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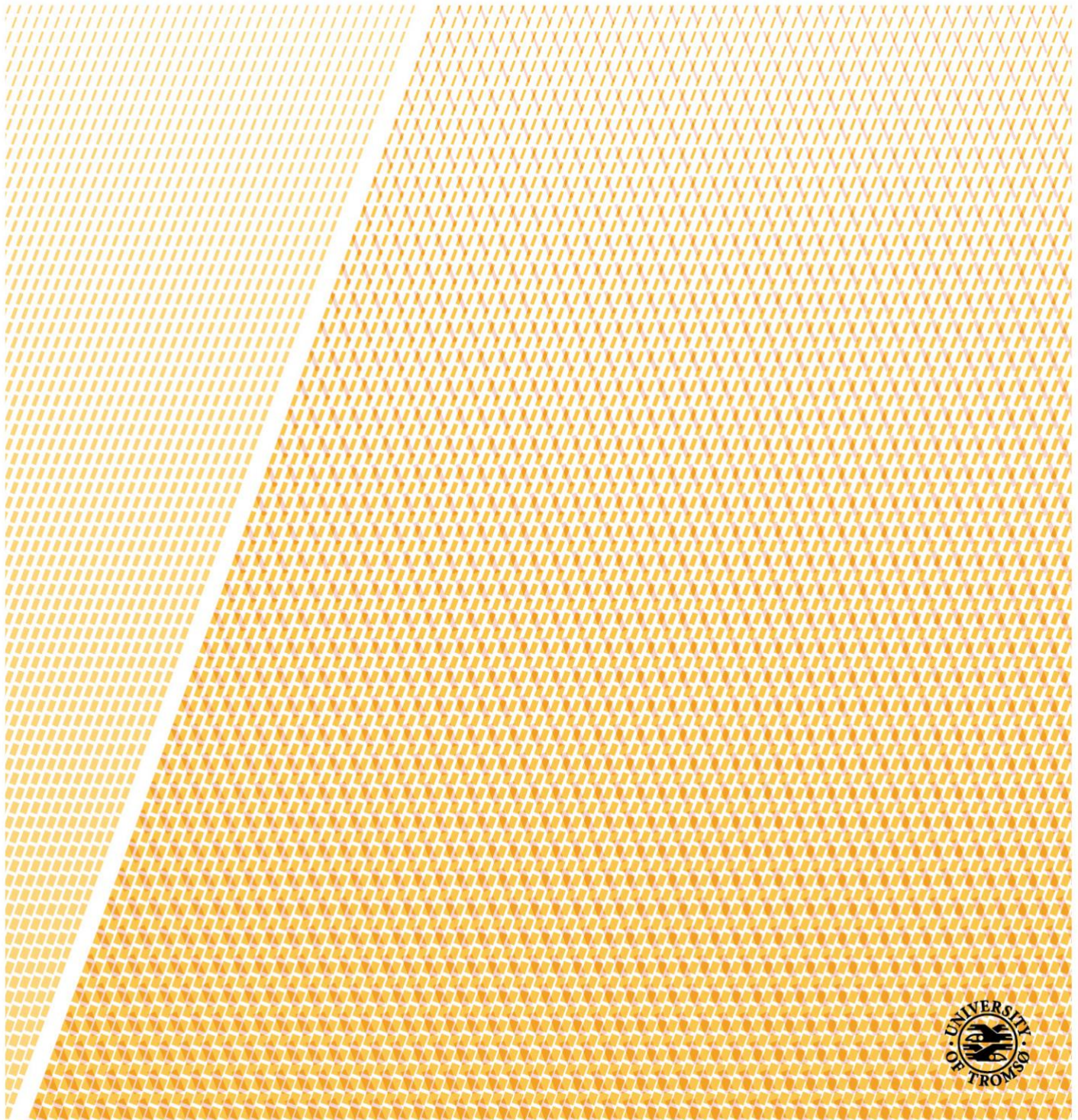
Self-regulating physical and mental activities:

Intensive longitudinal intervention studies of physical fitness and happiness

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and Happiness

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Abbreviations

CFA	Confirmatory factor analysis
EFA	Exploratory factor analysis
ESM	Experience sampling method
EWB	Eudaimonic wellbeing
FWA	Functional wellbeing approach
HWB	Hedonic wellbeing
MC	Mental contrasting
PF	Positive fantasizing
PS	Process simulation
SDT	Self-determination theory
SWB	Subjective wellbeing

List of papers

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Abstract

Being active is a primary necessity in life, but it is also an essential part of what makes life worth living. This thesis explored goal pursuit activities people might not experience as pleasant in the moment, but where the self-chosen activities are still considered good and worthwhile. We hypothesized that online self-regulation interventions would be effective in increasing effortful physical and mental activities and that a distinction between hedonic and eudaimonic conceptions of wellbeing would be evident in different stages of goal pursuit. Three papers, building on data from two studies, are presented. In Paper I, the effect of an online intervention for increasing physical activity, named *Lifestyle Tool*, was tested in a longitudinal study spanning three months. In Paper II, using global measures from a second study, we investigated the reciprocal effects of different wellbeing dimensions and goal pursuit stages before and after an intervention week. In Paper III, we used the experience sampling measures from the second study, and tested the assumption that HWB and EWB reflect two different dimensions of wellbeing and examined differences in emotions from goal pursuit interventions indicating discriminant validity. The results showed that online interventions helped participants self-regulate physical and mental activities. Furthermore, a duality between hedonic wellbeing (HWB) and eudaimonic wellbeing (EWB) were evident in the goal pursuit process: while EWB ignited and sustained wellbeing in effortful goal pursuits, HWB was more related to the outcome phase, rewarding goal achievement. Congruent findings from different analyses also supported convergent and discriminant validity of HWB and EWB as separate constructs. Interventions that help people self-regulate benefit actions viewed as good and conducive to physical and mental health, even though they are not always experienced as pleasant.

Introduction

To live means to act, and to act means to feel, at least for us humans. What we feel is fundamentally connected to how we behave, and activities that are good for us are often, but not always, experienced as pleasant. Being physically active, for example, is generally a good habit even if the experience of working out can be rather unpleasant. This mismatch between healthy behavior and unpleasant feelings might explain part of the reason why in Norway, for example, only 34% of women and 29% of men fulfill the minimum recommended guidelines for physical activity (Hansen et al., 2015). However, the pleasure-maximizing explanation cannot completely account for the feeling-acting interaction, and a science that more effectively accounts for these mechanisms will certainly contribute to a highly needed and very important body of knowledge.

Values also play a role in the reciprocity between feeling and acting. We typically value activities that are important to our way of life. Yet, the activities we value are idiosyncratic and resonate how we feel while we act. A person who values mountain hiking might report feeling good while climbing a mountain, even though the strain on the body might feel unpleasant. The same person, conversely, might not endure equivalent levels of unpleasantness when walking on a treadmill. While both examples entail physical activity, they differ with regard to both their outcomes and to how the activity feels. The experience of nature, the crisp and clean mountain air, and perhaps the goal of reaching the mountaintop are integrated into the positive experience of hiking in the mountains. Nevertheless, somewhere along the way, as the mountain becomes steeper or the physical strain intensifies, the mountaineer might cease to feel well. Still, by envisioning the goal of standing on the summit, she might regulate her thoughts, feelings and actions in a way that allows her to keep going. Ultimately, overcoming such struggles and conquering the mountain predictably feels good—very good. Furthermore, when a mountain

climber develops endurance and technical climbing skills, she might seek higher or more dramatic mountains, increasing the levels of complexity and difficulty she encounters—and reducing pleasant feelings along the way.

The above example illustrates some of the complexities of studying physical and mental activities in humans. Experientially, pleasure feels good and constitutes an important element of wellbeing. Nevertheless, pleasure is not the only motivator of goodness, or more precisely of prudential goodness, a philosophical term referring to individual goodness as opposed to moral goodness (see Griffin, 1986). For instance, acting (prudentially) good may connect to other positive feelings bounded by our goals, values and motivations—and supplemented by our ability to self-regulate. Thus, this thesis will examine different self-regulation strategies that aid in personally important goal pursuits and study their effects on physical activities and mental wellbeing.

Wellbeing

Wellbeing is about happiness in the sense of living a good life. Wellbeing thus includes “all the ways in which people experience and evaluate their lives positively” (Tov, 2018, p. 1). Not surprisingly, psychological science offers a broad range of definitions and measures of the concept. Generally, wellbeing refers to both state-level momentary and fluctuating feelings and to trait-level stable and enduring evaluations (Eid & Diener, 2004). These feelings and evaluations differ in terms of their temporal orientations and evaluative processes. State levels refer to feelings at a particular moment in time or within a restricted period of time (e.g., today, during your hike) and can reflect shifting influences from situational and contextual factors (e.g., time of day, physiological necessities, social interactions). Wellbeing at the trait level refers to

how a person feels or how satisfied they are in general or on average (across time and situations) and can be influenced by personality traits (Steel, Schmidt, & Shultz, 2008), memory and heuristic biases (Fredrickson, 2000; Schwarz & Strack, 1999) and general beliefs about the self (Robinson & Clore, 2002). Kahneman and Riis (2005) defines state wellbeing as being happy *in* your life and trait wellbeing as being happy *with* your life. What is missed by only conceptualizing wellbeing through these expressions is the developmental part of a good life; that is, the experience of being happy in *fulfilling* your life (Vittersø, 2016c). Researchers influenced by a eudaimonic approach reason that it is necessary to include some aspects of virtuous activities in order to fully define what it means to lead a full life (Ryan & Deci, 2001; Ryff, 1989). From the eudaimonic perspective, happiness is considered a process and is characterized by the development of resources and potentials, which are aimed at achieving optimal functioning and integral fulfillment. Thus, there are two major perspectives in the exploration of wellbeing; these perspectives are usually referred to as hedonic well-being (HWB) and eudaimonic wellbeing (EWB; Ryan & Deci, 2001; Tov, 2018; Waterman, 1993). Although not all wellbeing researchers concur with the usefulness of a distinction between the two (see, Kashdan, Biswas-Diener, & King, 2008; Sheldon, 2016), both are central to the focus of this thesis and will thus be described next.

Hedonic wellbeing

The term hedonic comes from the Greek word *hêdonê*, meaning pleasure. In psychological research, there are several meanings of pleasure; pleasure as a distinct or general feeling (happy *in* your life) and pleasure as an attitude (happy *with* your life; Vittersø, 2013). As a general feeling, pleasure has been described by some as an affective state, experiential quality or hedonicity that accompanies all emotional experience (Russell, 2003, 2009). Kahneman

(1999) describes it as a good/bad dimension of human experience. Grouping a set of emotions together as positive emotions is validated by seeing pleasure as an affective state, as in Fredrickson's (2001) Broaden-and-build theory of positive emotions. Following this understanding, pleasure guides approach and avoidance behavior. Conversely, Burgdorf and Panksepp (2006), in their summary of neurobiological research, maintain that there are at least two distinct categories of positive emotions: consummatory and appetitive. In this understanding, pleasure is the distinct feeling accompanying the reward processes that help maintain homeostatic equilibrium, collapsed as consummatory emotions. Appetitive emotions, by contrast, are associated with approach behavior. Building on evidence that consummatory and appetitive emotions are regulated by independent brain systems (controlling opioids and dopamine, respectively), this neurobiological research indicates that pleasure's main function is to maintain stability by communicating that a return to the homeostatic set-point has been achieved. On the other hand, appetitive emotions are better suited to explaining the eagerness and exploration that characterize approach behavior. Thus, from a neurobiological perspective, pleasure is understood as a distinct feeling, separable from other groups of positive emotions, such as appetitive emotions. Pleasure as both a general and distinct feeling is often referred to as affective wellbeing (e.g., Tov, 2018).

Attitudinal pleasure refers to evaluating an object, event or action by the niceness or badness of the experience, following Frijda's (2009) description of pleasure as "a gloss of niceness". In global measures of wellbeing, e.g., life or domain satisfaction, this evaluation is based on a set of standards a person has rather than on feelings (see, Vittersø, 2016a for a comprehensive discussion on satisfaction being hedonic). Attitudinal pleasure is often referred to as cognitive wellbeing (e.g., Feldman, 2006; Tov, 2018).

In line with the conception of pleasure reviewed above, subjective wellbeing (SWB)—which covers life satisfaction and positive and negative affect (Diener, 1984)—is now regularly deemed hedonic (e.g., Disabato, Goodman, Kashdan, Short, & Jarden, 2016; Kristjánsson, 2017; Ryan & Deci, 2001; Tov, 2018; Vittersø, 2013, 2016a). While people’s affective feelings and cognitive evaluations of their own lives often are perceived to be separate dimensions of HWB, both are integrated in the sense of reflecting an evaluation in terms of individual goodness or badness (e.g., Kahneman, 1999; Schwarz, 2000). In sum, HWB concerns what people typically associate with being well (King & Pennebaker, 1998).

Eudaimonic wellbeing

Eudaimonia is also an ancient Greek term, formed by combining the prefix “eu” (good) and “daimon” (spirit); this term is often considered to mean wellbeing in the Aristotelian tradition (e.g., Kristjánsson, 2017). A commonly accepted language for EWB has yet to be established (Disabato et al., 2016; Kashdan et al., 2008). Accordingly, eudaimonia is often referred to as encompassing important aspects of a good life that are not captured by HWB (e.g., Huta & Waterman, 2014). Although from a eudaimonic perspective, wellbeing is regarded as a process (being happy *fulfilling* your life), the central aspects of EWB have typically been measured at the trait level rather than at the state level (Waterman, 2008). Some have abstracted EWB as a set of human virtues or dimensions of optimal functioning, varying in number (e.g., Peterson, Park, & Seligman, 2005; Peterson & Seligman, 2004; Ryff, 1989), and this conception has led to discussions of cherry-picking (Kashdan et al., 2008). In *The Handbook of Eudaimonic Well-being*, the essence of modern EWB is articulated as “...activities and experiences included in, or resulting from, the development of valuable individual potentials and social relations.” (Vittersø, 2016c, p. 19). Typical characteristics of EWB thus include some notion of personal

growth and the search for and creation of meaning. Sometimes EWB is described as being about functioning well, as opposed to the feeling good of HWB (Keyes & Annas, 2009). However, in modern emotion theory, feelings are considered integrated and highly functional parts of activities (Scherer, 2005), they are not just outcomes of some activity—they are part of that activity. Thus, EWB also has a feeling component, which requires attention to make progress on theories of EWB (Besser, 2016). The most detailed effort to include feelings in EWB comes from the functional wellbeing approach (FWA; Vittersø, 2013, 2016a), which also bridges HWB and EWB in a unitary, holistic theory of wellbeing.

Functional wellbeing

Mapping on to the neurobiological evidence that there are at least two different positive feeling states, the FWA understands consummatory emotions as hedonic and appetitive emotions as eudaimonic (Vittersø, 2016a). Other scholars have made similar distinctions, such as liking versus wanting (Berridge & Kringelbach, 2013) and low-arousal versus high-arousal positive emotions (Gable & Harmon-Jones, 2008). According to the FWA, HWB and EWB serve different functions connected to our human nature: The function of HWB is to maintain stability, and the function of EWB is to foster change. The importance of these two functions is substantiated in writings by Damasio (2018) and Pross (2016), which suggest that stability and change represent the two most essential features in the life of all biological organisms. Hence, while the function of hedonic feelings is to reward need fulfillment, goal achievement and activities that are familiar and simple, the function of eudaimonic feelings is to support change processes when one is confronted with novelty, complexity or uncertainty and thereby foster learning and growth. Interest and inspiration are predictably connected to personal growth (Straume & Vittersø, 2012; Vittersø & Sørholt, 2011), and when dealing with novel, complex

tasks, participants will typically report feelings of interest rather than pleasure (Turner & Silvia, 2006). Thus, in FWA, feelings of interest are collectively suggested as a main candidate for describing eudaimonic feeling states (Vittersø, 2016a).

Physical Activity

Being physically active is strongly connected to both physical and mental wellbeing: Conversely, the detrimental effect of an inactive lifestyle on both physical and mental health are well-covered in research (Deslandes et al., 2009; Hamilton, Healy, Dunstan, Zderic, & Owen, 2008; Pawlowski, Downward, & Rasciute, 2011; Warburton, Nicol, & Bredin, 2006). Physical activity can be undertaken in many forms: as active recreation, as part of work and as part of domestic tasks. Mental health benefits are more evident when people engage in active recreation, while all forms of physical activity can provide health benefits (e.g., Wen et al., 2011). The crucial factor is regular exercise of sufficient duration and intensity. As little as 15 minutes of moderate-intensity exercise every day can have an important impact on health outcomes (Wen et al., 2011), and for both physical and mental health, it seems that the more vigorous the exercise is, the better (e.g., Arem et al., 2015; Tyson, Wilson, Crone, Brailsford, & Laws, 2010). The Norwegian government follows international guidelines and recommends 30 minutes of medium-intensity physical activity on at least five but preferably all days of the week (Jansson & Andersson, 2009). However, as mentioned in the introduction, most of the Norwegian population fails to meet these guidelines and the rest of Europe is no better (Hansen et al., 2015; Sjöström, Oja, Hagströmer, Smith, & Bauman, 2006). Increasing physical activity is a common goal both for individuals and the society as a whole. The summarized research shows that physical activity is good for both physical and mental wellbeing, although physical activity requires effort and

different degrees of unpleasantness. Physical activity is thus a good arena for researching the benefits of self-regulating activities.

Goal Pursuit

Like well-being, goals also have a broad range of definitions and conceptualizations in the psychological literature. Life tasks (Cantor & Sanderson, 1999), current concerns (Klinger & Cox, 2004), personal projects (Little, 1989, 2014; McGregor & Little, 1998), personal strivings (Emmons, 1986), and possible selves (Markus & Nurius, 1986) are some of the goal constructs often referred to in the literature. Common among all conceptions of goals is the notion that goals have an impact on our daily lives by affecting our thoughts and actions—and by providing structure and meaning to our lives. Differences emerge from the general consensus that goals have a hierarchical structure containing many levels of abstraction, from magnificent obsessions to trivial pursuits (paraphrasing Little, 1989), and concepts of goals can differ accordingly (Austin & Vancouver, 1996; Carver & Scheier, 2001; Emmons, 1986; Kruglanski et al., 2002). Most goals—including life tasks, current concerns, personal projects and this thesis—take the mid-level approach, focusing on concrete plans that tend to be rather specific. Important to such goal pursuits are motivation and self-regulation, which will be elaborated on in the next two sections.

Motivation

Motivation concerns the reason why we engage in a particular activity, but it also connects to the what and the how of goal pursuit processes (Deci & Ryan, 2000). Motivation is what ignites and guides human behavior: When motivated, we are filled with energy and direction. From a purely hedonic perspective, the only motivation is to approach desired feelings

and avoid undesired feelings, that is, to maximize pleasure and minimize pain. However, the psychological research on motivation has shown that this is an oversimplification (Higgins, 2006, 2014). Thus, psychological theories have largely moved away from purely instrumental theories of motivation towards a more integrative approach that also take into account eudaimonic ideas.

For example, in self-determination theory (SDT; Ryan & Deci, 2000), our motivations for pursuing a goal fall along a continuum from autonomous (intrinsic) to controlled (extrinsic), where intrinsic (autonomous) motivation is of the highest quality. This type of motivation arises when we experience that our needs for autonomy, competence and relatedness (i.e., basic psychological needs) are supported. Intrinsic motivation is characterized as doing something because it is inherently interesting or enjoyable (Deci & Ryan, 2000). Behavior contingent on external rewards or on some other eventual outcome is considered to be lower-quality, extrinsic motivation. The motivations underlying activities and pursuits are closely connected to both goal achievement and wellbeing outcomes (Sheldon et al., 2010; Sheldon & Elliot, 1998).

A related but slightly different conception of motivation is Schwartz and Wrzesniewski's (2016) internal motivation. In their view, rewards or ends can be just as important for behavior motivated from within as for instrumentally motivated behavior. The important criterion for being internally motivated, these authors tell us, is that the activity corresponds to the goal of the activity. It is the route a person takes to achieve a goal, i.e., how ends and outcomes are achieved, that differentiates those who are internally motivated from those who are not. Real internal motives are when outcomes are tied to an activity and could not be achieved through any other activity. When there is correspondence between the goal and the activity, both the pursuit and the outcome contribute to a good life. Even when motivated from within, not all of the tasks

involved in the pursuit of difficult goals are inherently enjoyable, as they typically require costly effort (Ericsson, Krampe, & Tesch-Römer, 1993; Shenhav et al., 2017). So, what are the processes that aid us in pursuing such goals?

Self-regulation

Goal pursuit implies behavior change, and behavior change is often a difficult task. Consequently, sometimes during goal pursuit, we need to apply our capacity to actively control thoughts, feelings and behavior in accordance with our long-term goals in order to stay on track, that is, we need to self-regulate (Baumeister & Vohs, 2007). Self-regulation is seen as a process that involves monitoring and regulating behavior in relation to our goals or values; it consists of a variety of purposeful plans and strategies to actualize the pursuit of a goal. In the process of goal pursuit, the goal serves as a standard, and current movement toward it is the standard of measuring progress (Carver & Scheier, 1990, 2001). The discrepancy between the goal standard and the present state gives rise to different affective experiences that serve as feedback on what to do next. Researchers have identified several adaptive techniques for utilizing the feedback system involved in self-regulation. For example, mental contrasting is one strategy that triggers this feedback loop by first activating the goal and all the positive outcomes of achieving it and then activating thoughts about the present situation and obstacles that may stand in one's way of achieving the goal (Oettingen, Pak, & Schnetter, 2001). Process simulation is another self-regulation strategy that takes the more concrete route to directly envisioning the pursuit and thereby forming strategies and plans for problem-solving and coping with negative emotions that may arise (Taylor, Pham, Rivkin, & Armor, 1998). Such strategies may also help in abstracting goals to the optimal level and in supporting ideal experiences of progress (Trope & Liberman, 2003).

Subjective Experience of Goal Pursuit

We are not passive spectators of our surrounding world. We take in our external world and—based on the internal states of our complex biological system—we create a representation of the external world (Chalmers, 1995). Accordingly, when people are asked about their feelings and thoughts in response to an activity, their responses are their subjective experiences of the activity. Emotional and cognitive information are integrated to whole, personal experiences and represent a person's idiosyncratic experience of the world (Scherer, 2005). How has the subjective experience of effortful goal activities typically been described?

Some have emphasized the importance of goal types and proposed that we put more effort into goals that give us a high sense of autonomy when we pursue them, i.e., self-concordant goals, which increases the likelihood of attaining such goals and thus increases our wellbeing (Sheldon & Elliot, 1998; Sheldon & Elliot, 1999; Sheldon & Houser-Marko, 2001). Another line of research has found that we experience fewer obstacles when pursuing self-concordant goals and suggested that it is subjective ease (i.e., our subjective experience of how easy a goal is to pursue) rather than conscious effort that is responsible for the improved progress we make on self-concordant goals (Milyavskaya, Inzlicht, Hope, & Koestner, 2015; Werner, Milyavskaya, Foxen-Craft, & Koestner, 2016).

These scholars relate this pattern to the flow phenomenon identified by Chikszentmihalyi, where the experience of being completely absorbed can keep bodily feelings (such as effort) outside conscious awareness (Nakamura & Csikszentmihalyi, 2014). However, when making progress on a goal is difficult and problematic the goal are more likely to intrude into consciousness (Bongers, Dijksterhuis, & Spears, 2010), thus it seems unlikely that flow

experiences are constructive in difficult goal pursuits (Ericsson et al., 1993). Pleasure is also typically experienced when processing easy situations (Reber, Schwarz, & Winkielman, 2004), while interest is often experienced in difficult and novel situations (Thrash, 2007).

By explaining the subjective experience of goal pursuit through the lens of self-regulation, we can make different predictions of what different stages of goal pursuit feel like (Carver & Scheier, 1990). For example, if there is no discrepancy between the goal and the present state, this alignment signals that the goal has been reached, which gives rise to feelings of pleasure and satisfaction (Vittersø, Søholt, Hetland, Thoresen, & Røysamb, 2010); thus, the typical subjective experience of goal achievement is pleasure and satisfaction. Conversely, a large discrepancy leads to unpleasant and sometimes distressing states of negative emotions. Though chronic negative emotions are reported to be harmful (Moberly & Dickson, 2016), state levels may be beneficial in some goal pursuits (Mayne, 1999). Last, most beneficial to effortful and continuous goal pursuit seems to be a scenario in which there is a fitting discrepancy between the goal and the present state, i.e., when the goal is difficult but specific (Locke, Latham, & Fowler, 2002). Such pursuits are often described by feeling states such as interest, challenge and engagement.

Interventions

There has been a shift from a time when most people viewed happiness and wellbeing as something we are born with that are out of our control towards it now being seen as something that we can, and perhaps even should, improve through our efforts (McMahon, 2018; Proctor, 2017). The latter belief is, in itself, associated with greater wellbeing (Van Tongeren & Burnette, 2016). Wellbeing interventions are often discussed as positive psychology interventions (PPI),

which are "...treatment methods or intentional activities that aim to cultivate positive feelings, behaviors, or cognitions" (Sin & Lyubomirsky, 2009; p. 468). Increased wellbeing can also be a by-product of other behavior change interventions, such as physical activity and lifestyle interventions that also target nutrition (Johnson, Robertson, Towey, Stewart-Brown, & Clarke, 2017; C. W. Wiese, Kuykendall, & Tay, 2018).

Pioneering work by Fordyce (1977, 1983) marks the start of research on interventions directly focused on increasing happiness. After the formal inception of positive psychology, interventions designed to increase people's happiness levels flourished (Seligman, Steen, Park, & Peterson, 2005). PPIs have proven effective when there is a fit between person and activity (Lyubomirsky & Layous, 2013) and for women (Thompson, Peura, & Gayton, 2015).

Interventions can have long-term effects when they use intentional activities and when they are engaged in over time (Cohn & Fredrickson, 2010; Lyubomirsky, Sheldon, & Schkade, 2005).

Like other lifestyle interventions, PPIs have also been shown to be effective when administered online (Bolier et al., 2013; Layous, Nelson, & Lyubomirsky, 2012), and new technology presents innovative opportunities for designing more engaging interventions (Botella, Banos, & Guillen, 2017).

Experience Sampling

Studying the functioning of a person and the change processes in their daily life requires a specialized method. ESM is a methodology developed for that specific purpose (Hektner, Schmidt, & Csikszentmihalyi, 2007) and has been referred to as the gold standard for measuring online, state-level wellbeing (e.g., Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004).

In ESM, data are collected in natural settings, in (or close to) real-time, and repeatedly (Conner, Tennen, Fleeson, & Barrett, 2009). Analogous methods include ecological momentary assessment (Shiffman, Stone, & Hufford, 2008), daily diary methods (Bolger, Davis, & Rafaeli, 2003), intensive longitudinal methods (Bolger & Laurenceau, 2013), day reconstruction methods (Kahneman et al., 2004) and ambulatory assessments (Fahrenberg, Myrtek, Pawlik, & Perrez, 2007). The advantage of ESM is that subjective experiences can be investigated in the natural and immediate context of people's daily lives. Participants in ESM studies are typically asked to fill out short questionnaires in response to a signal one or more times a day for a period of several days. Currently, mobile phones or computerized methods are usually used for signaling and for collecting participants' responses, although pen-and-paper using a preprogrammed watch for signaling have generally proved equally effective (Green, Rafaeli, Bolger, Shrout, & Reis, 2006). The main advantage of using mobile phones is that participants do not need to carry materials or remember to wear the watch, as people in western societies generally bring their mobile phones everywhere. The use of mobile phones thus decreases participant burden and also benefits the researcher because computerized methods allow data to be directly imported for statistical analysis, and response-times and durations can also be objectively measured. For some studies, add-on sensors (blood pressure measure) and ubiquitous data (e.g., noise using the mobile microphone, GPS-location references) are highly relevant and can be obtained (only, of course, after specifying this in the participant consent form and receiving permission from adequate authorities).

Different sampling protocols are possible within the ESM framework. Subjective experiences can be sampled randomly or at pre-determined times, either at fixed time intervals or in response to when a pre-designated event occurs (Wheeler & Reis, 1991). Decisions about

sampling procedure and study duration time should reflect the phenomenon of interest to the study. While random sampling has the advantage of reducing memory bias the most, it also has the highest participant burden, with some studies using as many as ten signals a day. Interval sampling typically has a lower participant burden but increases the likelihood of memory biases. Event sampling is appropriate when researchers are interested in subjective experiences in a specific context (e.g., during social interactions; Côté & Moskowitz, 1998); however, the practicality of such designs is often complicated, and the events reported on (or missed) may vary in a systematic way. Thus, study design is an essential part of ESM.

ESM yields a hierarchical dataset with multiple data points per person over time, which warrants within-person analyses. By providing access to the dynamics of how individuals think, feel, and behave, ESM is thus seen as an idiographic approach (Conner et al., 2009). However, within-persons patterns can also be summarized to make inferences about a larger population. In this thesis, ESM is used to study the dynamic within-person relations between goal pursuit and measures of physical activity and wellbeing. For example, we investigate how ESM can be used to test how experiences of progress and regress during goal pursuit may be followed by increases or decreases in wellbeing.

Aims of Thesis

The overarching aim of this thesis is to study the effects of online assistant self-regulation strategies on physical and mental activities. A second and integrated purpose is to investigate the interplay between planning, executing and pursuing goals on the one hand, and two different dimensions of wellbeing on the other hand. The distinction between effortful goal pursuit and rewarding goal achievement will be studied in particular. The thesis makes use of longitudinal designs and experience sampling methods. Information from self-reported data will be analyzed by means of a variety of statistical methods.

Paper I. Aims: To evaluate the effectiveness of the Internet-based intervention, *Lifestyle Tool*, for increasing physical activity among healthy adults. Hypotheses: Participants randomized to the Lifestyle group will report more physical activity than will the control group. The effect will be greatest on the first measurements after implementation of the intervention.

Paper II. Aims: To examine the reciprocal relationship between effortful goal pursuit and global wellbeing and to explore differences between HWB and EWB related to different mental strategies for goal pursuit and demographic variables. Hypotheses: EWB is a stronger predictor of goal achievement through increasing effortful behavior than HWB. By contrast, HWB is more strongly affected by goal achievement than EWB because HWB is the primary response to need fulfillment and goal achievement.

Paper III. Aims: To validate indicators of HWB and EWB as distinct concepts using data from an intensive longitudinal study. A second aim was to explore emotional experiences

connected to an experimental part of the design, where participants used different mental techniques (i.e., *mental contrasting*, *process simulation* and *positive fantasizing*) to aid them in pursuing a personally important goal. Hypotheses: Factor analyses will support the idea that indicators of HWB and EWB are caused by correlated, but distinct, latent factors. A multitrait-multimethod analysis will provide evidence for convergent and discriminant validity for both the concept of HWB and the concept of EWB. A multi-level regression analysis will show group differences in event-based emotions, with the positive fantasizing group showing higher levels of hedonic emotions (i.e., pleasure), but no differences with regard to eudaimonic emotions (i.e., interest). At the level of episodic emotions, effort will be associated with eudaimonic feelings, but not with hedonic feelings. Furthermore, in analyses of “whole day”-based emotions we expect no group differences.

Method

The work presented in this thesis consists of data from two projects. The sample for Paper I was recruited in a collaborative project with Telenor, through Tromsø Telemedicine Laboratory, and funded by The Research council of Norway, called *Lifestyle Tool*. The sample for Paper II and III was recruited through the project *Happiness as a goal* (Lykke som mål: en internettdagbokundersøkelse om livskvalitet, mental øvelse og måloppnåelse).

Lifestyle Tool (Paper I)

Design

The study was a two-arm randomized controlled trial that pilot-tested the effectiveness of an online physical activity intervention named Lifestyle Tool. Measures were administered at baseline and post-intervention after 4, 8 and 11 weeks. The Lifestyle group was given the intervention and registered their physical activity; a parallel control group only registered their physical activity. Participants were blinded to group-allocation.

Sample and Procedure

Participants self-recruited through ads in local newspapers. Initial contact was made by 55 people; 31 of these continued on and provided information on age, gender and physical activity level. To ensure equal representation in the two groups, we divided participants into sets based on the following criteria: physically active or passive, below or above average age, and male or female. We then used a stratified sampling procedure where members from each set were randomly assigned to the two experimental groups, 19 to the Lifestyle group and 12 to the control group. Eligibility criteria were access to the Internet, owning a mobile phone and not having any known medical diseases. The final analysis sample consisted of 20 participants—10 men and 10 women—who ranged in age from 35 to 73 years ($M=55.3$, $SD=11.2$). The Lifestyle

group consisted of 12 participants; the control group consisted of 8 participants (a participant flow diagram is reported in Paper I, p. 3).

Baseline physical activity was measured in the week leading up to information meetings that were held separately for the two groups. At the meetings both groups received general information about the study and handed in a consent form received in the mail. In addition, the Lifestyle group was given information about—and basic training in using—the Lifestyle Tool, and they were asked to create a personal account on the Lifestyle Tool website. All of the participants in the Lifestyle group registered on the website within three days. Both groups reported on physical activity (described in the measure section) at 4, 8, and 11 weeks following the information meeting. A richer questionnaire that included quality of life indicators and physical activity attitudes was also distributed at corresponding time-points. These questionnaires are, however, not included in any of the analyses, thus they are not further described in this work. Participants in the Lifestyle group were encouraged to use the Lifestyle Tool intervention during the three-month study period. As a reward for their participation, all participants took part in a raffle for three gift certificates of 5000 Norwegian Kroner (approximately equivalent to 500 Euro or 650 USD) at the end of the study.

Intervention

The Lifestyle Tool was an interactive, computer-tailored intervention website with supplemental text-messages designed to help people increase their physical activity level. Creating a user-account on the Lifestyle Tool portal gave access to a personal page that included different features: a physical activity calendar, a physical activity chart, and gamification elements.

The calendar was designed to help participants plan their physical activity. Pre-registering an activity prompted text-message reminders to be sent to participants' mobile phones before start-up and follow-up questions were also sent after the scheduled end-time of the physical activity. Post-registration for spontaneous physical activity was also possible.

The physical activity chart was designed to help participants monitor their physical activity. It was a graphical representation of the current week's completed physical activity in relation to the recommended guidelines from the World Health Organization (2010).

The gamification elements were designed to increase usage of the website and fuel motivation by making participation interactive and fun. Participants received points for completed physical activities based on the length and intensity of the activity. Accumulated points and a hierarchical category status level were visible on participants personal sites. The status level was based on physical activity points, ranging from novice to enthusiast. By earning points, the participants moved up the ladder. There were also two social gaming components available in the Lifestyle Tool; social contracts and competitions. When forming a social contract those involved committed to completing all of their planned physical activities within a set period of time (determined by the initiator of the agreement). If successful, participants received bonus-points (50% of the points they earned in this period were added in addition to the regular points). Violation of the contract meant no bonus points. There were two options for the objectives of social competitions a) to be the first one finish a pre-set sum of physical activity minutes, or b) to complete the most minutes of physical activity within a finite period of time (set by the initiator). Successful participants received bonus points (75% extra for first place, 50% extra for second place, and 25% extra for third place). In addition, they received virtual medals for first (gold), second (silver), and third (bronze) places. Medals won were visible on the

participants' personal pages. Invitations to join a competition or engage in a social contract were sent by text-messages and were visible on their personal page.

The Lifestyle Tool also sent out mobile text-messages from a message library. The text-messages were designed to promote physical activity by informing participants about the benefits of being physically active and the potential harmful risks of being inactive, and they also included concrete tips on what to do. Messages were personalized by referring to the participants by their first name and the information content was individually adapted to match age and gender and physical activity motivation (assessed at the first log-in using the behavioral regulation in exercise questionnaire; Markland & Tobin, 2004; Mullan, Markland, & Ingledew, 1997).

Measures

The outcome of primary interest was change in physical activity behavior. In each registration week, physical activity was self-reported through a daily report form every night at 9 PM. This method is comparable to the day reconstruction method (Kahneman et al., 2004), which relies on short recall periods with the benefits of reducing errors and biases of recall, however, it may still be susceptible to influences of social desirability. Participants reported physical activity episodes with information on activity type, the duration in minutes they engaged in this activity, and how strenuous each activity was using Borg's ratings of perceived exertion scale (RPE scale; Borg, 1985). Borg's RPE scale ranges from 6 (no exertion at all) to 20 (maximal exertion) with verbal anchors on each numbering. The scale is designed in such a way that one's approximate pulse can be found by multiplying the reported number by ten (e.g., if you score an activity as 8, your pulse during this activity would be approximately 80). The scale measures perceived exertion, which is the heaviness and strain experienced subjectively in physical activity (Borg, 1998). The RPE-rating is a well-established subjective indicator of

exercise intensity when compared to physiological measures (Chen, Fan, & Moe, 2002; Scherr et al., 2013). The daily report forms were completed every night of study weeks 1, 5, 9 and 12. Physical activity in minutes was combined with the respective Borg's score and averaged to compute an effectual physical activity score, in addition to being analyzed separately.

Analytic strategy

We used SPSS version 21 for the data analyses. The differences in physical activity minutes, Borg and effectual physical activity (BorgXmin) between the Lifestyle and the control group in weeks 5, 9, and 12 were evaluated using analysis of covariance (ANCOVA). Week 1 measures were included as a covariate in the models to control for the effect of initial physical activity. In all tests, differences were considered statistically significant if the *p*-value was less than 0.05.

Ethical considerations

Participants received an information letter with information about the background and aims of the study, what participation entailed, and protection of privacy. Signed consent forms were handed in by all participants at the information meeting. Participation was voluntary and participants were informed that they were free to withdraw at any time, without giving any reason. Participants were assigned an ID that was used instead of names in all questionnaires. The identifier was only available to the PhD candidate and was kept in a locked cabinet separate from any data files and questionnaires. Shortly after the study period, the identifier was shredded, leaving the questionnaires completely anonymized. Completed paper questionnaires are stored in a locked cabinet.

Happiness as a Goal (Papers II and III)

Design

In the second study we used intensive longitudinal methods in combination with an experimental design to investigate the relationship between goal pursuit and wellbeing over two weeks. We had three different conditions where participants received different mental exercises to advance goal pursuit; the first group received instruction for *mental contrasting* (MC); the second group *positive fantasizing* (PF); and the third group *process simulation* (PS). Global measures were administered at baseline (T1) and post-intervention following the intervention week (T2) and at a one-week follow-up (T3). The design included a one-week ESM-period between T1 and T2 with a combined event- and interval-contingent procedure. The focus of Paper II was on the global questionnaire measures, while in Paper III the experience sampling data were analyzed.

Sample and procedure

The sample in this study was collected in two sequences. First, undergraduate psychology students were recruited by advertising the study in class and by sending an invitation e-mail, yielding 69 participants. Second, we sent out invitation letters to a representative Norwegian sample of 2000 addresses from the general population, yielding 116 participants. In total, 185 participants volunteered for the study. They ranged in age from 21 to 77 years, with a mean of 36.08 ($SD = 13.44$); 24 participants did not report their age and gender. The study was disseminated online using Qualtrics in combination with Surveysignal (Hofmann & Patel, 2015). Eligibility criteria were owning and knowing how to use a mobile phone with Internet access. Participants navigated to the information site through a link in the invitation e-mail/letter. After

giving online consent, participants were randomized to the three experimental conditions using the randomizer in Qualtrics: 52 to MC, 61 to PF and 72 to PS.

Upon registration all participants completed an identical questionnaire (T1) and set a goal that was “a little challenging, but achievable”. We followed Little (1983) in our descriptions of goals, and portrayed what we meant by goals by stating that *people have many kinds of things that they think about, hope for and dream of accomplishing. Think about the different goals you have in your life at the moment. The goal may be related to hobbies, work, education, family, friends, yourself or something else that is important to you in the present.*

An introduction to the group-specific instructions for the mental exercise was given after setting the personal goal. The next week (7 days), during the ESM period, participants received a text message with a link to a daily report form every night at 9 PM. In the report form participants were given (and asked to follow) the instructions for the mental exercise; then they were asked to complete a short questionnaire that first tapped into episodic emotions in the event of doing the mental exercise, followed by questions inquiring about daily goal pursuit and emotional experiences. After the ESM-period participants in all three groups filled out the second questionnaire (T2) and one-week afterwards, they filled out a follow-up questionnaire (T3).

Participants received a gift certificate of 200 NOK (approximately equivalent to 20 Euro or 24 USD) for completing T1, the ESM period and T2, and an additional gift certificate of 100 NOK for completing the follow-up at T3. In the student sample we had a raffle for a bonus gift certificate of 5000 NOK among those who completed all measures.

Interventions

In all three interventions, the personal goal that participants set at T1 was made salient by being integrated into the instructions the participants received. Participants were asked to think about the goal while following the instructions for the exercises. The exercises took approximately the same amount of time to complete; they did however differ with regard to the focus in the instructions.

The Mental-Contrast intervention was adapted from Oettingen et al. (2001). In this condition participants first identified one positive aspect of achieving their goal, pictured events and experiences connected to the positive outcome and wrote down a few words describing what they thought about. Then, they identified one negative aspect of the current situation that stood in the way of achieving their goal, and in the same manner, they pictured events and experiences connected to this obstacle and wrote down a few words describing what they thought about.

Participants receiving this intervention were asked to identify one positive aspect of achieving the goal and one negative aspect of the current situation that stood in the way of achieving it. The instructions for the positive aspect were as follows:

You will now focus on a positive aspect of reaching your goal of ...

What would be the most positive thing about reaching this goal? Choose a positive aspect of the goal that is important to you and think through it thoroughly. Picture events and experiences associated with it as vividly as possible. Let the mental images slide by and give your fantasies free reign. Spend a few minutes daydreaming like this.

In the column below, write down a few words describing your thoughts.

The instructions for the negative obstacle were as follows:

Sometimes things do not go according to plan. Think about what it is that can prevent you from achieving your goal of ...

Choose a personal obstacle that stands in your way of reaching your goal. Focus on this critical obstacle and think through it thoroughly. Picture events and experiences associated with it as vividly as possible. Let the mental images slide by and give your fantasies free reign. Spend a few minutes daydreaming like this.

In the column below, write down a few words describing your thoughts.

The mental exercise is designed to create a mental contrast between the positive fantasy of the goal and the negative aspects of the present that may hinder goal achievement, ultimately inducing in participants a feeling of a necessity to act.

In the *Positive Fantasy condition* participants were given the same instructions as in the *Fantasy-Contrast* except that they were not asked to think about negative aspects at all (Oettingen et al., 2001). Instead, they were asked to think about another positive aspect. That is, instead of creating a contrast to the positive aspect, people were allowed to fantasize only about the positive outcomes of realizing their goals. This is similar to the outcome simulation condition in Taylor's work (e.g., Pham & Taylor, 1999).

The Process Simulation intervention was adapted from Taylor and colleagues (Pham & Taylor, 1999; Taylor et al., 1998). Participants in this condition were given the following instructions:

Think about your most important goal of ... and consider the processes you need to go through in order to achieve your goal. Picture yourself collecting the materials or resources you will need in your work towards the goal. Do this in as detailed and realistic a way as possible. It is important that you actually see yourself completing tasks

that will lead you to goal achievement. Close your eyes and spend approximately 5 minutes on this exercise.

This mental exercise is designed to help participants identify activities and steps involved in goal achievement, prompting them to form a plan for how they are going to achieve their goal. Additionally, the mental exercise may help anticipate and regulate emotions that occur while working towards the goal.

Measures

ESM measures

We used two types of measures in the ESM form: event and daily emotions and cognitive evaluations of the goal pursuit process. Both event and daily emotional experience were measured by the Basic Emotions State Test (BEST; Vittersø, Oelmann, & Wang, 2009). Participants were asked to rate the frequency of nine emotions on a scale from 1 (*not at all*) to 7 (*all the time*), first, while doing the mental exercise (episodic, daydreaming emotions), and later during the day as a whole (daily emotions). The nine items tap into the three broad emotional states of pleasure, interest and negative emotions, measured by three items each. Items representing pleasure were pleasure, satisfaction, and happiness; Items representing interest were interest, immersion, and engagement; and negative emotions were measured by sadness, anger, and fear.

The goal pursuit process was evaluated in terms of effort, progress, and difficulty with one item each. Participants were asked to indicate on a scale from 1 (little) to 5 (a lot) how much effort they had put towards goal pursuit and how much progress they had made. Difficulty was measured by “how has it been working towards the goal today?” on a five-point scale from easy to difficult.

Global self-reports

Life satisfaction. A short 3-item version of the Satisfaction with life scale (SWLS: Diener, Emmons, Larsen, & Griffin, 1985) was used to capture life satisfaction. Participants were asked to evaluate to what extent the following items were true for them on a scale from 1 (not true) to 7 (completely true). The items included were “In most ways my life is close to my ideal”, “The conditions of my life are excellent” and “I am satisfied with my life”. Cronbach’s alphas were .87 at T1, .86 at T2 and .88 at T3.

Trait emotions. Interest, pleasure and negative emotions were measured by the Basic Emotions Trait Test (BETT: Vittersø, Dyrdal, & Røysamb, 2005). The emotions were measured by three items each: Interest by interest, immersion and engagement; pleasure by pleasure, satisfaction and happiness; and negative emotions by anger, sadness and fear. Instructions asked participants how often they felt each of the emotions in their everyday life with response options ranging from 1 (never) to 7 (all the time). Cronbach’s alphas at T1, T2 and T3 were .86, .83 and .89 for the interest subscale; .88, .88 and .91 for the pleasure subscale; and .65, .73 and .75 for the negative emotions subscale.

Personal growth composite. The instrument comprises four subscales: Curiosity (Amabile, Hill, Hennessey, & Tighe, 1994) with three items; Absorption (Kashdan, Rose, & Fincham, 2004) with three items; Complexity (from Cattell’s 16PF, see IPIP, 2002) with three items; and Competence (from Cloninger’s TCI, see IPIP, 2002) with three items. The participants responded on a 5-point response scale from 1 (strongly disagree) to 5 (strongly agree). Example items are as follows: ‘I enjoy trying to solve complex problems’ (Curiosity), ‘When I am participating in an activity, I tend to get so involved that I lose track of time’

(Absorption), ‘I love to think up new ways of doing things’ (Complexity), and ‘I can perform a wide variety of tasks’(Competence). Cronbach’s alphas were .80 at T1, .81 at T2 and .75 at T3

Goal effort and goal achievement. We measured goal effort and goal achievement at both T2 and T3 with one item each. Goal effort was measured with the question “How much effort have you exerted to reach your goal?” with answer alternatives ranging from 1(very little) to 5 (a lot). Goal achievement was measured by the yes/no-question “Do you feel that you have reached your goal during this week?”.

Analytic strategies

Missing data

In Paper II, where we used the global measures, our analysis dataset consisted of 167 responses at T1, 128 responses at T2 and 107 responses at T3 = 402 observations from a total of 185 participants (185x3 = 555 possible, 72.43%). We imputed missing data on the wellbeing variables using multiple imputation and the EM imputation algorithm provided by IBM SPSS (see the methods section of Paper II for details).

In Paper III we analyzed the daily diary data and thus only included the 155 participants who provided one or more daily diary reports. Due to a technical error, 17 participants did not complete the intake survey (including measures of age, gender and the T1 wellbeing measures), leaving $n = 138$ (57 students and 81 from the general sample). We used robust maximum likelihood estimation in our multilevel path analyses, where all available information is used, thus reducing common biases due to handling missing data using pairwise and listwise deletion. The distribution of missingness was not equal across intervention groups, $\chi^2(2, N = 185) = 6.10$, $p = .047$, that is, proportionally more participants dropped out in the MC group.

Data preparation

In Paper II, for parsimony and for the purpose of keeping a maximum number of participants in our analysis, we composed hedonic wellbeing (HWB) as SWLS + pleasure - negative emotions and eudaimonic wellbeing (EWB) as personal growth + interest. This was supported by a principal component analysis (PCA). We also combined the T2 and T3 measures of goal effort and goal achievement and used an average of T2 and T3 for EWB2 and HWB2 in the path model.

Time was coded $T1 = 0$, $T2 = .5$, and $T3 = 1$, so that the slope could be interpreted as the increase from T1 to T3. Intervention groups were effect coded, so that the intercept represented the grand mean.

In Paper III, given the hierarchical structure of the data (i.e., event and daily reports nested within participants), we used multilevel modeling and, following advice from Bolger and Laurenceau (2013), we separated the within and between components of the explanatory variable. This form of centering enables us to focus on the within person variability while considering people's variability in how they use a scale. We centered time on the fourth day so that the intercept could be interpreted as the value for a typical day of a week. Intervention groups were dummy coded, so that the intercept represented the mean for the PF group.

Exploratory factor analysis

In Paper III, in four exploratory factor analyses (EFA), we investigated the factor structure of all wellbeing indicators. The basic emotions (measured by the BEST and BETT) were analyzed separately in three models for life overall, the whole day and during daydreaming. In the fourth EFA the mean-scores for SWLS, each of the subscales of PG, trait pleasure, trait interest, and trait negative emotions were used in a conceptual second-order factor model. We

used maximum likelihood estimation and promax rotation as provided by the IBM SPSS statistical software.

Confirmatory factor analysis

Also in Paper III, the four EFA models presented above were tested using a confirmatory factor analyses (CFA) approach. Both single-level and multi-level factor models were fitted to the data using the full information maximum likelihood algorithm in Mplus version 8.0. Conventional criteria for evaluating goodness-of-fit were used.

Linear mixed models

In Paper II we investigated how the one week of active goal pursuit contributed to changes in EWB and HWB during our study period. For that purpose, we specified and estimated two multilevel linear growth models: one for HWB and one for EWB. Both models included a random intercept in order to take each participant's baseline score into account; and both models included the same level 2 covariates: gender, age and student vs. general population survey sample. We expected no intervention group differences in initial levels of wellbeing as our participants were randomized to the groups. Our focal explanatory variable at level 1 was time and we were interested in whether the intervention period of working towards a personal goal influenced either EWB or HWB, or both.

In Paper III, we estimated four hierarchical multilevel regression models with daydreaming and daily interest and pleasure as outcome variables. For each regression, we included time, dummy variables for the intervention groups at the first level, and within and between estimates of daily goal effort at the second level.

Path Model

In Paper II, a path model was articulated, and standardized regression coefficients were estimated in Mplus using robust maximum likelihood (MLR). Pre-intervention HWB and EWB were regressed on goal effort and goal achievement, which in turn were all regressed on post-intervention HWB and EWB to examine the reciprocal relationship between goal pursuit and wellbeing. Differences between HWB and EWB were tested using the Satorra-Bentler chi-square difference test for MLR estimation, comparing a model where paths to and from HWB and EWB were allowed to vary freely to a model where EWB and HWB paths were constrained to be equal.

Multilevel path model

We used a multilevel path model in Paper III for the purpose of investigating the convergent and discriminant validity of HWB and EWB in a multitrait-multimethod approach (see Paper III for further explanation of the method). Dispositions (SWLS and PG) were regressed on traits (trait pleasure and trait interest), which were regressed on daydreaming pleasure and interest, which in turn were regressed on daily pleasure and interest. Both between and within beta weights were estimated for the ESM data.

Ethical considerations

The Happiness as a Goal-study was approved by the Norwegian Centre for Research Data (NSD; 38397). The invitation letter/e-mail included the background and aims of the study, description of what participation entailed and information about privacy protection. This information was elaborated at the pre-registration site before participants gave online consent and were sent to the registration site at Surveysignal, which was the software we used to send out text-messages with links to electronic questionnaires. The questionnaires and the data were kept

separately in Qualtrics, where no personal information was stored, only an ID for linking an individual's data over time. Participation was voluntary and participants were informed that they were free to withdraw at any time, without stating any reason. To receive a gift card as a reward for participating, participants sent the PhD-candidate an e-mail with a code generated by Qualtrics. All the files containing contact information in Surveysignal and all the e-mails from and to participants were deleted when the project ended in December 2016.

Results

Paper I

Increasing physical activity efficiently: An experimental pilot study of a website and mobile phone intervention.

In Paper I, we tested the effectiveness of the Lifestyle Tool in increasing physical activity. The goal of the Lifestyle Tool was to help people incorporate physical activity into their daily lives; thus, its effect was examined over time with measures of physical activity pre-intervention in week 1 and post-intervention in weeks 5, 9 and 12. One-way analyses of variance showed that there were no differences between the groups in baseline physical activity. To test the interventions effect over time we performed ANCOVAs with physical activity minutes, Borg scores and BorgXmin at the different measurement times as the dependent variables. Initial physical activity was controlled for using physical activity in week 1 as a co-variate. Our analyses showed that there was an initial increase in both minutes and intensity of physical activity in week 5 where the Lifestyle group performed more minutes of physical activity, $F(1, 17) = 4.74, p = .044$, and performed at a higher intensity level, $F(1, 16) = 5.21, p = .037$, than did the control group. The effect was largely sustained to week 9 where the Lifestyle group still performed more minutes of physical activity than the control group in, $F(1, 17) = 4.51, p = .049$, and also more effectual physical activity, $F(1, 17) = 6.12, p = .024$. However, by week 12, this initial effect had worn off and there were no observable differences between the two groups.

Paper II

Striving for wellbeing: The different roles of hedonia and eudaimonia in goal pursuit and goal achievement.

In Paper II we looked at the reciprocal relationship between goal pursuit and global measures of wellbeing. We hypothesized that EWB would be a stronger predictor of goal achievement than HWB and that the effect of EWB on goal achievement would be mediated by goal effort. HWB was expected to be more affected by goal achievement and to increase after the goal pursuit week. We also explored how different goal strategies and demographic variables affect HWB and EWB during goal pursuit.

A path model found that EWB, and not HWB, significantly predicted subsequent goal effort directly ($\beta = .33, p < .001$) and goal achievement indirectly (fully mediated by goal effort; $\beta = .14, p = .001$). Testing the difference between this path model and a nested model in which the paths from EWB at T1 to goal effort and the path from HWB at T1 to goal effort were constrained to be equal, we found, using a Satorra-Bentler chi-square difference test for robust ML estimation, a significant difference in goodness-of-fit between the two models, $\Delta\chi^2(1) = 3.96, p = .047$. This result indicates that the impact of EWB on goal effort is significantly stronger than the impact of HWB on goal effort. There was no difference in the strengths of the paths from EWB at T1 and HWB at T1 with regard to goal achievement, $\Delta\chi^2(1) = 0.10, p = .746$.

Further, the model showed that goal effort caused an increase in post-intervention measures of HWB, $\beta = .17, p = .001$, but not in EWB, $\beta = .10, p = .109$. Constraining the two paths to be equal gave a significantly worse goodness-of-fit in the nested model, $\Delta\chi^2(1) = 6.43, p = .011$. When goal effort was not included as a mediator in the model, the path from goal achievement to HWB at T2 was significant, $\beta = .13, p = .001$, and the chi-square of a nested

model constraining the two paths to be equal was different from the chi-square of a model in which the two paths were not constrained to be equal, $\Delta\chi^2(1) = 4.27, p = .039$.

In a multilevel model of change we found that HWB increased for all three intervention groups after the goal pursuit period, $\beta = .24, p < .001$. There were no differences between the three intervention groups in HWB and there were no observed effects of demographic variables. For EWB there were no general time-trends, but there was a significant time trend for the positive fantasy group, $\beta = .29, p < .001$. Moreover, older participants reported higher initial EWB, $\beta = .02, p = .013$. For both HWB and EWB, large within-person random effects and evidence of auto-correlation in the within-person residuals yields uncertainty in the estimates of typical patterns.

Paper III

Now you see it, now you don't: Solid and subtle differences between hedonic and eudaimonic wellbeing analyzed with experience sampling data from a goal pursuit intervention experiment.

In Paper III we investigated the convergent and discriminant validity of HWB and EWB as distinct concepts using ESM data from the intensive longitudinal study. Results from EFA showed that HWB and EWB indicators loaded on separate factors for all three ways of measurement and furthermore in a fourth conceptual second-order factor model. A parallel analysis approach also suggested two-factor solutions for all analyses. The two factors correlated between .49 and .63. Testing these four EFA models with a CFA approach supported separating between hedonic and eudaimonic wellbeing as well. However, models that added a third, negative emotion factor showed even better fit.

A multitrait-multimethod test also revealed acceptable convergent and discriminant validity for HWB and EWB. Across methods the similar trait-coefficients were much stronger than the different-trait coefficients. However, the similar-method correlations were high between HWB and EWB indicators, approaching .70 between participants and .50 within participants.

Finally, four hierarchical multilevel regression models were estimated to further investigate discriminant validity. As hypothesized both the MC group ($\beta = -.40, p = .005$) and the PS group ($\beta = -.27, p = .048$) experienced less pleasure while daydreaming than the PF group. Daydreaming interest was not affected by the intervention. Not supporting our hypothesis, effort predicted both interest *and* pleasure, while we expected only a relationship between effort and interest. However, in the interest model we found indications of a suppressor effect; interest decreased over time, but only when effort was included in the model. Time affected effort and

interest in opposite directions and effort and interest were positively related. That is, increasing effort over time compensates for the otherwise decreasing interest over time. In other words, effort did in itself produce higher levels of interest. This effect was not observed for pleasure. As expected we found no effect of the interventions on daily emotions, but pleasure, and not interest, increased over time. Overall, these differences between pleasure (HWB) and interest (EWB) shows evidence for discriminant validity.

Discussion

The driving question behind this thesis is how effortful self-regulating processes impact physical and mental activities measured at different levels and different time-points—and how this fit into a larger wellbeing taxonomy. A starting point is that viewing happiness as a process that involves activities, and not just as a state, may help us bring together feeling good and doing good in a coherent theory of wellbeing. In an attempt to both activate behavior change and study how this change is related to indicators of wellbeing, we disseminated interventions online and combined momentary ESM measures with global measures in intensive longitudinal designs. As a result, this thesis presents data from two studies where indicators of physical and mental wellness were measured over time.

The first study showed that an online physical activity intervention was effective in helping people attain their goal of becoming more physically active—at least for a few months. The intervention included self-regulating components such as planning, self-monitoring, and feedback. As reported in Paper I, there was an initial physical activity increase in the group receiving the intervention compared to a control group, but the effect diminished over time. By week 12, at the end of the study, there were no differences between the two groups.

While the physical activity intervention reported on in Paper I focused on being easy and fun to use, with external prompts for becoming more physically active, in the second study, we wanted to trigger internal motives and reasoning for pursuing a personally meaningful goal. Therefore, in the second study we used previously tested mental exercises for self-regulating goal pursuit and examined wellbeing at different levels (global and momentary) and timepoints over two weeks.

In Paper II, we used the global wellbeing indicators pre- and post-intervention (from study 2) to examine a potential reciprocal relationship between goal pursuit and wellbeing. We found no differences between the interventions in goal outcomes. We did however, find that hedonia and eudaimonia played different roles in the goal pursuit process. While EWB predicted increased overall effort and goal achievement, only HWB increased after actually putting in effort and achieving the goal. Being growth-oriented and experiencing interest were beneficial in stages of active goal pursuit, while outcome stages influenced satisfaction and pleasure. EWB did not change during the study period, but HWB increased.

In Paper III, we examined the validity of separating HWB and EWB using ESM indicators of wellbeing from the goal pursuit week in study 2. We included in our analyses measures with different temporal foci, from traits and dispositions to daydreaming and daily emotions that covered both hedonic and eudaimonic conceptualizations of wellbeing. The results from both exploratory and confirmatory factor analyses generally supported HWB and EWB as related but separate dimensions of wellbeing. Hedonic and eudaimonic wellbeing indicators also followed different paths, from dispositions to traits to state emotions. However, HWB and EWB shared communality when measured at the same level, with the notable exception of a weak association between life satisfaction and personal growth. Additionally, the mental activities also impacted hedonic and eudaimonic daydreaming emotions differently and while daydreaming interest decreased during the study period, no such effects for pleasure were found. Conversely, daily pleasure increased towards the end of the study, while interest remained the same.

Self-regulating physical and mental activities

The interventions used in these studies targeted self-regulation processes to increase goal pursuit activities. Interventions disseminated in both study 1 and study 2 were effective at

increasing physical and mental wellness. While the intervention in study 1 targeted physical activity specifically, in study 2 participants were asked to set their own personal goal and the interventions were flexible enough to accommodate all sorts of goals. The small number of participants in study 1 made it difficult to investigate the possible mechanisms behind the effect. However, review papers have singled out goal-setting and self-monitoring as beneficial in physical activity interventions (Conn, Hafdahl, & Mehr, 2011; Lewis, Napolitano, Buman, Williams, & Nigg, 2017; Samdal, Eide, Barth, Williams, & Meland, 2017). Although we did not ask participants to set a specific goal for their physical activity level, the recruitment procedure in study 1 sought out participants wanting to improve their physical activity levels. The intervention website also facilitated self-monitoring with visual feedback and follow-up text messages.

Decreased intervention usage and effect over time is a common finding in the research literature (Vandelanotte, Spathonis, Eakin, & Owen, 2007), and the competition and gaming components of the Lifestyle Tool intervention were not able to fully counteract such attenuating effects in our study either. Perhaps the gaming industry holds promise for future physical activity interventions (LeBlanc & Chaput, 2017)?

In study 2, all participants were asked to set a goal, and the interventions focused on different aspects of the goal pursuit process. When analyzing global measures (Paper II) the only difference between groups was that EWB increased for the positive fantasizing group (i.e., when participants only thought about positive outcomes of achieving a goal). There were no other differences between the three intervention groups on the other outcomes—and all three groups increased in HWB. Due to the lack of a no-intervention control group we cannot say with certitude that the interventions increased HWB. However, previous studies have observed similar

effects of goal pursuit interventions on HWB (MacLeod, Coates, & Hetherington, 2008; Steca et al., 2016).

At the momentary level (in Paper III), we found that participants instructed to daydream only about positive outcomes experienced an increase in pleasure compared with participants who simulated both the positive outcome and possible obstacles or who simulated only the possible obstacles. Although we did not find differences between intervention groups on goal outcomes, previous research indicates that pleasure is not an optimal feeling for effortful pursuits (e.g., Dreisbach & Goschke, 2004; Witt Huberts, Evers, & De Ridder, 2012). An interesting finding of Paper III concerns the relationship between effort and daydreaming interest. The analyses showed that interest decreased over time, but only when effort was controlled for. Considering that interest is triggered by novelty and complexity (e.g., Silvia, 2006), a decrease in interest when the novelty wears off seems natural. However, because effort and time were positively related this means that effort compensates the decrease in interest over time. Others view interest as a replenishing source of increasing effort (e.g., Thoman, Smith, & Silvia, 2011); however, these findings might suggest that effort increases interest—or at least neutralizes a decrease in interest—over time. This might be a topic for future studies.

Dimensions of wellbeing

Overall, this thesis contributes to several discussions in the field of wellbeing research. First, finding that EWB, and not HWB, was responsible for increased effort (Paper II) partly challenges the predictions of the broaden-and build theory of positive emotions (Fredrickson, 2001) in its claim that both EWB and HWB will aid goal pursuit effort and that by broadening and building resources, goal pursuit effort will then lead to even higher levels of both EWB and HWB in an upward spiral. In Paper II, when analyzing trait-level measures, HWB was only

related to the outcome, and not active, phases of goal pursuit. However, in Paper III when analyzing state-level measures during goal pursuit effort the picture was less clear. The results indicated that effort increased both HWB (pleasure) and EWB (interest).

While the first findings are in line with both SDT and FWA, the second are more in line with Fredrickson's theory. That is, the results of Paper II offer support to the view of FWA that wellbeing serves different functions; EWB helps facilitate change and effortful behavior, HBW helps maintain stability by rewarding goal achievement (Vittersø, 2013, 2016b). The results are also consistent with the perspective of SDT where EWB seems to be viewed as a underlying predictor and HWB the outcome (e.g., Ryan & Martela, 2016). The finding in Paper III is in line with the broaden-and-build theory as well. However, as discussed above, effort seemed to help sustain interest over time while no such effect was found for pleasure. This finding might indicate subtle differences that a more intensive design would be better able to capture (this is further elaborated in the limitations section).

Other empirical studies have also found that related to our conceptualization of EWB, growth-related traits can predict positive goal-related outcomes and HWB. For example, Kashdan and Steger (2007) found that trait curiosity predicted more activities and more daily meaning and SWB. This is used as an argument against distinguishing between these two forms of wellbeing, the argument being that EWB can easily be incorporated into HWB, as its major outcomes consists of SWB (Kashdan et al., 2008). This argument is also put forward by Sheldon (2016). In their view, it seems, only the end outcome can constitute wellbeing, whereas the feelings intertwined with being active are only precursors. In terms of goal pursuits, the end, being goal achievement, often gives rise to immediate pleasure and satisfaction, which wears off easily. Other elements during the goal pursuit process have shown to have greater impact on

wellbeing than does goal achievement; these elements include goal progress (Klug & Maier, 2015) and goal involvement (B. Wiese & Freund, 2005). Goal pursuit is an active process. Integrated in goal pursuit activities are feeling qualities, and in our view, these feeling qualities also constitute wellbeing in themselves. Thus, wellbeing is better captured when viewed as a process.

Second, our research extends previous findings on the distinction between HWB and EWB. Specifically, in line with Vittersø and Søholt (2011), our data challenge the claims of SDT that EWB is only important because it enhances HWB. While hedonic and eudaimonic wellbeing indicators were separable as two distinct latent constructs, our findings in Paper III also suggest parallel routes of wellbeing guided by discrete wellbeing indicators integrated in the process of goal pursuit.

Third, while other studies report high levels of correlation between measures of HWB and EWB (e.g., Disabato et al., 2016), we found somewhat smaller correlations for the emotional indicators of HWB and EWB and much smaller correlations between the cognitive/life orientation indicators (i.e., life satisfaction and personal growth). The conceptualization of—or the lack of consistency in conceptualizing—EWB, has been strongly debated. FWA follows the Aristotelian approach to eudaimonia, emphasizing nature fulfillment as the core element of EWB and personal growth as a main indicator. Ryff (1989), too, noted that personal growth seems to be most closely related to Aristotele's conception of eudaimonia. Ryff has developed a self-report instrument to measure the six dimensions of her psychological wellbeing concept, and the correlation between life satisfaction and the subscale gauging personal growth is typically small, one study reported it to be $r = .25$ (Keyes, Shmotkin, & Ryff, 2002).

In attempting to capture “all the ways in which people experience and evaluate their lives positively” (Tov, 2018, p. 1), this thesis thus supports personal growth and interest as good candidates to complement hedonic elements.

Furthermore, in this thesis we measured hedonic balance with items (BEST and BETT; Vittersø et al., 2009) that tap the pleasure concept specifically by using items such as contentment, pleasure and satisfaction. The PANAS (Watson, Clark, & Tellegen, 1988) is another commonly used measure to capture affective balance. This measure includes emotions such as excitement and enthusiasm that may capture effort toward meaningful goal pursuits, rather than pleasure (Deci & Ryan, 2000). In our view, excitement and enthusiasm are appetitive and thus eudaimonic emotions. By being mindful of such subtle, but important differences, this thesis is better able to capture differences where HWB and EWB diverge. Still, more refinement of study methods and design would conceivably further our understanding of the dynamic relationship between HWB and EWB. While this thesis examined effortful goal activities to identify differences between HWB and EWB, other studies have found that negative experiences can better differentiate HWB and EWB better (Tov & Lee, 2016)—thus, activities that are unpleasant but still viewed as prudentially good may be useful for investigating differences between HWB and EWB.

Limitations

Although the present thesis provides new insights into the dynamics between self-regulation, goal pursuits and wellbeing, our data also have some shortcomings.

In Paper II it was reported that HWB increased during the study period for all three groups, presumably due to engaging in goal pursuit. However, we do not have an appropriate control group to claim that it was the interventions that increased HWB. To make that claim, we

need a control group that did not receive any goal pursuit intervention (Gundersen & Svartdal, 2010). However, defining an appropriate control group is difficult for psychological interventions (Mohr et al., 2009), and in our study we were more interested in differences between the interventions used. Oettingen and colleagues (Oettingen et al., 2001) have used the positive fantasy intervention for the control group in their studies on goal pursuit, and have reported on long-term detrimental effects of positive thinking on wellbeing (Oettingen, Mayer, & Portnow, 2016). Study 2 was of shorter duration, which may explain why we did not observe differences in wellbeing between groups.

The ESM procedures used in both studies place a high burden on participants. In study 1, we had no missing data, probably due to meeting participants in person and personally conveying the importance of providing data. In study 2, because of the representative sample with participants spread across Norway, all contact with participants was online and the procedure was automatic. Thus, this study had higher levels of missing data. Missing data and attrition are problems in longitudinal research such as ESM studies (Enders, 2017; Gustavson, von Soest, Karevold, & Røysamb, 2012).

We used self-report in study 1, where we could have used more objective markers. For example, Actigraph-sensors were available, though quite expensive considering the objective was an initial test of whether the Lifestyle Tool intervention increased physical activity. Now that these sensing devices are integrated into common smart phones, wristbands and smart watches, new studies should use such ubiquitous measures of physical activities. Additionally, just-in-time adaptive interventions are a thought-provoking opportunity where the technology already exists (Nahum-Shani et al., 2017). Here, the design can enable the individuals to receive feedback and support adapted to the changing individual's changing internal and external states.

However, a stronger theoretical basis for designing such interventions is needed, and insights from self-regulation theories may be particularly useful here.

Usually, we do not pursue one goal at a time, but rather have a multitudes of goals (Kruglanski et al., 2002), and are evidently able to name up to 15 personal goals when prompted (Emmons, 1986). The interrelations between goals can be a critical component of the dynamics between goals and wellbeing (Austin & Vancouver, 1996; Carver & Scheier, 1990); these interrelations were not taken into account in this study.

In study 2 participants were asked to set a personally relevant goal in any domain of their lives. Participants' goals were thus seemingly a mix of intrinsic/extrinsic, self-concordant/non-self-concordant, and any other type of differentiation based on internal motives. Other studies have shown that these motives can influence the relationship between goals and wellbeing (e.g., Kasser & Ryan, 2001; Sheldon & Elliot, 1999). We did not include measures tapping into goal motives, and it seems unreasonable to identify a person's internal motives based on a short goal sentence. Thus, we did not take means of classifying participants' goals after the fact.

The design of study 2 made it difficult to disentangle the effects of interest on effort from the effects of effort on pleasure, and our results found a positive relationship among all three. Something can be experienced as interesting in the moment, but recalled as pleasure (and not interesting) in subsequent follow-up studies (Løvoll, Vittersø, & Wold, 2016). Goal effort and emotions were measured in the same questionnaire, thus it is also possible that one was used as a heuristic for the other (e.g., Cho & Schwarz, 2008; Kruger, Wirtz, Van Boven, & Altermatt, 2004). Increased sampling per day with in-vivo reports of emotions rather than daily emotions may shed better light on the relationship among interest, pleasure and effort.

Conclusion

Life is full of action. While modern lifestyles make a sedentary existence possible, humans are fortunately motivated by things other than pleasure and pain. However, still extensive wellbeing research relies on this hedonic balance when explaining what it means to be well. The importance of having personal goals and striving to reach them is an argument in favor of expanding the notion of wellbeing beyond pleasure and satisfaction. This thesis suggests that for the process of making a positive activity change, considering wellbeing in terms of growth attitudes and feelings is more beneficial, than focusing on feelings of pleasure, satisfaction and contentment. Our inherent systems for growth help us move towards and sustain doing things that feels good, even though they are unpleasant. Engaging self-regulatory processes are an important piece of the puzzle where psychological interventions can contribute. Activity is what moves us forward, goals are what guides us, and our motivation and how activities feel are integrated into the whole experience. Encouraging prudentially good actions might thus be a good place to start when helping people to improve their physical activities and wellbeing.

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Paper I

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Paper II

Thorsteinsen, K. & Vittersø, J. (in press). Striving for wellbeing: The different roles of hedonia and eudaimonia in goal pursuit. *International Journal of Wellbeing*.

Paper III

Thorsteinsen, K. & Vittersø, J. (2018). *Now you see it, now you don't. Solid and subtle differences between hedonic and eudaimonic wellbeing as analyzed with experience sampling data from a goal pursuit intervention experiment.* Manuscript submitted for publication.