



BEHAVIOR CHANGE THEORY

**An introduction to a behavior change theory framework
by the LIVE INCITE team**

This document is not a formal part of the LIVE INCITE Request for Tender and PCP. It may thus be used for better understanding of the background to and needs of LIVE INCITE but no content in this document will be part of the evaluation and/or assessment process of LIVE INCITE, unless stated in the Request for Tenders.

LIVE INCITE is a Horizon 2020 project*, including Stockholm City Council/Karolinska University Hospital, Bispebjerg-Fredriksberg Hospital, Copenhagen, Clinic Hospital, Barcelona, and Karolinska Institutet, Stockholm

* funded under the call H2020-SC1-2016-CNECT and topic H2020-EU.3.1.4. - Active ageing and self-management of health

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1 Introduction

This document is published in relation to the overall LIVE INCITE project. The information can be used as background information to LIVE INCITE, supplementing the information provided in the request for tenders regarding background information to and understanding about behavior change theory.

Overall, this document describes a theoretical framework for behavior change. The purpose is to provide information to readers not familiar with behavior change theory but also an explanation on how LIVE INCITE view behavior change theory and will serve as one foundation for our assessment of the potential for solutions in accomplishing behavior change.

Addressing the LIVE INCITE challenge, there are many popular and frequently used theories and terms, such as for instance self-determination theory, that could represent a part of a suggested framework but not in itself be a complete behavior change base for a successful solution.

The starting point of the framework described herein is *contextual behavioral science* followed by *learning theory* including respondent conditioning, operant conditioning and behavior analysis. First the theoretical framework is described in brief, then behavior economics as a complementary conceptual framework for nudging behavior change, and finally behavior change in practice is described regarding values and goals, precision and relevance as well as compliance, motivation and feedback. Lastly, the question of assessing, addressing and monitoring comorbidities and adverse events is raised.

2 A contextualist view on behaviors

A central objective in LIVE INCITE is to influence users'/patients' behaviors to optimize future health outcomes. The term behavior is used frequently in various settings and may have different meanings. The information provided to guide the development of a "behavior intervention and support engine" presented in LIVE INCITE is based on *contextualism*. From this perspective, a behavior is inseparable from its current and historical context, and is defined as the actions by which an organism adjusts to its environment.

Behaviors can be both overt (i.e. can be seen by others) and covert (i.e. not observable by others, such as thoughts, emotions, and physiological responses). An individual's behavior occurs within a specific *context*, which consists of a set of situational and historical factors. Situational factors can be environmental, for example the people in the room, and historical factors can consist of previous experiences brought into the situation, such as memories. Thus, understanding a behavior requires an analysis that takes the context in which it occurs into consideration.

3 Theoretical framework: Learning theory

Many individuals engage in behaviors that may appear logical, but that do not contribute to physical or mental well-being. Such dysfunctional behavior patterns can be understood using a *learning theory model*.

According to learning theory, avoiding situations associated with negative psychological experiences (e.g. social interactions that elicit anxiety) can have clear benefits in the short term. Over time, however, a behavior pattern characterized by avoidance of pain and distress may gradually decrease everyday functioning and life quality. Thus, avoidance behaviors may be central to the understanding of dysfunction, and can be explained by both *respondent* and *operant* conditioning mechanisms.

3.1 Respondent conditioning

Respondent conditioning (also referred to as classical or Pavlovian) occurs when a neutral stimulus is presented together with another, unfamiliar stimulus that is strongly related to innate drives or instincts (*unconditioned*) at about the same time. After repeated presentations, or pairings, of the two stimuli, the neutral stimulus will then begin to elicit similar behavioral responses to those that result from the previously unfamiliar stimulus (*unconditioned*). Thus, if a certain activity is associated with a stimulus that elicits a negative response (*nociceptive*), this previously neutral stimulus will now increase pain and/or distress. Respondent conditioning deals with the learning of automatic, or involuntary, responses and focuses on antecedents, i.e., factors or events occurring before the behavioral response. A painful injury (e.g. twisting the knee while running during a soccer game) elicits an automatic distress response. This could be referred to as an unconditioned stimulus and response. Through processes of respondent conditioning, neutral stimuli (e.g. running, or a soccer ball) will acquire similar psychological functions to those of the event that inflicted pain and distress (i.e. the injury). Thus, the previously neutral stimulus is now conditioned and provides an aversive context for the individual, resulting in conditioned responses that are similar to those following from the unconditioned stimulus.

- Before learning: playing soccer → neutral
- During learning: playing soccer + pain
- After learning: playing soccer → pain (or distress/fear of pain)

3.2 Operant conditioning

In contrast to respondent conditioning, operant conditioning concerns the modification of voluntary behaviors, and is focused on the consequences following the behavior. In short, the consequences following a certain behavior may be experienced as *appetitive* or *aversive*. Depending upon the consequence(s) of the behavior, the probability that this behavior will be repeated in a similar situation will either increase or decrease. Positive reinforcement refers to an increase in desired consequences (e.g. attention), and negative reinforcement represents a decrease in aversive events (e.g. symptom alleviation). Both positive and negative reinforcement are of importance when explaining the development and retention of behavior patterns. Notably, positive and negative reinforcement sometimes co-occur; behaviors such as smoking may provide a sense of pleasure (positive reinforcement) as well as reduce e.g. stress or anxiety (negative reinforcement). See Figure 1.

		Stimulus	
		Applied (+)	Withdrawn (-)
		Positive Reinforcement	Negative Reinforcement
Increased (Reinforcement)		<i>Giving a child dessert for eating her vegetables.</i>	<i>Allowing a child to leave the table for finishing her vegetables.</i>
Decreased (Punishment)		<i>Scolding a child for disrupting class.</i>	<i>Putting a child in "time out" or making her miss recess for disrupting class.</i>

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Figure 1: Increasing and decreasing behaviors through applied or withdrawn stimuli.

3.3 Behavior analysis – a clinical model to understand and modify behavior patterns

Based on learning theory, behavior analysis represents an analytical tool for understanding the development and maintenance of behavior patterns. Behavior analysis aims to clarify the associations between a situation (A, the antecedent), behaviors (B) and consequences (C).

For example, a behavior analysis applied to a specific situation may reveal the following: In a situation associated with an increase in pain or distress (A: taking a long walk), the patient engages in activities (B: reducing the length of the walk, taking medication prior to the walk) that produce short-term relief (C: decrease in fear of pain, lower pain, sense of control).

While these positive short-term effects explain why this pain management strategy is maintained, they result in a lifestyle that is less active and may be less meaningful. From the behavior analysis perspective, we know that avoidance of unpleasant experiences (e.g. pain, distress) is a core problem resulting in reduced functionality and reduced quality of life. Based on this information an intervention can be designed with the objective to improve the ability to manage pain and distress more effectively; i.e., the intervention enhances the achievement of long-term positive consequences by assisting the person to engage in physical activity despite short-term pain and distress.

Because the frequency and intensity of behaviors are highly influenced by contextual factors, altering the context (i.e. antecedents and/or consequences) is likely to result in behavioral changes. **Clinical research and experience suggest that behavioral interventions should focus on activities that can be varied (variables that can be experimentally adjusted and varied) in a person's context, and that this facilitate behavior change in the long-term. In other words, changing behavior (B) can be accomplished through systematic and monitored variations of antecedents (A) and/or (C) consequences.**

4 Behavioral economics – nudging behavior change

In behavioral economics, psychology and behavior analysis are applied to better understand and influence economic decisions. As mentioned earlier individuals commonly engage in behaviors that may appear logical, but that do not contribute to long-term physical or mental well-being. In many

situations, humans have limited capacity to process information that would help them make rational decisions. This may result in problems with identifying the most adequate behavior that maximizes long-term outcomes, and to take the appropriate actions. The main focus in behavioral economics is to describe and understand *actual* human behavior rather than supposedly *rational* human behavior.

In recent years, behavioral economics research has been increasingly focused on strategies to change unhealthy lifestyle behaviors, on national, community and individual levels. A behavior is the action by which an organism adjusts to its environment. Thus, adjusting the environment, or the context, in which the behavior occurs, may change a behavior. Nudging refers to the manipulation of the choice architecture to systematically change the decisions, for example rearranging the order of appearance of stimuli. Nudging may, thus, be used to increase health-promoting decisions among individuals, groups or communities where unhealthy choices are common; nudging has been shown to e.g. affect children's health food choices and has led to increased organ donations.

5 Behavior change in practice

As described earlier, behavior analysis provides a contextual model for understanding behavioral patterns. In summary, situational factors that elicit the behavior are referred to as antecedents. Consequences perceived as reinforcing increase the likelihood that the behavior will be used again to manage a similar situation in the future. Behavioral economics offers tools to influence the context of choice architecture and nudge people's behaviors in healthy directions.

Specific information about the behavior and the context in which it occurs is essential, and behavior analysis constitutes a useful framework for an individually designed program for behavior change. Furthermore, to motivate change in the presence of e.g. pain and distress, it is important that the long-term negative effects of maintaining the dysfunctional behavior are clear to the patient. Behavioral economics tools can complement and perhaps catalyze change processes that are conceptualized from a behavior analysis point of view.

5.1 Emotional engagement – values and goals

Emotional engagement is critical for behavior change to occur. Identifying relevant life values and long-term goals increases the ability to engage in behavior change, and to tolerate negative psychological reactions that are likely to occur during the behavior change process. More specifically, assisting the individual in making associations between the target behavior and the long-term consequences is important. Even if the immediate reaction is negative, a strong association with a future positive outcome may be enough in order for the individual to pursue the new lifestyle.

5.2 Precision and relevance

Habits are robust and behavior change commonly requires more than general instructions, such as "eat more healthy food" or "stop smoking". Thus, the LIVE INCITE solution needs to be able to direct the attention of the user towards specific and individually tailored aspects of *what* to change, *how* and *why*. With information from a personal behavior analysis (antecedent, behavior, consequence, within the situational context) the interaction and support need to be precise and relevant in an individually tailored format in order for behavior change to occur. Behavioral economic tools can support and strengthen the individual tailoring.

5.3 Compliance, motivation and feedback

Positive outcome in behavior change programs is assumed to relate directly to treatment compliance, i.e., completion of treatment modules and tasks. This implies that the patient must be able to alter and maintain behaviors over time, in the presence of e.g. distress or other challenging circumstances. It is therefore of critical importance that the healthcare provider offer an easily administered tool to facilitate self-management and commitment to a behavior change program.

Ideally, the individual receives individually tailored support that facilitates compliance. This requires the identification of risk factors such as comorbid conditions through e.g. patient self-reports. Another aspect of such support might include reminding the patient of his/her life values or a prompt to engage in social interaction with friends. Such individually tailored support can serve the function of promoting compliance with the behavior change program.

Motivational factors will increase engagement, commitment to the treatment goals as well as compliance with the program. Continuous feedback, e.g. continuous personal reports on individual performance in the program may be highly motivating for the user and have a significant influence on behaviors and improve outcome. It is well known that personal and concrete feedback, immediately following the behavior has a strong reinforcing effect that highly influences the likelihood that this behavior is repeated, just as well as negative feedback, or lack of feedback, tends to decrease the frequency of that behavior.

For most people, general information on risks is not enough to motivate and lead to implementation of behavior change, due to the phenomena of bounded rationality and willpower. Behavior change requires additional, and more specific, intervention, such as detailed and personalized feedback about one's own risk situations and performance, skills training (e.g. how to cope with distress and other emotions), modeling or other forms of enablement and support.

5.4 Comorbidities may need to be addressed

Treatment effects always vary across individuals. A factor that may influence the effects is physical and psychiatric comorbidity, since such symptoms may negatively influence the ability to engage in the behavioral change program. Knowledge about comorbidities can enhance precision in how and when interaction and support will be given to a specific patient. Also, such knowledge provides a better understanding of what additional support that may be required for the individual to engage with and complete the behavior change program.

5.5 Assess, address and monitor adverse events

Psychological interventions, including behavior change programs, may trigger negative thoughts and emotions. For some individuals, such negative reactions may be overwhelming and trigger dysfunctional or even destructive behaviors. It is therefore of importance to continuously monitor not just the outcome measures but also possible negative reactions to the program, i.e. adverse events. This provides an opportunity to intervene if necessary.

6 Overall needs derived from behavior change theory

Below we have summarized how the behavior change framework described above translates to overall needs. The table can be used to further understand the complexity of changing behavior and give some idea of what a solution should be capable to address. However, as LIVE INCITE is an innovation project, both behavior change theory and related solutions are to be explored.

NEED FROM BEHAVIOR CHANGE THEORY PERSPECTIVE	NEED TRANSLATED TO CAPABILITIES
We need to be able to identify, create, and leverage an emotional engagement to optimize chances for behavior change.	To be able to identify/define relevant life values and long-term goals and leverage such information to create and maintain an emotional engagement.
	To be able to provide emotional engagement content in the right time for optimum support, for instance at pre-defined or otherwise triggered risk situations and/or short-term discomfort.
We need to be able to identify the underlying reasons and the context for an unwanted behavior as well as its short-and long-term consequences to provide insight and awareness for the user as well as the tools to provide a contextually relevant and precise individual intervention.	To be able to execute a behavior analysis for the specific individual which data can become solution data/content to be leveraged for effective behavior change support/intervention for the specific individual.
We need to identify other behavioral/contextually relevant problems which can complicate behavior change.	To be able to identify behavioral problems and comorbidities and use such in the individually applied intervention program.
We need to be individually relevant in all communication, content, and interaction in order to optimize chances for behavior change.	To be able to be contextually aware and individually relevant in configuring and providing intervention programs, in other words be individually precise in all interaction.
We need to be able to provide general information about the risks and consequences (long-term but also contextually relevant, in other words surgery related) of the unhealthy behavior as well as the positive effects of a behavior change in an emotionally engaging and positively reinforcing way.	To be able to define engaging content related to the risk factor (-s) and make as individually relevant as possible and which can be consumed anywhere, anytime by the patient but also used as content by which to intervene and motivate in contextually relevant situations.
We need to be able to be ever present in the individual's context and intervene with contextually aware and individually relevant support on the right time.	To be able to leverage behavior analysis and all information pre-known about a user's context and support need as well as such support pulled by user or system generated triggers.
	To be able to define and deliver alternative strategies, rewards etc in the right way on the right time.

We need to provide social support to supplement and strengthen non-human intervention support.	To be able to leverage family, friends, behavior change community or other social support.
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Table 2: Overall needs derived from behavior change theory

Illustrated in the below table is the difference between function and form. A function/need can be satisfied in a range of different forms/solutions. The table should be seen as another attempt by LIVE INCITE to provide perspectives on the challenge in relation to behavior change and to spur ideas for what needs and how the challenge might be addressed.

FUNCTION	POSSIBLE FORM
Emotional engagement	High level of positive reinforcement when accessing digital tool
Identification of relevant life values and long-term goals that can be facilitated via behavior change	Value formulation → goal setting → identification of most important behavior change to begin with
Support for tolerating the short-term discomfort during behavior change	Remind the user of the relationships between behavior change and short- and long-term consequences
Help the user understand “why I do what I do.”	Information about what comes before an unwanted behavior, and what direct short-term consequences the behavior leads to, as well as long-term consequences. Behavior analysis (ABC)
Individually designed program that learns from the user and provides relevant support via prompts at the right time.	Just in time adaptive interventions (JITAI).
Provides information to users on general risks of continuing an unhealthy behavior	General information that is emotionally engaging and positively reinforcing.
Provide tailored information to users about their individual risk profile, possible post-operational complications, long-term consequences etc.	Individualized information based on collected data (e.g., machine learning), specific prompts on how to carry through the behavior change, where to start etc. Can be used to coach and guide the user through the process of change.
Create and maintain motivation, maintain high engagement and encourage/nudge commitment, maintain compliance and address lapses in compliance.	Feedback system, e.g., relevant (individually tailored), clear and specific to serve as a motivator.
Social support function	Facilitate communication with health care providers, concerned significant others (CSOs), other individuals in the behavior change community, as well as individual contact with buddy, partner etc.
The solution needs to identify other behavioral problems that can complicate behavior change.	Identifies behavioral problems and comorbidities, and communicates them to user and health care provider.

Table 3: Functions in relation to capabilities in context of Behavior change framework