From good intentions to healthy behaviour: Strategies and resources in bridging the intention-behaviour gap

by

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The smallest act of kindness is worth more than the grandest intention.

Oscar Wilde

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Abstract

Noncommunicable diseases often have their roots in insufficient health behaviour and could be prevented or managed by health behaviour change. Although many people are aware of this, too many are not sufficiently performing regular physical activity and healthy nutrition. In other words, even in the face of good intentions behaviour change can become a challenging task that requires a high amount of self-regulation, by attempting to overcome established behavioural patterns. Research has shown that intentions are a crucial factor in the phase of health behaviour initiation, however, until now, it is not clear which mechanisms can bridge the intention-behaviour gap most effectively with regard to long-term behaviour maintenance. Therefore, the aim of this thesis was to broaden the understanding of motivational and volitional processes involved in single and multiple health behaviour change. Determinants of successful lifestyle management must be unveiled, in order to enable further examination of social-cognitive and behavioural mechanisms in individuals. Specific research questions were outlined and examined in three observational studies, in clinical and nonclinical samples, across the lifestyle factors of physical activity and diet. Results from the studies in this dissertation indicate that personal and social resources (self-determination, social support, intergoal facilitation) as well as self-regulatory strategies (planning, self-efficacy, selective optimization with compensation) foster behaviour change in the domains of physical activity and healthy nutrition. The findings provide a solid basis for intervention design to empower individuals to sustainable health behaviour change: Self-regulatory strategies, such as planning and selective optimization with compensation, should be taken into account to achieve long-term adaptation to a healthy lifestyle, in particular with regard to multiple health behaviour change.
German abstract

Chapter 1: Introduction

Introduction
Introduction

Noncommunicable diseases (NCDs) account for 38 million deaths each year, with nearly half of these occurring before the age of 70 (World Health Organization, WHO, 2015a). According to the WHO (2014), “NCDs currently cause more deaths than all other causes combined and NCD deaths are projected to increase […] to 52 million by 2030” (p.8). The growing problem of premature mortality and morbidity (WHO, 2014) places a burden on society and calls for global action.

Health behaviour plays a substantial role in this development: Physical inactivity and an unhealthy diet are two of the main risk factors for chronic disease and premature death (Fisher et al., 2011; WHO, 2015a). Since behaviour can be modified, the lifestyle factors of physical activity and diet depict two central elements in the prevention and management of chronic conditions (Fisher et al., 2011; WHO, 2015a). Both should therefore be targeted to improve health outcomes on an individual level (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012).

In response to this, the main objective of this thesis is to shed light on the processes that are involved in health behaviour change and adherence to a healthy lifestyle, on the basis of well-established theories of deliberate behaviour regulation (for an overview, see Figure 1). This thesis aims at identifying proximal determinants of single and multiple health behaviour change, focusing on the domains of physical activity and healthy nutrition, to derive practical implications and recommendations for future research.

The first chapter (Chapter 1) describes the context of this thesis, in order to draw a picture of the current state of the research in health behaviour change and point out the need for further studies of the mechanisms involved in health behaviour change and adherence to a healthy lifestyle. An extensive theoretical and empirical background on motivation and self-
regulation is provided, in order to outline the rationale behind this thesis, and to embed the research questions that are addressed in the following chapters (Chapters 2-4).

**Physical activity and nutrition recommendations and their implementation**

Recommendations have been developed to guide health behaviour change (e.g., WHO, 2015b, 2015c). Regular physical activity and a healthy, balanced diet form a basis for sustained health benefits. Healthy choices are encouraged to help individuals maintain and maximize their health. The WHO (2015b) recommends physical activity of moderate-to-strenuous intensity carried out on a regular basis for at least 150 minutes per week. An active lifestyle is ideally complemented and accompanied by a healthy diet rich in dietary fibre and whole grain, as well as fresh fruit and vegetables; at least 5 portions (400g) per day to reduce health risks (WHO, 2015c).

Despite this knowledge, substantial parts of the population remain insufficiently physically active or maintain an unhealthy diet (WHO, 2015b, 2015c). The inability to follow the existing recommendations is in most cases neither a matter of ignorance nor weakness of character, but rather a shortage of self-regulatory resources within the individual (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007; Carver & Scheier, 1981, 1982).

The domain of health psychology aims to illuminate the processes and mechanisms involved in behaviour change, in an effort to provide explanations for successful or unsuccessful behaviour initiation and maintenance. Health behaviour change theories assume that it requires a large amount of cognitive effort to leave well-worn trails (Hagger, Wood, Stiff, & Chatzisarantis, 2009). It can thus be a long way from will to action, or in other words: from good intentions to healthy actions.

**Motivational and volitional processes of health behaviour change**

Goals and intentions of individuals constitute the starting point for considerations regarding health behaviour change. Intention has been considered a proximal determinant of
health behaviour in many of the early health behaviour change theories (for a review, see Armitage & Conner, 2000). Intentions can explain about 30% of the variance in actual health behaviour (Sheeran, 2002), however, good intentions are often not sufficient to ensure goal pursuit (Schwarzer, 2008; Schwarzer, Lippke, & Luszczynska, 2011). This has been regarded as the intention-behaviour gap and has elicited further investigation of potential linking mechanisms in the intention-behaviour relationship. The motivation compound can be decomposed in a quantitative and qualitative component. While intentions indicate how strongly individuals are motivated to adopt certain behaviours (Schwarzer, 2008), the concept of self-determination distinguishes between autonomous and externally controlled modes of motivational regulation (Deci & Ryan, 1985). Several reasons for behaviour change have been weighed against each other and assigned to the dominant motivational source where applicable: extrinsic/external vs. intrinsic/internal (Ryan & Deci, 2000). The more autonomous and internalized motivational regulations are, the more the individual perceives actions and self-determined motives, and the sooner they are put into practice (Deci & Ryan, 2002).

Heckhausen (1991) suggested that there are motivational as well as volitional processes in behaviour change (cf. Rubicon model of action phases). Current models and theories integrate this differentiation and examine volitional constructs (Biddle & Fuchs, 2009). The review and revision of prevailing theories is essential for two main reasons. It can improve the predictive power of health psychological assumptions and accelerate the effectiveness of related interventions and initiatives (Craig et al., 2013), and theoretical underpinning of studies and interventions in the field of behaviour change is imperative to obtain reliable results and implications from empirical findings (Brazil, Ozer, Cloutier, Levine, & Stryer, 2005; Medical Research Council, MRC, 2008).

In this regard, the Health Action Process Approach (HAPA; Schwarzer, 2008; Schwarzer et al., 2011) is solid ground to build on. The HAPA integrates motivational and
volitional constructs, and it represents a parsimonious framework to describe and explain health behaviour change (Schwarzer, 2008; Schwarzer et al., 2011).

An approach for single health behaviour change: The Health Action Process Approach

The HAPA (Schwarzer, 2008; Schwarzer et al., 2011) starts from the idea of a motivational stage. In this phase, the individual holds certain outcome expectations regarding a health behaviour or its effect on the individual’s life, certain risk appraisals and perceptions, as well as certain self-efficacy beliefs about the ability to handle difficult situations and carry out the behaviour even in the face of barriers. On this basis, an intention to perform a specific health behaviour is formed. Since intentions might be forgotten or jeopardized in another way, self-regulatory strategies must be applied. The volitional phase of the HAPA considers competencies that enhance the actual realization of goals and intentions. Planning becomes a proximal predictor of the actual health behaviour as the individual specifies where, when and how to act on their goals (action planning), and what to do in the face of barriers (coping planning). Again, self-efficacy can be a powerful resource to initiate or maintain a health behaviour. The social environment is also taken into account within the HAPA framework. Social support is pointed out as an important resource for individuals in the process of health behaviour change.

Beyond single health behaviour change: The Compensatory Carry-over Action Model

While the HAPA primarily considers single health behaviour change, it might also be useful to take a closer look at the more complex mechanisms of multiple health behaviour change, because certain lifestyle factors manifest themselves as risk clusters, and affected individuals show multiple risk profiles (Ding et al., 2014; Fleig, Küper, Lippke, Schwarzer, & Wiedemann, 2015; Portinga, 2007; Tobias, Jackson, Yeh, & Huang, 2007). Better understanding of cross-behavioural processes and interaction effects of health behaviours can yield insights into health behaviour change management in non-clinical as well as clinical populations. On this basis, more effective preventive strategies can be developed (for a
review, see Loef & Wallach, 2012). Such an approach has been adapted by the Compensatory Carry-over Action Model (CCAM; Lippke, 2014), which looks at the social-cognitive determinants established by the HAPA (Schwarzer, 2008; Schwarzer et al., 2011) from a multiple health behaviour change perspective, and integrating cross-behavioural mechanisms.

Social-cognitive interrelations in multiple health behaviour change

Recent approaches do not only examine the co-occurrence of health behaviours and the incidental inter-behavioural associations, but also take a closer look at the interrelated social-cognitive processes (Fleig, Ngo et al., 2015; Lippke, 2014). Individuals might already have subjective beliefs and theories regarding how certain behaviours go together and how or even if they could handle such demanding change processes and situations (e.g., Fleig, Kerschreiter, Schwarzer, Pomp, & Lippke, 2014; Knäuper, Rabiau, Cohen, & Patriciu, 2004). Cognitive appraisals determine whether a number of co-existing behaviours can be turned into a healthy lifestyle or not.

If individuals hold the belief that one behaviour can be compensated by another, it often stands in the way of multiple health behaviour change and the successful adoption of a healthy lifestyle. This way of thinking is a cognitive strategy called compensatory health belief (CHB; Knäuper et al., 2004): the belief that the detrimental effect of one behaviour can be neutralized by engaging in another healthier behaviour instead (e.g., Eating fast food once in a while is OK if I exercise regularly). This aims at reducing cognitive dissonance, but does not automatically lead to the actual implementation of healthy options (Radtke, Scholz, Keller, Perren, & Hornung, 2015). While the initial dissonance is fading away the cathartic effect of the intended healthy compensation remains – and again the way from good intentions turns out to be a long one. Without any volitional strategies, the intention might not be acted upon and only the unhealthy behaviour is carried out (e.g., Radtke, Inauen, Rennie, Orbell, & Scholz, 2014).
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If individuals hold the belief that one behaviour facilitates another behaviour, this can stimulate multiple health behaviour change and the implementation of a healthy lifestyle. This describes the idea and concept of transfer, knowledge and competence from one context can be successfully applied in another context (Barnett & Ceci, 2002). Thus, transfer cognitions might be a determinant of multiple health behaviour change (Fleig et al., 2014). Recent research has found that an indirect effect of such cognitions on the actual behaviour should be assumed (Fleig, Ngo et al., 2015).

Individuals might hold both of the above cognitions, but the dominant strategy determines the behavioural outcomes. In the case of multiple health behaviour change, goal pursuit should be viewed in the context of interacting goals: Multiple goals can hinder or facilitate each other (i.e.; intergoal conflict vs. intergoal facilitation; cf. Riediger & Freund, 2004). When individuals strive for the attainment of a higher-level goal (Lippke, 2014), subordinate goals have to be defined and aimed at, step by step. The integration of partial goals, e.g., sufficient levels of physical activity and healthy nutrition, under a higher-level objective, such as well-being or weight management, aid intergoal facilitation (McKee & Ntoumanis, 2014). Health goals can complement each other and reinforce individuals to adhere to their multiple goals and their paramount objective (Riediger & Freund, 2004).

This line of research shows that health behaviour change involves complex mechanisms both on the social-cognitive and behavioural level, as illustrated in Figure 1. Certain health goals and health behaviours might be interrelated and interact with each other. The actual initiation and maintenance of health behaviours then presents individuals with a self-regulatory challenge that requires certain resources.

The dynamics of self-regulation in health behaviour change

The concept of self-regulation is often consulted to shed light on effective measures and antecedents of health behaviour change. The idea behind self-regulation is that individuals are equipped with cognitive, emotional and behavioural resources, and that the
achievement of certain goals depends on the available capacities (cf. Duckworth & Kern, 2011). With self-regulation, current barriers and temptations can be overcome to pursue long-term goals and establish a desired behaviour, or even lifestyle (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). Social-cognitive models of health behaviour change, such as the HAPA, have integrated the concept of self-regulation in the form of volitional competencies such as self-efficacy beliefs or strategic planning of action and coping (Schwarzer, 2008; Schwarzer et al., 2011). The idea of self-regulation in the context of health behaviour change has been further developed, and a recent approach postulates the strength model of self-control, in which self-control is considered a limited resource that can be depleted (Baumeister et al., 1998; Baumeister et al., 2007). When capacities for self-control are exhausted, self-regulatory failure follows, something comparable to the fatigue of a muscle under maximum load for longer periods of time (Baumeister et al., 1998). This state is called ego depletion (Baumeister et al., 1998), and might account for the disengagement from certain health goals and behaviours. Ego depletion might explain why people fail to act on their good intentions, especially in cases in which the management of a complex situation becomes too challenging and exhausting (for an overview, see Hagger et al., 2009). Multiple health behaviour change might depict such a challenging situation, both from a non-clinical, preventive perspective, and from a clinical perspective in the context of chronic disease management. It becomes even more relevant in the face of daily hassles and other demands of everyday life.

But the process is not irreversible and, to consult the muscle metaphor again, self-control resources can be replenished by recovery or even increased by training (cf. Hagger et al., 2009). Self-regulatory strategies, such as action and coping planning, help to reduce the demand on resources (Webb & Sheeran, 2003) and can complement self-control investments. In the face of complex situations, individuals might also make a studious effort to save up some energy for future demands (cf. Hagger et al., 2009). Thus, compensating strategies
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should also be taken into account in health behaviour change research. From a life-management perspective, the investigation and integration of global self-regulatory processes, such as selective optimization with compensation (SOC; Baltes & Baltes, 1990; Freund & Baltes, 2002), can broaden the understanding of linking mechanisms in health behaviour change. With limited or scarce resources at hand, SOC strategies can assist an optimal functioning in daily life and management of a healthy lifestyle for individuals, at different ages, with or without existing health impairments.

Figure 1 summarizes and integrates the theoretical cornerstones that form the basis for the research questions addressed in this thesis.

Figure 1. Overview of the theoretical constructs integrated into the cumulative research framework within this thesis.

Note. Solid lines indicate relationships between study variables, i.e. how social-cognitive determinants predict and facilitate other cognitive as well as behavioural processes.

Research aims of the present thesis

The paramount aim of this thesis is to broaden the understanding of motivational and volitional processes involved in single and multiple health behaviour change. Determinants of successful lifestyle management must be identified, in order to predict and describe social-
cognitive and behavioural mechanisms in individuals, and to develop effective, sustainable interventions in the future. The domain of physical activity will be closely examined, as a physically active lifestyle has proven to be relevant and critical in the prevention and management of NCDs. In particular, self-regulatory strategies will be subject to investigation, as they have shown to bridge the gap between intentions and behaviour. Well-established research frameworks are brought together and integrated to serve as fertile ground for the analysis of health behaviour in individuals from a clinical and a non-clinical field setting. Finally, a comprehensive approach is taken, and the inter-behavioural processes of multiple health behaviour change will be examined in the domains of physical activity and healthy nutrition.

In more detail, this thesis outlines the following research questions:

1) **Processes of single health behaviour change**

a) Working in orchestration to bridge the intention-behaviour relationship: How relevant are planning, perceived social support and global self-regulation strategies in mediating the link between intention to be physically active and moderate-to-vigorous physical activity (see *Chapter 2*)?

- Planning: Does planning act as a mediator between intention to be physically active and actual levels of physical activity 6 months later?
- Social support: Does perceived social support also link the intention-behaviour relationship, over and above the effect of planning?
- Self-regulation: Can SOC strategies further facilitate the maintenance of physical activity in the long run, acting in a sequence with planning and social support as proximal behavioural determinants?

b) The complex mechanisms involved in goal enactment in the rehabilitation setting: To what extent do self-determination, action planning and self-efficacy act as linking mechanisms between intention to be physically active, and social support,
respectively, and physical exercise, in particular strength training and endurance training (see Chapter 3)?

- Social support: Can received social support from friends and family, in addition to intention, stimulate the qualitative motivational processes of self-determination? Does received social support also facilitate volitional processes, such as action planning, self-efficacy, and actual physical activities?
- Self-determination: How does self-determination guide the use of self-regulatory strategies, such as action planning and self-efficacy?
- Planning: Does action planning bridge the gap between intentions at discharge from an orthopaedic rehabilitation and actual physical exercise 1, 3 and 7 years later?
- Self-efficacy: Does coping self-efficacy act as a mediator between intention to be physically active and actual levels of endurance and strength training 1, 3 and 7 years after orthopaedic rehabilitation treatment?

2) Processes of multiple health behaviour change

The interplay of cognitions on physical activity and healthy nutrition: Which roles do intergoal facilitation, planning of physical activity and healthy nutrition, respectively, and global self-regulation strategies play in mediating the link between intention to be physically active and to eat a healthy diet, respectively, and moderate-to-vigorous physical activity and healthy nutrition, respectively (see Chapter 4)?

- Intergoal facilitation: Do the carry-over cognitions of intergoal facilitation foster the processes of multiple behaviour planning, beyond and in sequence with intentions of a healthy diet and physical activity?
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- Planning: Can behaviour-specific planning act as mediator in the related behaviour-specific intention-behaviour chain? Does behaviour-specific planning contribute to a global self-regulation strategy on healthy living?
- Self-regulation: Does SOC strategy use account for multiple health behaviour maintenance 6 months after baseline, reconciling the preceding behaviour-specific planning mechanisms and thus linking the specific intention-behaviour relationships?

Figure 2 visualizes the key areas of research for the empirical chapters (Chapters 2-4) within the previously introduced theoretical framework (see Figure 1).

Studies in this thesis

This thesis comprises three observational studies with different health behaviours and samples from non-clinical and clinical populations. The focus of the investigation was put on volitional processes of behaviour maintenance. All participants were recruited in field settings. Baseline assessments were conducted in primary or secondary prevention (after an orthopaedic rehabilitation) settings. Participants were invited to follow-ups 6 months (Chapter 2, 4) or 7 years after baseline (Chapter 3), in order to capture long-term changes in health behaviour(s) based on personal and social resources, as well as on self-regulatory strategies. Paper-pencil questionnaires (Chapter 3) and online surveys (Chapter 2, 4) were employed to deliver the questionnaires to all participants at baseline and follow-ups. Physical activity was examined as relevant lifestyle factor contributing to health in all studies, with Chapter 4 additionally integrating healthy nutrition to expand the angle of vision to multiple health behaviour change processes. More detailed information about study design, participants and procedures will be provided in the empirical chapters (Chapters 2-4).
Figure 2. Overview of the established research priorities for each chapter within this thesis.

Note. Solid lines indicate studies relationships between variables, i.e. how social-cognitive determinants predict and facilitate other cognitive as well as behavioural processes. Ch. = Chapter(s).
References


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Chapter 1: Introduction

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Chapter 1: Introduction


Chapter 2: The long way from good intentions to the uptake of physical activity

Like a rolling stone – The long way from good intentions to the uptake of physical activity through planning, social support and self-regulation

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Chapter 2: The long way from good intentions to the uptake of physical activity

Abstract

**Background:** Although many people know that an active lifestyle contributes to health they fail to translate their intentions into action. This has been explained by deficits in self-management and resources, such as enabling social support, planning and self-regulation in the face of barriers. The present study examines the role of perceived social support, planning and self-regulation in facilitating physical activity.

**Methods:** In a prospective online study, intention was assessed at baseline (Time 1), planning and social support at 4-week follow-up (Time 2), self-regulation and physical activity at 6-month follow-up (Time 3). A path analysis was conducted to shed light on psychological mechanisms that contribute to maintenance of physical activity.

**Results:** Perceived support (Time 2), planning (Time 2) and self-regulation (Time 3) mediated the link from intention (Time 1) to physical activity (Time 3); the specific and total indirect effects were significant.

**Conclusions:** Findings suggest that perceived social support, planning and self-regulation can bridge the intention-behaviour gap. Behaviour change interventions should target those mechanisms in vulnerable individuals.

**Keywords:** mediation, HAPA, lifestyle, volition, leisure time activity, SOC
Chapter 2: The long way from good intentions to the uptake of physical activity

**Background**

As the proverb suggests, a rolling stone gathers no moss. The same holds true for human beings: those persons who are physically active on a regular basis do not take in ballast easily with regard to health and weight. A *physically active lifestyle* helps to improve muscular and cardio-respiratory fitness as well as bone and functional health, at the same time the risk for coronary heart disease, high blood pressure, stroke, diabetes and obesity decreases (Norton, Norton, & Lewis, 2015; World Health Organization, WHO, 2014). Physical inactivity, on the other hand, is ranked the fourth leading risk factor for global mortality by the WHO and is assumed to account for approximately one third to one fourth of breast and colon cancers, diabetes, and ischaemic heart disease burden (WHO, 2014).

Moderate-to-vigorous physical activity results in more pronounced health benefits than physical activity of low intensity (WHO, 2014). The WHO recommends “at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity” (WHO, 2010, p.26). Although the benefits of physical activity and the risks accompanying inactivity are obvious one third of the population worldwide and even 36% of Europeans show insufficient levels of physical activity (WHO, 2014). Effective steps have to be taken in public health in the near future to improve activity levels in the population. To set the stone rolling behaviour change theory needs to be consulted and applied.

**Theory-driven behaviour change**

The use of theoretical underpinning should find its way as a standard of good practice into to the design and evaluation of studies and interventions in the field of behaviour change (Brazil, Ozer, Cloutier, Levine, & Stryer, 2005; Medical Research Council, MRC, 2008). In the realm of health promotion research the *Health Action Process Approach* (HAPA; Schwarzer, 2008; Schwarzer, Lippke, & Luszczynska, 2011) represents a reliable and
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parsimonious framework to describe and explain health behaviour change for a multitude of behaviours and settings. Furthermore, other theoretical frameworks, focusing on the global self-regulatory processes of selective optimization with compensation (SOC; Baltes & Baltes, 1990; Freund & Baltes, 2002) can enrich the understanding of processes involved in health behaviour change.

**Social-cognitive predictors of physical activity**

The HAPA differentiates between a motivational and a volitional phase in the health behaviour change process. In the first phase, an individual needs to develop the *intention* to change a current health behaviour, for example, to become more physically active (Schwarzer, 2008; Schwarzer et al., 2011). This intention needs to be put into action in the volitional phase: the physical activity has to be initiated and maintained (Schwarzer, 2008; Schwarzer et al., 2011). An effective strategy to bridge the intention-behaviour gap is *planning*, whereas others resources, such as *social support*, can come into play in the volitional phase as well to underpin the behaviour change process (Schwarzer, 2008; Schwarzer et al., 2011).

Recent reviews and meta-analyses indicated consistently that intention is a key factor in health behaviour change and maintenance; however, intention alone cannot sufficiently explain the complex patterns of physical activity (Amireault, Godin, & Vézina-Im, 2013; Bauman, Reis, Sallis, Wells, Loos, & Martin, 2012; Bélanger-Gravel, Godin, & Amireault, 2013; Rhodes & de Bruijn, 2013). Despite strong intentions many individuals fail to translate their goals into action (Schwarzer, 2008).

Besides intentions, other social-cognitive determinants are of considerable importance to bridge this gap between intention and behaviour. Volitional strategies help to initiate and maintain health behaviours, such as physical activity, and planning has been found to be a mediator of the intention-behaviour relationship (Bélanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006; Mistry, Sweet, Latimer-Cheung, & Rhodes, 2015; Schwarzer, 2008; Hagger &
A combination of *action and coping plans* is the most effective approach with regard to health behaviour interventions (Bélanger-Gravel et al., 2013). Self-regulatory challenges with regard to a physically active lifestyle can be overcome by determining the when, where and how of intended activities and also what to do in the face of barriers.

*Social environment* can give an impetus to maintain healthy behaviour (Amireault et al., 2013; Bauman et al., 2012; Tay, Tan, Diener, & Gonzalez, 2013). Research conducted in the context of health behaviours suggested that received social support may explain the adoption of healthy diet over and above the HAPA-based cognitions, but its effect may be restricted to some types of support receipt (Scholz, Ochsner, Hornung, & Knoll, 2013). In turn, perceived social support was shown to enhance global self-regulation and operate in concert with social-cognitive variables in predicting physical activity (Anderson-Bill, Winett, & Wojcik, 2011; Anderson, Winett, Wojcik, & Williams, 2010). Thus, perceived social support may be seen as another linking mechanism in the intention-behaviour relationship.

*Global self-regulation* processes of selective optimization with compensation may represent the crucial link in the intention-behaviour chain working in orchestration with social support and planning (Anderson et al., 2010; Anderson-Bill et al., 2011; Reuter, Ziegelmann, Wiedemann, Lippke, Schüz, & Aiken, 2010). When applied in the context of health behaviour change, the SOC model (Freund & Baltes, 2002) provides an extensive repertoire of self-regulatory strategies which aid initiation and maintenance of a physically active lifestyle. Identifying relevant SOC strategies may enrich the understanding of complex behavioural mechanisms, such as physical activity, not only from a loss-based perspective of life cycle but also from a global life management view (Reuter et al., 2010; Son, Kerstetter, Mowen, & Payne, 2009).

**Aims of the study**
Chapter 2: The long way from good intentions to the uptake of physical activity

Aim of the present study is to examine linking mechanisms of the intention-behaviour relationship and to analyze the interplay between intention, planning, perceived social support and global self-regulation with regard to moderate-to-vigorous physical activity in an overall model.

![Hypothesized mediation model](image)

*Figure 1. Hypothesized mediation model.*

The primary objective was to model the complex intention-behaviour relationship and identify to which extent planning, perceived social support (measured at Time 2) and global self-regulation strategies (measured at Time 3) mediate the link between intention to be physically active (measured at Time 1) and moderate-to-vigorous physical activity (measured at Time 3) (see Figure 1).

**Methods**

**Participants and procedure**

The present data come from a German online longitudinal study which was conducted using the software dynQuest (Rademacher & Lippke, 2007). Potential respondents had to give informed consent to receive the link to the self-administered questionnaire. The study was conducted in consideration of the Helsinki Declaration. At Time 1 (T1) \( N = 991 \) participated in the survey. Respondents were invited to follow-up assessments at 4 weeks (Time 2, T2; \( n = 742 \)) and at 6 months (Time 3, T3; \( n = 463 \)) later. Those who provided responses to at least 50% of the questions at T1 were considered as enrolled participants.
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There were no significant differences found between those who answered more than half of the questions and those who responded to less (all ps > .05).

Participants in the final analyzed sample were 16 to 78 years of age ($M = 37.83, SD = 12.27$). The sample consisted of 72.8% women; 55% of the participants were married or living with a partner; 77.7% had completed senior high school and 53.0% held a university degree.

Measures

At T1 intentions, baseline physical activity, age and gender were assessed. The T2 questionnaire measured planning and perceived social support. At T3 self-regulation and physical activity were assessed. All psychological variables were measured using 4-point Likert scales ranging from 1 (totally disagree) to 4 (totally agree).

**Intentions to become more physically active** were measured as suggested by Nigg (2005), matching different levels of physical activity intensity. This measure was validated in earlier studies (Nigg, 2005). An index was used corresponding to the behaviour measurement: strenuous and moderate physical activities. A sample from the questionnaire was “I intend to perform the following activities at least 5 days per week for 30 minutes strenuous (rapid heartbeats, sweating) physical activities.” The item intercorrelation was $r = .17$ reflecting the brevity of the aggregated construct.

**Perceived social support from family or friends** for regular physical activity was assessed by 2 items (Jackson, Lippke, & Gray, 2011). Participants were asked how they perceive their environment and responded, for example, to the following item: “My family helps me to be physically active.” The item intercorrelation was $r = .39$.

**Planning** was assessed by measuring action and coping planning with 3 items each (Ziegelmann & Lippke, 2007). Action plans were characterized by the when, where and how of physical activity; the sample items was “I have already planned when and how often I will be physically active.” The coping planning measure assessed plans for physical activity in the
face of barriers, e.g., “I have already precisely planned what to do if something intervenes.”

Item intercorrelations ranged from $r = .42$ to $r = .90$. Both subscales were combined into a general planning index. The reliability coefficient for the index was Cronbach’s $\alpha = .90$.

**Self-regulation** was measured with an adapted version of the SOC strategies questionnaire (Freund & Baltes, 2002). This adapted version of the SOC questionnaire assesses the use of self-regulation strategy in the domain of healthy lifestyle has been validated by Reuter et al. (2010). The scale consisted of 4 items, reliability in the present sample was good (Cronbach’s $\alpha = .82$). A sample item was “When it is getting more difficult to lead a healthy lifestyle I only strive for my most important health goal.”

**Physical activity** was assessed by a modified version of the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985; Plotnikoff et al., 2007). The self-report measure asked participants to provide information on the average number of sessions per week and average duration in minutes per week of their leisure-time physical activity. An index of moderate (not exhausting, light perspiration) and strenuous activities (rapid heartbeats, sweating) was built to reflect the range of intensity levels in physical activity as recommended by the WHO (2010). A sum score was built from the responses (product of frequency and duration) for each intensity level.

**Data analysis**

Manifest path analysis using Mplus 6.1 was applied to test the hypothesized model (see Figure 1). Missing data were treated by Full Information Maximum Likelihood estimation to make use of all available information in the model. Predictors were mean-centered. Baseline behaviour, gender ($1 =$ female, $2 =$ male) and age were included as covariates. Bias-corrected bootstrapping (5000 samples) was employed to aid data non-normality and to estimate indirect effects (Preacher, Rucker, & Hayes, 2007).

**Results**

**Preliminary Analysis**
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Dropout analyses revealed no differences between those who completed the study and those who dropped out after T1 (all ps > .05) except for the age of the completers who were slightly younger than those who did not respond after T1 ($t(949) = -3.01$, $p = .003$).

Means, standard deviations and intercorrelations of all variables can be found in Table 1. All social-cognitive variables were significantly positively interrelated. The highest correlation occurred between planning (T2) and self-regulation (T3), which may be due to their volitional character. But as they share only 17% of variance and show differential patterns with the other variables construct validity could be assumed for each of the two constructs and they were included as distinct variables in the analyses. Gender was positively associated with age and negatively with intention T1. Age showed significant negative associations with planning T2 and physical activity T1.
Table 1

Means, standard deviations, ranges and intercorrelations of study variables

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gender</td>
<td>-</td>
<td>-</td>
<td>1/2</td>
<td>.24**</td>
<td>- .08*</td>
<td>.02</td>
<td>-.04</td>
<td>-.05</td>
<td>.07*</td>
<td>-.01</td>
</tr>
<tr>
<td>2. Age</td>
<td>37.83</td>
<td>12.27</td>
<td>16-78</td>
<td>.04</td>
<td>-.03</td>
<td>-.09*</td>
<td>.07</td>
<td>-.11**</td>
<td>-.03</td>
<td></td>
</tr>
<tr>
<td>3. Intention T1</td>
<td>2.56</td>
<td>0.78</td>
<td>1-4</td>
<td>.13**</td>
<td>.26**</td>
<td>.20**</td>
<td>.20**</td>
<td>.13**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Social support T2</td>
<td>2.12</td>
<td>0.85</td>
<td>1-4</td>
<td>.27**</td>
<td>.22**</td>
<td>.15**</td>
<td>.10**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Planning T2</td>
<td>2.73</td>
<td>0.81</td>
<td>1-4</td>
<td>.41**</td>
<td>.21**</td>
<td>.19**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Self-regulation T3</td>
<td>2.44</td>
<td>0.66</td>
<td>1-4</td>
<td></td>
<td></td>
<td></td>
<td>.16**</td>
<td>.23**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Physical activity T1</td>
<td>151.24</td>
<td>157.69</td>
<td>0-630</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.33**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Physical activity T3</td>
<td>116.18</td>
<td>139.06</td>
<td>0-630</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Note. ** p < .01. * p < .05. Gender: 1 = female, 2 = male; T1 – Time 1; T2 – Time 2, 4-week follow-up; T3 – Time 3, 6-month follow-up.
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**Mediation analysis**

We used multiple mediation analysis, assuming parallel mediators (planning and perceived social support) which operated in a sequence with self-regulation, to test the model. In particular, the model assumed the indirect (via planning at T2 and perceived social support at T2, respectively, and self-regulation at T3) effects of intention to be physically active at baseline on physical activity 6 months later. The model was controlled for baseline behaviour, gender and age. Model-data fit was very good, \( \chi^2(1, N = 901) = 1.19, p = .28; \) RMSEA = .01 (90% CI [0.00; 0.09]); CFI = 1.00, TLI = .99, SRMR = .01.

Figure 2 and Table 2 show the standardized and unstandardized path coefficients along with the explained variance in each variable. The results of mediation analysis corroborate the assumed associations between the social-cognitive variables: Intention at T1 predicted planning (T2) and perceived social support (T2) which, in turn, were significantly associated with self-regulation (T3). Planning (T2) and self-regulation (T3) predicted physical activity (T3). Furthermore, baseline physical activity was significantly associated with planning (T2), perceived social support (T2), and physical activity (T3); age was also significantly related to planning at T2 (all \( p < .05 \), see Table 2).

*Figure 2.* Mediation model with standardized coefficients (controlled for gender, age, baseline behavior).

*Note.* T1 – Time 1; T2- Time 2, 4-week follow-up; T3 – Time 3, 6-month follow-up.

*** \( p < .001 \). ** \( p < .01 \). * \( p < .05 \).
All estimated indirect effects were significant. Intention T1 had specific indirect effects on physical activity T3 through planning T2 and self-regulation T3, $B = 1.98$, BC 95% CI [0.59; 3.92], and via perceived social support T2 and self-regulation T3, $B = 0.27$, BC 95% CI [0.03; 0.99]. The total indirect effect was significant, $B = 7.92$, BC 95% CI [4.32; 12.68].

Table 2

*Model results with unstandardized path coefficients*

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
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<td><strong>Planning T2</strong></td>
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<td>0.25</td>
<td>0.04</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Gender</td>
<td>&lt;0.01</td>
<td>0.06</td>
<td>.98</td>
</tr>
<tr>
<td>Age</td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>.03</td>
</tr>
<tr>
<td>Physical activity T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td><strong>Social support T2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention T1</td>
<td>0.09</td>
<td>0.05</td>
<td>.05*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.05</td>
<td>0.06</td>
<td>.37</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.13</td>
</tr>
<tr>
<td>Physical activity T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td><strong>Self-regulation T3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning T2</td>
<td>0.28</td>
<td>0.04</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Social Support T2</td>
<td>0.10</td>
<td>0.04</td>
<td>&lt;.01</td>
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<td>Intention T1</td>
<td>0.07</td>
<td>0.03</td>
<td>.06</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.01</td>
<td>0.05</td>
<td>.82</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.26</td>
</tr>
<tr>
<td>Physical activity T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.37</td>
</tr>
<tr>
<td>Physical activity T3</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Discussion

The study aimed to broaden the understanding of linkages between the intention to be physically active and moderate-to-vigorous physical activity at 6-month follow-up. As hypothesized, planning and perceived social support, respectively, as well as global self-regulation mediated the relationship between intention and physical activity measured six months later. Prior findings showed the effects of planning, social support or self-regulation strategies operating directly or as single mediators (e.g. Anderson-Bill et al., 2011; Reuter et al., 2010). The present study provides novel evidence and explains how the three social-cognitive variables may operate jointly, forming a specific sequence.

Individuals with high intentions – in contrast to individuals with low levels of intention – were more likely to have higher global self-regulation and thus be more physically active 6 months later when they had planned their activities and perceived their social environment as highly supportive in the meantime. High levels of intention predicted both high levels of planning and high levels of perceived social support which both in turn were associated with higher levels of global self-regulation and thus led to higher levels of physical activity. The indirect effects were significant confirming the hypothesized mediation model.
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The results provide support for the crucial role of planning in adoption and maintenance of healthy behaviour (cf. Schwarzer, 2008). Planning may be defined as a strategy fostering further conscious and effortful self-regulation processes (Hagger & Luszczynska, 2014). In line with this assumption, we found that planning prompted the use of conscious and effortful self-regulatory strategies, which in turn predicted physical activity.

The indirect effect of intention on physical activity via social support and self-regulation may seem weaker than the indirect effect of intention on physical activity via planning and self-regulation. Furthermore, the explained variance in social support was relatively low indicating that other predictors should be included besides intention, e.g., characteristics of the perceived supporters such as self-efficacy (Ayotte, Margrett, & Patrick, 2013). Additionally, the sources of support could be further differentiated to understand their individual contribution to physical activity in the long run. Future studies may also further investigate the differential effects of perceived and received social support (cf. Scholz et al., 2013).

Limitations of the study and further directions

Some limitations have to be considered in the present study and overcome in future research. The longitudinal design of the study could be expanded to longer follow-ups as prior research has shown that physical activity levels may decrease after six months and only stabilize in the following years (Reuter, Ziegelmann, Lippke, & Schwarzer, 2009). Despite the theoretical underpinning and the time-lag design only limited causal inferences can be drawn from the results. Future studies should apply the experimental manipulation to gain more insight into cause and effect relationships.

While the study shed some light on how individuals can put their intentions into action the question of moderators remains untouched. Those linking mechanisms might work for certain subgroups particularly well while others might need something else to become physically active on a regular basis. From a public health perspective it might be useful to
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offer vulnerable groups specific aid. Future studies should include specific moderators of the intention-behaviour relationship such as intention stability, conscientiousness, or anticipated regret (e.g., Rhodes & Dickau, 2013).

**Outlook**

To understand processes of the uptake and maintenance of complex behaviours such as moderate-to-vigorous physical activity – in other words to get and keep the stone rolling – several social-cognitive variables have to be taken into consideration. Intention, planning and social support have been derived as important predictors from the theoretical framework of the HAPA (Schwarzer, 2008; Schwarzer et al., 2011). The construct of global self-regulation (Baltes & Baltes, 1990; Freund & Baltes, 2002) replenished the strategic repertoire of highly motivated individuals on their way to a physically active lifestyle and the explanatory model in our study.
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References


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Chapter 3: Individual and social factors of long-term physical exercise

The seven-year itch in medical rehabilitation –

Individual and social factors of long-term physical exercise after orthopaedic treatment: Findings from a study over seven years


*This paper has not yet been published (09/2015). Do not copy or cite without author's permission.
Abstract

**Background:** Although it has been confirmed that physical exercise improves orthopaedic conditions many individuals fail to maintain a regular exercise regimen after discharge from medical rehabilitation. Deficits in self-management and resources, such as social support, self-determination and planning, can account for an inactive lifestyle. The present study examines the role of intention, social support, self-determination, planning and self-efficacy in facilitating strength and endurance training.

**Methods:** In a 7-year observational study, intention, received social support and self-determination were assessed at baseline (Time 1), self-efficacy and planning at 6-month follow-up (Time 2), and physical exercise at 1-year (Time 3), 3-year (Time 4) and 7-year (Time 5) follow-up. Path analyses were applied to investigate if personal and social resources contribute to long-term physical activity.

**Results:** Self-determination and planning mediated the link from intention and from social support to physical exercise at 1-, 3- and 7-year follow-ups. Self-efficacy facilitated planning and bridged the intention-behaviour-relationship in the domain of strength training after 1 year. An inverse direct relationship between social support and strength training was also found for all follow-ups.

**Conclusions:** Findings indicate that intention, received social support and self-determination act as crucial resources in the long-term management of exercise. Planning can bridge the intention-behavior gap on a long-term basis. Behavior change interventions should replenish personal and social resources to empower individuals to maintain a healthy lifestyle.

**Keywords:** mediation, HAPA, lifestyle, volition, self-determination
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Theoretical background

Regular physical activity has been proven to be beneficial to health: improving muscular and cardiorespiratory fitness as well as bone and functional health, at the same time reducing the risk for cardiovascular diseases (Reiner, Niermann, Jekauc, & Woll, 2013; WHO, 2015). Already a minimum of “150 minutes of moderate-intensity aerobic physical activity throughout the week or 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity” (WHO, 2010, p.26) can produce substantial health benefits.

Most recommendations apply to the general population for prevention (CDC, 2008; WHO, 2015) but physical activity can also enhance and complement the management of existing conditions, such as orthopaedic disorders or events (Conn, Hafdahl, Minor, & Nielsen, 2008; Resnick et al., 2007). It is critical to empower individuals to make use of this well supported knowledge because so far physical inactivity remains one of the leading risk factors for global mortality (WHO, 2015). Recommended levels of physical activity are often not met: About three out of ten adults do not show sufficient levels of physical activity (WHO, 2010).

There is an urgent need to develop and implement successful health behavior change interventions to motivate inactive individuals and help them to act on their intentions. As regular exercise regimens have the potential to improve recovery and thus quality of life this is even more important in clinical populations, targeting the often highly-motivated rehabilitation patients after discharge in their transition to new daily routines.

Health behavior change

Theoretical underpinning of studies is a cornerstone of good research practice (Brazil, Ozer, Cloutier, Levine, & Stryer, 2005; Medical Research Council, MRC, 2008). In this regard, the Health Action Process Approach (HAPA; Schwarzer, 2008; Schwarzer, Lippke, & Luszczynska, 2011) represents a reliable, parsimonious framework to describe and explain
health behavior change. It has been tested in and applied to different settings and domains (Schwarzer, 2008; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). The HAPA has also shown to be valid in clinical populations, predicting behavioral patterns in rehabilitation settings and chronic disease (Chiu, Lynch, Chan, & Berven, 2011; Schwarzer et al., 2011). The integration of further theoretical frameworks can broaden the understanding of the complex processes involved in goal setting and goal pursuit, taking into account different aspects of motivation as in Self-Determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2000).

**Social-cognitive predictors of health behavior change**

After discharge from rehabilitation, individuals often face a self-regulatory challenge: They have learnt how to be more physically active and are full of good intentions to keep levels of physical activity up but that newly established behavioral patterns need to be integrated into their daily lives, beside work and family life. Such lifestyle changes require social and cognitive resources, as described in the HAPA (Schwarzer, 2008; Schwarzer et al., 2011).

The HAPA draws a dividing line between individuals who are in the motivational phase of health behavior change and individuals who have reached the volitional phase of the change process. In the first phase, an intention has to be formed, for example, to become more physically active (Schwarzer, 2008; Schwarzer et al., 2011). This intention needs to be translated into action in the second phase. The initiation and maintenance of the intended behavior, for example, physical activity, is driven by self-regulatory processes, such as planning and self-efficacy (Schwarzer, 2008; Schwarzer et al., 2011).

Empirical findings emphasize the role of intention as a key determinant of health behavior change after rehabilitation (Niven, Nevill, Sayers, & Cullen, 2012; Webb & Sheeran, 2006) but still many individuals fail to act on their good intentions or to maintain the health behavior (Amireault, Godin, & Vézina-Im, 2013; Bélanger-Gravel, Godin, & Amireault,
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2013; Reuter, Ziegelmann, Lippke, & Schwarzer, 2009; Schwarzer et al., 2011). The social environment can chime in here and encourage physical activity (Amireault et al., 2013; Tay, Tan, Diener, & Gonzalez, 2013). Social support depicts a resource in health behavior change and can enhance the management of chronic conditions by facilitating physical activity (cf. Courneya, Plotnikoff, Hotz, & Birkett, 2000; Trost, Owen, Bauman, Sallis, & Brown, 2002). Prior research has shown that the support of significant others (e.g., family and friends) can sometimes directly predict physical activity (e.g., Gellert, Ziegelmann, Warner, & Schwarzer, 2011; Giles-Corti & Donovan, 2002) but that indirect links should also be considered and investigated (e.g., Anderson, Winett, Wojcik, & Williams, 2010; Rackow, Scholz, & Hornung, 2015). The latter approach has become well-known as the ‘enabling hypothesis’ (Benight & Bandura, 2004): The receipt of social support might pave the way for self-regulation when it strengthens the individual’s ability to complete even difficult tasks (Schwarzer & Knoll, 2007). Self-efficacy is enhanced and patients might feel enabled to perform a desired behavior (Schwarzer, 2008, Schwarzer et al., 2011).

Recent research indicates that the facilitating effect of social support also applies to other self-regulatory strategies, such as planning (Paech, Fleig, Pomp, & Lippke, 2014; Rackow et al., 2015), besides the initially mentioned self-efficacy (Benight & Bandura, 2004; Schwarzer & Knoll, 2007). The postintentional phase focuses on exactly those linking mechanisms and more proximal determinants of behavior. Volitional strategies and resources can bridge the gap between intention and behavior (Gollwitzer & Sheeran, 2006; Hagger & Luszczynska, 2014) as well as social support and behavior (Paech et al., 2014; Rackow et al., 2015). Difficulties in the initiation and maintenance of health behaviors can be overcome by planning the when, where and how of physical activity and coping self-efficacy (Schwarzer, 2008; Schwarzer et al., 2011, Sniehotta, Scholz, & Schwarzer, 2005).

Self-determination
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The HAPA postulates a motivational phase and describes how intentions are determined (Schwarzer, 2008; Schwarzer et al., 2011). The insights into the dynamics of motivation can be broadened by additionally taking self-determination into account. While goal intentions give information about the fact that an intention has been developed, self-determination casts light on the reasons and sources of this intention. Motivation is conceptualized along a continuum, ranging from intrinsic to extrinsic (Ryan, Williams, Patrick, & Deci, 2009).

In SDT, processes of motivation and psychological adaptation can be interpreted as indicators of internalization (Deci & Ryan, 1985; Ryan & Deci, 2000). That might be particularly interesting in the context of rehabilitation and chronic disease where individuals form their intentions due to autonomous needs and preferences or in response to externally-imposed demands, for example, by doctors or concerned relatives. Thus, it seems quite promising to integrate the construct of self-determination into the HAPA-framework for this study to assess both, the quality and quantity of motivation.

Due to its affinity with the intention construct, self-determination should be integrated into the motivational phase of the HAPA (Schwarzer, 2008; Schwarzer et al., 2011) for this study. Self-determination should follow intention and social support as the goal has to be set first in a specific social context before the quality and sources of this goal can be elaborated on (Li, Iannotti, Haynie, Perlus, & Simons-Morton, 2014; Seelig & Fuchs, 2006).

Aims of the study

The main objective of this study is to fathom the complex mechanisms involved in goal enactment in the domain of exercising. The intention-behavior relationship is examined for mediators that operate on a long-term basis, considering social, motivational and volitional resources. The study aims to estimate to what extent self-determination (measured at Time 1), self-efficacy (measured at Time 2) and action planning (measured at Time 2) act as mediators of the links between intention to be physically active, and social support,
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respectively (measured at Time 1), and physical activity, in particular strength training and endurance training (Time 3).

Methods

Participants and procedure

The data for the current longitudinal study were drawn from the rehabilitation setting. The study was conducted in consideration of the Helsinki Declaration. Informed consent had to be provided to become participant in the study. Patients from an orthopaedic outpatient rehabilitation center were invited to participate in the survey when they met the inclusion criteria (no cognitive impairments, no contraindication to exercise, proficiency in German language). Paper-pencil-questionnaires were employed to obtain information on social-cognitive variables and physical activities.

Baseline (Time 1, T1) was assessed at discharge from rehabilitation, \( N = 641 \) participated in the survey. Respondents were invited to follow-up assessments at 6 months later (Time 2, T2; \( n = 495 \)) and at 1 (Time 3, T3; \( n = 373 \)), 3 (Time 4, T4; \( n = 330 \)) and 7 (Time 5, T5; \( n = 191 \)) years after rehabilitation. The sample consisted of \( n = 247 \) men (38.8%) and \( n = 390 \) women (61.2%), the age ranged from 15 to 80 years (\( M = 46.26, SD = 11.79 \)). More than half of the participants were married or living with a partner (\( n = 436, 68.9\% \)). The examination of the educational level of the sample reveals that 42.1% (\( n = 267 \)) have a high school or similar diploma, 6.9% (\( n = 44 \)) had completed senior high school and 18.5% (\( n = 117 \)) held a university degree.

Dropout analyses

Dropout analyses revealed no differences regarding gender, age, social support, intention, self-determination planning, self-efficacy between participants who completed the study and those who dropped out after T1 (all \( ps > .05 \)).

Measures
At the end of rehabilitation (T1) intentions for physical activity, received social support, self-determination, subjective health, baseline physical activity, age and gender were measured. The questionnaire that was provided 6 months after discharge from rehabilitation (T2) assessed planning of physical activity as well as self-efficacy. At follow-ups (T3, T4, T5) physical activities were obtained. All social-cognitive variables were measured using 4-point Likert scales ranging from 1 (totally disagree) to 4 (totally agree) if not stated otherwise.

**Subjective health** was measured by a single item taken from the SF12 Health Survey (Bullinger & Kirchberger, 1998). Participants were asked to rate their overall health status on a 5-point Likert scale ranging from bad (1) to excellent (5)

**Intentions to be physically active** were assessed by a validated measure (Schwarzer, Schüz, Ziegelmann, Lippke, Luszczynska, & Scholz, 2007), consisting of nine items. A sample item from the questionnaire read “I intend to exercise for 20 minutes or more on at least two days per week on a regular basis.” The reliability coefficient for the index was Cronbach’s $\alpha = .68$.

**Self-determination** was measured by ten items. A sample was “I want to be physically active on a regular basis because I want to do as much as I can for my recovery.” The reliability coefficient for the index was Cronbach’s $\alpha = .79$.

**Received social support** was composed of two subscales, integrating family and friends as different sources of support. A sum score was built from both scales, each scale consisted of five items. Participants responded, for example, to the following item: “Family members have reminded me to exercise.” The reliability coefficients for the single indices of family and friend support were Cronbach’s $\alpha = .84$ and Cronbach’s $\alpha = .82$ respectively.

**Self-efficacy for physical activity** was assessed by six items that focused on the confidence to maintain physical activity, even in the face of barriers (Scholz, Sniehotta, & Schwarzer, 2005; Sniehotta, Scholz, & Schwarzer, 2005). A sample item read: “I am confident to engage in physical activity on a long-term basis even when I am faced with
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situations that strongly remind me of my old habits.” The reliability coefficient for the index was Cronbach’s $\alpha = .85$.

**Action planning for physical activity** was measured by six items. Action planning captures the when, where and how of physical activity; a sample items was “In the last six months, I have planned precisely where I will be physically active.” The reliability coefficient for the index was Cronbach’s $\alpha = .93$.

**Physical activity** was assessed by a modified version of the International Physical Activity Questionnaire (IPAQ; Mäder, Martin, Schutz & Marti, 2006). Participants were asked to report the average number of days per week and average duration in minutes per week of their exercise routine. Endurance and strength training were assessed separately.

**Data analysis**

Path analysis was applied to test the relationships between the study variables. Missing data were treated by Maximum Likelihood (ML) estimation. All predictors were mean-centered. Baseline behavior and subjective health at the end of rehabilitation were included as covariates. Indicators of multicollinearity were inconspicuous. Bias-corrected bootstrapping (10000 samples) was employed to estimate indirect effects (Preacher, Rucker, & Hayes, 2007).

**Results**

**Preliminary Analysis**

Means, standard deviations, ranges and intercorrelations of study variables are on display in Table 1. All social-cognitive variables were significantly positively interrelated, except for social support (T1) and self-efficacy (T2). The longitudinal behavioral measures were positively associated with each other, except for endurance training (T4) and strength training (T5). Baseline strength training (T1) was not significantly correlated with activities at later points in time. Baseline endurance training (T1) was only associated with strength training (T1) and with endurance (T3 and T4). As the means in Table 1 show, physical
activity in both domains decreased over time. Compared to baseline behavior, the reduction of exercise duration after 1 year (T3), 3 years (T4) and 7 years (T5) was significant, except for the drop ($\Delta M = 6.40, \Delta SE = 7.77$) in endurance training between baseline and T3, $t(640) = 0.82, p = .41$. Participants, on average, managed to keep up their endurance training for at least 54 minutes per week until 3 years after rehabilitation, the duration of strength training had dramatically decreased even at 1-year follow-up (see Table 1).

**Path analyses**

Manifest path analyses were used to test longitudinal multiple mediation models. The same determinants were used to predict physical activity at 1-year, 3-year and 7-year follow-ups. Intention (T1) and social support (1) were independent predictors in each of the models; self-determination (T1), self-efficacy (T2), and action planning (T2) acted as mediators. In particular, the models estimated the indirect effects of intention to be physically active (T1) and received social support (T1), respectively, on physical exercise 1 year later (T3), 3 years later (T4) and 7 years later (T5). The models were controlled for baseline behaviors and subjective health at discharge from rehabilitation (T1). Model fit indices were regarded as good, for the main model predicting exercise at 1-year follow-up ($\chi^2(8, N = 628) = 7.48, p = .49$; RMSEA = <.01 (90% CI [0.00; 0.05]); CFI = 1.00, TLI = 1.01, SRMR = .01), as well as for the models predicting exercise 3 years ($\chi^2(8, N = 628) = 9.38, p = .31$; RMSEA = .02 (90% CI [0.00; 0.05]); CFI = 1.00, TLI = 0.98, SRMR = .02) and 7 years after rehabilitation ($\chi^2(8, N = 628) = 8.67, p = .37$; RMSEA = .01 (90% CI [0.00; 0.05]); CFI = 1.00, TLI = 0.99, SRMR = .02).

Unstandardized path coefficients as well as the explained variance in each variable can be found in Table 2 and 3. Figure 1 shows the standardized path coefficients for the model predicting physical exercise at 1-year follow-up. This model turns out to be the central one as it provides the most information in the prediction of physical activity in the long run.

**Predicting physical exercise at 1-year follow-up**
Table 1

Means, standard deviations, ranges and intercorrelations of study variables

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<th>SD</th>
<th>Range</th>
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<th>3.</th>
<th>4.</th>
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<td>14. PA – strength T5</td>
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<td>68.16</td>
<td>0-1050</td>
<td>.43**</td>
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</tr>
</tbody>
</table>

Note. ** p < .01. * p < .05. Gender: 0 = female, 1 = male; T1 – Time 1; T2 – Time 2, 6-month follow-up; T3 – Time 3, 1-year follow-up; T4 – Time 4, 3-year follow-up; T5 – Time 5, 7-year follow-up.
The results of the mediation analyses only partially corroborated the assumed links between the social-cognitive variables and exercise (see Table 2). Intention of being physically active at baseline (T1) predicted self-determination (T1) as well as self-efficacy (T2) and action planning (T2). Received social support (T1) predicted self-determination (T1) and strength training (T3). Action planning (T2) was predicted by self-efficacy (T2), self-determination (T1) and intention (T1), and, in turn, predicted both, endurance and strength training (T3), whereas self-efficacy (T2) was only related to strength training (T3). Baseline endurance training (T1) predicted endurance training (T3) whereas strength training (T1) would not predict strength training at follow-up (T3).

The specific indirect effect of intention (T1) on endurance training (T3) through self-determination (T1), self-efficacy (T2) and action planning (T2) was significant, $B = 0.36$, BC 95% CI [0.05; 1.01]. The direct effect of intention (T1) on endurance training (T3) turned out to be insignificant, $B = 13.95$, BC 95% CI [-10.56; 37.77].

The specific indirect effect of social support (T1) on endurance training (T3) through self-determination (T1), self-efficacy (T2) and action planning (T2) was also significant, $B = 0.08$, BC 95% CI [0.01; 0.24]. The direct effect of social support (T1) on endurance training (T3) was not significant, $B = -3.51$, BC 95% CI [-12.66; 4.81].

The respective specific indirect effect of intention (T1) on strength training (T3), via self-determination (T1), self-efficacy (T2) and action planning (T2), showed to be significant, $B = 0.13$, BC 95% CI [0.02; 0.39]. The direct effect of intention (T1) on strength training (T3) remained insignificant, $B = 3.02$, BC 95% CI [-10.94; 13.28].

The significant specific indirect effect of social support (T1) on strength training (T3), via self-determination (T1), self-efficacy (T2) and action planning (T2), was also significant, $B = 0.03$, BC 95% CI [0.01; 0.09]. This was the only direct effect that turned out be significant, $B = -5.40$, BC 95% CI [-8.65; -2.06].
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Table 2

Model results with unstandardized path coefficients

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>p</th>
<th>R²</th>
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<td></td>
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<td>0.05</td>
<td>&lt;.01</td>
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</tr>
<tr>
<td>Social support T1</td>
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<td>0.02</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Health T1</td>
<td>0.04</td>
<td>0.03</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>Self-efficacy T2</td>
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<td></td>
<td>.08</td>
</tr>
<tr>
<td>Self-determination T1</td>
<td>0.14</td>
<td>0.09</td>
<td>.05&lt;sup&gt;ab&lt;/sup&gt;</td>
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<td>Action planning T2</td>
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<td>Self-efficacy T2</td>
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<td>0.04</td>
<td>&lt;.01</td>
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<td>Self-determination T1</td>
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<tr>
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<td>&lt;.01</td>
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<td>.26</td>
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</table>
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| PA – strength T1 | <0.01 | 0.01 | .79 |

Note. *p < .047; * bootstrap: *p > .05; c p < .045; d bootstrap: *p < .01; T1 – Time 1, end of rehabilitation; 2 – Time 2, 6-month follow-up; T3 – Time 3, 1-year follow-up. PA = physical activity.

Predicting physical exercise at 3-year and 7-year follow-up

The results of the mediation analyses showed that the prediction of the long-term outcomes was limited with the given set of social-cognitive determinants (see Table 3). Action planning (T2) still predicted endurance and strength training after 3 years (T4) and strength training after 7 years (T5), whereas social support (T1) was related to strength training (T4 and T5). Intention (T1) also predicted strength training 7 years after rehabilitation (T5). Long-term follow-ups (T4 and T5) were independent of baseline exercise (T1) validating the bivariate correlational results.

The specific indirect effects of intention (T1) on endurance training (T4), and on strength training (T4) respectively, through self-determination (T1), self-efficacy (T2) and action planning (T2) were significant, $B = 0.56, BC 95\% CI [0.08; 1.38]$ and $B = 0.11, BC 95\% CI [0.01; 0.32]$, respectively. The respective direct effects were insignificant.

The specific indirect effects of social support (T1) on endurance training (T4), and on strength training (T4) respectively, through self-determination (T1), self-efficacy (T2) and action planning (T2) were significant, $B = 0.13, BC 95\% CI [0.02; 0.34]$ and $B = 0.03, BC 95\% CI [<0.01; 0.08]$, respectively. Only the direct effect of social support (T1) on strength training (T4) was significant, $B = -4.35, BC 95\% CI [-6.94; -2.05]$.

The direct effects of intention (T1), and social support (T1) respectively, on endurance training (T5), and the respective indirect specific effects through self-determination (T1), self-efficacy (T2) and action planning (T2) were not significant. Whereas the specific indirect effects of intention (T1), and social support (T1) respectively, on strength training (T5), through self-determination (T1), self-efficacy (T2) and action planning (T2) were significant,
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\[ B = 0.15, \text{ BC 95\% CI [0.03; 0.57]} \] and \[ B = 0.04, \text{ BC 95\% CI [0.01; 0.14]} \], respectively. The direct effects of intention (T1), and social support (T1) respectively, on strength training (T5), were also significant, \[ B = 18.62, \text{ BC 95\% CI [4.30; 45.59]} \] and \[ B = -3.96, \text{ BC 95\% CI [-7.79; -0.88]} \], respectively.

Table 3

Model results with unstandardized path coefficients

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<tr>
<th>Path</th>
<th>Estimate</th>
<th>SE</th>
<th>p</th>
<th>Path</th>
<th>Estimate</th>
<th>SE</th>
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Note. ^a bootstrapping: \( p < .01 \); T1 – Time 1, end of rehabilitation; 2 – Time 2, 6-month follow-up; T4 – Time 4, 3-year follow-up; T5 – Time 5, 7-year follow-up. PA = physical activity.
Figure 1. Model with significant paths only and standardized coefficients (bootstrapping samples = 10000).

**p < .01, * p < .05.

**p < .01, * p < .05.
Chapter 3: Individual and social factors of long-term physical exercise

**Discussion**

Aim of the study was to enrich the understanding how on the one hand intentions to be physically active, and on the other hand social support, are linked to physical exercise in the domains of strength training and endurance training over a long-term follow-up in rehabilitation patients. The conceptual framework of the study was derived from the HAPA (Schwarzer, 2008; Schwarzer et al., 2011) which provided a valid basis for the rehabilitation research and allowed to integrate another antecedent of goal-directed behavior, namely self-determination (Deci & Ryan, 1985; Ryan & Deci, 2000).

Results indicate that action planning and self-efficacy mediated the relationship between intention and physical activity at 1-year follow-up (see Figure 1). Action planning directly predicted both endurance and strength training, action planning was predicted by self-efficacy which in turn also predicted strength training. Self-determination acted as a linking mechanism between intention and action planning but did not predict self-efficacy or physical activity at later points in time directly. Self-determination also mediated the link between received social support and action planning which in the following predicted exercise behavior, as mentioned before. Social support directly predicted participation in muscle strengthening activities at 1-year follow-up but this turned out to be an inverse relationship.

This pattern was validated by the results for physical activity at the 3- and 7-year follow-up (see Table 3). Action planning mediated the intention-behavior relationship for both types of physical activity three years after rehabilitation but only the link between intention and strength training seven years after rehabilitation. Social support was also negatively associated with strength training in the long run directly predicting muscle strengthening activities three and seven years after rehabilitation. Unexpectedly, baseline intention appeared to be a predictor of strength training seven years later.

In line with prior research (Schwarzer et al. 2008; Sniehotta et al. 2005), the intention-behavior gap could be bridged by action planning. Patients who were highly motivated to be
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physically active after discharge from rehabilitation were more likely to plan their physical activity at 6-month follow-up. Specifying the where, when and how of their activities then helped them to be more physically active one year after rehabilitation, compared to those who did not make action plans. Both types of physical activity were predicted, endurance as well as strength training, even at follow-ups three and seven years after rehabilitation (except for T5 endurance training). The results show that action planning is one of the crucial links in long-term behavior maintenance. Integrating the qualitative component of motivation, by interposing self-determination between intention and planning, strengthens the bridging of the intention-behavior gap. This is in line with prior research (e.g., Ryan et al., 2009; Li et al. 2014) but also extends past findings as this research integrated two valid theoretical frameworks (i.e. HAPA, SDT) and thus took a progressive approach to determine behaviour change.

Another strategy that enhances self-regulation and goal enactment is self-efficacy. Again, patients who were highly motivated to be physically active at the end of their rehabilitation program were more confident to engage in physical activity on a long-term basis even in the face of barriers at 6-month follow-up which in turn facilitated their adherence to strength but not endurance training one year after discharge from rehabilitation. These findings suggest that different social-cognitive mechanisms might be involved in varying modes of exercise. The higher intensity of strength training often demands more self-regulatory resources, as the experience of greater displeasure during physical activity suppresses the reward pathways for exercise (de Geus & de Moor, 2011). Then high self-efficacy helps to maintain the strength training even in the face of barriers, such as pain or displeasure (Schwarzer et al., 2011, Sniethotta et al., 2005). It must also be considered that aversive sensations during physical activity might be especially hard to bear for people with a chronic condition which itself can cause pain and restrictions in daily life (Fleig, Lippke, Pomp, & Schwarzer, 2011; Parschau et al., 2014). Chronic disease management constitutes a
specific situation for the affected individuals and requires additional resources of self-control in everyday life. Thus self-regulatory resources can be depleted when too many pressures have to be handled at the same time (Baumeister, Bratlavsky, Muraven, & Tice, 1998; Baumeister, Vohs, & Tice, 2007). This fact might serve as an explanation for the relatively low levels of physical activity in the rehabilitation sample. At baseline, after discharge from rehabilitation, the participants of the survey claimed to be physically active for about 120 minutes per week ($M_{endurance \ training} = 74.58, M_{endurance \ training} = 45.06$; see Table 1). The level of intensity for indicated exercise should be vigorous to reach the recommended levels of physical activity and to gain substantial health benefits from the exercise (CDC, 2008; WHO, 2015). As the duration of endurance and strength training decreased over the time of the survey the minimum recommended levels of physical activity were not reached anymore. Both types of physical activity were positively associated which means that endurance training and strength training complemented each other as suggested by activity guidelines (CDC, 2008; WHO, 2015). Individuals who performed aerobic activities were also more likely to integrate muscle strengthening activities into their exercise regimen – or vice versa. This is a solid basis to build on, with the premise that the duration of the exercise must be extended in the studied population.

Social support was examined for its enabling effect (Benight & Bandura, 2004) and linking mechanisms in progression towards physical exercise (Paech et al., 2015; Rackow et al., 2015). A facilitating effect was found on self-determination but not on action planning or self-efficacy as expected (Paech et al., 2015; Rackow et al., 2015). But as self-determination is closely related to the social context (Ryan & Deci, 2002) the indirect link on planning might be a crucial component in the volitional phase for behavior change on a long-term basis. A study by Li et al. (2014) found a similar pattern for internal motivation. Individuals that received more social support were more likely to perceive themselves to be self-determined (i.e., autonomously motivated) which in turn facilitated planning of physical
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activity which has shown to be a good predictor of strength and endurance training. The
direct effect of social support on strength training remained significant, at all follow-ups.
Surprisingly, the relationship was of inverse nature: Individuals who received more social
support were less likely to maintain their strength training. Prior research came across similar
findings and suggested that co-occurring social conflict could account for this effect (Warner
et al., 2013). Furthermore, moderator analyses could shed light on the negative relationship:
While lower self-efficacy could be compensated by social support, high levels of self-efficacy
were in conflict with social support as the autonomy might be called into question by the
support (Warner, Ziegelmann, Schüz, Wurm, Tesch-Römer, & Schwarzer, 2011). This
moderation effect was not found in the current study but a negative correlation between social
support and self-efficacy (see Table 1) could be an indicator that the underlying mechanisms
are related to social conflict and autonomy. The differential effects of social support should
still be considered in further research and practice. The question of long-term availability of
social support might yield another explanation. Social support could only have been available
for a limited period around the rehabilitation program but was omitted in the long run and
thus accompanied by a decrease in strength training at later points in time due to a lack of
resources then. This might be especially true for strength training as this can be associated
with displeasure and stronger depletion of resources as discussed above.

The present study provides insights into the complex interplay of the social-cognitive
determinants of different types of physical activity. The specific indirect effects were
significant confirming the assumption that intention and social support, respectively, are
linked with physical activity via intermediating mechanisms that explain how patients can
maintain a physically active lifestyle after discharge from rehabilitation on a long-term basis.

Limitations of the study and further directions

The low explained variances for longitudinal physical activity outcomes pose the
question of so far unconsidered mechanisms and other influential factors. First and foremost,
habit must be mentioned, especially with regard to the longitudinal perspective of the current studies. Future studies should incorporate measures of habit and habit strength (Fleig et al., 2015; Fleig, Pomp, Schwarzer, & Lippke, 2013) because the maintenance of health behaviors is more likely if a high degree of automaticity has been acquired (Rothman, Sheeran, & Wood, 2009; Verplanken & Wood, 2006).

In the context of chronic disease and medical rehabilitation, multiple health behavior change should be considered and other lifestyle factors, cross-behavioral, and transfer effects, that facilitate or hinder goal pursuit should be taken into account (Fleig et al., 2014; Lippke, 2014). A broader design and measurement of health behaviors (Fleig et al., 2014) and related higher-level health goals (Lippke, 2014) might cast light on multiple health behavior change processes on a long-term basis. Moderation effects might also be considered and closely examined, e.g., social conflict, functional restrictions, transfer motivation or self-regulatory efficacy (Jung & Brawley, 2013; Rhodes & Dickau, 2013; Warner et al., 2013). The identified resources and mechanisms might work for certain groups of individuals particularly well while others have different needs and mind-sets that require specific tailoring.

**Outlook**

The understanding of chronic disease and preventive lifestyle factors needs further improvement to exhaust left reserves and resources of long-term health behavior change. The findings from the current study should be considered in future study design and intervention development. Further research is needed to develop and evaluate interventions targeting at (multiple) health behavior change in chronic conditions and disease-specific effects, such as transfer cognitions (Fleig et al., 2014) and carry-over mechanisms (Lippke, 2014).
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References


Göttingen: Hogrefe.
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Put two (and two) together to make the most of physical activity and healthy nutrition –

A longitudinal online study examining interbehavioural mechanisms in multiple health behaviour change

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Abstract

Objective: Although many people know that physical activity and healthy nutrition contribute to health they fail to translate their knowledge and intentions into action. This can be explained by deficits in self-management and resources, such as intergoal facilitation, planning and self-regulation in the face of barriers. The present study examines the complex interplay of intention, intergoal facilitation, planning and self-regulation in facilitating physical activity and healthy nutrition. Cross-behavioural mechanisms are taken into consideration.

Design and main outcome measures: In a prospective online study, intentions were assessed at baseline (Time 1), intergoal facilitation and planning at 4-week follow-up (Time 2), self-regulation, physical activity and healthy nutrition at 6-month follow-up (Time 3). A path analysis was run to gain insight into psychological mechanisms that contribute to lifestyle change.

Results: Intergoal facilitation (Time 2), planning (Time 2) and self-regulation (Time 3) mediated the link from intention (Time 1) to physical activity and healthy nutrition (Time 3); the specific indirect effects were significant.

Conclusion: Findings suggest that intergoal facilitation, and self-regulation can bridge the intention-behaviour gap, in addition to the well-researched planning variable. Cross-behavioural mechanisms might facilitate lifestyle change in several domains. Behaviour change interventions should target those mechanisms in vulnerable individuals.

Keywords: diet, intergoal facilitation, multiple health behaviour change, volition, SOC
Theoretical background

A healthy lifestyle is a long-term project: Strategies to initiate and maintain health behaviours on a regular basis have to be established to reduce risk factors even in the face of barriers or challenges, from childhood to old age. Two cornerstones of healthy living are *behavioural nutrition and physical activity*. The global strategy of the World Health Organization (WHO, 2004) aims at the promotion and protection of health by the very two: healthy nutrition and physical activity.

Those domains of lifestyle depict two main risk factors for noncommunicable diseases (NCDs), such as cardiovascular diseases, cancer, chronic respiratory diseases and diabetes (WHO, 2014). There is an urgent need for action as the WHO (2014) points out, “NCDs currently cause more deaths than all other causes combined and NCD deaths are projected to increase from 38 million in 2012 to 52 million by 2030” (p.8). NCDs have become a global burden and coordinated action is required to tackle the growing problem of premature mortality and morbidity (WHO, 2014). On the individual level, risk factors such as physical inactivity and unhealthy diet should be targeted to improve health outcomes (Broekhuizen, Kroeze, van Poppel, Oenema, & Brug, 2012; Schwinshackl, Dias, & Hoffmann, 2014; Washburn et al., 2014).

Physical activity of moderate or strenuous intensity should be carried out on a regular basis for at least 150 minutes per week, as recommended by the WHO (2010). A physically-active lifestyle is associated with decreased risk of ischaemic heart disease, stroke, diabetes, breast and colon cancer (WHO, 2010). Physical activity also plays a critical role in energy balance, and therefore in weight control and prevention of obesity (WHO, 2010).

Another key determinant of health is nutrition which influences the risk of obesity, diabetes, heart disease, stroke and cancer (WHO, 2015). According to the WHO (2015), a healthy diet should be rich in fresh fruit and vegetables, dietary fibre and whole grain. Daily
meals should include at least 5 portions of fruit and vegetables (400g) per day to reduce health risks (WHO, 2015).

The positive effects of physical activity and healthy nutrition can be multiplied if both work in orchestration (Schwingshackl et al., 2014; Washburn et al., 2014). Recent health behaviour theories take this into account and throw light on the mechanisms of multiple health behaviour change (e.g. Fleig, Kerschreiter, Schwarzer, Pomp, & Lippke, 2014; Lippke, 2014).

**Theoretical approach to multiple health behaviour change**

Good practice demands the use of theoretical underpinning of studies and interventions in the field of behaviour change (Brazil, Ozer, Cloutier, Levine, & Stryer, 2005; Medical Research Council, MRC, 2008). In this context, the Health Action Process Approach (HAPA; Schwarzer, 2008; Schwarzer, Lippke, & Luszczynska, 2011) represents a reliable, parsimonious framework to describe and explain single health behaviour change in different settings and domains. This approach has been adapted to the more complex scenario of multiple health behaviour change (Lippke, 2014) integrating the valid social-cognitive constructs of the HAPA (Schwarzer, 2008; Schwarzer et al., 2011). Furthermore, the integration of other theoretical frameworks, focusing on resources and multiple goal interrelations (Riediger & Freund, 2004) and on global self-regulatory processes (SOC; Baltes & Baltes, 1990; Freund & Baltes, 2002) can broaden the understanding of linking mechanisms in multiple health behaviour change.

**Social-cognitive predictors of health behaviours**

Lifestyle changes in the domains of physical activity and healthy nutrition can be explained and predicted by the social-cognitive determinants of the HAPA (Schwarzer, 2008; Schwarzer et al., 2011) which makes a distinction between individuals who are in the motivational phase of health behaviour change and individuals who have reached the volitional phase of the change process. In the motivational phase, at first an intention to
change a current health behaviour has to be developed, for example, to become more physically active or to eat a more healthy diet (Schwarzer, 2008; Schwarzer et al., 2011). The intention will be translated into action in the volitional phase. The initiation and maintenance of physical activity and healthy nutrition respectively is fostered by self-regulatory processes, such as planning (Schwarzer, 2008; Schwarzer et al., 2011).

Prior research shows that intention is a key determinant of health behaviour change but despite strong intentions many individuals still fail to translate their goals into action (Schwarzer, 2008). Volitional strategies come into play here: Planning can bridge the gap that might occur between intention and behaviour (Gollwitzer & Sheeran, 2006; Hagger & Luszczynska, 2014). Difficulties in the initiation and maintenance of physical activity and healthy nutrition can be overcome by determining the when, where and how of intended activities and also what to do in the face of barriers (Schwarzer, 2008).

**Intergoal facilitation**

In the domain of multiple health behaviour change, interrelating processes should be considered. In the pursuit of higher level goals, detailed upstream processes need to take place first and more specific, subordinate goals have to be attained, e.g., to lose weight the energy balance should be optimized by a healthy diet and physical activity. Patterns of health behaviour change are activated and multiple health goals can facilitate each other when pursuing one goal makes it easier to attain another goal (Riediger & Freund, 2004). In the pursuit of related goals transfer from resources (e.g., energy) can be perceived by the individual (Riediger & Freund, 2004). Intergoal facilitation can be a predictor of social-cognitive variables and health behaviour (Presseau, Sniehotta, Francis, & Gebhardt, 2010; Riediger & Freund, 2004) and should be considered as another linking mechanism in the intention-behaviour relationship.

**Global self-regulation**
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Global self-regulatory processes appear to be the crucial link in the intention-behaviour chain (Anderson et al., 2010; Anderson-Bill et al., 2011; Reuter, Ziegelmann, Wiedemann, Lippke, Schüz, & Aiken, 2010). The selective optimization with compensation model (SOC; Freund & Baltes, 2002) provides a multitude of self-regulatory strategies to reach health goals even in the face of barriers or deficits. In the context of global life management, complex behavioural mechanisms, such as physical activity and healthy nutrition, can be stimulated and established for the benefit of higher health goals and well-being (Lippke et al., 2014; Reuter et al., 2010; Son, Kerstetter, Mowen, & Payne, 2009).

**Aims of the study**

The present study aims at a broadened understanding of linking mechanisms in the intention-behaviour relationship in the context of multiple health behaviour change, namely behavioural nutrition and physical activity. The interplay of intentions for physical activity and healthy nutrition, intergoal facilitation, planning of both behaviours, and global self-regulation will be analyzed in terms of initiation of moderate-to-vigorous physical activity and healthy nutrition in an overall model. The main objective was to model the complex intention-behaviour relationships of multiple health behaviour change and shed light on the interrelations of social-cognitive determinants of related, but distinct health behaviours.

The study seeks to estimate the extent to which intergoal facilitation (measured at Time 2), planning of physical activity and healthy nutrition respectively (measured at Time 2) and global self-regulation strategies (measured at Time 3) mediate the link between intention to be physically active and to eat a healthy diet respectively (measured at Time 1) and moderate-to-vigorous physical activity and healthy nutrition respectively (measured at Time 3) (see Figure 1).

**Methods**

**Participants and procedure**
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The data for the current longitudinal study were drawn from an online survey. All respondents had to provide informed consent before they could access the self-administered questionnaire. The study was conducted in consideration of the Helsinki Declaration. At Time 1 (T1) \( N = 991 \) participated in the survey. Respondents were invited to follow-up assessments at 4 weeks (Time 2, T2; \( n = 741 \)) and at 6 months (Time 3, T3; \( n = 711 \)) later. At least 50% of the questions at T1 had to be answered to be included as participant in the study. There were no significant differences found between those who answered more than half of the questions and those who responded to less (all \( p_s > .05 \)).

The final sample consisted of 27.2% men and the age ranged from 16 to 78 years (\( M = 37.83, SD = 12.27 \)); 55% of the participants were married or living with a partner; 77.7% had completed senior high school and 53.0% held a university degree.

Dropout analyses

Dropout analyses were conducted to identify differences between participants who completed the study and those who dropped out after T1. Except for the age of the dropouts who tended to be slightly older than those who were staying in the study (\( t(949) = 3.44, p < .001 \)) no other differences were found (all \( p_s > .05 \)).

Measures

At T1 intentions for physical activity and healthy nutrition, baseline physical activity, baseline nutrition, age and gender were assessed. The T2 questionnaire measured planning of physical activity and healthy nutrition as well as intergoal facilitation. At T3 self-regulation, healthy nutrition and physical activity were assessed. All social-cognitive variables were measured using 4-point Likert scales ranging from 1 (totally disagree) to 4 (totally agree) and validated before (Schwarzer, Schüz, Ziegelmann, Lippke, Lusczynska, & Scholz, 2007) if not stated otherwise.

**Intentions to be physically active** were assessed by a validated measure (Nigg, 2005), matching different levels of physical activity intensity. An index of strenuous and
moderate physical activities was built. A sample item from the questionnaire read “I intend to perform the following activities at least 5 days per week for 30 minutes strenuous (rapid heartbeats, sweating) physical activities.” The item intercorrelation was $r = .17$ indicating the brevity of the aggregated construct.

**Intentions to eat healthily** were measured by three items. A sample was “I intend to eat at least 5 servings of fruit and vegetables every day.” The reliability coefficient for the index was Cronbach’s $\alpha = .57$.

**Intergoal facilitation** was assessed by two items. Participants were asked how much energy and strength they gained from their physical activity and healthy nutrition; they responded, for example, to the following item: “Due to my physical activity I have much less (1)… much more (5) strength and energy for my healthy nutrition.” The item intercorrelation was $r = .53$.

**Planning for physical activity** was measured by assessing action and coping planning with 3 items each. Action planning focuses on the when, where and how of physical activity; the sample items was “I have already planned where I will be physically active.” Coping plans address the anticipation of barriers, e.g., “I have already precisely planned what to do if something intervenes.” Item intercorrelations ranged from $r = .42$ to $r = .90$. A general planning index for physical activity was built from the subscales. The reliability coefficient for the index was Cronbach’s $\alpha = .90$.

**Planning for healthy nutrition** was measured by assessing action and coping planning with 3 items each. Action planning characterizes the when, where and how of healthy nutrition; the sample items was “I have already planned precisely how I will prepare the fruit and vegetables.” The coping planning measure assessed plans for healthy nutrition in the face of barriers, e.g., “I have already planned precisely what to do in difficult situations to maintain my intention to eat 5 servings of fruit and vegetables on a daily basis.” Item
intercorrelations ranged from $r = .43$ to $r = .78$. Both subscales were combined into a general planning index. The reliability coefficient for the index was Cronbach’s $\alpha = .88$.

**Self-regulation** was measured with an adapted and validated version of the SOC strategies questionnaire (Reuter et al., 2010). The reliability coefficient for the index was Cronbach’s $\alpha = .82$. A sample of the 4 items was “When it is getting more difficult to lead a healthy lifestyle I only strive for my most important health goal.”

**Physical activity** was assessed by a modified version of the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985; Plotnikoff et al., 2007). Participants were asked to report the average number of sessions per week and average duration in minutes per week of their leisure-time physical activity. Moderate (not exhausting, light perspiration) and strenuous activities (rapid heartbeats, sweating) were combined to an index of physical activity to reflect the range of intensity levels in physical activity. A sum score was built from the responses (product of frequency and duration) for each intensity level.

**Healthy nutrition** was assessed by asking participants how many servings of several foods they have had on average on a typical day during the last month. Information was to be provided on servings per day of salad and raw vegetables, fruit, fruit/vegetable juice, and boiled or steamed vegetables.

**Data analysis**

Multiple regression analyses were applied to test the hypothesized model (see Figure 1). Missing data were treated by Maximum Likelihood estimation. Predictors were mean-centered. Baseline behaviours were included as covariates. Indicators of multicollinearity were checked and regarded as inconspicuous. Bias-corrected bootstrapping (10000 samples) was employed to aid data non-normality and to estimate indirect effects (Preacher, Rucker, & Hayes, 2007).

**Results**
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**Preliminary Analysis**

Descriptive statistics and intercorrelations of all variables are displayed in Table 1. Most social-cognitive variables were significantly positively interrelated (see Table 1). However, some associations were found to be non-significant. These observations touch upon a small set of cross-behavioural associations, in particular.

Gender was negatively associated with both, intentions of physical activity (T1) and intentions of healthy nutrition (T1) as well as with planning of healthy nutrition (T2) and healthy nutrition at baseline (T1). This indicates that women were more likely to harbor higher intentions and plans as well as eating more fruit and vegetables at baseline but to perform less physical activity at baseline than men. There were negative correlations with age and baseline physical activity (T1) indicating that older people were less likely to perform physical activity. Age showed significant positive correlations with planning of physical activity (T2) and planning of healthy nutrition (T2), negative associations were found with both baseline behaviours, physical activity (T1) and healthy nutrition (T1).

Drawing attention to the change management of participants over the course of the study (see Table 2), descriptive analyses showed that one fifth of the participants were successful to increase both their mean levels of fruit and vegetable intake and physical activity from baseline to 6-month follow-up. A similar number of participants relapsed into minor levels of physical activity and healthy nutrition from baseline until 6 months later. However, approximately 40 % of the participants managed to reach higher levels in at least one domain of health behaviour until 6-month follow-up: increasing portions of fruit and vegetables but showing less physical activity or rather increasing the amount of weekly physical activity but eating less fruit and vegetables compared to baseline. Whereas \( n = 6 \) (0.85 %) participants did not change any of the two behaviours during the course of the study. Only a small group of participants reached recommended amounts of fruit and vegetable intake (*at least 5 servings of fruit and vegetables every day*) at T3, \( n = 4 \) (0.56 %).
Table 1
Means, standard deviations, ranges and intercorrelations of study variables

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<td>.09*</td>
<td>.06</td>
<td>.05</td>
<td>.11*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Planning PA T2</td>
<td>2.73</td>
<td>0.81</td>
<td>1-4</td>
<td>.45**</td>
<td>.41**</td>
<td>.23**</td>
<td>.19**</td>
<td>.07</td>
<td>.16**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Planning N T2</td>
<td>2.12</td>
<td>0.80</td>
<td>1-4</td>
<td>.50**</td>
<td>.06</td>
<td>.08*</td>
<td>.18**</td>
<td>.23**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Self-regulation T3</td>
<td>2.44</td>
<td>0.66</td>
<td>1-4</td>
<td>.15**</td>
<td>.23**</td>
<td>.13**</td>
<td>.19**</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>9. Physical activity T1</td>
<td>176.10</td>
<td>158.48</td>
<td>0-630</td>
<td>.35**</td>
<td>.10**</td>
<td>.16**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Physical activity T3</td>
<td>116.73</td>
<td>138.76</td>
<td>0-630</td>
<td>.12**</td>
<td>.19**</td>
<td>.33**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Nutrition T1</td>
<td>1.43</td>
<td>1.10</td>
<td>0-15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Nutrition T3</td>
<td>1.35</td>
<td>0.70</td>
<td>0-7.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Note. ** p < .01. * p < .05. Gender: 0 = female, 1 = male; T1 – Time 1; T2 – Time 2, 4-week follow-up; T3 – Time 3, 6-month follow-up.
Chapter 4: A longitudinal online study examining interbehavioural mechanisms

Figure 1. Hypothesized model. Note. PA = physical activity, N = nutrition, SOC = self-regulation.
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Figure 2. Model with significant paths only and standardized coefficients (bootstrapping samples = 10000). Note. ** $p < .01$.

* $p < .05$. PA = physical activity. N = nutrition. SOC = self-regulation.
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Recommended levels of physical activity (at least 5 days per week for 30 minutes moderate and/or strenuous physical activities) were reached by n = 346 (34.91 %) participants at 6-month follow-up.

Table 2
Number of participants changing levels of health behaviours between T1 and T3

<table>
<thead>
<tr>
<th>Levels of healthy nutrition</th>
<th>N increased (%)</th>
<th>N decreased (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N increased (%)</td>
<td>n = 138 (19.46 %)</td>
<td>n = 136 (19.18 %)</td>
</tr>
<tr>
<td>N decreased (%)</td>
<td>n = 144 (20.31 %)</td>
<td>n = 160 (22.57 %)</td>
</tr>
</tbody>
</table>

Note. T1 – Time 1; T3 – Time 3, 6-month follow-up.

Path analysis

Manifest path analyses were used to test multiple mediation. The path model depicted cross-behavioural processes assuming parallel mechanisms for different behaviours, namely healthy nutrition (T3) and physical activity (T3) (see Figure 1). Intergoal facilitation (T2), planning of both behaviours (T2), and self-regulation (T3) acted as mediators which operated in a sequence to link the intention (T1)-behaviour (T3)-relationship. In particular, the model estimated the indirect effects of intention to be physically active (T1) and intention to eat a healthy diet (T1), respectively, on physical activity 6 months later (T3) and on healthy nutrition at 6-month follow-up (T3). The model was controlled for baseline behaviour. Model fit was very good, $\chi^2(2, N = 991) = 0.04 , p = .98; \text{ RMSEA} = .01 (90\% \text{ CI}[0.00; 0.00]); \text{ CFI} = 1.00, \text{ TLI} = 1.04, \text{ SRMR} = .01$.

Standardized and unstandardized path coefficients as well as the explained variance in each variable can be found in Table 3 and Figure 2.
Table 3

*Model results with unstandardized path coefficients*

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>p</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intergoal facilitation T2</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intention PA T1</td>
<td>0.08</td>
<td>0.03</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Intention N T1</td>
<td>0.15</td>
<td>0.03</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>PA T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.08</td>
<td></td>
</tr>
<tr>
<td>N T1</td>
<td>-0.01</td>
<td>0.02</td>
<td>.75</td>
<td></td>
</tr>
<tr>
<td>Planning PA T2</td>
<td>.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intergoal facilitation T2</td>
<td>0.13</td>
<td>0.05</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Intention PA T1</td>
<td>0.17</td>
<td>0.04</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Intention N T1</td>
<td>0.22</td>
<td>0.04</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>PA T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>N T1</td>
<td>-0.02</td>
<td>0.03</td>
<td>.57</td>
<td></td>
</tr>
<tr>
<td>Planning N T2</td>
<td>.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intergoal facilitation T2</td>
<td>0.23</td>
<td>0.04</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Intention PA T1</td>
<td>0.09</td>
<td>0.04</td>
<td>.01$^a$</td>
<td></td>
</tr>
<tr>
<td>Intention N T1</td>
<td>0.41</td>
<td>0.04</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>PA T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.97</td>
<td></td>
</tr>
<tr>
<td>N T1</td>
<td>0.05</td>
<td>0.03</td>
<td>.06$^a$</td>
<td></td>
</tr>
<tr>
<td>Self-regulation T3</td>
<td>.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning PA T2</td>
<td>0.15</td>
<td>0.04</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Planning N T2</td>
<td>0.28</td>
<td>0.05</td>
<td>&lt;.01</td>
<td></td>
</tr>
<tr>
<td>Intergoal facilitation T2</td>
<td>0.09</td>
<td>0.04</td>
<td>.05$^b$</td>
<td></td>
</tr>
<tr>
<td>Intention PA T1</td>
<td>0.03</td>
<td>0.03</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Intention N T1</td>
<td>0.01</td>
<td>0.04</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>PA T1</td>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td>N T1</td>
<td>0.01</td>
<td>0.03</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>Physical activity T3</td>
<td>.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation T3</td>
<td>28.22</td>
<td>11.41</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Planning PA T2</td>
<td>16.71</td>
<td>6.29</td>
<td>.01$^a$</td>
<td></td>
</tr>
<tr>
<td>Planning N T2</td>
<td>-7.62</td>
<td>9.51</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td>Intention PA T1</td>
<td>5.08</td>
<td>6.00</td>
<td>.40</td>
<td></td>
</tr>
</tbody>
</table>
The results of the mediation analyses did not corroborate all of the assumed associations between the social-cognitive variables of both health behaviours. In the domain of physical activity the assumptions were met (all \( p < .05 \), see Table 3): Intention of being physically active at baseline (T1) predicted planning physical activity (T2) which, in turn, predicted physical activity (T3). The specific indirect effect of intention of physical activity (T1) on physical activity (T3) though planning physical activity was significant, \( B = 2.84, \) BC 95% CI \([0.87; 5.86]\).

Intention of being physically active (T1) also predicted intergoal facilitation (T2) which, in turn, predicted planning physical activity (T2). The specific indirect effect of intention of being physically active (1) on physical activity (T3) through intergoal facilitation (T2) and planning physical activity (T2) was significant, \( B = 0.17, \) BC 95% CI \([0.03; 0.60]\). Furthermore, planning physical activity (T2) predicted physical activity behaviour (T3) directly and also indirectly via self-regulation (T3). The specific indirect effect of intention to be physically active (T1) on physical activity behaviour (T3), via planning physical activity
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(T2) and self-regulation (T3), showed to be significant, $B = 0.71$, BC 95% CI [0.18; 1.77].
The significant specific indirect effect of intention of being physically active (T1) on physical activity (T3) still holds good via planning healthy nutrition (T2) and self-regulation (T3), $B = 0.74$, BC 95% CI [0.11; 2.03].

In the domain of healthy nutrition some other patterns were found. Intention of eating a healthy diet (T1) predicted intergoal facilitation (T2), planning healthy nutrition (T2), and healthy nutrition (T3) directly. Planning healthy nutrition (T2) was not associated with healthy nutrition (T3) but predicted self-regulation (T3) which, in turn, predicted healthy nutrition (T3). The specific indirect effect of intention of eating a healthy diet (T1) on healthy nutrition (T3), via planning healthy nutrition (T2) and self-regulation (T3), showed to be significant, $B = 0.01$, BC 95% CI [0.004; 0.03]. There was also significant, but quite small specific indirect effect of intention of eating a healthy diet (T1) on healthy nutrition (T3) via planning physical activity (T2) and self-regulation (T3), $B = 0.004$, BC 95% CI [0.001; 0.01].

Further indirect effects were estimated: Intention of being physically active (T1) had a specific indirect effect on physical activity (T3) through intergoal facilitation (T2), planning physical activity (T2) and self-regulation (T3), $B = 0.04$, BC 95% CI [0.01; 0.16]. The total indirect effect was significant, $B = 4.86$, BC 95% CI [1.82; 8.85], whereas the direct effect was not, $B = 5.08$, BC 95% CI [-7.23; 16.60].

Intention of eating a healthy diet (T1) had a specific indirect effect on healthy nutrition (T3) through intergoal facilitation (T2), planning healthy nutrition (T2) and self-regulation (T3), $B = 0.001$, BC 95% CI [<0.01; 0.003]. However, the total indirect effect was not significant, $B = 0.02$, BC 95% CI [-0.02; 0.07], but the direct effect was significant, $B = 0.14$, BC 95% CI [0.05; 0.22].

With regard to cross-behavioural effects, the specific indirect effect of intention to be physically active (T1) on physical activity (T3) through intergoal facilitation (T2), planning healthy nutrition (T2) and self-regulation (T3), $B = 0.14$, BC 95% CI [0.02; 0.44] was found.
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to be significant, whereas the specific indirect effect of intention to eat a healthy diet (T1) on healthy nutrition (T3) via intergoal facilitation (T2), planning physical activity (T2) and self-regulation (T3), $B = 0.01$, BC 95% CI [0.01; 0.001] was significant but very small. Baseline physical activity (T1) predicted physical activity (T3) as well as healthy nutrition (T3). But baseline nutrition (T1) was only associated with healthy nutrition at 6-month follow-up (T3) but not with physical activity at follow-up.

Discussion

Aim of the study was to enrich the understanding of linkages between the intentions to be physically active and to eat a healthy diet respectively and the actual behaviours, namely moderate-to-vigorous physical activity and healthy nutrition at 6-month follow-up. As hypothesized (see Figure 1), intergoal facilitation, planning of physical activity and global self-regulation mediated the relationship between intention to be physically active and physical activity measured six months later (see Figure 2). A similar sequential pattern was found in the domain of healthy nutrition: Intergoal facilitation, planning of healthy nutrition and global self-regulation mediated the relationship between intention to eat a healthy diet and healthy nutrition measured six months later (see Figure 2). Prior research showed the effects of intergoal facilitation, planning, or self-regulation strategies operating as direct predictors or as single mediators (e.g., Anderson-Bill et al., 2011; Presseau et al., 2010; Reuter et al., 2010). The present study provides new insights and shows how the three social-cognitive variables may operate jointly, in a specific sequence.

In both domains of health behaviour, high levels of behaviour-specific intention predicted higher levels of intergoal facilitation which in turn fostered behaviour-specific planning and subsequent global self-regulation. Individuals with high intentions – compared to individuals with low levels of intention – were more likely to have higher global self-regulation and thus be more physically active or eat a healthier diet 6 months later when they had perceived their goals facilitating each other and planned their activities in the meantime.
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The specific indirect effects were significant confirming the main assumptions of the hypothesized mediation model. However, the indirect effect of intention to eat a healthy diet at baseline on healthy nutrition 6 months later via intergoal facilitation, planning of healthy nutrition and self-regulation seems to be rather small, contrary to the specific indirect effect in the domain of physical activity. This might be due to the significant direct effect of intention on healthy nutrition.

Surprisingly, the intention-behaviour gap was not found in the domain of healthy nutrition in this sample and intention remained the key determinant of healthy nutrition at 6-month follow-up beside the linking chain of intergoal facilitation, planning and self-regulation. Contrary to prior research (Gollwitzer & Sheeran, 2006; Schwarzer, 2008) and to the hypothesized links in the domain of healthy nutrition (see Figure 1), planning did not predict healthy nutrition at 6-month follow-up directly but intention to eat a healthy diet did (see Figure 2). Planning of healthy nutrition was only indirectly associated with healthy nutrition via self-regulation.

These results suggest that global self-regulation fills a crucial role in the adoption and maintenance of health behaviours (Anderson et al., 2010; Anderson-Bill et al., 2011; Reuter et al., 2010; Son et al., 2009): Adapting, adjusting, prioritizing and other self-regulatory strategies seem to be the final link to the actual behaviour in the long run. The unexpected findings pose the question of so far unconsidered mechanisms and other influential factors: In this respect, moderation effects might be considered and closer examined. Another explanatory approach could be to target the measures themselves: The intention items in the domain of healthy nutrition already contain detailed information what is needed to perform the desired behaviour (i.e., 5 servings of fruit and vegetables, every day). Those situational parameters might address cues to action to an extent similar to those of action plans and thus the nutrition intention acts as a proximal construct in the prediction of healthy nutrition (Gollwitzer, & Sheeran, 2006). Intentions are then more likely to be put to practice when
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certain ideas of how the behaviour can be performed are integrated (Gollwitzer, 1993; Leventhal, 1970).

Furthermore, specific differences between the behavioural patterns of physical activity and nutrition might account for the different ways intention works in health behaviour change, since nutrition already is part of daily routine and has to be adapted to health recommendations, whereas physical activity often has to be initiated and incorporated as an extra point of the daily agenda. In the context of multiple health behaviour change, another promising approach lies in scrutinizing cross-behavioural and transfer effects that engender and facilitate goal pursuit in other health behaviour domains (Fleig et al., 2014; Lippke, 2014).

The current findings suggest that the mechanisms of behaviour change in the domains of physical activity and healthy nutrition are closely related as the cross-behavioural relationships of intention and planning show. The intention to be physically active not only predicts planning of physical activity but also planning of healthy nutrition, which holds true for the intention to eat a healthy diet as well. Subsequent behaviour is then predicted behaviour-specific. A staggered design and measurement of health behaviours (Fleig et al., 2014) over a longer period of time as well as considering related higher level health goals (Lippke, 2014) might give new insights into the interplay of multiple health behaviour change processes.

Limitations of the study and further directions

The study was subject to some limitations that should be overcome in future research. Although the longitudinal design of the study is considered as a strong point it should be expanded to longer follow-ups in the future. Prior research has shown that lifestyle changes, such as levels of physical activity and healthy diet, may decrease after six months and only stabilize in the following months or years (Anderson et al., 2010; Anderson-Bill et al., 2011; Reuter, Ziegelmann, Lippke, & Schwarzer, 2009). Furthermore, to draw far-reaching causal
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inferences from study results and gain more insight into cause-effect relationships

experimental manipulations need to be applied.

The current findings broaden the understanding of how individuals can translate their intentions into action to some extent but the question of buffering effects remains untouched. Those social-cognitive mediators might work for certain groups of individuals particularly well while others need something different or specifically tailored to change prevailing behavioural patterns of physical activity and healthy nutrition on a long-term basis. Future studies should account for specific moderators of the intention-behaviour relationship in the context of multiple health behaviour change, such as intention stability, conscientiousness, transfer motivation or self-regulatory efficacy (e.g., Gegenfurtner, Veermans, Festner, & Gruber, 2009; Jung & Brawley, 2013; Rhodes & Dickau, 2013).

Conclusions

To improve understanding of the complex regimen of multiple health behaviour change several social-cognitive variables have to be taken into consideration and the theoretical framework needs to be widened to cross-behavioural processes. Intention, intergoal facilitation, planning and global self-regulation have been derived from a theoretical background (Freund & Baltes, 2002; Lippke, 2014; Riediger & Freund, 2004; Schwarzer, 2008; Schwarzer et al., 2011) and integrated in the prediction of physical activity and healthy nutrition. Further research is needed to develop and evaluate interventions targeting at multiple health behaviour change and specific cross-behavioural effects and processes, such as transfer cognitions (Fleig et al., 2014) and carry-over mechanisms (Lippke, 2014).
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References


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Chapter 5: General discussion

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**General discussion**

Lifestyle is a choice, not inescapable fate. An unhealthy lifestyle, however, can seal one’s fate. Lifestyle factors play a crucial role in health and well-being, and health behaviours can be modified to reduce the personal risk of morbidity and mortality (WHO, 2014).

Individuals have the right and the responsibility to decide how they lead their daily life. Health psychology aims to understand different perspectives and approaches to lifestyle and self-management. Health promotion is about behaviour change: Information is provided in a climate of support and encouragement, to enable individuals to make informed choices, and provide them with tools and resources to improve their health behaviours. By empowering individuals to identify their own needs, determine plans, and evaluate the progress towards their goals, they get the opportunity to improve their own health (Shircore, 2009).

The main objective of this thesis was to advance research on single and multiple health behaviour change, primarily focusing on self-regulatory processes involved in the maintenance of physical activity in the first place and healthy nutrition in the second. A theory-driven and integrative approach was chosen as the basis for this research. In the following, the research questions outlined in the beginning (Chapter 1) will be revisited, followed by a brief summary and discussion of the results from the empirical chapters (Chapters 2-4) from a comprehensive perspective.

**Processes of single health behaviour change**

The first study (Chapter 2) examined the role of planning, perceived social support and global self-regulation in bridging the gap between intention and physical activity.

As hypothesized, planning acted as a mediator between the intention to be physically active, and actual levels of physical activity 6 months later. Social support had no direct
effect on physical activity but it operated in parallel to planning as a link between intention and global self-regulation. Thus, SOC strategy use further facilitated the maintenance of physical activity in the long run, acting as an intermediate mechanism in the volitional phase. The studied social-cognitive determinants came into effect in a specific sequence and determined the maintenance of physical activity on a fairly long-term basis of six months after baseline intention formation.

The second study (Chapter 3) explored the interplay of motivational and volitional determinants in long-term physical exercise maintenance, in a clinical population from an orthopaedic rehabilitation setting. Self-determination, action planning and self-efficacy were examined as linking mechanisms between intention to be physically active and social support, respectively, and physical exercise.

Received social support from friends and family, in addition to intention, can foster self-determination in individuals. Volitional processes, such as action planning and self-efficacy were not directly determined by social support in the rehabilitation sample under examination. Social support did, however, have an inverse direct effect on strength training, in particular, whereas no direct effect on endurance training was found. Self-determination was included to take qualitative aspects of motivation into account. Coping self-efficacy was affected by intention. Action planning was guided by both intention and self-determination, as well as self-efficacy. Action planning once again proved to be a proximal determinant of physical activity up to seven years after discharge from rehabilitation. Coping self-efficacy was also found to be a mediator between intention and physical exercise, but only for strength training one year after orthopaedic rehabilitation treatment, and mainly facilitated long-term behavior change indirectly via the self-regulatory strategy of planning.

The motivational and volitional processes under examination in this study determined the maintenance of physical exercise on a long-term basis up to seven years after discharge from rehabilitation.
Chapter 5: General discussion

Processes of multiple health behaviour change

The third study (Chapter 4) built on the prior investigations of social-cognitive determinants in this thesis. The findings were applied and expanded to the setting of multiple health behaviour change. The domains of physical activity and healthy nutrition and their antecedents were examined. A primary focus was placed on interbehavioural cognitions.

Intergoal facilitation can be considered a carry-over mechanism in settings where more than one behaviour needs to be changed. Intergoal facilitation fostered planning in both domains of health behaviour change, but was not directly related to the health behaviours. Behaviour-specific planning enhanced global self-regulatory strategies. Planning of physical activity acted as a mediator between intentions and actual levels of physical activity six months later, whereas planning of healthy nutrition was not directly related to a healthy diet. Planning turned out to be a critical component in the sequence of linking mechanisms between intentions and behaviours in both domains. Intergoal facilitation, planning and global self-regulation bridged the gap that might occur in the course of goal pursuit. Still, a direct effect of intention to eat a healthy diet on healthy nutrition remained. SOC strategy use contributed to a healthy lifestyle and was directly related to the health behaviours. A global self-regulatory strategy of prioritizing health goals and making the best of a given situation helped to maintain healthy nutrition and physical activity. The examined behaviour-specific and interbehavioural determinants provided insights into the complex mode of action in multiple health behaviour change.

Directions and implications for future research

The results from the single studies have been presented and discussed in more detail in the empirical chapters (Chapters 2-4) and are not meant to be subject of this discourse. Rather, a comprehensive approach as established in the introduction is pursued.

Models and studies in the domain of health psychology try to explain why and how individuals manage to maintain their intended health behaviours, and what might hinder them.
Chapter 5: General discussion

This thesis provided further evidence on the critical role of motivational and volitional processes in health behaviour change (Heckhausen, 1991; Schwarzer, 2008).

The initial process of intention formation constitutes the starting point for further examination, as the defining and setting of goals is a necessary prerequisite for change. Abandoning or modifying behavioural patterns that might have been part of individuals’ daily routines for a long time requires energy and resources, and this investment is more likely to be made when individuals can vividly picture a higher-level goal and partial objectives on the way to this goal (Hagger, Wood, Stiff, & Chatzisarantis, 2009). The present thesis showed that intention engenders secondary processes that serve as a basis for long-term behaviour change in the domain of physical activity (Chapters 2-4). Whereas in the domain of healthy nutrition intention remained a proximal determinant of behaviour maintenance (Chapter 3). As healthy nutrition was examined in co-occurrence of physical activity, cross-over mechanisms might account for that finding suggesting that self-regulatory resources are spared in the face of multiple behaviour change (Fleig, Kerschreiter, Schwarzer, Pomp, & Lippke, 2014; Fleig, Ngo et al., 2015; Lippke, 2014).

Apart from mechanisms that operate in deliberate behaviour change, such as transfer effects and interbehavioural cognitions (Fleig et al., 2014; Fleig, Ngo et al., 2015; Lippke, 2014), habitual regulation effects should be taken into account (Fleig et al., 2014). A dual-system perspective can offer an explanation of this.

A dual-system approach to behavioural regulation

Dual process theories, such as the Reflective Impulsive Model (RIM; Strack & Deutsch, 2004), presume that there are two kinds of processes involved in behavioural regulation whose respective activation depends on the available resources: When no resources are available or needed, automatized processes are more likely to be run. When more cognitive effort has to be used for elaborate action, the reflective system makes a contribution to behavioural regulation. The latter requires intention and is involved in self-
regulation to initiate or maintain health behaviours, whereas the automatic mode is driven by increasing levels of habituation (Aarts et al., 1997; Lally & Gardner, 2011; Neal et al., 2006; Rothman et al., 2009; Verplanken & Melkevik, 2008). Thus, with regard to long-term behaviour change and sustained health benefits, an economic approach should be chosen when habit formation plays a leading role (Aarts et al., 1997; Lally, Van Jaarsveld, Potts, & Wardle, 2010). This applies to single health behaviour change (Fleig et al., 2013; Fleig, Pomp, Schwarzer, & Lippke, 2013), and can be extended to multiple health behaviour change regimens (Fleig et al., 2014). Targeting and fostering habit formation in individuals engaged in health behaviour change depicts a potential future strategy for intervention design.

Allocation of personal and social resources in health behaviour change

The findings from this thesis demonstrate that the motivational phase of behaviour initiation can be further consolidated by personal and social resources. The Health Action Process Approach (HAPA; Schwarzer, 2008; Schwarzer, Lippke, & Luszczynska, 2011) pointed the way for the investigation of the fundamental mechanisms of health behaviour change, but the paradigm was extended by informative theories. The integration of further theoretically derived constructs brought meaningful insights into the complexity of the human mind in anticipation of change. As hypothesized in the respective empirical studies (Chapters 2-4), and in line with existing research (e.g., McKee & Ntoumanis, 2014; Ng et al., 2012; Riediger & Freund, 2004; Schwarzer, 2008; Schwarzer et al., 2011), the resources of self-determination, social support and, in the case of multiple health behaviour change, intergoal facilitation took effect in the initial phase of behaviour change.

Autonomy and self-determination

The consideration of autonomy concepts in health promotion has become indispensable as a means of communication on equal terms (e.g., Deci & Ryan, 2012; Ng et al., 2012). Autonomous motivation is associated with more successful and sustainable behaviour change, compared to externally suggested or controlled motivation (Ryan, Patrick,
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Deci, & Williams, 2008). The facilitating effect of self-determination can be better understood if the scope of the concept is defined thoroughly. The autonomous component of self-determination should not be equated impartially with independence (Vansteenkiste, Williams, & Resnicow, 2012). Dependence and control should be distinguished from another to understand how self-determination takes effect: Depending carries the meaning of relying on others for material, spiritual or informative support (Vansteenkiste et al., 2012). This is a type of relationship that can be reflectively struck up. Individuals become dependent but still maintain their autonomy. In contrast, when an element of pressure comes along with dependence, as it might be the case in the treatment of chronic disease, individuals might feel controlled. When individuals feel obliged to do something, with or without support from others, they cannot act autonomously and sustainable goal pursuit is put in jeopardy. Self-determination refers to this concept of autonomy and therefore can be considered a personal resource in health behaviour change that engenders volition (Deci & Ryan, 2012).

Social support and self-efficacy

The question of autonomy also indirectly prompts the question of how social influences or rather, the handling of the social environment, determines health behaviour change. Ideally, social environments should be supportive rather than controlling (Deci & Ryan, 2012). Deci and Ryan (2012) point out that it is fundamental to respect individuals’ frame of reference and provide the support they need to go their own healthy ways. This self-determination perspective (Deci & Ryan, 2012) can be applied to both non-clinical (i.e. prevention of chronic disease) and clinical settings (i.e. treatment of chronic disease). Besides autonomy, competence and relatedness are considered basic psychological needs (Deci & Ryan, 2000) that have found their way into health behaviour change models and research (Ng et al., 2012). Within the HAPA (Schwarzer, 2008, Schwarzer et al., 2011), competence appears in the form of self-efficacy, and relatedness has its counterpart in social support. The influence of those factors on health and health behaviours has been well documented: Social
support has shown reliable links to health via various intermediate mechanisms (cf. Uchino, 2009; Uchino, Carlisle, Birmingham, & Vaughn, 2011), and self-efficacy proved to be another key determinant of health and health behaviours (cf. Schwarzer, 2014). Synergistic effects of social support and self-efficacy have also been found (Schwarzer & Knoll, 2007; Warner, Ziegelmann, Schüz, Wurm, & Schwarzer, 2011) pointing to the importance of a combined approach with regard to social support and self-efficacy in fostering health behaviour change.

*The language of change: Motivational interviewing*

An important finding was that social support can under certain circumstances, also interfere with health behaviour maintenance (Warner, Ziegelmann, Schüz, Wurm, Tesch-Römer, & Schwarzer, 2011). Indications of such an interfering effect were revealed in this thesis (*Chapter 3*). In this context, paying attention to the third basic need of autonomy is an effective way to regard the interplay of resources. The basic psychological needs must be harmonized to attain satisfaction and stimulate constructive behaviour change processes (Ryan et al., 2008). An effective way to do that might be motivational interviewing as it addresses those needs directly (Markland, Ryan, Tobin, & Rollnick, 2005). Thus, motivational interviewing can be used to enrich future interventions that target health behaviour change, complementing existing health promotion programmes (Martins & McNeil, 2009; van Keulen et al., 2011). Combining principles of motivational interviewing and HAPA based elements seems to be a promising approach (Böhme, Geiser, Mühlenhoff, Holtmann, & Renneberg, 2012), which should be applied in the planning and design of long-term prevention and self-management initiatives. When applied to multiple health behaviour change settings, the identified interbehavioural cognitions can be targeted and optimized, e.g., intergoal facilitation, and further influential mechanisms might be identified.

*Intergoal relations*
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In the realm of lifestyle and self-management, it is not unusual that individuals strive for several goals that have to be synchronized. When health goals facilitate each other the effect is beneficial to health behaviour change (Riediger & Freund, 2004; Segerstrom & Solberg Nes, 2006), as it has also shown to be in this thesis (Chapter 4). Concurrent attention to several goals might, however, also result in conflict, perceived as hindering each other, in particular in the face of low self-regulatory resources (Riediger & Freund, 2004; Segerstrom & Solberg Nes, 2006). This has implications for goal attainment and subjective well-being (Boudreaux & Ozer, 2013; Riediger & Freund, 2004). Rival goals might come from the domain of health behaviour change, e.g., healthy nutrition and physical activity, or from different areas of life, e.g., physical activity and academic success. The situation of multiple goal striving is part of everyday life, since most individuals have several interests, tasks and social roles in different areas of life. Many individuals are able to handle their situation and successfully attain goals that would have the potential to hinder each other. This raises the question of interindividual differences: How do individuals who manage to attain several potentially conflicting goals differ from individuals who fail to do so? Trait-like differences between individuals might account for the variance in goal attainment (Kuhl, 1994).

Interbehavioural cognitions, such as intergoal facilitation or intergoal conflict (Riediger & Freund, 2004), work at the level of appraisals when behavioural initiation is still in preparation. The tendency to experience conflict is linked to information-processing mechanisms in the run-up of behaviour initiation, as Kuhl (1994) explains in his theory of action and state orientation. While action-oriented individuals concentrate on current strivings and shield their goals from competing demands, state-oriented individuals remain in rumination on alternative goals and unpleasant concomitants (Kuhl, 1994). Thus, action orientation provides a promising basis for goal pursuit, but state orientation rather points the way to difficulties in decision-making and adapting, in particular under stressful conditions and in the face of limited resources. Under the latter circumstances, goals are more likely to
be perceived as conflicting and hindering. Appraisal of resources and intergoal relations can differ tremendously depending on individual motivational orientation. It is even more important to understand how individuals perceive intergoal relationships (Boudreaux & Ozer, 2013). Future interventions need to assess both intergoal facilitation and intergoal conflict, and train individuals in handling multiple goals by taking an action-oriented approach.

Individuals need to learn how to make use of synergistic effects in their versatile self-management, and they can be assisted in volitional strategy use, such as planning concurrent goals and coordinating several activities, or prioritizing goals in accordance with selective optimization with compensation. Details on other valued goals and state orientation of individuals in the behaviour change process should be obtained, in order to tailor volitional strategies to their needs and establish a personalized approach that creates a long-term impact on health and self-management (cf. Wanyonyi, Themessl-Huber, Humphris, & Freeman, 2011). Appraisal of goal attainment must be considered, as it depicts a critical precursor of volitional processes, in single and in multiple health behaviour change.

**Self-regulatory strategies as a key to action**

The self-regulatory strategies applied and investigated in this thesis have shown to be proximal determinants of health behaviour maintenance (Chapters 2-4). In line with prior research (e.g., Freund & Baltes, 2002; Sniehotta, Scholz, & Schwarzer, 2005), the hypothesized facilitators of actual behaviour change had a stimulating effect on physical activity and healthy nutrition. In light of the aforementioned goal appraisals, self-regulatory strategies offer a solution to goal conflict and prevent both ego depletion and disengagement from health behaviour change (Baumeister, Vohs, & Tice, 2007; de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Hagger et al., 2009; Riediger & Freund, 2004). Self-regulatory strategies are used to conserve the energy available for goal investment, i.e. individuals do not only need self-regulation but also strategies for how to apply it most effectively (Jung & Brawley, 2010). Self-regulation does not occur in isolation,
but several tasks have to be managed in conjunction with daily life. Global self-regulatory strategies, as examined in this thesis (*Chapters 2, 4*), help individuals to keep track of their higher levels goals and synchronize subsequent strivings (Freund & Baltes, 2002). While strategic planning determines the how and when of successful scenarios by identifying cues for action (Schwarzer, 2008; Schwarzer et al. 2011), selective optimization with compensation integrates adaptive mastery and optimal functioning with available resources (Bajor & Baltes, 2003; Freund & Baltes, 2002). In the context of selection, optimization and compensation, limited resources do not lead to goal disengagement but to alternative approaches of handling the situation. Self-regulatory failure can be overcome by adaptive coping strategies, and should guide the development of future interventions (Hagger et al., 2009).

*Lifestyle factors from a holistic perspective*

From a paramount perspective of lifestyle management and well-being, besides health behaviour change, other areas of life must be taken into consideration. Individuals need to be approached holistically, balancing short-term costs and long-term benefits of behavioural regulation (Joireran, Balliet, Sprott, Spangenberg, & Schultz, 2008; Wan & Sternthal, 2008), and leaving room for other needs, such as recreation, enjoyment and relaxation (Baumeister & Heatherton, 1996). Mindfulness has gained attention in recent research and practice with regard to the empowerment of individuals (e.g., Chiesa & Serretti, 2011; O’Reilly, Cook, Spruijt-Metz, & Black, 2014) – another step to take on the way to effective health behaviour change interventions. Mindfulness practices cultivate skills that foster self-regulation and sensitize individuals for their needs by improving awareness of emotional and sensory cues (Shapiro, Carlson, Astin, & Freedman, 2006), which may also be important for behaviour change in the domains of activity and nutrition. Future interventions can only benefit from a mindfulness approach, as the overall goal of health behaviour change and promoting initiatives should be an increase in quality of life and healthy life years.
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*Lifestyle recommendations as a tool of health promotion*

The findings from this thesis (*Chapters 2-4*) show that effective measures and mechanisms have already been identified. Those key determinants of successful health behaviour change need to be applied to the practices of health promotion and respective programmes in clinical and non-clinical settings of primary and secondary prevention. When it comes to the design of successful interventions, it is crucial to identify the optimal number of behavioural recommendations to target (Wilson et al., 2015). Interventions must set manageable tasks and not overwhelm individuals with too many demands simultaneously, in particular in the face of limited resources and self-control capacity. The relationship between motivation and the capacity to change can be pictured as an inverted U-curve: Moderate levels of demands, compared to low or high levels, produce the best results with regard to the invested effort of individuals (Silvia, McCord, & Gendolla, 2010). Thus, interventions with a moderate number of recommendations can be considered most effective.

As discussed above, multiple health behaviour change is a meaningful approach, as risk factors tend to cluster within individuals (Ding et al., 2014; Poortinga, 2007) and multiple health behaviour change processes can be accompanied by interbehavioural mechanisms (i.e. carry-over effects) that foster further improvement of lifestyle (e.g., Fleig et al., 2015; Lippke, 2014). Multiple health behaviour change is also more demanding as more recommendations are likely to be given. Individuals will make a large effort to change if they perceive their goals to be attainable, but will cut down their activities if goals seem to be unattainable (Carver & Scheier, 1998).

*Stronger curvilinear effects in specific populations*

Motivation to change current behavioural patterns and lifestyle factors varies across settings and populations. As a result, the curvilinear effect might be stronger in specific settings or samples.
Individuals from non-patient populations or non-clinic settings are less likely to experience health conditions that require active treatment, which might be reflected as lower motivation to change (e.g., Hardcastle, Taylor, Bailey, Harley, & Hagger, 2013).

Best practice demands equality of opportunity; disadvantaged populations that might not be easily reached still need to be given access to behaviour change resources. Lay community facilitators can be involved in bridging this gap and overcoming barriers (e.g., language, cultural differences, lack of internet access) to supplying services to marginalized individuals (e.g., Nies, Artinian, Schim, Wal, & Sherrick-Escamilla, 2004).

By taking these factors into account and adapting interventions to the specific needs of certain populations, however, behaviour change can still be facilitated successfully.

*Impact of the included number of recommendations*

A recent meta-analysis (Wilson et al. 2015) supported the assumption of a curvilinear effect with regard to the optimal number of behavioural recommendations. A moderate number of recommendations (i.e. 2-3) provided in lifestyle interventions has shown to be most effective to behaviour change. Samples with presumably lower motivation benefit most from this effect, compared to highly motivated populations, such as rehabilitation patients (Wilson et al., 2015). Future research needs to resolve whether the optimal number of recommendations depends on the type of interventions combined with regard to behavioral domains (e.g., simultaneously targeting healthy nutrition and physical activity vs. healthy nutrition and smoking cessation).

*Matters of culture, culture matters*

Health is highly valued in all countries and cultures. However, different cultures share different understandings and manners. Thus, culture-specific approaches to health consider those health issues important that are emphasized within a certain community (Dutta, 2007). Major behavioural health risks for morbidity and mortality are governed by lifestyle choices and sociodemographic factors. Most research has been conducted in developed, Western
countries, e.g., Canada (Qi, Phillips, & Hopman, 2006), USA (Kim, Symons, & Popkin, 2004), Germany (Schneider, Huy, Schuessler, Diehl, & Schwarz, 2009). Cross-cultural studies have revealed distinct patterns of lifestyle and socioeconomic status between those developed and developing countries, such as China: While in the USA higher socioeconomic status is associated with lower risk and a healthy lifestyle, in China higher socioeconomic status is accompanied by higher risk and an unhealthy lifestyle (Kim et al., 2004). A recent study (Chan & Leung, 2015) that further examined the profiles of healthy vs. unhealthy lifestyle groups in China, found that gender partly accounts for this effect: The group that showed less physical activity and less healthy nutrition was predominantly male, younger, employed, and had high-to-middle levels of education. Another study (Chou, 2008) investigated the prevalence of smoking, alcohol consumption, physical inactivity, and low fruit and vegetable intake among older individuals in China, and ascertained that unhealthy lifestyle factors cluster particularly in older men with higher levels of education but without employment. Such culture-specific risk profiles provide essential information regarding who needs what, and can thus enrich health promotion interventions.

In spite of culture-specific perceptions, practices and burdens, current research has found similar mechanisms of health behaviour change in international samples with diverse cultural backgrounds (e.g., Gholami, Lange, Luszczynska, Knoll, & Schwarzer, 2013; Lhakhang, Gholami, Knoll, & Schwarzer, 2015; Reyes, Montenegro-Montenegro, Knoll, & Schwarzer, 2014). Thus, the applicability of health behaviour change theories to other cultural contexts is scientifically supported. It might still be necessary to apply culturally focused interventions to meet specific cultural needs (e.g., Airhihenbuwa, 2010; Airhihenbuwa, Ford, & Iwelunmor, 2013). For example, prior research suggests that the cultural context determines how food and nutrition are appraised, and how the relationship between weight and health is evaluated (Dietz, Story, & Leviton, 2009; Fitzgibbon & Beech, 2009). Successful health promotion programmes allow for individual-level factors, as well as
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cultural norms when targeting health behaviours, such as nutrition and activity, and related
cognitive constructs, such as attitudes or beliefs about bodily constitution (James, 2004).

Predictive accuracy

As the research in this thesis was solely based on self-report instruments potential
inaccuracies must be considered, as discussed in the respective empirical chapters (Chapters 2-4). The insights gained from this thesis should not be belittled as the assumptions guiding
the research have been theoretically derived and have been found to be in line with prior
research. The findings make a meaningful contribution to the existing body of research in the
field of health behaviour change, and fill gaps in the current knowledge on linking
mechanisms in the intention-behaviour-chain.

With due caution, however, results based on self-reports have to be scrutinized
thoroughly and every effort must be made to replicate the findings under more objective
conditions. Self-report data on health behaviour and social-cognitive variables might be
biased by social desirability, response shifts or recall errors (Prince, Adamo, Hamel, Hardt,
Gorber, & Tremblay, 2008). Previous findings can be enhanced with objectively measured
clinical biomarkers (Wilson et al., 2015) and objective behaviour measures (Wilcox &
Ainsworth, 2009). This approach enables researchers to compare objective with subjective
behavioural data, and allows the effect of health behaviour change on indicators of health to
become quantifiable. Bringing together both approaches, integrating objective and subjective
measures, gives validity to health psychological theories and studies, and provides researchers
with an integral perspective.

Conclusion

In conclusion, the findings in this thesis provide insights into health behaviour change
that can inform both theory and practice: Self-determination and self-regulatory strategies
have been shown to be two cornerstones of health behaviour change and complement existing
research paradigms. Theoretical integration can be a promising and useful approach in
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examining the complex interplay of social-cognitive determinants and health behaviour, in particular in the realm of multiple health behaviour change. Based on the observational findings from this dissertation, effective interventions should be developed to target critical mechanisms, and thus empower individuals in their desire to change and maintain a good quality of health at all ages.
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References


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Components to Prevent and Manage Chronic Diseases. *European Health Psychologist, 16*(S), 616.


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Curriculum Vitae

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List of publications

Articles in peer-reviewed journals (* indicates those that are part of the thesis)  
2012 – 2015


Under review

*Paech, J. & Lippke, S. (under review). Put two (and two) together to make the most of physical activity and healthy nutrition – A longitudinal online study examining interbehavioural mechanisms in multiple health behaviour change. British Journal of Health Psychology.


**Miscellaneous**


**Selected presentations (first authorships only)**

Publications


