

# Digital Therapy: Addressing Willpower as Part of the Cognitive-Affective Processing System in the Service of Habit Change

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**Abstract.** We know much too little about how to design effective digital interventions to support sustained behavior change and improved well-being. The purpose of the present paper was to contribute in two ways. First, we want to contribute to current practice in designing such interventions. Second, we try to identify key research questions that could be a point of departure for a more detailed and comprehensive future research program. The propositions we suggest reflect that the construction of digital interventions should be seen as an iterative process which should take into account both "content" and "design" factors. However, we argue that intervention research and practical design experience is not just something that follows basic research at a polite distance, but rather is its inherent complement.

**Keywords:** Digital Therapy, Persuasive Technology, Willpower, Cognitive-Affective Processing System, Emotion Regulation, Ego Depletion, Implementation Intentions, Behavior Change, Health Behavior, Emotional Design, Interactivity, Successful Information Systems.

## 1 Introduction

The present paper addresses how psychological theory and research related to behavior change and maintenance, can be utilized in designing digital interventions. In particular, interesting questions are: How can interventions be designed not only to motivate clients to initiate change, but to maintain change as well? How important is it to provide additional just-in-time therapy and how can this be achieved? How can digital technologies be used to prevent ego depletion? How can digital interventions support the making of implementation intentions? How can digital technologies help detecting and preventing lapses and relapses?

It is self evident that digital interventions should utilize insights from cutting edge psychology in order to maximize effect. However, many would say, that it is of equal importance to acknowledge that in order to be effective, digital interventions must be able to reach the audience and hold the interest of the user over time. No doubt, the fact that the intervention is judged by the client to be effective in helping her achieving her ultimate goals (utility), may contribute considerably to this end. Nevertheless, we also need to capitalize on insights about how user interface and

information technology influence upon both initial and continued use, and hence ultimate effect. Because we restrict ourselves to talk about the area of psychological change (e.g. behavior change and well-being), a specific focus will be on such questions as: How do you maximize adherence to digital interventions (stickiness)? What characterize successful information systems in this area? How do different information architectures influence user perceptions? How can (perceived) individualization and personalization be enhanced? How important is interactivity, and how can it be increased? It is not a purpose of the present paper to provide detailed guidelines for the design of digital interventions. Rather, this paper provides a foundation for design-decisions when developing such interventions.

## 2 Digital Health Interventions: Basic Insights from the Psychology of Behavioral Change

**Proposition:** The structure of digital health interventions should reflect the psychological chronology of the change process.

Personalized, interactive, digital media makes tailoring and individualization possible, that is, by providing information relevant to the phase of the change process that the individual client is in. Individualization can be achieved by designing a program that reflects the “psychological chronology” of the change timeline, but also by including feedback systems to ensure individualization of the change program. By collecting information throughout the change process, individualization is made possible. Hence, the amount of information, help and support that the client receives can be reduced and be more focused to the specific needs of the client. In other words, one can capitalize on the principle of reduction [1]. Reduction make target behaviors easier to achieve by breaking a complex activity into more manageable steps, and providing only task-relevant pieces of information. For example, complex goals may be broken down into specific sub goals or behaviors that may foster successful goal attainment. Additionally, and perhaps more importantly, the reduction implies that the information that the client needs during the change process is broken down into chunks that are presented to the client at the relevant time, stage, phase or even situation in the change process. This will increase the client’s perceived utility of the program, a key factor for the use of any kind of media or communication channel. Also, since the content appears relevant and useful to the user, the likelihood of elaborated information processing will be increased.

Having modeled the “psychological chronology” of the change process that the client goes through, a natural next step is to lead the client through a predetermined sequence of intervention components, step by step. To some extent, this resembles the idea behind what has been called tunneling [1]. For the client, tunneling makes it easier to go through a process. He or she is not introduced to a web-based help-yourself library of information, but is instead “led by the hand” through the change process. The client enters the tunnel (i.e., starts the program) when they initiate the change attempt. By entering the tunnel they give away a certain level of self-determination in that information and activities are presented to him/her in a predetermined sequence. However, the principles of reduction and tunneling ensure

that the client is led through a predetermined change sequence and receives the most appropriate information, support and therapy at the right time.

**Proposition:** Digital interventions should be constructed to account for the fact that when people initiate a behavioral change, relapse is often the rule rather than the exception.

Large numbers of people try (hard) to loose weight, change their drinking habits, quit smoking, control their gambling, stop taking illegal drugs, take up regular exercise, adhere to their medication, and more. Some of those who try to change actually succeed. Nevertheless, if you try to change yourself in one of those areas, the odds of success are generally not on your side. On the contrary. Depending on the area of change, the methods used (and a number of other factors), relapse rates typically varies between 50 and 95%. For example, if you quit smoking without the use of any behavioral support or medicines, the probability that you are still smoke free a year later is about 3-7% [2]. Likewise, if you try to loose weight, your probability of one year of sustained weight loss is less than 5% [3]. We also know that large proportions of people with serious medical conditions fail to adhere to their treatment regimens, including taking their drugs as prescribed (for review see [4]). In, sum when people try to change their health behaviors (and other habits too), relapse appear to be the rule rather than the exception.

**Proposition:** Digital interventions should be constructed to account for the fact that motivation and self-regulation involves different psychological processes.

Relapse means that after a (short) period of successful initial change, you return to your full-blown pattern of the old habit. It seems obvious that in some cases (and we do not know how often) people actually choose to go back to their old habit as a result of comparing the new versus the old behavior [5]). In these cases we are not actually talking about relapse because people take up the old habit due to a change in motivation; in many ways this resembles the same process as when we establish brand new habits. In these cases we see something that could be denoted "deliberative relapse" stemming from a self-conscious choice [5]). However, because a vast majority of those who try to change, but relapse, try again (and again and again...), it is likely that for many, relapse is not primarily due to a change in (long-term) outcome expectancies (i.e. motivation) related to change. In contrast, many of those who try to stop smoking, drink less or loose weight, invest great efforts trying to resist temptations that could make the snowball roll and make the way for a full-blown relapse. In other words, they try to mobilize willpower, or stated differently they try to successfully self-regulate themselves. Hence while making a change attempt requires motivation – change maintenance requires self-regulation, that is “operations performed by the self to alter its own habitual or unwanted responses to achieve a conscious or nonconscious goal” [6].

**Proposition:** Digital interventions should be constructed to prevent ego depletion.

The inability to maintain a wanted, newly established behavior most often represents a self-regulation failure, i.e. an inability to exert self-control and thus acting out an impulse that runs counter to the person's values or long-terms goals [7]. In other

words, self-control is a necessary means to enable us to override undesirable thoughts, feelings, and responses, and to avoid temptation [8].

Temptations often come in the form of impulses. Such impulses are of course not always problematic, e.g. the impulse to drink a glass of water when you are thirsty. The impulses that are problematic are those that imply that living them out will be at odds with our personal (long-term) goals or standards. For example, the urge of having a cigarette may ruin your quit attempt and hence your highly valued, long-term goal of a smoke free life; the impulse of having a chocolate bar may be at odds with your long-term goal of losing weight. In such situations successful self-regulation involves taking control of your actions and emotions, in order to ensure that you do "what is good for you" (in the long-term) instead of "what is good" (right now). Since relapse is so prevalent in behavioral change, this is oftentimes obviously not what happens.

Successful self-regulation is a multifaceted process. Unfortunately, many factors can contribute to a failure in self-regulation (for overview see [9]). One major account of self-regulation failure is an inadequacy in self-regulatory "strength". This implies that you are not able to mobilize (psychologically) what it takes to override unwanted thoughts, feelings or impulses [9]. According to this resource-depletion model of self-regulation a person at any time has limited amounts of generalized self-regulatory resources [9]. Accordingly, an initial act which requires self-regulatory resources, may be followed by a period of vulnerability, i.e. when self-regulatory resources are needed but depleted. Thus, if one, in this period of ego-depletion, is exposed to a situation (impulse) which requires effective self-regulation, then a failure in self-regulation is likely to happen because you are temporarily depleted on those resources (for overview see [6]).

People can be temporarily depleted or fatigued of self-regulatory resources, for example when they try to resist temptations, control their emotions or try not to act (automatically) upon their impulses [10]. For example, if you a few days into a smoking cessation attempt experience a problematic job situation (e.g. you get negative feedback from your boss) you may need to use self-regulatory resources to both cope with the resulting negative emotions and try to improve your performance. If you simultaneously or short after, are exposed to a temptation to smoke (e.g. is exposed to someone smoking a cigarette) then you are probably at risk to relapse because your self-regulatory capacities may be temporarily (partially) depleted.

**Proposition:** Digital interventions should address factors which cause slow oscillations in relapse proneness.

In order to understand the process of relapse, there seems to be a need for identifying the chronology of relapse risk forces, i.e. how the strength of the various relapse forces wax and wane throughout a change attempt. On the basis of much existing research it is likely that relapse proneness is both multi-faceted and follows a certain chronology. Hence behavioral change interventions should be designed accordingly.

More specifically, we know from certain areas that some relapse forces and risk factors may manifest themselves in slow oscillations in "relapse proneness" over time [11]. One framework (among many) that may provide an explanation on what causes these slow oscillations in relapse proneness is the cognitive-affective processes model (CAPS) [12]. In CAPS, the "know" is thought to be specialized for thinking and it can

be characterized by words like "cognitive, complex, reflective, slow, develop late, attenuated by stress, and self-control". Related to behavioral change and maintenance this system may thus contain e.g. outcome and mastery expectancies, previous experiences with behavior, perceived social norms, personal values and goals, etc. Most psychologically oriented change interventions appear to address such cognitive processes. Hence we could say that they have contained components which have a psycho educational approach. This implies that they try to educate people who change about what to expect and how to handle difficult times. For example, you "learn" from for example self-help books to identify a goal structure, what the consequences of successful behavioral change are (likely) to be in the future ("what is good for you"); your self-efficacy is boosted by persuasion ("you can do it") or by means of progress reports, etc. You may also learn how (e.g. by means of cognitive behavioral therapy) to intervene on your thoughts, feelings and actions.

**Proposition:** Digital interventions should help people make implementation intentions.

An important characteristic of a digital intervention appear to be their potential help to prevent ego depletion in clients. An equally important characteristic would be the ability to offset the consequences of ego depletion (i.e. self-regulation failure) if and when it occurs. Webb & Sheeran [8] have shown that the formation of implementation intentions may help serve both needs.

Implementation intentions are sub-ordinate to goal intentions [13]. Thus, while a goal intention may be that "I will loose weight" an implementation intention is a statement of the form: "As soon as situation *y* occurs, I will initiate goal-directed behavior *x*". By specifying the coping response (goal directed behavior), before the situation arises, one assumable passes control of behavior to specified cues (e.g. feeling an urge to eat a chocolate bar) to the environment. Time, place and situation hence are cues that automatically activate the relevant coping response. The idea is that this probably implies that the need for cognitive control is circumvented, a process called "strategic automatization" [8].

Additionally, when the client experiences temptations, i.e. close call situations in which the client is brought to the brink of relapse, the occurrence of relapse seem to be influenced by the clients coping responses. In this respect, the use of both cognitive and behavioral coping strategies seem to effectively prevent relapse in such situations (for overview see [14]), which is why behavior change programs typically aim to prepare people by improving their coping resources. It seems reasonable to expect that although interventions which improve the clients coping resources in general (pre- and post-change self-efficacy) may be justified, intervention elements which support adequate coping in close call situations would seem particularly promising.

**Proposition:** Digital interventions should offer instant, just-in-time therapy in order to prevent relapse due to sudden spikes in relapse proneness.

It appears important to take into consideration that profiles of relapse proneness often vary considerably across time, situations and persons (see for example [15,16]). Focusing the dynamics and consequences of "sudden spikes" in symptomatology and relapse proneness may provide important insight about successful change. In the CAPS framework such sudden spikes are conceptualized as being part of the "go

system" [12]. Sudden spikes in relapse proneness can be considered as parts of the "hot emotional system", specialized for quick emotional responding on the basis of situational (originating from outside or inside the individual) triggers. Such "hot spots" can be characterized by such words as "emotional, go, simple, reflexive, fast, develops early, accentuated by stress, and stimulus control" [12].

These peaks in relapse proneness seem to be difficult to predict. They may occur suddenly and in many cases they disappear after a relatively short period of time. Hence coping with them can't wait until you have gotten home and have consulted your self-help material (or until next week when you have your next your group-therapy class). The peak in symptoms is a "close call situation" that must be dealt with "asap"; i.e. relevant help and support should be available whenever and wherever you need it. Thus, more effective digital interventions are likely to offer support or therapy which is available just before, during, and after a peak in relapse proneness.

**Proposition:** The just-in-time therapy that digital interventions offer should help individuals tackle the experience of negative affect.

The next question which arises is then of course what kind of treatment that should be available at the "close call" situation. Generally, it seems reasonable that the content of the treatment should reflect what the client experience psychologically during a peak in relapse proneness. In this respect it seems relevant to point to the fact that a considerable amount of research has testified to the important role that negative affect seem to play in relapses (for research on smoking and dieting see for example [17,18]). It seems reasonable to expect this to be the case in a number of different behavioral domains; hence negative affect seems to play an important role for relapse.

As a corollary, it seems pertinent to consider negative affect to be both as a proximal predictor of relapse and a mediator and/or index of the processes that yield relapse vulnerability (see for example [11,17]). Thus, in addition to its own unique contribution, negative affect seem to mediate and moderate the impact of a number of both pharmacological and non-pharmacological events and processes upon relapse proneness. A number of explanations which may possibly account for the causal mechanisms which may underlie the relationship between negative affect and relapse proneness have been offered (for overview see [18]). Although further research into these specific mechanisms is welcomed, it seems that we know enough to suggest that more effective behavioral change interventions probably should include some elements that can effectively help individuals tackle the experience of negative affect – whenever and wherever negative affect is experienced simultaneously with an urge to relapse.

One possible mechanism is that negative affect either signals and/or is a mediator/moderator of ego-depletion. Whatever the causal mechanisms are [19]. (Tice et al) a dose of positive affect could apparently be prescribed as the best medicine (in addition to sleep and rest) (see for example [19,20]).

**Proposition:** Digital interventions should utilize recent insights from positive psychology.

A change process is often motivated by long-term goals that we have. People want to control their blood pressure, loose weight, drink less alcohol, stop smoking, get better grades, have a better marriage, etc. In many cases, the achievement of such long-term

goals involves that we must abandon choices and behaviors that normally give us pleasure and positive affect on a short-term basis (having a drink, having a cigarette, eating a chocolate, etc.). Hence in many situations effective change involves that behaviors which lead to the attainment of long-term goals (reduce your cholesterol level) override behaviors that relates to short-term goals (enjoying a fatty meal).

Often, the attainment of long-term goals are based on cognitions about “what is good for me”, while the attainment of short-term goals are more often based on affections about “what is good”. Accordingly, to be able to change successfully in the long run, we must regulate ourselves in the service of our long-term goals. As described above, this often involves effort, self-monitoring and vigilance. In particular in order to resist temptations, impulses or particularly demanding situations. Thus, in the middle of a change attempt we may feel “drained of change energy”, or ego depleted. In such a situation the “change muscle” may have become tired or exhausted, and the change attempt is at risk for a breakdown.

Importantly, ego depletion, and a breakdown in self-regulation, often occurs in combination with negative emotions. Hence negative emotions may cause, contribute to or be an effect of self-regulation breakdown. Often, negative emotions are also caused by the fact that behaviors that we have valued cannot longer be performed (having a drink, having a cigarette, having a cake, etc.).

Consequently, the client would benefit from not only having a behavior change intervention, and support to self-regulate successfully, but also interventions that may help him/her to feel better, be more happy, and value life positively even after the behavior change has been initiated. The theoretical basis for such interventions can be found in the field of positive psychology. Positive psychology is an umbrella term for the study of positive emotions, positive character traits, and enabling institutions [21].

There is good reason to expect that people, who are striving to change important aspects of their lives, will benefit from positive psychology interventions. It is likely that interventions that install positive affect will both increase the likelihood that the change attempt itself will be successful and give the client a better life during the change process. Hence interventions should capitalize on what we know about “affect regulation” (we use the term to subsume the management of subjective feeling states in general). The reason is that affective states influence subsequent behavior, experience, and cognition [22]. So one function of affect regulation is to limit the residual impact of lingering emotions and moods on subsequent behavior and experience. Certainly, feelings provide important information to a person and serve to direct subsequent thought and behavior in mostly adaptive ways.

Future digital health and well-being interventions should include intervention elements that are based on a number of affect regulation strategies. These specific strategies would probably reflect one of four general classes of affect regulatory strategies: those strategies that are either behavioral or cognitive, and are focused on changing the situation or the emotion [23]. Most likely, interventions should aim at influencing both NA and PA. However, negative life events have a stronger impact on subjective feelings than do positive events [24] and NA is two to three times stronger than PA [23]. Additionally, change reactions and consequences (e.g. ego depletion and relapse) are often paired with the experience of NA. Still, the increase in PA is also an important goal of digital interventions, since people in their daily lives often try to induce or maintain PA [23].

### 3 Digital Health Interventions: Reaching and Holding the Audience

**Proposition:** Digital interventions should be designed with the explicit purpose of holding the interest of the user.

It takes time to change one's habits or personal characteristics. For example, people who quit smoking are at substantial risk of relapse for at least one year after quitting. Hence to be effective, digital interventions should be able to hold the interest of the user over time. Empirical studies have demonstrated this to be a potential serious short-coming digital health interventions (see for example [25,26]).

So what keeps users coming back to a program (day after day, week after week, and months after months)? One could think of at least two main reasons. First, users have a primary need that is sought satisfied by initially taking up the program. This need is fuelled by the fact that the program is seen as a useful tool to help reach a valued personal goal (change in health behavior, well-being, etc.). The motivation for both initial and continued use may hence be the expected utility of use. Most probably, continued use is heavily influenced by experienced utility (which fuel expected future utility). Hence to ensure long-term use, digital interventions should be constructed to optimize subjective expected utility, i.e. to be judged by the client to help her to achieve her goal that motivated initial use of the intervention in the first place (more on this below).

However, media choices are affected by both individual needs for information and stimulation [27]. To better understand continued use of digital health interventions, research should consider additional motives to "instrumental" use, i.e. motives other than the expected completion of the initially intentional goals. Specifically, what are the "experiential" reinforces for continued use? To what extent do latent gratifications motivate continued or increased use? Consequently, it seems important to address more broadly the psychological (and social and cultural) needs that contribute to media choice and use. In other words, one has to search for the correlations between observed gratifications and the psychological origins of the satisfied need. Hence one must fully recognize that both affective and cognitive states influence media usage. In this context it seems important to take into account that the initially sought-after gratifications may be different from the gratifications that are actually received [27]. For example, there is every reason to expect that digital interventions (e.g. web based interventions) must fulfill user's expectations that use must provide entertainment and relaxation [28], and we would add positive affect (see above).

**Proposition:** Digital interventions should be constructed according to the principles on what constitute a successful information system.

There is an apparent need to more systematically approach digital intervention in the health and well-being domain as information systems. To this end, the Information systems success model [29] may offer a promising point of departure. According to this perspective, six categories of characteristics should be assessed to determine the success of an information system: 1) system quality, 2) information quality, 3) use, 4) user satisfaction, 5) individual impact, and 6) organizational impact. The system's quality refers to the technical accuracy and efficiency from which the information

system produces the information, and is generally assessed by means of e.g. response times, reliability and usability measures. Information quality refers to the system's ability to successfully convey the intended meaning (i.e. semantics). Measures of information quality assess the perceived quality of contents, accuracy, timeliness, relevance, etc. Finally, use, user satisfaction, individual and organizational impact; reflect the effect that the information has on the user. These categories can be assessed, for instance, by measuring the amount of time spent (e.g. on a website), user satisfaction ratings (e.g. confusing or clear instructions), instrumental support in decision making and responsiveness (e.g. behaviour change). Future design and research on digital interventions should address these issues more thoroughly.

**Proposition:** Digital interventions should be constructed to produce an emotional impact.

Can digital interventions be designed so that they are to use and understand, and also have an emotional impact? According to Norman [30] emotional design is dependent on a balance between three levels of design: the basic level, the behavioral level and the reflective level. The basic level is dominated by the physical features – look-and-feel, the use of images, sounds, colors, etc. Information processing at this level is considered to be automatic due to the fact that we from an evolutionary perspective are attracted to objects that are simple, symmetrical, harmonious, balanced and proportional. At the behavioral level one is concerned with how the use of the product (outside explicit awareness) is perceived by the client in terms of for example functionality, comprehensibility, user friendliness, and the physical perception of the program. At this level is considered of primary importance that the program provide feedback to the client (see below on interactivity). The reflective level is related to the construction of meaning of program use, on behalf of the user. Particularly important features are program and client identity congruency, the experience of personal touch (e.g. personalization) and mastery of program use (see above on successful information systems). We know much too little today about how digital health interventions could capitalize on "emotional design". But we know enough to suggest that "emotional design" is likely to contribute to initial and continued use, as well as effect of digital interventions. For example, increased interactivity seems to improve the emotional quality of the product [30].

**Proposition:** Digital interventions should be constructed to increase interactivity.

To the extent that interactivity can increase user involvement is must be considered a critical characteristic of a digital intervention. Most often change involves a considerable effort and involvement by the client. Although the change program will contain information, tasks and advices, successful change depend on the active involvement and participation of the client [7,31]. On the one hand this involves that the client comply with recommendations in terms of following the program closely; reading, thinking, doing, etc. as advised in the program. On the other hand, active involvement is necessary for effective self-monitoring to take place, selection of situations to be effective, appropriate handling of impulses to be initiated, etc. Specifically, for such change elements that are based on client input (feedback, progress reports, relapse prevention, etc.) to work appropriately, it is necessary that the client adhere and actively take part in the change program.

As discussed above, many changes require long-term maintenance in order to be successful. Furthermore, individuals must be able to gauge their progress against some frame of reference, which might include their own change plan (hold against their own prior history), the behavioral progress of others who are in a similar situation to themselves, or a regimen from a trustworthy source. In other words, efforts to change are likely to be successful when individuals receive timely monitoring and feedback on their progress. With such feedback, individuals can be motivated by their own achievements. They can modify their strategies and gauge the proximity of their goals. Research indicates that changes are much more likely to occur when interventions include a significant feedback component [32].

The effectiveness of feedback can be enhanced in three ways (for a more detailed description of these principles see [33]). First, the program should pay attention to motivators and reinforces that are personally relevant to the client (see below). Second, the program should make use of personalized self-evaluation and self-assessment techniques. Third, the program should stimulate the client to actively participate. For example, the client could be prompted to provide data about motivation, progress, etc. on numerous occasions before and throughout the program. On the basis on this collected user data, the program could provide three kinds of feedback; personal, normative and ipsative. The personal feedback provided to the client is based on his/her individual responses. For example, these types of feedback include the pointing out of the individual's risk status. The normative feedback is information of how an individual compares with others, for example how the client's risk status compares with others. Finally, ipsative (iterative) feedback is provided by representing information which compares the client's current and prior states. One example is that the client receives information of the development of the individual's risk appraisal over time (but also information on achievements, money saved, increased life expectancy, etc.). Hurling and colleagues [34] have provided empirical data which demonstrate the importance of interactivity in digital health behavior interventions. They showed that more interactive systems were judged by the client to be more engaging (increased user retention) created higher expectations for behavior change, greater satisfaction with motivation and improved self-perception related to behavioral change.

## 4 Conclusions

We know much too little about how to design effective digital interventions to support sustained behavior change and improved well-being. What we know is that cutting edge psychological theory and research is likely to represent a rich source of relevant knowledge. We have used this source to express 18 propositions which relate to the "content" and "design" of digital interventions. The list of propositions is by no means considered to be exhaustive or final. The propositions may help assist current design of digital interventions. They do, however, also represent research questions that should further developed and addressed to help establish a theoretical basis for the construction of digital interventions.

University people are often said not to be too concerned with "if things work in practice". Oftentimes we think it more interesting to discuss "if things work in theory". This was also, at least to some extent, the point of departure of the present paper. It primarily discussed how and why digital interventions designed to support

self-regulation in the service of behavior change should work "in theory". This endeavor was clearly inspired by the famous social psychologist Kurt Lewin's [35] saying that "there is nothing as practical a good theory". However, it is less well known that Lewin [36] also expressed that the best way to understand a psychological phenomenon is to try and change it. Hence intervention research and practical design experience is not just something that follows basic research at a polite distance, but rather is its inherent complement [37].

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