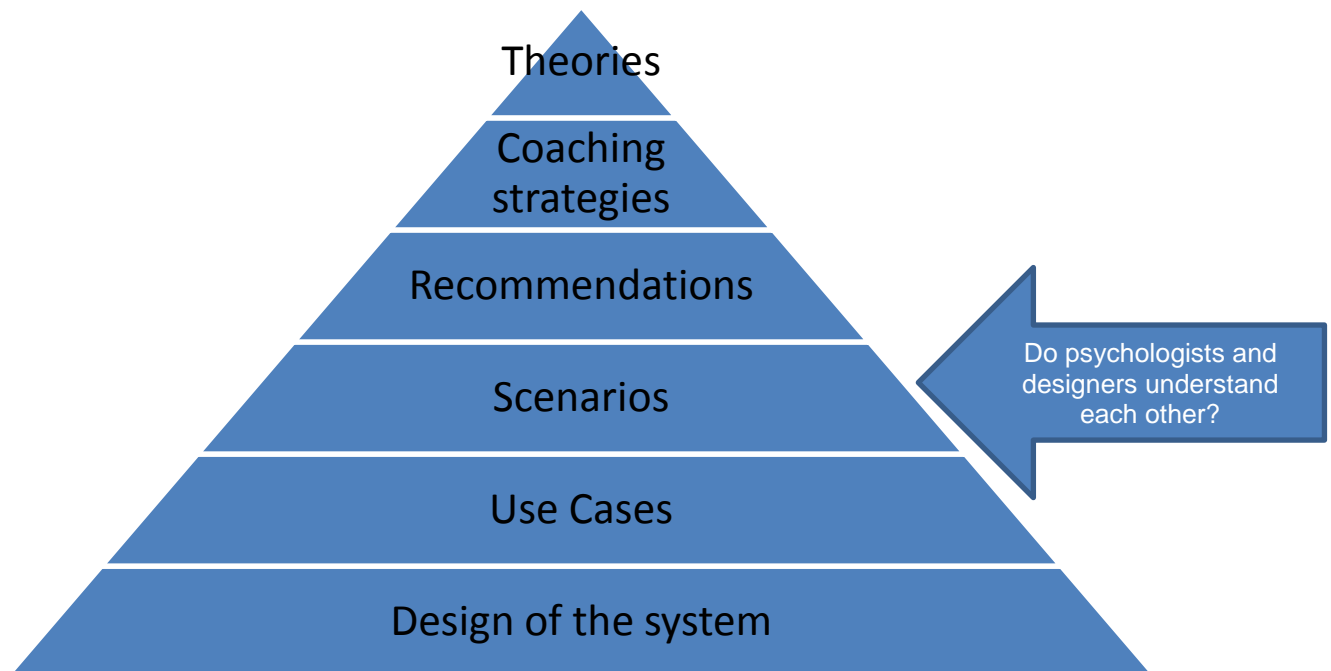
5.1   Self-determination theory

5.1.1   BCT: Self-Monitoring

To satisfy the need for competence, the behaviour change technique "Self-Monitoring" could be used. When applying self-monitoring, a person is asked to keep a record of specified behaviour(s) (e.g., in a diary). This can be done on paper, or digitally (Burke, Wang, & Sevick, 2011). It was found that self-monitoring is more effective when in a PDA format, than when keeping a paper record (Burke et al., 2012).

Application Belgium Pilot
Peter has an objective of 30 minutes of moderate exercise every day. During the day he can see his progress on this target. He gets instant feedback from the system to reward him when doing fine or to stimulate him when falling behind. He can see his graph of this objective, his rewards and the coach can use these to give him some more feedback.

5.1.2   BCT: making own choices / motivational interviewing

To satisfy the need for autonomy, the With-Me System should be driven based on choices made by the user (coachée), instead of having the system (or coach) make decisions for him. Motivational interviewing is a method in which this is used. Motivational interviewing assumes that direct persuasion is not an effective method for resolving ambivalence. The method uses asking questions and summarizing to come to certain behaviour and decisions (see for example Miller et al., 1992).

> **Application Belgium Pilot**
>
> Peter is able to tailor his dashboards, he can adapt his goals and objectives (the coach gets a warning about these choices). When faced with a problem Peter gets different questions, his answers to these questions generate a next set of questions, information or actions from which he can choose. In this way part of a motivational interview can be created.

5.1.3   BCT: providing an interpersonal environment and social support

To satisfy the need for relatedness, the With-Me system can have the possibility to have a community of peers or friends.

> **Application Belgium Pilot**
>
> Peter entered a peer group on the platform. This group is based on the goals and objectives, age and if preferred even gender. This group has a forum where they can talk about their progress, barriers or whatever. Peter can also introduce friends to the system. Peter chose to take on the role as motivator. He tries to stimulate as much people as he can. This has a positive effect on his With-Me status.

5.2   Theory of Planned Behavior – BCT: Creating a different norm

Behavior is affected by social influences in several ways. The most common way by which people are influenced, is trough social norms. Social norms are rules that are understood by members of a group, and that guide and/or constrain social behaviour without the force of laws. These norms may evolve out of interaction with others; they may or may not be stated explicitly, and any sanctions for deviating from them come from social networks, not the legal system (Cialdini & Trost, 2008). By making norms more visible you can influence people's behaviour. There are different norms that can be made more visible:

Subjective norms

A subjective norm is the person's perception that most people that are important to him think whether he should or should not perform the behaviour in question.

Descriptive norms

One source of evidence that people take into account when trying to maximize the effectiveness of their social behaviour, is the descriptive norm operating in the situation. Descriptive norms are derived from what other people do in any given situation. When the appropriate behaviour is unclear, people tend to rely on "social reality" as displayed by others. The greater number of people who respond to the same situation in the same way, the more correct we perceive the behaviour to be. A wide array of research shows the substantial effect descriptive norms have on action (see e.g., Cialdini & Trost, 1998).

Injunctive norms

Injunctive norms specify what "should" be done, rather than what is done in a certain situation. They characterize what most people approve or disapprove. Injunctive norms motivate behaviour by promising social rewards of punishments for it. Injunctive norms are pervasive, and argued to explain behaviour substantially (Cialdini & Trost, 1998). i.e people tends to keep clean and not litter in places that are clean, this tendency is even reinforced if they see someone pick up trash instead of throwing it[1].

> **Application Belgium Pilot**
>
> Peter has never seen a lot of influential others who behave in line with his goals and objectives (descriptive norm). Although his parents criticized him continuously, due to their busy job they didn't make time to exercise or to eat healthy themselves. His fellow classmates and colleagues in ICT were also never involved in a lot of healthy behaviour. By creating a community in With-Me of peers and/or colleagues who so show healthy behaviour a new subjective norm can gradually be installed.

5.3   Dual process theory (unconscious route) – BCT: Approach-avoidance training

Approach-avoidance training refers to training of motoric response inhibition or activation by consistently pairing stimuli with an approach or an avoidance action. During approach/avoidance training, people are generally presented with either unhealthy or neutral/healthy stimuli, and are

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[1] http://www.psychwiki.com/wiki/PSY322-Injunctive_Norms

instructed to push the joystick in response to unhealthy stimuli, and to pull it in response to neutral/healthy stimuli.

For example: This method has been successfully used to reduce automatic action tendencies towards the hedonic alcohol related cues in hazardous drinkers (Wiers, Rinck, Kordts, Houben & Strack, 2010). In a joystick task, wherein participants were instructed to pull or push, the movements where either consistently and respectively paired with soft drinks and with alcohol pictures (experimental condition), or vice versa (control condition). The training reduced automatic action tendencies to approach alcohol, and participants in the experimental condition drank less alcohol after the approach/avoidance training.

Some boundary conditions for successful application of approach-avoidance training should be noted:

- Whether the effect of approach/avoidance training goes via attitudes or by changing other cognitive processes remains unclear relying on the current studies. Effects on the tendencies themselves and actual behaviour have been found, but research on mediation effects in order to specify the underlying process has yielded mixed results (see for instance Wiers, Eberl, Rinck, Becker & Lindenmeyer, 2011; MacLeod, Koster, & Fox, 2009).
- Although the example above illustrates an effect of approach/avoidance training on reducing action tendencies towards the hedonic goal, theoretically approach/avoidance training can also be implemented to create approach tendencies for control goal (Wiers et al., 2010), though no studies aiming at creating approach motivation towards wanted responses using training are known. Even though approach avoidance training has been effective in retraining approach avoidance training in the domain of alcohol abuse, effects of such training in other domains remain to be tested.

Application Belgium Pilot

Peter has a tendency to eat fatty foods. The With-Me system suggests to play a little game (Smartphone application) where Peter has to toss hamburgers in a trash bin and catch fruits and vegetables. Peter likes the game a lot. He shows it to other people and is able to play it against them. He even likes the fact that he has a high score and he listed it with the nickname the greasemaster.

5.4   Self-regulation theory

5.4.1   BCT: Providing feedback on outcomes of behaviour

Feedback is essential for pursuing goals, since it gives you information whether or not you are reaching the goal. Feedback enables individuals to adjust their efforts and decide which goals to pursue, and which to let go (at least temporarily). Thus, feedback affects goal persistence, disengagement, and goal change. You can provide feedback on in which degree a person shows the intended behaviour (e.g. exercising), or whether a specific goal is reached (e.g. losing 20 pounds). There are numerous ways to provide feedback. It should always be adapted to the person receiving the feedback, and the context.

Positive versus negative feedback

One distinction that can be made in providing feedback, is whether you choose for positive or negative feedback. People express greater motivation to persist on a goal after they receive either positive or negative feedback, however, there are some differences in when positive or negative feedback works best.

Positive feedback increases motivation when it increase the belief that you have the ability to pursue the goal, that you will be successful. Or when you associate the positive feedback with increased goal value. Positive feedback serves as an incentive, something that triggers positive affect. Negative feedback, on the other hand, can undermine motivation by lowering the expectancy of success.

In contrast, negative feedback increases motivation through a discrepancy-reduction mechanism: you can see you have not reached the goal yet, and your efforts should be increased. Sometimes, positive feedback can lead a person to think a goal is (almost) reached and energy is needed for other (neglected) goals.

When positive feedback is useful, negative feedback is often harmful. More specifically, more recent work on regulatory focus theory argues that negative feedback is particularly effective for the pursuit of prevention goals and might be less effective for the pursuit of promotion goals. These differences in

effects of positive and negative feedback become more pronounced as the goal end state became closer. Positive feedback on distant goals increases motivation to pursue the same goals in the present because it signals a boost in commitment. In addition, negative feedback on proximal goals increases present motivation because it signals insufficient goal progress.

For example, a researcher found that those dieters who felt good about their achievement at the beginning of their diet increased their effort more than those who were disappointed with their achievement. But later on the pattern reversed: those who felt good toward the end of their diet when they were about to meet their weight-loss goal, relaxed their dieting efforts compared with those who were less satisfied with their achievement.

Attribution: signal of commitment or progress?

It depends on the attribution of feedback, the way in which it is interpreted, whether it will motivate or demotivate certain behaviour. Locus of control (internal vs. external), stability (causes change over time or not), and controllability (high vs. low). Can I become better in the thing I am trying to do by increasing effort? Or do I think it is a stable trait?

When people interpret pursuit of a goal as a signal of their commitment, they highlight that goal after successful pursuit. That is, they prioritize the goal by making consistent choices after successes and forgoing the goal after lack of successes. When people interpret pursuing a goal as a signal of their progress, they balance between this goal and others. In doing so, they alternate goals after successes and focus on pursuing the focal goal after unsuccessful actions. A number of variables, then, influence whether people represent goal pursuit in terms of commitment or progress and thus, whether they then exhibit a dynamic of highlighting and increase engagement in response to positive feedback, or a dynamic of balancing and increase engagement in response to negative feedback.

Positive feedback on distant goals increases motivation to pursue the same goals in the present because it signals a boost in commitment. In addition, negative feedback on proximal goals increases present motivation because it signals insufficient goal progress.

Pre-existing levels of commitment to a goal also determine whether people interpret their actions as a signal of commitment or of progress and their subsequent response to feedback. People wish to evaluate their commitment when it is relatively low, and consequently, they are more likely to persist on the goal after receiving positive feedback signalling the goal is important and worthwhile. However, when goal commitment is high, people ask about their pace of progress and are more likely to persist on a goal after receiving negative feedback because negative feedback signals to the committed individuals greater discrepancy and need for progress.

For example, a researcher found that those dieters who felt good about their achievement at the beginning of their diet increased their effort more than those who were disappointed with their achievement. But later on the pattern reversed: those who felt good toward the end of their diet when they were about to meet their weight-loss goal, relaxed their dieting efforts compared with those who were less satisfied with their achievement.

Application Belgium Pilot

Peter's physical activity results are shown in a graph. This graph depicts what he has done so far but there is also a future timeline where Peter can see what his results will be if he sticks to the plan. He can also see future goals (rewards) on this timeline. If he hovers over those goals, he receives an explanation on how to reach them. On this timeline there can be automatic messages to stimulate him. Peter can even add motivational quotes himself (or he can choose them from our motivational quotes gallery. Under the graph there is the possibility to share the graph with people who can give feedback on his progress. Peter chooses whether he wants this feedback and from whom. He invites a supportive friend, Xavier from the With-Me community. He does not invite his parents.

5.4.2   BCT: Implementation Intentions

Forming implementation intentions is a behaviour change technique subordinate to forming goal intentions. Implementation intentions specify the how, when and where of responses to goal attainment (Gollwitzer, 1999). An example of such an implementation intention is: "When I see chocolate bars in the supermarket, I will buy carrots instead!" Implementation intentions are effective in changing behaviour because of a strengthened cue (if)-behaviour (then) association as the mechanism. That is, by forming implementation intentions, control of behaviour is delegated to specified situational cues that initiate action automatically (Webb & Sheeran, 2007).

Some boundary conditions for successful application of implementation intentions should be noted:

- First of all, tailoring implementation intentions to one's personally relevant reasons yields bigger behavioural effects (Adriaanse, de Ridder, & de Wit, 2009).
- Second, when the behaviour has a strong habitual component, implementation intentions tend to have a minimal effect of behaviour change (Webb, Sheeran, & Luszczynska, 2009).
- Third, implementation intentions are ineffective when they have a negating structure, e.g. if (situation), then not (action) (Adriaanse et al., 2010). This implies that they are effective in initiating new, wanted behaviour, but not in withholding unwanted responses. Implementation intentions can help to prevent unwanted responses though, if the critical cue for eliciting the unwanted action is identified and replaced by a new, wanted if-then sequence, creating new cue-response associations (Adriaanse, de Ridder, & de Wit, 2009).

For example: Implementation intentions have been used as a change method in several domains. In the domain of physical exercise, Prestwich, Lawton and Conner (2003) researched whether forming implementation intentions has an additional effect over a motivational intervention. The motivational intervention involved completing a decision balance sheet that reflected anticipated gains and losses that would accrue from increasing exercise by two sessions a week. Findings from a behavioural follow-up indicated that participants who completed the motivational intervention and formed implementation intentions were most likely to increase physical activity. Hence, implementation intentions have a behavioural effect, additive to other behaviour change techniques.

Application Belgium Pilot

Peter enters the implementation intentions application. The With-Me system asks him some questions about his new exercise program. These questions are based on the most common barriers people experience. For example the system will ask: "Peter what will you do when you want to go Nordic Walking and it is raining" Peter can choose possible answers from a list or create an answer himself. In this case he creates one by himself: "I will put on my shoes and my windproof, waterproof jacket and go out anyway". Once in a while this question will be asked spontaneously by the system. Also he can highlight a training session where he realized this intention.

5.5   Theories on emotions – BCT: Narrative persuasion

Narrative persuasion refers to the use of narrative messages (narratives) as a persuasion tool. Narratives are messages that present information in a story format as opposed to an abstract format. They are designed to engage the audience, and typically involve a protagonist, and contain emotionally appealing information. In some cases, storylines are embedded with the intent of influencing behaviour. In other cases, the storylines are added for their dramatic appeal but nonetheless may incidentally promote healthy behaviours (Moyer-Gusé, 2008).

For example: McQueen and Kreuter (2010) exposed women to either an informational video about breast cancer, or a narrative video. The videos provided the same information but in a different format. The informational video provided the information in a didactic, expository form, whereas the narrative video provided the information in the form of personal stories of breast cancer survivors. Women who watched the narrative video experienced more positive and negative emotions, reported stronger identification with the message source, and were more engaged with the video than women who watched an informational video. The narrative video was also better liked, enhanced recall, reduced counterarguing, and increased breast cancer discussions with family members.

Some boundary conditions for successful application of narratives should be noted:

- **Transportation (absorption, engagement)**. The effectiveness of narratives depends on the degree to which people experience transportation. Transportation is defined as "a convergent process, where all mental systems and capacities become focused on events occurring in the narrative" (Green & Brock, 2000). It is the state of being primarily engaged in the storyline, rather than in one's immediate environment, and experiencing cognitive and emotional responses to the narrative as it unfolds. The degree to which one experiences transportation depends on personal as well as message characteristics.
- **Personal characteristics**. Appel and Richter (2010) found that need for affect (i.e., the degree to which people approach emotional stimuli) was positively associated with the extent an individual experiences transportation into the story world and the extent to which his or her beliefs are

affected by the information presented in the narrative. Narratives have been found to be more persuasive than informational messages for individuals who have low need for cognition and low involvement with the message topic. Mazzocco et al. (2010) found that transportability (the tendency to become transported into narratives) predicts the degree of attitude change as a result of exposure to a persuasive narrative. Slater and Rouner (1996) found that statistical evidence was more persuasive when the message was congruent with recipients' values and that narrative evidence was more persuasive when the message was incongruent with their values.

- **Message characteristics**. Transportation is thought to be greater when the storyline appeals to the person exposed to it, the quality of production (writing, filming, etc.) is high, and when the subtext is unobtrusive (e.g., a persuasive subtext should not interfere with the storyline (Slater & Rouner, 2002). Good craftsmanship entails the use of imagery and stylistic techniques such as metaphor, irony, and alliteration (Green & Brock, 2005). Keer, Van den Putte, De Wit, and Neijens, (2013) found that testimonials (a form of narratives) were judged more positively and perceived as more persuasive when they include affective rather than instrumental arguments. Affective arguments are arguments pertaining to the affective consequences of a behavioural decision (e.g., "If I exercise regularly, I will feel energetic."). In contrast, instrumental arguments pertain to the instrumental consequences of a behavioural decision (e.g., "Regular exercise is good for my cardiovascular system." Braverman (2008) found that testimonials were more effective when they were presented in an audio format rather than a written format.

- **Involvement with characters**. The degree of involvement with story characters is thought to positively affect the persuasiveness of a narrative. Involvement with characters is an umbrella term encompassing among others identification with characters, similarity, and liking (Keer et al. 2013).

Application Belgium Pilot
Peter is not convinced that his eating pattern is flawed. He is not convinced that breakfast is the most important meal of the day. As Peter has a high need for affect and a low need for cognition, we chose a video based narrative testimonial of Xavier (ICT professional, overweight, got bullied at school, has hardworking unsupportive parents) where Xavier gets interviewed at his lowest point. He is practically at tears about wanting to make a change in his life. A short action part where he is showing his efforts (with a small part of the bigger picture explaining the importance of eating healthy and regularly) and an interview about how he is feeling now and what his results are.

5.6   Social Cognitive Theory – BCT: Modelling

Modelling is a behaviour change technique in which an expert shows the person how to correctly perform a behaviour. A role model (coach –real or avatar-, peer) that has certain characteristics in common with the user, provides him information. This will convince a coachée that he is also able to change his behaviour in a similar way. Therefore his self-efficacy will grow (Bandura, 1986).

Some boundary conditions for successful application of modelling should be noted:

- The model should be representative for the user.
- The model must be (intrinsically) rewarded

Application Belgium Pilot
Peter is linked to coach Johan (Real or avatar) who is a bit older but not too much, who is interested in computers and who has knowledge about parental pressure. Peter is also introduced to Xavier. Who is also an ICT professional, about the same age as Peter and who shares his experiences and results with Peter by standardized examples in the system, by video messages or even true skype meetings. Xavier becomes a role model or mentor for Peter.

6   Gap analysis

Many tools, products and apps, that could support a person to obtain a healthy lifestyle, are available on the market. Sensors like Fitbit, Misfit Shine and the Nike+ Fuel Band (see Figure 10), help people to monitor physical activity and sleep quality. Apps and online platforms exist in all kind of formats, for example:

- **Vojo** (http://vojo.fi/?p=57) is an iPhone application that helps people to recognize and share meaningful moments in their lives, and to understand what makes them feel good, thus impacting well-being and vitality.

- **WalkingSpree** (http://www.walkingspree.com/) provides an online program that encourages people to be more physical active. The system exists of a pedometer, interactive food & body trackers, and an online community. Focus lies on tracking data and sharing on social media. The system provides a feature for individual encouragement messages.

- **RunKeeper** (http://runkeeper.com/) exists of a smartphone app and an online community (see Figure 11). It tracks physical activity through GPS and manual logging, it provides training programs and offers a feature to share results on social media.

A more extended overview on existing technology can be found in DT1-2: State-of-the art report on health prevention.

Figure 10: (1) Fitbit, (2) Nike+ Fuel Band

Figure 11: Runkeeper on iPhone

Although some of these tools, products and apps do apply behaviour change techniques, most only focus on one or two aspects of motivation. Our experience is that many existing solutions mainly focus on tracking data and providing feedback by presenting data in graphs and numbers. Some provide a feature to set goals and sometimes social interaction is implemented, mainly by allowing users to share results on social media.

A recent study of Pagoto et al. (2013) found that many weight loss apps on the market do not employ long-established behaviour change techniques to bring about behaviour change. For their study they used a list of 20 behaviour change techniques, commonly included in evidence-based behavioral weight-loss interventions from the Diabetes Prevention Program (DPP) Lifestyle Intervention Protocol (e.g. goal-setting, problem-solving). Only two out of the 30 apps they examined, used 13 out of the 20

behaviour change techniques. Most commonly used techniques were goal-setting and self-monitoring. They conclude that weight-loss mobile apps have proliferated in the marketplace, but appear to reflect a narrow range of behaviour change techniques, although the quality of the apps varies. This study was not the first to analyse whether weight loss mobile apps followed long held guidelines.

Despite the limitations of these studies, it does indicate that there is still a need for high quality platforms -like With-Me- that combine good design with existing knowledge of social sciences. Such platforms should combine different behaviour change techniques, adjusted to different types of users and contexts in which the system will be used. Combining these techniques and therefore focusing on different aspects of motivation and behaviour change, will enlarge the impact of such a system on the habits of a user.

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8   Appendices

8.1   Appendix 1: the Mind map
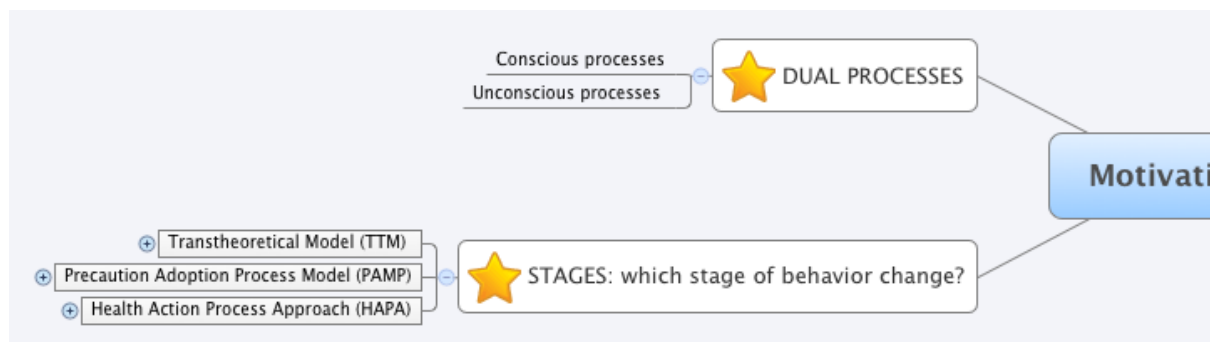
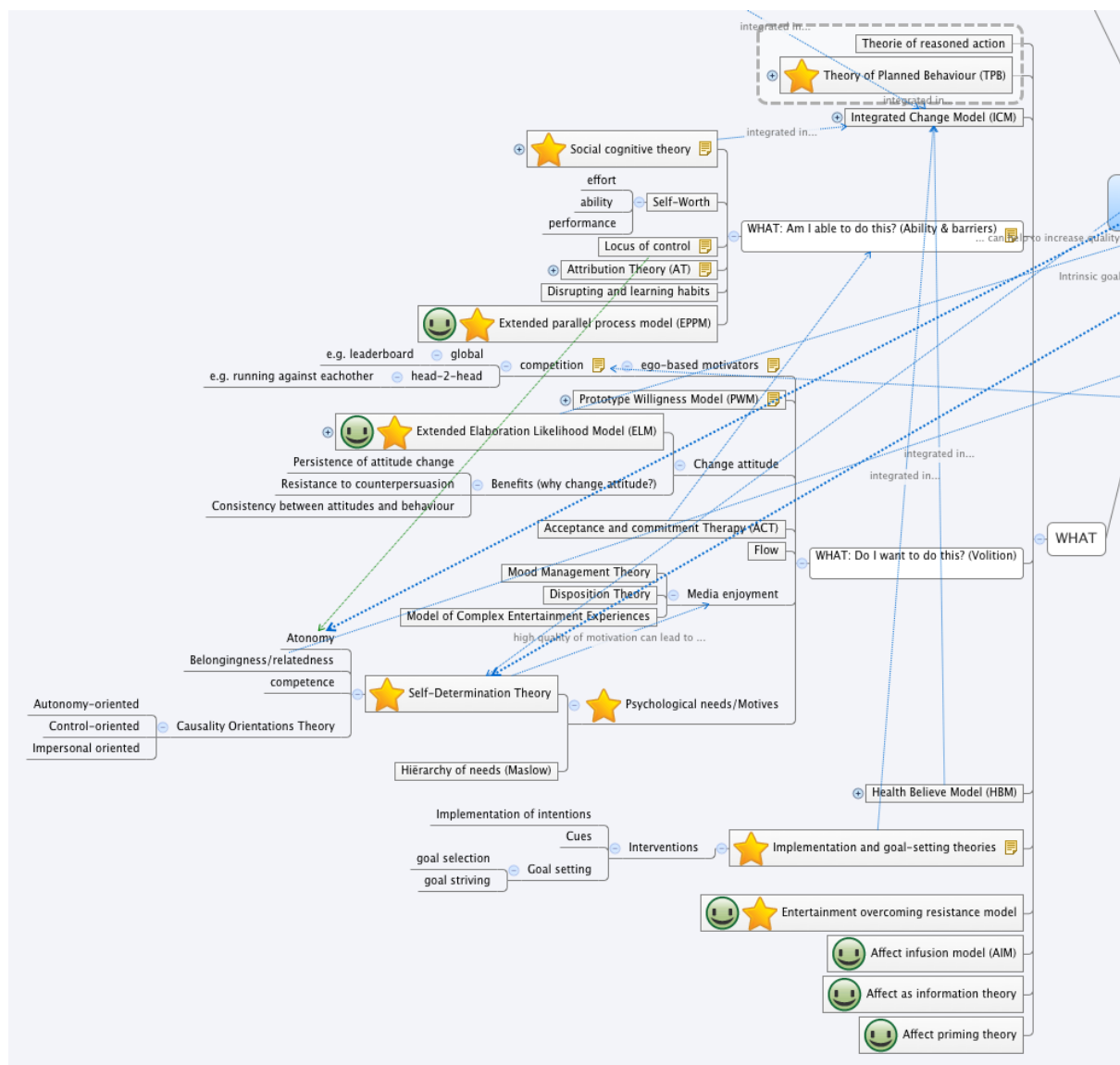Figure 12: Branches Dual processes and Stages
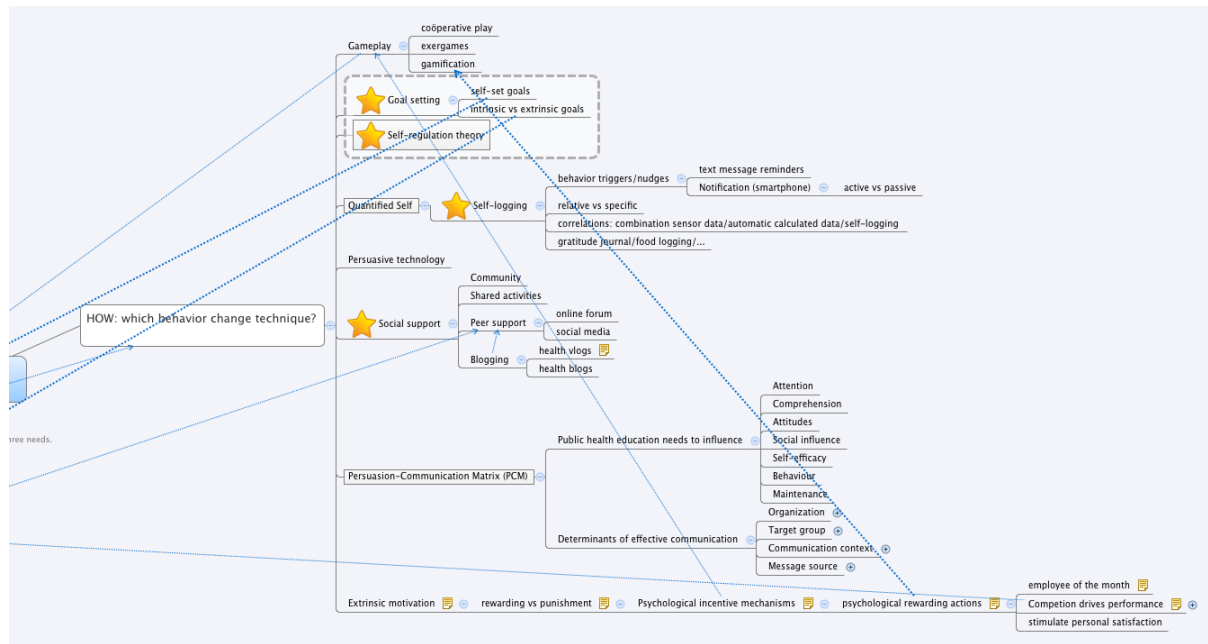

Figure 13: Branche What

Figure 14: Branch How

8.2   Appendix 2: Screenshots Wiki (wiki.scetool.nl)

Figure 15: Wiki Main page

Figure 16: Wiki Theories

Figure 17: Wiki Determinants

Figure 18: Wiki methods

Figure 19: Wiki Behavior Change Techniques

Figure 20: Wiki BCT: implementation intentions

SCET
The Student Cognitive Engineering Tool

Pagina | Overleg   Lezen | Brontekst bekijken | Geschiedenis weergeven   [OK] [Zoeker

Implementation intentions

Inhoud [verbergen]
1 Method / behavior change technique description
2 Example
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4 Boundary conditions
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Navigatie

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Method / behavior change technique description

Forming implementation intentions is a behavior change technique subordinate to forming goal intentions. Implementation intentions specify the how, when and where of responses to goal attainment (Gollwitzer, 1999). An example of such an implementation intention is: "When I see chocolate bars in the supermarket, I will buy carrots instead!" Implementation intentions are effective in changing behavior because of a strengthened cue(if)-behavior(then) association as the mechanism. That is, by forming implementation intentions, control of behavior is delegated to specified situational cues that initiate action automatically (Webb & Sheeran, 2007).

Example

Implementation intentions have been used as a change method in several domains. In the domain of physical exercise, Prestwich, Lawton and Conner (2003) researched whether forming implementation intentions has an additional effect over a motivational intervention. The motivational intervention involved completing a decision balance sheet that reflected anticipated gains and losses that would accrue from increasing exercise by two sessions a week. Findings from a behavioral follow-up indicated that participants who completed the motivational intervention ánd formed implementation intentions were most likely to increase physical activity. Hence, implementation intentions have a behavioral effect, additive to other behavior change techniques.

Theory

The formation of implementation intentions delegates control over goal-directed action to the situation, similar to the operation of habits. However, the automatic control implied in implementation intentions is created at once through a willful act, rather than established over time via repeated pairings of stimulus and response (de Ridder & de Wit, 2006).

Boundary conditions

Some boundary conditions for successful application of implementation intentions should be noted:

First of all, tailoring implementation intentions to one's personally relevant reasons yields bigger behavioral effects (Adriaanse, de Ridder, & de Wit, 2009).

Second, when the behavior has a strong habitual component, implementation intentions tend to have a minimal effect of behavior change (Webb, Sheeran, & Luszczynska, 2009).

Third, implementation intentions are ineffective when they have a negating structure, e.g. if (situation), then not (action) (Adriaanse, Van Oosten, De Ridder, De Wit, & Evers, 2010). This implies that they are effective in initiating new, wanted behavior, but not in withholding unwanted responses. Implementation intentions can help to prevent unwanted responses though, if the critical cue for eliciting the unwanted action is identified and replaced by a new, wanted if-then sequence, creating new cue-response associations (Adriaanse et al., 2009).

Determinants

- Accessibility

8.3   Example of sCE-tool: the offline Intervention Mapping module filled in for the Belgium pilot

With-Me: Belgium Pilot Peter; 15 october 2013
Pilot leader: Wouter Goris, R2i, wouter_goris@ready2improve.eu

Introduction

Developing and evaluating an intervention for changing behavior can be complicated and challenging. Therefore, we created an online tool that can facilitate the process, combining two different design methods.

Intervention Mapping (Bartholomew, et al., 2011) is a method for developing and evaluating health related interventions in a systematic and theory-based manner for various stakeholders (i.e., end users and intermediates). Situated Cognitive Engineering (sCE) is a method for developing and evaluating cognitive systems. Combining these two methods in the situated Cognitive Engineering tool (sCET) enables developing and evaluating cognitive systems supporting behavior, such as ePartners.

In short: the tool helps you to think about the problem, how the problem is caused, and how your intervention can solve this problem by using behavior change techniques. It also helps to think about the use and design of your E-partner concerning these techniques.

This document is an offline representation of the online tool. Online the tool is smarter than offline. Online the tool links information together to help the user as much as possible.

The steps in the tool:

1. Needs Analysis: *what is the (health) problem? What (lack of) behavior and environmental factors cause the problem?*
2. Change Objectives: *what do we want to change to address these causes?*
3. Behavior Change Techniques: *which techniques can we apply to realize these changes?*
4. Design: *how can we apply these techniques?*
5. Evaluation: *what is the effect of the application?*
6. Implementation: *what is needed for the application to be successfully used?*

Step 1: Needs Analysis

- <u>1.1 Problem Definition</u>

Guiding questions:

1. What is the central problem that needs to be understood and addressed?
2. Why is a particular issue perceived as a problem in the first place?
3. For whom is it a problem?
4. What causes the problem and how do these causes affect the problem?
5. Who should be convinced of the problem?
6. Whose cooperation is necessary to help solve the problem?

The first problem at hand is that many people in the Western world suffer from overweight, leading to high cholesterol and other health problems. A large part of them even are clinically obese.

This is a problem for the people suffering from obesity, since their quality of life is diminished, both physically (e.g. sweating, problems going up the stairs, …) and mentally. In addition it is a problem for employers, since the quality of their employees can diminish as they might be unhappy and might have problems staying concentrated for a longer period of time. Also their employees will be sick more often. Finally it costs society a lot of money on healthcare, since overweight eventually will lead to diseases and health problems for which people will address a doctor.

For the problem fill in:

Name: ……

Description:……

……..

……..

- <u>1.2 At-risk population</u>

Guiding questions:

1. Which individuals are at risk for the problem?
2. What are characteristics of this population?

All individuals with a less healthy lifestyle are at risk for becoming overweight and eventually obese. This risk is higher for the following groups in the population:

- Children, more specific children with a high or low birth weight and children with overweight parents.
- People with a (family) history of being overweight
- People with a more sedentary job (e.g. IT)
- People with a low social-economic status
- People who are non-Western in origin
- People with chronic and mental diseases
- People who attempt to quit smoking
- Elderly
- Women

For each population/actor fill in:
Actor 1
Name: ……

Description:………

- 1.3 Situational factors

Individuals are embedded in multiple, interacting levels of environment:
  - Interpersonal (e.g., peer pressure)
  - Organizational (e.g., policy within organizations)
  - Community (e.g., social norms)
  - Society (e.g., laws)

Guiding question:
  1. What are the situational/environmental contributors to the problem among the at-risk population?

  The at-risk population mostly lives in areas in which owning a car is necessary to get around. And for most individuals the work environment is not that supportive:
  - many have sedentary jobs,
  - since often colleagues are struggling with the same issues (eg in IT), being at work confirms their (unhealthy) habits people (eg snacking through the day, …), and
  - often the office restaurants provides mainly unhealthy food.

Fill in for each contributor:
Factor 1
Name: ………
Description:………

This factor is a problem for this actor:……………………………………………………………………………
This is part of this problem definition:…………………………………………………………………………

- 1.4 Problem behavior

Guiding question:
What do individuals in the target group do that contributes to the problem?
  - Poor dietary habits (soda instead of water, little fruit and vegetables, large amounts of coffee, …)
  - Little to no sports / physical exercise
  - Eating fast-food and prepackaged food
  - Irregular eating patterns (eg not having breakfast)

Fill in for each problem behavior:
Problem behavior 1
Name: ………
Description:………

This problem is linked to this actor:……………………………………………………………………………………
This is part of this problem definition:…………………………………………………………………………

Step 2: Change Objectives

- 2.1 Performance objectives

Performance objectives are specific sub-behaviors that are necessary to accomplish the desired behavior or environmental outcome. Performance objectives clarify the exact performance from someone affected by the intervention.

1. What do participants in this program need to do, to accomplish the behavioral outcome?

For example, when you like to promote condom use ((health) promoting behavior), you want people to obtain condoms in order to use them.

Patient
- Keeps doing the exercises presented by his coach
- is more physical active (at least 30min a day)
- knows how he can integrate being physical active in his own life
- experiences pleasure in being physical active
- Monitors and work on a healthy and regular diet
- Knows what types of food are good for him and what types of food he should avoid
- monitors his mood and sleep
- learns when and why he feels motivated
- learns about the barriers that prevent him from succeeding
- has regular appointments with a coach
- seeks support from family and people in the same situation
- sets goals and strive to accomplish them

To determine the performance objectives for environmental conditions, ask yourself the following question:
2. What does someone in the environment (environmental agent) need to accomplish to reach the environmental outcome?

For example, you want to make it easy for people to acquire condoms. They should be easily available, for example "bar owners provide free condoms in gay bars".

Note: One rule of thumb may help; always put "After having participated in the program…." before the performance objective.

Others
- Coach:
  - Intake
  - Regular face2face sessions
  - follow his results/alerts in with-me (notification)
- Other people on the platform: coplay and social support
- Family and friends: being supportive
Availability of healthy food (shops, prices)
Easy to walk or cycle in the neigborhood

For each performance objective fill in:

Performance objective 1

Name: ....

Description: (performance objective)..

This is linked to this actor:...

This is part of this problem behavior:..

This is linked to this situational factor:...

- ## 2.2 Determinants

Determinants are those factors that have been found associated with the performance of the behavior of the target population or agents that have control or influence over environmental outcomes. Personal determinants usually include cognitive factors and capabilities, such as skills. Environmental conditions rest outside the individual.

Brainstorm determinants, try to apply behavioral theories and use the determinants of the behavioral or environmental outcomes addressed in the needs assessment.

Guiding question:

1. Why would people (not) perform the behavior or performance objectives?

Note: It is recommended that the relevance and changeability of behaviors and environmental conditions is rated using findings from the needs assessment. Relevance refers to the strength of the evidence relating a determinant and the behavior or environmental factor you want to change; changeability is the strength of the evidence that the proposed change can be realized by an intervention.

Consult the literature and your common sense to make these decisions. Identify the determinants that you want to focus on.

- He knows he is overweight, and causes him to have problems with his self-image. How does this affect the problem? (obesity)
- As a child he was bullied. This still causes him feeling bad about his weight. How does this affect the problem? (obesity)
- His self-efficacy is low (partly still the bullying)
- He is not always aware of his unhealthy habits
    - He does not always know what healthy food means
    - He is not aware that irregular eating patterns (eg not having breakfast) contribute to the problem
- He does not have the right skills to prepare a healthy meal and to integrate healthy eating and more physical exercise in his current lifestyle
- He was not a happy child and he is not happy as an adult.
- Not being a sporty-like person, he is not aware that physical exercise does not always mean 'sport'
- He should become aware of his barriers for moving, eating healthy → This comes from an idea called 'barrier button': each time the user has the feeling that it is not going well, or when he experiences a reason not to stick to the plan, he can push the button, annotate why and alert his coach.

- He should experience the values and intrinsic reward (fun, feeling good) of living a healthy lifestyle. This is important since a healthy lifestyle is something 'for life', not just temporary.
- He needs social support from his coach, friends and family and he seeks form the feeling of 'being a part of a group', eg the With-Me community.

For each determinant fill in:

Determinant 1

Name: ………

Description:……

This is linked to this actor: …………………………………………………………………………………………………..

- 2.3 Change objectives

Change objectives are specific goals of your intervention, stating what should change at the individual levels, or what should change among environmental agents. Change objectives can be formulated when you cross performance objectives with their determinants. Therefore, you have to build matrices. You need one matrix for every health promoting behavior, every target group, and every environmental agent, that needs to be influenced (differentiation of the population).

Matrices are simple tables formed by entering the performance objectives on the left side of the matrix and determinants along the top. Change objectives are entered into the cells formed at the intersection of each performance objective and determinant.

Matrices of change objectives are created for each level of intervention planning (individual, interpersonal, organizational, community, and societal) by crossing performance objectives with determinants.

Guiding question:

1. What is the desired end state related to the determinant after the intervention?

Performance Objectives					
					Personal determinants

Step 3: Behavior Change techniques

- 3.1 Change techniques

Chance techniques are general techniques or processes for influencing changes in determinants of behaviors of the target group or environmental agent. To match a method with a change objective, the linking concept is the determinant involved.

For example, take the change objective: adolescents (the population) demonstrate skills (the determinant) in communicating with a partner about condom use (the performance objective). The method to reach this objective can be found by looking at methods for the determinant: skills.

To identify and select methods:

- Review existing empirical evidence in the literature
- Review theories of change

For examples of change techniques see http://wiki.scetool.nl/index.php?title=Categorie:Methods

Note: Try as much as possible to link objectives to theoretical methods. If you are unable to identify methods but able to identify applications, ask yourself – why would this application be effective in accomplishing my objective, why would it work? The answer will lead you to a method.

For each behavior change technique, fill in:
Technique 1
Name: ………
Description:………
This technique is linked to these determinants: ………………………………………………………………………

- 3.2 Boundary conditions

Boundary conditions are the conditions under which a specific behavior change technique is effective.
Guiding question:
1. Can you find information on when a behavior change technique will be most effective?

For each boundary condition fill in:
Boundary condition 1
Name: ………
Description:………

This is linked to this change technique: ………………………………………………………………………………

- <u>3.3 Mapping</u>

Mapping: Practical applications are specific techniques for practical use of theoretical methods in ways that fit the intervention population and the context in which the intervention will be conducted.

Note. One method may be accomplished by many applications.

Select applications by evaluating all the suggested applications on the strength of the evidence that the proposed change in the targeted determinant can be realized by this application in a specific setting.

Guiding questions:

In selecting practical applications, several routes can be taken:

- Move from objectives to methods and then to applications
- Move from objectives to applications and then back to the underlying method
- Brainstorm methods and applications simultaneously

Regardless of the work style, it is essential that methods are identified, and the parameters of the methods – the conditions under which the methods are shown to be effective - are kept in mind during the translation from method to application and to program.

Per actor, fill in for each application:

Application 1

Name: (behavior change technique applied to determinant)……………………………………………………….……
Description:……

This is linked to this technique: …………………………………………………………………………………………………

This is linked to these boundary conditions:……….………………………………………………………………………

Step 4: Design

- 4.1 Design Scenario

Design scenarios are high level descriptions of how the proposed technology enabled intervention works in daily life. It describes the involved actor(s) and which activities are performed by this actor. Also, it describes how the intervention is put to practice while the actor is performing this activity, in which situation and context, accordingly.

Guiding question:

1. Which actor is involved and which activities are performed by this actor
2. How, when and where does the technology enabled intervention work in practice while performing these activities?

For each design scenario fill in:
Design scenario 1
Name: ……….
Description:……….
This is linked to this actor:……

- 4.2 Uses Cases

Use cases describe how the actor(s) interacts with the technology enabled intervention interacts at a practical level to realize the system goal, i.e., apply the selected behavior change techniques to change the actor's behavior.

Guiding questions:

1. What is the main outcome of the use case? (description)
2. What is the current situation? (pre-condition)
3. What is the desired situation after executing the use case? (post-condition)

For each use case fill in:
Use case 1
Name: ……
Description:……….
Pre-condition:…….
Post-condition:………..

- 4.3 Action sequences

Action sequences are stepwise descriptions of the interaction between the actor(s) and the technology enabled intervention, at a more detailed level. The level of detail ranges from medium level (e.g., 'actor addresses system') to low level (e.g., 'actor swipes finger diagonally across the systems monitor to activate the system'). The selected level of detail is strongly related to the detail level of the requirements (see Requirements). The more detailed the interaction sequence, the more detailed requirements you can elicit.

Moreover, sequences can be initial (i.e., sequence only takes place the first time the use case is performed), main (i.e., how the sequence mainly run) or alternatively (e.g., how the sequence alternative run).

Guiding question:

1. What is the action sequence detail level necessary to elicit the requirements?
2. What are the initial interaction steps between the actor(s) and the system necessary to reach the post-conditions?
3. What are the main interaction steps between the actor(s) and the system necessary to reach the post-conditions?
4. What are alternative interaction steps between the actor(s) and the system necessary to reach the post-conditions?

For each sequence fill in:
Sequence 1
Sequence: ……
This is linked to this actor :………………………………………………………………………………………………………
This is linked to this scenario :……………………………………………………………………………………………………
This is linked to this application:………………………………………………………………………………………………..

- 4.4 Requirements

Requirements are concrete descriptions what the system will do, how, and when. They can be elicited from the use cases' action sequence steps. For example: *The technology enabled intervention shall provide feedback in the form of traffic lights, when the actor is performing exercise.*

Guiding question:

1. What shall the system do, how, and when?

For each requirement fill in:
Requirement 1
Identifier: ……
Name:………
Description:……
This is linked to this use case:…………………………………………………………………………………………………..

- Claims/hypotheses

Claims describe the hypothetical effect when a requirement is fulfilled. For example, it describes the expected effect of providing feedback in the form of a traffic light when exercising, namely that the actor becomes aware of his or her own performance level. Moreover, it provides positive and negative implications of this effect. For example, the actor becomes motivated to continue exercising (positive) but also loses motivation when the novelty of the feedback runs out (negative).

Guiding questions:

1. Which effects do you expect when realizing a selected requirement?
2. If this effect occurs, what would be a positive implication? (positive)

3. If this effect occurs, what would be a negative implication? (negative)

For each claim/hypotheses fill in:
Requirement 1
Identifier: ………
Name:………
Description:……
Positive:……..
Negative:……..
This is linked to these requirements:……………………………………………………………………………..

Step 5: Evaluation

The primary purpose of the evaluation is to see whether your intervention resulted in the desired effects in the at-risk population (effect evaluation). However, if the effect is absent or suboptimal, an explanation may be that the program was not delivered correctly and consistently. An evaluation of the adoption and implementation of the program (process evaluation) will add to your understanding of your effect evaluation.
Develop a plan for the effect and process evaluation. Consider how matrices can be used to create measurement instruments (to serve as measurement blueprints).

Guiding questions:
1. Did the intervention reach its goals?
2. Did the intervention match the target group?
3. Did the intervention 'work' for the implementers?

- 5.1 Hypotheses

Hypotheses describe the hypothetical effects of the decisions made at each step in the logic model (i.e., problem definition, situational factor, problem behavior, determinant, performance objectives, change technique, boundary condition, application, use case). For example, it describes the expected effect of applying a specific BCT on a specific determinant, when fulfilling a specific boundary condition.

Guiding question:

1. Which effects do you expect from applying the developed (technological) intervention?

For each hypothesis fill in:
Hypothesis 1
Name:………
Description:………
This is linked to this problem definition, situational factor, problem behavior, determinant, performance objectives, change technique, boundary condition, application and/or use case
……..
…….

- 5.2 Instruments

Instruments are used to test hypotheses. Examples of instruments are surveys, rating scales, and checklists.

Guiding question:
1. Which instruments will be used to test hypotheses?

For each instrument fill in:
Name:………
Description:………
(attach file)

- <u>5.3 Planning and results</u>

What are you going to test? Choose one (or more) out of the following:

- 5.3.1.Pretest: *usability and feasibility of the materials of the intervention*
- 5.3.2 Effect: *effects of the intervention on determinants of behavior and behavior*
- 5.3.3 Process: *effects of the implementation on other effects*
- 5.3.4 Impact: *effects of the intervention on quality of life*

- <u>5.3.1. Pretest</u>

Pretest progamme materials and protocols.

For each pretest/effect/process or impact fill in: **Pretest 1** Select hypothesis: …… Provide a name for the plan Name:……… Description:……… This is linked to this use case:………………………………………………………………………………………………. This is linked to these actors:………………………………………………………………………………………………. Participants:…….   Research design:……… Procedure:…… Select instrument:………. Data analysis:…….

- <u>5.3.2 Effect</u>

To specify expected changes in objectives, look at:

·   Performance objectives

·   Change objectives

For each pretest/effect/process or impact fill in: **Effect test 1** Select hypothesis: …… Provide a name for the plan Name:……… Description:……… This is linked to this use case:………………………………………………………………………………………………. This is linked to these actors:………………………………………………………………………………………………. Participants:……. Research design:……… Procedure:…… Select instrument:………. Data analysis:…….

- 5.3.3. Process

Guiding questions:

1. How did the program go in terms of:
o Program dissemination and adoption
o Program implementation
o Intervention exposure

2. How did the program go in terms of:
o Context: aspects of the larger social environment that may affect implementation
o Reach: the proportion of the intended audience to whom the program is actually delivered
o Dose delivered: the amount of intended units of each program component that is delivered
o Fidelity: the extent to which the intervention was delivered as intended
o Implementation: an overall score that shows the extent to which the program was implemented and received
o Recruitment: a description of the approach used to attract program participants

For each pretest/effect/process or impact fill in:
Process test 1
Select hypothesis: ………
Provide a name for the plan
Name:……….
Description:……
This is linked to this use case:………………………………………………………………………………………………
This is linked to these actors:……………………………………………………………………………………………….
Participants:……
Research design:……….
Procedure:……..

Select instrument:…….
Data analysis:………

- 5.3.4. Impact

Determine the expected impact of the program (within a reasonable timeframe) on (health,) quality of life, and on the behavioral and environmental causes of the (health) problem. (IM, p.519)

Guiding questions:
1. How much was the (health) problem changed in the designated time frame?
2. How much was the quality of life problem changed in the designated time frame?
3. What changes in behavior and environmental conditions were achieved?

For each pretest/effect/process or impact fill in:
Impact test 1
Select hypothesis: ………
Provide a name for the plan
Name:……
Description:………

This is linked to this use case:……………………………………………………………………………………………………….
This is linked to these actors:………………………………………………………………………………………………………..
Participants:………..
Research design:………
Procedure:……..
Select instrument:……
Data analysis:……

- ### 5.4 Results

For each hypothesis fill in:
Hypothesis 1
Select hypothesis: ………
Result: true / false / unknown
Implications:
Select instrument:……….
Data analysis:………
Control group:
　　　　　　　　　　　　　　Pre M:……………　　　　　Pre SD:………….
　　　　　　　　　　　　　　Post M:　　　　　　　　…………….Post SD:………….
Intervention group
　　　　　　　　　　　　　　Pre M:……………　　　　　Pre SD:………….
　　　　　　　　　　　　　　Post M:　　　　　　　　…………….Post SD:………….
Difference in mean:…………..
Standard Error:…………………..
P-value:………………………………
Other:………

Step 6: implementation

Identify the people or organizations that are involved in adoption and implementation of the program. Identify decision-makers, stakeholders, intermediaries, et cetera, set up a linkage system and identify what you wish/want adopters and implementers to do to facilitate the adoption and implementation of the intervention.

- Repeat steps 1/5 with these actors and problem behaviors.