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**Cognitive and Behavioral Preparations:  
Examining Strategies to Increase and Maintain Physical  
Activity Levels**

Dissertation zur Erlangung des akademischen Grades

Doktorin der Philosophie (Dr. phil.)

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Disputation: 12.06.2015

Berlin, April 2015

Freie Universität



Berlin

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Danksagung

## **Danksagung**

*For reasons of data protection, the acknowledgements are not included in this version.*

### Abstract

Regular physical activity offers a variety of physiological and psychological health benefits. Nevertheless, only few individuals in Germany adhere to physical activity guidelines. Therefore, this thesis examines strategies to increase physical activity levels. As it has been found that the problem is rarely a lack of intention to increase physical activity, the present thesis focuses on volitional strategies that are supposed to facilitate the translation of an intention into action. Within the framework of the health action process approach (HAPA, Schwarzer, 1992, 2008), four empirical studies investigated volitional factors, such as self-efficacy, action planning, coping planning, preparatory behaviors, and action control as predictors of physical activity. By means of multivariate analysis of variances and multiple mediation, the first study confirmed the effectiveness and the working mechanisms of a volitional intervention to promote physical activity with action planning, coping planning, and self-efficacy as active ingredients of the intervention. The second study showed that a specific preparatory behavior of physical activity, namely the acquisition of an action control tool, was predicted by self-efficacy beliefs. Furthermore, the preparatory behavior was related to increased physical activity at follow-up. In the third and fourth study, planning and preparatory behaviors were tested simultaneously in different mediation models to predict physical activity. Using structural equation modeling in the third study, planning and preparatory behaviors were found to be sequential mediators of the intention-physical activity relationship. Moreover, preparatory behaviors were identified as working mechanisms of planning. In order to test whether this applies in a similar way to individuals with different levels of self-efficacy beliefs, a moderated mediation analysis with the interaction self-efficacy x preparatory behavior predicting physical activity was modelled in the fourth study. The results indicate that preparatory behaviors might be especially beneficial for individuals with self-doubts.

## Zusammenfassung

Regelmäßige körperliche Aktivität bietet eine Vielzahl an körperlichen und psychologischen Gesundheitsvorteilen. Dennoch schaffen es nur wenige Personen in Deutschland so körperlich aktiv zu sein, wie es verschiedene Richtlinien empfehlen. Aus diesem Grund ist es Ziel dieser Arbeit, Strategien zu untersuchen, die zu einer Steigerung von körperlicher Aktivität führen können. Bisherige Studien zeigen, dass die Motivation von Personen, körperlich aktiver zu werden, nur selten ein Problem darstellt. Daher liegt der Schwerpunkt dieser Arbeit auf der Analyse von volitionalen Strategien. Volitionale Strategien sollen Personen dabei helfen, ihre bereits gefasste Intention in tatsächliches Verhalten umzusetzen.

Auf Grundlage des Health Action Process Approach (HAPA, Schwarzer, 1992, 2008) wurden in vier empirischen Studien volitionale Faktoren als Prädiktoren von körperlicher Aktivität untersucht. Bei diesen volitionalen Faktoren handelt es sich um Selbstwirksamkeit, Handlungsplanung, Bewältigungsplanung, vorbereitende Handlungen und Handlungskontrolle. Der zentrale Fokus liegt dabei auf der Unterscheidung zwischen kognitiven und behavioralen Vorbereitungen für körperliche Aktivität. Handlungs- und Bewältigungsplanung können unter dem Konstrukt der kognitiven Vorbereitungen zusammengefasst werden. Durch kognitive Vorbereitungen sollen Personen in Bereitschaft versetzt werden, ein Verhalten zu initiieren. Behaviorale Vorbereitungen werden auch vorbereitende Handlungen genannt. Man versteht darunter eine Vielzahl unterschiedlicher Verhaltensweisen, die auf die eine oder andere Art die Verhaltensinitiierung erleichtern. Zusätzlich wurde getestet, wie kognitive und behaviorale Vorbereitungen mit Selbstwirksamkeitserwartungen zusammenhängen.

Mithilfe einer multivariaten Varianzanalyse und einer multiplen Mediation wurden in der ersten Studie die Effektivität und die Mechanismen einer volitionalen Intervention zur Förderung von körperlicher Aktivität getestet. Die Teilnehmer der Interventionsgruppe berichteten über höhere Werte körperlicher Aktivität als die Kontrollgruppe. Die wirksamen Bestandteile der Intervention waren die Unterstützung bei der Handlungsplanung und Bewältigungsplanung sowie Elemente zur Steigerung von Selbstwirksamkeitserwartungen.

Die zweite Studie untersuchte die Beschaffung eines Schrittzählers als eine spezielle Form einer vorbereitenden Handlung von körperlicher Aktivität. Ein Schrittzähler ist ein Instrument der Handlungskontrolle, welches die Selbstbeobachtung bei körperlicher Aktivität unterstützt. Es zeigte sich, dass Selbstwirksamkeitserwartungen die vorbereitende Handlung vorhersagten, und dass Personen mit einem Schrittzähler über mehr körperliche Aktivität beim Follow-Up berichteten als Personen ohne Schrittzähler.

Die dritte und vierte Studie untersuchten sowohl kognitive als auch behaviorale Vorbereitungen der körperlichen Aktivität. Dafür wurden verschiedene Mediationsmodelle getestet. Die Ergebnisse der dritten Studie zeigen, dass Planung und vorbereitende Handlungen den Zusammenhang von Intention und körperlicher Aktivität sequentiell mediieren. Außerdem wurden vorbereitende Handlungen als Mechanismen von Planung identifiziert. Um zu testen, ob dieser Mechanismus in gleicher Weise auf Personen mit unterschiedlich ausgeprägten Selbstwirksamkeitserwartungen anwendbar ist, wurde in der vierten Studie eine moderierte Mediation modelliert. Selbstwirksamkeit moderierte die Beziehung von Planung, vorbereitenden Handlungen und körperlicher Aktivität auf die Weise, dass Personen mit stärkeren Selbstzweifeln eher von vorbereitenden Handlungen profitieren als Personen mit hohen Selbstwirksamkeitserwartungen.

# **Chapter 1**

## **General Introduction**

## **Behavioral Background**

Numerous studies have shown that sufficient levels of physical activity can help to prevent or reduce symptoms of several diseases: e.g., cardiovascular diseases, such as coronary heart disease (Vuori, 2010) and stroke (Middleton et al., 2013), type-2 diabetes (Gill & Cooper, 2008), musculoskeletal diseases, such as osteoporosis (Muir, Ye, Bhandari, Adachi, & Thabane, 2013) and arthritis (Sandberg et al., 2014), and some types of cancer (Brown, Winters-Stone, Lee, & Schmitz, 2012). Some of these positive health outcomes of physical activity can be traced back to its influence on an individual's energy balance. That is, a physically active lifestyle facilitates weight maintenance and weight reduction (Mekary et al., 2009; Simon et al., 2008). In addition to the improvement of weight control, physical activity is related to reduced cholesterol levels (Vega-Lopez et al., 2014), improved insulin sensitivity (Berman, 2012), glucose homeostasis (Hansen et al., 2012), and reduced blood pressure (Figueira et al., 2014). These effects on physiological mechanisms may help to understand why individuals who are engaging in regular physical activity are less likely to suffer from non-communicable diseases than individuals who follow a rather sedentary lifestyle. Furthermore, physical activity has demonstrated beneficial effects for the prevention of cognitive decline, especially for Alzheimer's disease and vascular dementia (Denkinger, Nikolaus, Denkinger, & Lukas, 2012). Moreover, the incidence and the course of mental disorders seem to be related to physical activity. Mammen and Faulkner (2013) concluded in their review that the promotion of physical activity can be a useful strategy to reduce the risk of developing depression. Additionally, physical activity has been found to be beneficial in the treatment of anxiety disorders (Ströhle, 2009).

Apart from the above mentioned physiological and psychological health benefits of an active lifestyle, studies from the field of positive psychology demonstrated that physical



activity is related to increased well-being, self-rated health irrespective of objective health outcomes (Engberg et al., 2014; Mack et al., 2012; Sylvester, Mack, Busseri, Wilson, & Beauchamp, 2012), as well as reduced stress (Kettunen, Kyröläinen, Santtila, & Vasankari, 2014).

In Germany and other western countries, the prevalence of the above mentioned diseases and chronic conditions are relatively high and have either increased within the last decades or remained stable at a high level. The prevalence of obesity (+ 3%, Mensink et al., 2013) and especially of type-2 diabetes (+ 38%, Heidemann, Schubert, Rathmann, & Scheidt-Nave, 2013) increased dramatically within the last 15 years. The lifetime prevalence of cardiovascular diseases is currently high, but stable (heart attack: 4.7%, coronary heart disease: 9.3%, Gößwald, Schienkiewitz, Nowossadeck, & Busch, 2013; and stroke: 2.9%, Busch, Schienkiewitz, Nowossadeck, & Gößwald, 2013). Furthermore, depression (11.6% lifetime prevalence, Busch, Maske, Ryl, Schlack, & Hapke, 2013) and chronic stress (11.1%, Hapke et al., 2013) are also widespread in the German society.

Thus, even though each of the named diseases is multi-causal, the low adherence rates to physical activity recommendations play a role in the high prevalence of both, chronic diseases and their associated conditions. Unsurprisingly, increasing physical activity is one of the main strategies of global and national health promoting institutes in order to reduce the burden of non-communicable diseases (WHO, 2013; Krug et al., 2013).

Some success in increasing physical activity levels might have been achieved by health-promoting campaigns. In Germany for example, levels of physical activity have slightly increased within the last years (Kurth, 2012). Especially the awareness of the importance of physical activity is quite high and many individuals are trying to be sufficiently active. However, most of them do not succeed. As recent epidemiological data indicated, only 20.4 % of the German population met the recommended level of at least 150 minutes per week

(Haskell et al., 2007) of leisure time physical activity (Krug et al., 2013). Furthermore, especially work-related physical activity has decreased over the years (Froböse & Wallmann-Sperlich, 2015), indicating a change towards a more sedentary work environment. Taken all together, the presented findings point to the need of theory and evidence based interventions that promote a sustained improvement in physical activity levels.

### **Theoretical Background**

In order to change physical activity, it is important to understand the individual mechanisms that lead to behavior change. Several theoretical models have been used to describe how and why people change their behavior. Some of these theories explicitly focused on health behavior change, such as the health belief model (Rosenstock, 1966), the protection motivation theory (Rogers, 1975, 1983), the transtheoretical model (Prochaska & DiClemente, 1983), the precaution adoption process model (Weinstein, 1988), the health action process approach (HAPA, Schwarzer, 1992, 2008), and the MoVo process model (Fuchs, Seelig, Göhner, Burton, & Brown, 2012), while others have been successfully adapted to the health behavior domain, e.g., the social cognitive theory (Bandura, 1977) and the theory of planned behavior (Ajzen, 1985, 2002). The above named theoretical models of behavior change can be subdivided into two different kinds of models: stage models or volitional models and continuous or motivational models (Sniehotta & Schwarzer, 2003). Motivational models assume that the motivation or intention to perform a certain behavior is the most immediate antecedent of behavior, whereas volitional models presume that intention does not automatically lead to behavior. Therefore, volitional models define volitional strategies (i.e., self-regulatory strategies) that are supposed to increase the likelihood of behavior. For both

categories, one model is described as an example: the theory of planned behavior as a motivational and continuous model and the transtheoretical model as a stage and volitional model. Afterwards the HAPA (Schwarzer, 1992, 2008), which served as the framework for this thesis, is delineated. The HAPA (Schwarzer, 1992, 2008) has also been labeled a "hybrid model" as it combines continuous and stage assumptions. With its emphasis on post-intentional strategies, it can be further classified as a volitional model.

### **Motivational Theories of Behavior Change**

The health belief model (Rosenstock, 1966), the protection motivation theory (Rogers, 1975, 1983), the social cognitive theory (Bandura, 1977), the theory of reasoned action (Ajzen & Fishbein, 1980), and the theory of planned behavior (Ajzen, 1985, 2002) can be described as continuous or motivational models. They share the assumption that individuals can be arranged along a continuum of a specific likelihood for behavior change. The likelihood can be calculated on the basis of a regression equation. The higher an individual scores on the predictor variables, defined in the model, the higher is the likelihood that behavior change is adapted successfully. Furthermore, intention or motivation is the most proximal predictor of behavior change. The models specify a range of variables that are supposed to predict an intention, which in turn predicts a behavior.

**The theory of planned behavior.** The theory of planned behavior (Ajzen, 1985, 1991, 2002) as an extension of the theory of reasoned action (Ajzen & Fishbein, 1980) is among the most widely applied models to health behavior.

According to Ajzen (1991) the individual's intention to perform a behavior is the most important predictor of a behavioral outcome. He defined intentions as "indications of how hard people are willing to try, of how much effort they are planning to exert in order to perform the behavior" (Ajzen, 1991, p.181). As in the other motivational models Ajzen

(1991) assumed that the more an individual intends to perform a behavior, the more likely its performance becomes. However, assumptions of the theory of planned behavior are based on the requirement that individuals need to perceive control over their set behavioral intentions as well as the behavior they intend to perform. Thus, according to Ajzen (1991), perceived behavioral control is both, a predictor of intention and behavior, even though the latter relationship supposed to be rather weak. The construct of perceived behavioral control relates to whether an individual evaluates a behavior as difficult or easy to perform. The inclusion of perceived behavior control constitutes the extension of the theory of reasoned action (Ajzen & Fishbein, 1980) to the theory of planned behavior. Further predictors of intention are the attitude towards the behavior and subjective norm. The attitude describes the extent to which an individual evaluates a given behavior positively or negatively (Ajzen, 1991). The construct of subjective norm refers to the social pressure an individual perceives, when he or she considers whether to perform a behavior or not (Ajzen, 1991). The dominance of a factor in the prediction of intention is supposed to differ across situations and different types of behavior (Ajzen, 1991).

The theory of planned behavior has been successfully applied to a variety of different health behaviors, such as physical activity (e.g., Armitage, 2005; Blanchard et al., 2008; Brickell, Chatzisarantis, & Hagger, 2006), dietary behavior (e.g., Armitage & Conner, 1999; Blanchard et al., 2009), smoking cessation (Nehl et al., 2009; Rise, Kovac, Kraft, & Moan, 2008), condom use (Albarracín, Johnson, Fishbein, & Muellerleile, 2001), screening behavior (Cook & French, 2008), speeding (Elliott, Armitage, & Baughan, 2003), blood donation (Giles, McClenahan, Cairns, & Mallet, 2004), and breastfeeding (McMillan et al., 2008). However, similar to discussions regarding other motivational models of health behavior change, the relatively weak relationship between intention and behavior, especially if controlled for past behavior, was rated as a critical issue (McEachan, Conner, Taylor, &

Lawton, 2011; Rhodes & Dickau, 2012; Sheeran, 2002). Moreover, in the physical activity domain, several recent studies reported difficulties to predict behavior with the constructs of the theory of planned behavior (Hardeman, Kinmonth, Michie, & Sutton, 2011; Hobbs, Dixon, Johnston, & Howie, 2013).

### **The Intention-Behavior Gap**

The fact that physical activity has many health benefits is assumed to be well known among the general population, as health campaigns, newspapers, and magazines spread this information regularly. Thus, it seems likely that the intention to be physically active is high among the general population. However, low physical activity levels in Germany (Froböse & Wallmann-Sperlich, 2015; Krug et al., 2013) and other western countries (USA, Center for Disease Control and Prevention, 2014) indicate that there must be a discrepancy between the individuals' intention and the actual behavior. This discrepancy, which is known as the 'intention-behavior-gap' (Sheeran, 2002), has attracted a great deal of research. Among individuals who hold intentions to undergo a cancer screening program, Orbell and Sheeran (1998) compared a group of individuals who did not act in line with their intentions ("inclined abstainers") with a group of individuals who intended and participated in the screening program ("inclined actors"). They found that the group of inclined abstainers was even bigger (57%) than the group of inclined actors (43%). This indicates that individuals who intend to perform a certain behavior do not automatically act in accordance with their intentions. A recent meta-analysis by Rhodes and de Bruijn (2013) tried to quantify the intention-behavior gap in the physical activity domain. They analyzed 10 studies with overall 3,899 participants and found that among those who intended to be physically active only 54% succeeded in adhering to their physical activity intentions.

Furthermore, findings of other studies yielded low correlations between intention and behavior which also points to an “intention-behavior-gap”. For example, Rebar, Maher, Doerksen, Elavsky, and Conroy (2014) found that especially intentions for moderate physical activity corresponded only marginally to the actually performed behavior.

To conclude, findings on weak associations between intention and behavior indicate that theoretical models of behavior change need to be further improved. This could be done by considering post-intentional or volitional antecedents of behavior. Post-intentional or volitional constructs become especially relevant when theories are applied to design interventions to improve health behaviors. If an intervention only targets the individual’s intention, being assumed as the most immediate predictor of behavior, it can be speculated that only a few individuals will benefit from such an intervention.

### **Volitional Models of Health Behavior Change**

Apart from motivational theories, another line of research exists that describes health behavior change processes that include self-regulatory strategies next to individual’s intention. Models from this research can be subsumed under the label volitional models or stage models. According to Weinstein, Rothman, and Sutton (1998, p. 291), stages can be defined as “...categories with relatively small differences among people in the same stage and relatively large differences between people in different stages.” Moreover, it is hypothesized that individuals traverse these discrete stages during the process of behavior change (Schüz, Sniehotta, Mallach, Wiedemann, & Schwarzer, 2009). Another assumption is that each stage has different factors that are important for stage transition (Sutton, 2005). Examples for stage theories are the transtheoretical model (Prochaska & DiClemente, 1983), the precaution adoption process model (Weinstein, 1988), the Rubicon model (Gollwitzer & Malzlacher, 1995; Heckhausen, 1989), and as a hybrid model, that includes both stage and continuum

assumptions, the HAPA (Schwarzer, 1992, 2008). These theories define different numbers of stages from three stages of the HAPA (Schwarzer, 1992, 2008) to seven stages of the precaution adoption process model (Weinstein, 1988). What they all have in common is a distinction between (a) pre-intentional stage(s), (b) an intentional stage, and (c) an action stage. This differentiation already includes the assumption that a gap exists between intention and behavior, which implies that “intenders” and “actors” differ in terms of their cognitions and behaviors. Moreover, most stage theories explicitly define volitional or post-intentional strategies that facilitate the progress from the intentional stage to action, i.e., self-regulatory strategies.

Regarding the designing of interventions, stage theories offer a very different approach when compared to continuum models. Whereas interventions based on continuum models offer the same intervention for each individual (“one-size fits all interventions”), stage theories allow to tailor interventions in terms of the stage an individual can be allocated to (“stage-matched interventions”). Individuals in pre-intentional stages would receive a different intervention (a motivational intervention that increases intention) than individuals in the intentional or action stage (a volitional intervention that stimulates self-regulation).

The following section describes the transtheoretical model as an example of stage theories as it is the most widely applied stage model in the health behavior change context. Afterwards the HAPA (Schwarzer, 1992, 2008) is described as a hybrid model with a focus on volitional processes.

**The transtheoretical model.** The transtheoretical model defines six different stages, namely the precontemplation, the contemplation, the preparation, the action, the maintenance, and the termination stage (Prochaska & DiClemente, 1983, DiClemente et al., 1991). The model was originally developed to predict the process of smoking cessation. Therefore, the respective stage descriptions were tailored to characteristics of this specific process. In the

first stage, the precontemplation stage, individuals are not yet considering to quit smoking, while in the second stage, the contemplation stage, they aim at stopping smoking within the next six months. In the third stage, the preparation stage, individuals seriously think about quitting within the next month. Following this stage, the action stage begins. In the action stage, which lasts six months, individuals have actually stopped smoking. Afterwards the maintenance stage is reached. Individuals stay in the maintenance stage as long as the smoking cessation continues to be problematic. The termination stage is reached if an individual has managed to abstain from smoking for five years and is no longer tempted to smoke (Prochaska, Johnson, & Lee, 1998).

Prochaska, DiClemente, and Norcross (1992) also defined processes of change that predict stage transition. They distinguished between cognitive, affective, and evaluative as well as behavioral processes of change. On the one hand, cognitive, affective, and evaluative processes (consciousness raising, social liberation, dramatic relief, self-reevaluation, environmental reevaluation) are rather conducive in the precontemplation, contemplation, and preparation stages. On the other hand, behavioral processes (self-liberation, helping relationships, reinforcement management, counterconditioning, stimulus control) are supposed to be especially beneficial for individuals in the action and maintenance stages, but can also be conducive in the preparation stage. The distinction between these two groups of processes resembles the distinction between motivational and volitional processes: Cognitive, affective, and evaluative processes can be compared with motivational processes, whereas behavioral processes overlap with volitional processes.

Additionally, self-efficacy beliefs, i.e., the beliefs in one's own capabilities to reach a certain goal (Bandura, 1997), and a positive outcome of a decisional balance, i.e., weighing up the pros and cons of the behavior, are supposed to increase the likelihood of stage transition as intermediate outcomes (Sutton, 2005).



However, the transtheoretical model together with other stage theories has also been criticized for some aspects: (1) The time criterion of six months that seems to be arbitrary (Brug et al., 2005), (2) the problem of pseudostages (Sutton, 2005), i.e., continuously distributed factors are artificially divided into stages, and (3) problems with the stage algorithm (Borland, Balmford, Segan, Livingston, & Owen, 2003; Littell & Girvin, 2002; Sutton et al., 1996; Sutton, 2000), i.e., the proposed stages are not discrete, which allows individuals to be allocated to several stages, even though they should be mutually exclusive.

Despite the criticism, the transtheoretical model has been used to explain a variety of different health and risk behavior processes, e.g., fruit and vegetable consumption (Horwarth, Nigg, Motl, Wong, & Dishman, 2010), oral hygiene (Wade, Coates, Gaul, Livingstone, & Cullinan, 2013), smoking (Choi, Chung, & Park, 2013), driving behavior (Kowalski, Jeznach, & Tuokko, 2014), sun protection behavior (Borschmann, Lines, & Cottrell, 2012), contraception (Dempsey, Johnson, & Westhoff, 2011), cancer screening (Duncan et al., 2012), binge drinking (Kazemi, Wagenfeld, van Horn, Levine, & Dmochowski, 2011), and drug use (Harrell, Trezn, Scherer, Martins, & Latimer, 2013). In addition, it has also been used as a background model for designing stage-matched interventions, e.g., for dietary behavior (Salmela, Poskiparta, Kasila, Vähäsarja, & Vanhala, 2009), for weight management (Johnson et al., 2008), and for smoking cessation (Robinson & Vail, 2012).

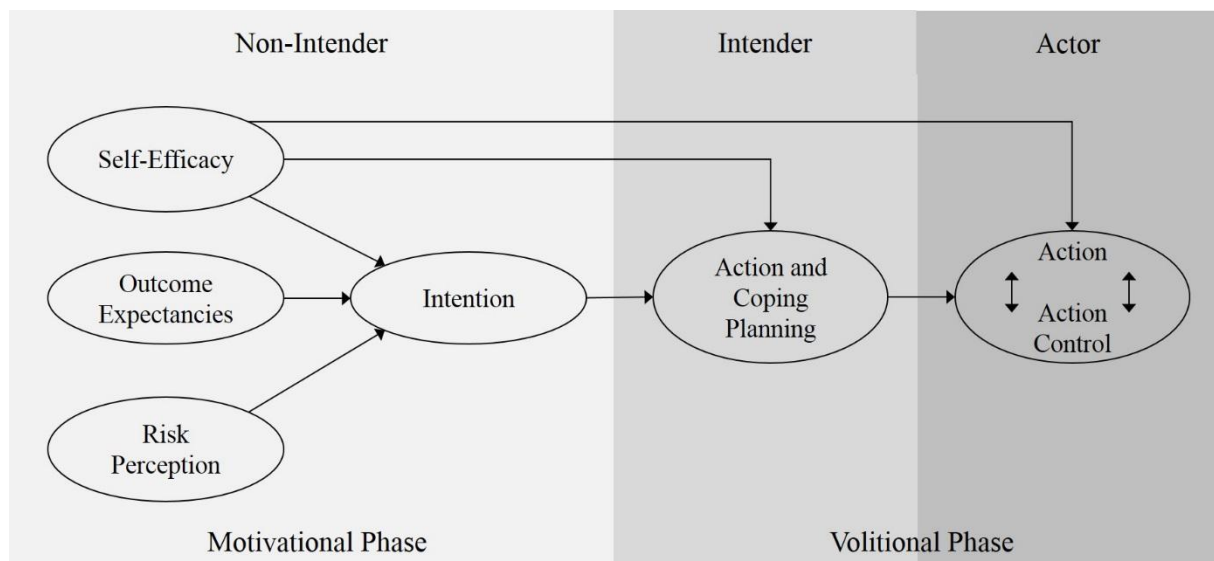
In the context of physical activity, a huge body of studies has investigated the transtheoretical model (e.g., Dishman et al., 2009, Kirk, MacMillan, & Webster, 2010, Paxton et al., 2008). Furthermore, several reviews summarized the model's applicability to physical activity interventions. Spencer, Adams, Malone, Roy, and Yost (2006) found that 80% of the reviewed stage-matched interventions based on the transtheoretical model were successful in fostering stage promotion. However, Hutchison, Breckon, and Johnston (2009) came to a

more critical conclusion. They stated that due to the heterogeneity of applied constructs the effectiveness of interventions based on the transtheoretical model could not be determined.

**The health action process approach.** The HAPA (Schwarzer, 1992, 2008) takes an exceptional position among the stage models for two reasons. Firstly, it is a very parsimonious model with only two phases or three stages, respectively. Secondly, it also incorporates assumptions of continuum models. The latter feature of the model leads to a distinction between two layers of model characteristics (Schwarzer, Lippke, & Luszczynska, 2011). The first layer comprises continuous assumptions. However, in contrast to motivational models, not only predictors of intentions are specified, but also volitional factors that are supposed to mediate between intention and behavior are included. The motivational factors of the HAPA (Schwarzer, 1992, 2008) are risk perception (individuals' beliefs about their own probability to be affected by any kind of negative condition), outcome expectancies (individuals' balance between advantages and disadvantages of a certain behavior, comparable to the construct of decisional balance of the transtheoretical model, Prochaska & DiClemente, 1983), and self-efficacy beliefs (individuals' beliefs in their own capabilities to reach a certain goal). Accordingly, Schwarzer (1992) postulated that risk perception, outcome expectancies, and self-efficacy are joint predictors of intention. However, risk perception and outcome expectancies are rather seen as distal predictors, whereas self-efficacy can be regarded as a necessary precondition for the development of an intention. The volitional factors are action planning, coping planning, action control, and also self-efficacy, as the latter is assumed to be important during the whole process of behavior change. The construct of action planning stems from Leventhal, Singer, and Jones (1965) and can be defined as a specific indication of when, where, and how a behavior is exerted. Coping plans consists of (1) the anticipation of barriers that might occur during behavior change and (2) alternative ways to reach the desired goal (Sniehotta, Schwarzer, Scholz, & Schüz, 2005). The action

control construct was derived from self-regulation theories (Carver & Scheier, 1981). For the application in health psychology, Sniehotta, Scholz, and Schwarzer (2005) subdivide action control into three sub-facets: awareness of standards, self-monitoring, and self-regulatory efforts.

In behavior change processes, the volitional factors become important after an intention is built. Action and coping planning are assumed to be the most important self-regulatory predictors of behavior. Furthermore, self-efficacy is supposed to affect planning processes and behavior directly and indirectly via intention. The process of action initiation and action maintenance is guided by action control processes.



*Figure 1.* The health action process approach (Schwarzer, 1992).

The second layer of the model constitutes the model's stage assumptions. Schwarzer (2008) defines two phases, namely the pre-intentional motivation phase and the post-intentional volition phase. In contrast to the post-intentional volition phase, individuals in the pre-intentional motivation phase have not formed an intention yet. The aim of the motivation phase is to promote intention formation, whereas the focus of the volition phase lies on

processes that facilitate actual behavior change. Moreover, Schwarzer (2008) suggested to further subdivide the volition phase into two different stages with regard to whether the behavior is only intended or already performed. Correspondingly, individuals who are assigned to the different stages are labeled: “non-intenders”, “intenders”, and “actors” (Schwarzer, 1992, 2008).

The model’s applicability has been tested and proven for several different health behaviors, such as breast self-examination (Luszczynska & Schwarzer, 2003), dietary behaviors (Renner et al., 2008), sunscreen use (Craciun, Schüz, Lippke, & Schwarzer, 2012), condom use (Teng & Mak, 2011), vaccination (Ernsting, Gellert, Schneider, & Lippke, 2013), and the reduction of binge eating (Wood & Odgen, 2014). Furthermore, several studies used the HAPA as a backdrop for developing an intervention. For example, Kreasukon, Gellert, Lippke, and Schwarzer (2012) used self-efficacy as well as action and coping planning to design a volitional intervention to increase fruit and vegetable consumption. The volitional intervention was compared to a knowledge-based education session. They found that at a six weeks follow-up, individuals in the volitional group reported significantly more fruit and vegetable intake as compared to the control group. Moreover, they found mediation effects indicating that self-efficacy and planning contributed to the intervention effects.

Similar intervention effects have been found for sun screen use (Craciun, Schüz, Lippke, & Schwarzer, 2011), for oral hygiene (Gholami, Knoll, & Schwarzer, 2014; Knoll, & Schwarzer, 2015; Schwarzer, Antoniuk, & Gholami, 2015), and vaccination (Payaprom, Alabaster, Bennett, & Tantipong, 2011). Even though most interventions were successful in changing the desired behavior, the interventions did not explicitly test stage assumptions, as stage-matched interventions were not compared to stage-mismatched ones.

A similar pattern occurs when summarizing the results of the HAPA (Schwarzer, 1992, 2008) studies in the field of physical activity. Among others, the HAPA (Schwarzer, 1992,

2008) has been tested as a prediction model for physical activity in adults with obesity (Parschau et al., 2014), in individuals with type-2 diabetes (Lippke & Plotnikoff, 2014), in orthopedic outpatients (Lippke, Ziegelmann, & Schwarzer, 2005), and in different age groups (Barg et al., 2012; Berli, Loretini, Radtke, Hornung, & Scholz, 2014; Renner, Spivak, Kwon, & Schwarzer, 2007).

Regarding intervention studies in the physical activity context, some progress has been made to apply stage-matched interventions. For example, Schwarzer, Cao, and Lippke (2010) investigated stage-specific effects of a motivational resource communication and a volitional planning intervention in Chinese adolescents. They found that non-intenders profited from the motivational intervention and intenders benefitted from the volitional intervention, whereas for actors no beneficial effect was observed.

However, to date there are only few studies to test stage-specific assumptions in randomized controlled trials. Therefore, the usefulness of the HAPA (Schwarzer, 1992, 2008) as a backdrop for stage-matched interventions to foster physical activity cannot be evaluated definitively. In this thesis, the usefulness of the HAPA (Schwarzer, 1992, 2008) for designing interventions is explored in Chapter 2. Thereby, the effectiveness and working mechanisms of a volitional intervention are analyzed.

The next sections describe some specific volitional constructs, namely self-efficacy, planning, preparatory behaviors, and action control and their relationship with physical activity in detail, as they are relevant for the research questions addressed in this thesis.

### **Self-Efficacy in Health Behavior Change**

Self-efficacy has been defined by Bandura (1977, p. 193) as “conviction that one can successfully execute the behavior required to produce the [desired] outcomes.” In addition to outcome expectancies, self-efficacy is the main construct of Bandura’s social-cognitive theory

(1991). According to Bandura (1991, p. 257), “people’s beliefs in their efficacy influence the choices they make, their aspirations, how much effort they mobilize in a given endeavor [and] how long they persevere in the face of difficulties and setbacks (...).” As these characteristics of self-efficacy seem to be especially relevant for health behaviors, self-efficacy or similar constructs, such as perceived behavioral control, were included in several other (health) behavior change theories, such as the theory of planned behavior (Ajzen, 1991), the transtheoretical model (Prochaska & DiClemente, 1983), and the HAPA (Schwarzer, 1992).

As self-efficacy beliefs depend very much on context and situation (Resnick & Jenkins, 2000), Bandura (1977) suggested to assess self-efficacy domain specific, e.g., exercise self-efficacy or dietary self-efficacy. Moreover, Scholz, Sniehotta, & Schwarzer (2005) proposed to distinguish between different phase-specific self-efficacy beliefs: Task self-efficacy, maintenance self-efficacy, and recovery self-efficacy. They found that within the stages of the HAPA (Schwarzer, 1992, 2008) intenders benefitted most from maintenance self-efficacy, whereas actors benefitted more from recovery self-efficacy. Maintenance self-efficacy and recovery self-efficacy have also been subsumed under the label volitional self-efficacy (e.g., Ochsner, Scholz, & Hornung, 2013).

In a review of 59 studies investigating predictors of physical activity, van Stralen, De Vries, Mudde, Bolman, and Lechner (2009) found that self-efficacy was among the most important predictors of physical activity initiation (e.g., Burke, Beilin, Cutt, Mansour, & Mori, 2007; Cheung et al., 2006; Lucidi, Grano, Barbaranelli, & Violani, 2006) and physical activity maintenance (Litt, Kleppinger, & Judge, 2002; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; Stevens, Lemmink, van Heuvelen, de Jong, & Rispens, 2003). Moreover, the results of several studies suggested that self-efficacy might have an enabling effect on different self-regulatory strategies in enhancing physical activity. For example, Lippke, Wiedemann, Ziegelmann, Reuter, and Schwarzer (2009) as well as Luszczynska et al. (2010)

found synergistic effects of planning and self-efficacy on physical activity change, indicating that individuals with confidence in their abilities to be physically active are more likely to act upon their plans. Self-efficacy was also found to moderate the planning-behavior relation in interventions that foster physical activity (Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011). These findings indicate that individuals who are harboring self-doubts profit less from planning interventions. Furthermore, Parschau et al. (2013) found that also action control works in orchestration with self-efficacy beliefs. Chapter 5 transfers the assumption of an enabling effect of self-efficacy beliefs to preparatory behavior by presenting a study that tested whether individuals with high self-efficacy beliefs are more likely to benefit from preparatory behaviors in the context of physical activity, than those with low self-efficacy beliefs.

With regard to the overall positive effects of self-efficacy on physical activity outcomes, a major concern of health behavior promoting professionals is about the change of individual's self-efficacy levels. Williams and French (2011) tried to address the question of how self-efficacy can be effectively changed in interventions that aim at enhancing physical activity levels. They conducted a systematic review and identified 27 intervention studies on healthy adults that provided data for self-efficacy and physical activity. The studies were rated according to the 26 behavior change techniques by Michie, Abraham, Whittington, McAteer, and Gupta (2009). Williams and French (2011) found that only three of these techniques (e.g., reinforcing towards behavior) were both associated with higher levels of physical activity and enhanced self-efficacy beliefs. Additionally, effect sizes of the interventions on changes in self-efficacy were low. These findings point to the difficulty in improving self-efficacy beliefs. Research is needed on both strategies to enhance self-efficacy for physical activity and strategies that help individuals with low self-efficacy beliefs to be physically active despite their self-doubts.

These issues are further elaborated in Chapter 2 and 5. In Chapter 2, self-efficacy is investigated as a part of a volitional intervention to increase physical activity. Thus, Chapter 2 investigates strategies to improve self-efficacy beliefs, which in turn should foster physical activity. In Chapter 5, the performance of physical activity related preparatory behaviors is suggested as a strategy for individuals with low self-efficacy beliefs.

### **Planning in Health Behavior Change**

In this thesis, planning represents the cognitive part of the preparations that might be performed prior to physical activity performance. The term action plan was presented by Leventhal et al. (1965). They conducted a study on tetanus vaccination and confronted their study participants with fear-arousing materials on the negative impact of tetanus. They found that only when individuals were encouraged to make a specific plan on “when”, “where”, and “how” to get the shot, vaccination rates increased. Apart from its prominent role in the HAPA (Schwarzer, 1992, 2008), planning has also been used to enhance other models’ predictability of behavior such as the theory of planned behavior (e.g., Brickell, Chatzisarantis, & Pretty, 2006). In health psychology research, planning or implementation intentions (Gollwitzer, 1999) are among the most promising and most widely applied techniques aiming at overcoming the intention-behavior gap (Hagger & Luszczynska, 2014).

As described in the section on the HAPA (Schwarzer, 1992, 2008), two kinds of planning can be differentiated, namely action planning and coping planning (Sniehotta, Schwarzer et al., 2005). In contrast to interventions targeting self-efficacy increases, interventions that foster planning are relatively easy to implement. Study participants of paper and pencil or online interventions might fill in the specific situation in which they want to perform the behavior (action plan), or they are supposed to write down a potential obstacle that might restrain them from their goal and an alternative strategy that should in turn increase the



likelihood of behavior performance (coping plans). Another possibility is to apply assisted planning. Assisted planning describes a process in which a plan is generated with the help of a practitioner. Regardless of which method is applied, participants are usually either encouraged to memorize their plans, or the plans might also be handed out to them.

Two recent meta-analyses by Carraro and Gaudreau (2013) and Bélanger-Gravel, Godin, and Amireault (2013) tried to quantify the effects of planning on physical activity. Carraro and Gaudreau (2013) examined correlational and experimental studies on action and coping planning. The correlational studies yielded medium to large effects sizes with slightly higher effect sizes for action planning than for coping planning. The experimental studies yielded small to medium effect sizes, which is in line with the results by Bélanger-Gravel et al. (2013). Moreover, action planning and coping planning were identified as mediators between intention and physical activity. A review by Kwasnicka, Penseu, White, and Sniehotka (2013) corroborated the specific role of coping planning in interventions, but also emphasized that combined action and coping planning interventions are most efficacious. In Chapter 2 of this thesis, the effectiveness of a volitional intervention that included not only self-efficacy enhancing strategies but also action and coping planning sheets is demonstrated.

Despite the overall positive findings on planning as a strategy for health behavior change, the mechanisms that underlie the relationship between planning and behavior have only attracted little attention. In laboratory settings, where very specific operations are planned and exerted, a strategic automatism is supposed to guide the individual's behavior (Gollwitzer, 1999). It is assumed that the plan produces a mental representation of the situation and that the "goal-directed behavior specified in [...the action plan] is triggered without conscious intent once the critical situational context is encountered" Gollwitzer (1999, p. 498). This might be the case for behaviors that are easy to perform in a controlled laboratory setting, but it is debatable whether this is true for complex health behaviors such as physical activity.

Thus, different attempts to investigate the working mechanism of planning have been made. For example, in a study on fruit and vegetable consumption, Wiedemann, Lippke, and Schwarzer (2012) explored the issue whether the effect of a planning intervention can be explained by memory performance. They found that the number of recalled plans was not related to behavior change, indicating that memory performance could not explain the intervention effect. In the physical activity domain, Dugas, Gaudreau, and Carraro (2012) examined life-management strategies of selection, optimization and compensation as defined by Freund and Baltes (2002) as potential mediators between planning and physical activity. They found that elective selection and compensation were able to explain this relationship. Elective selection can be defined as a strategy to intensively pursue aspiring goals (e.g., committing to go cycling regularly instead of walking), whereas compensation is a strategy similar to the coping planning construct. It can be defined as the use of alternative ways in order to maintain or reach a certain level of functioning if previously used means are no longer available (Freund & Baltes, 2002).

Furthermore, in a recent study, Reyes Fernández et al. (2015) found action control to be a potential mediator between planning and physical activity. However, they conclude that planning and action control work in orchestration, suggesting that they are both important at different time points of behavior change and that action control is a more proximal predictor of physical activity. No theoretical assumptions were made on whether action control is the explaining mechanism that translates planning into physical activity.

With regard to the applicability to interventions, this thesis investigates preparatory actions as potential behavioral mechanism of planning (Chapter 4 and 5). Preparatory behaviors are supposed to be easily implemented and fostered in interventions and, thus, might represent another promising health behavior change strategy.

### **Preparatory Behaviors in Health Behavior Change**

Preparatory behavior is a construct that has mainly been applied to safer sex research. In a meta-analysis by Sheeran, Abraham, and Orbell (1999) it was found that carrying a condom and condom availability was positively associated with condom use. Several more recent studies found that preparatory behaviors mediate between intention and actual condom use (Bryan, Fisher, & Fisher, 2008; Carvalho, Alvarez, Barz, & Schwarzer, 2015; van Empelen & Kok, 2006). Turchik and Gidycz (2012) found that condom use preparations were among the variables that best differentiated between individuals who only intend to use a condom and those who actually used them.

Theoretically, the construct of preparatory behaviors can be embedded into the preparation stage of the transtheoretical model that combines intentional and behavioral criteria (Prochaska, DiClemente, & Norcross, 1983). In this stage of change, individuals have not yet started with the health behavior (or stopped the health-risk behavior), but they are assumed to have performed some preparations (e.g., reducing cigarettes smoked, telling friends that they want to perform a health behavior, litter all cigarettes). Furthermore, preparatory behaviors might stimulate the following behavioral processes of change defined in the transtheoretical model: (a) self-liberation (i.e., commitment to a plan might be strengthened when a preparatory behavior is performed), (b) helping relationship (i.e., if preparatory behavior includes a social interaction), or (c) stimulus control (i.e., availability of a situational cue is increased or decreased by the preparatory behavior, e.g., packing a sports' bag, litter all cigarettes).

Also, assumptions of the MoVo concept by Fuchs et al. (2011) provide some overlap with the construct of preparatory behaviors. In the MoVo concept, apart from action planning, situational cues and barrier management are suggested to initiate behavior. Preparatory behaviors can be a strategy for both: (1) the increase of the availability of situational cues

(e.g., carrying a condom) and (2) reduction of barriers to act (e.g., the condom is already bought).

However, preparatory behaviors have not been widely applied to other health behavior domains aside from safer sex research. A recent study on sun screen use by Araujo-Soares, Rodrigues, Pesseau, and Sniehotta (2013) tested the role of what they called “facilitation planning” (e.g., planning to buy sunscreen, to carry sunscreen, to set reminders). They found that despite the high correlation between facilitation planning and sun screen use, facilitation planning did not make any contribution to the prediction of sun screen use, when controlling for intention.

In the nutrition context, van Osch et al. (2009) found that planning of preparatory behaviors predicted increased fruit and decreased snack consumption. In 2010, van Osch et al. tested action planning and the planning of preparatory behaviors concurrently as predictors of fruit consumption. The results showed that planning of preparatory behaviors was superior to action planning in the prediction of a healthy diet. Moreover, an intervention study by Chapman and Armitage (2012) indicated that preparatory planning is more useful for vegetable than for fruit intake.

In general, preparatory behaviors have not been investigated in the physical activity domain. Preparations for physical activity can be manifold: e.g., packing of a sports’ bag at an early stage, making an appointment with a friend in order to be physically active in company, buying or preparing sports’ clothes or sports’ equipment, carrying sports’ equipment with oneself to be physically active, keeping time available for sport activities or writing one’s sport’s schedule into a calendar. The different preparations might assist individuals in different ways. Some strategies increase the situational cue availability (sports’ bag) or enhance social expectations (appointment with a sport’s friend). According to the sunk cost effect (Arkes & Blumer, 1985), the commitment to a plan should be increased if an

investment has already been made that is supposed to pay off (buying or preparing of sports' equipment). Moreover, a preparatory behavior which is not followed by the desired health behavior might create cognitive dissonance in individuals (Festinger, 1962). Festinger (1962) assumed that individuals strive for cognitive dissonance reduction. One way to reduce cognitive dissonance would be to act in line with one's intention and to use the preparatory behavior for behavior enactment.

The so far neglected research on preparatory behaviors in the physical activity context might be due to the illustrated heterogeneous nature of physical activity related preparatory behaviors. However, as the performance of regular physical activity requires a lot of self-regulatory efforts, individuals' preparations regarding barrier management or increased availability of situational cues might be crucial for their behavior initiation and long-term maintenance. The usefulness of the construct of preparatory behaviors in the physical activity context is scrutinized in Chapter 4 and Chapter 5.

### **Action Control in Health Behavior Change**

Derived from self-regulation theories (Carver & Scheier, 1981), the action control construct underlies the rationale of cybernetic feedback loops. Carver and Scheier (1991) assume that when information on a behavior is perceived, a comparison between actual and target state is triggered. If a discrepancy is discovered, an individual would make an effort to reduce this discrepancy. The reduction might either be achieved by goal or behavior adjustment.

The action control construct was added to the HAPA (Schwarzer, 1992, 2008) by Sniehotta, Scholz et al. (2005). According to Sniehotta, Scholz et al. (2005), action control in health behavior comprises the awareness of standards, e.g., the recommendations of 150 minutes of physical activity per week (Haskell et al., 2007), self-monitoring, e.g., knowledge

on achievements and comparison to recommendations, and self-regulatory efforts, e.g., increased endeavor if the accomplishment of the goal is at risk. Action control is assumed to be especially important during the process of action maintenance and, thus, to prevent individuals from relapses. Action control can be distinguished from planning by its temporal order with regard to the behavior. Planning takes place prior to the behavior. In contrast, the behavior in question is supposed to be continuously attended by action control processes so that the behavior can be evaluated with regard to standards (Schwarzer, 2008).

In health psychology, action control has mainly been used to predict dietary behavior (Godinho, Alvarez, Lima, & Schwarzer, 2014; Zhou, Gan, Miao, Hamilton, & Schwarzer, 2015), smoking (Scholz, Nagy, Göhner, Luszczynska, & Kliegel, 2009), and physical activity (Reyes-Fernandes et al., 2015; Parschau et al., 2013; Sniehotta, Nagy, Scholz, & Schwarzer, 2006; Schniehotta, Scholz et al., 2005). Action control interventions have been found to stimulate physical activity among cardiac patients (Scholz & Sniehotta, 2006) and dental flossing in university students (Schüz, Sniehotta, & Schwarzer, 2007).

**Pedometers: Action control tools in health behavior change interventions.** The research on pedometers as self-regulatory tools that facilitate the performance of physical activity has increased tremendously over the past 15 years. Pedometers are by now cost-saving and easy to apply. Furthermore, some applications for smartphones offer step counting functions. The recommendation to walk 10,000 steps per day (Tudor-Locke & Bassett, 2004) is well known and is easily monitored with a pedometer. Due to their monitoring character pedometers can be allocated theoretically to self-regulation theories. Pedometers and similar monitoring devices are very promising, as they might raise the awareness of standards (i.e., 10,000 steps a day), help to monitor a behavior, and also to foster self-regulatory efforts, when reaching the desired goal is at risk (compare with the components of the action control construct, Sniehotta, Scholz et al., 2005).

A meta-analysis by Kang, Marschall, Barreira, and Lee (2009) certified moderate effect sizes for pedometer-based intervention studies in enhancing the participants' daily step counts. However, these effects cannot be solely attributed to the pedometer used in the studies as they might also be a result of other intervention components. Another meta-analysis by Richardson et al. (2008) tried to quantify the unique contribution of pedometer-based interventions on weight loss by excluding studies that comprised any other intervention techniques. Their results showed that participants lost on average 1.27 kg during the intervention, indicating that levels of physical activity have been improved.

Recently, pedometer-based interventions have been applied to individuals with type-2 diabetes (van Dyck et al., 2013), cardiac patients (Furber, Bulter, Phongsavan, Mark, & Bauman, 2010), individuals with obesity (Cayrir, Aslan, & Akturk, 2014), older adults (Kolt et al., 2012), adolescents (Ho et al., 2013), and sedentary women (McMurdo et al., 2010). However, predictors of pedometer use have only attracted marginal attention. Chapter 3 examines the effects of pedometer usage and predictors of pedometer.

### **Aims of this Thesis**

This thesis aims at investigating different volitional strategies of physical activity based on the HAPA (Schwarzer, 1992, 2008). Therefore, a distinction is made between cognitive preparations (i.e., planning) and behavioral preparations (i.e., preparatory behaviors). The research on planning in health behavior change is extended by the behavioral component of preparatory actions. The purpose of this thesis is to test the predictive value of cognitive and behavioral preparations on physical activity, to examine predictors of both strategies, and their interrelationship. Moreover, it is examined whether levels of self-efficacy beliefs

moderate the relationship between planning, preparatory behaviors, and physical activity. As another volitional strategy, this thesis investigates the effectiveness of pedometers as action control tools. However, as pedometer acquisition was assessed instead of actual pedometer use, it might also be considered as a very specific objectively measured preparatory behavior.

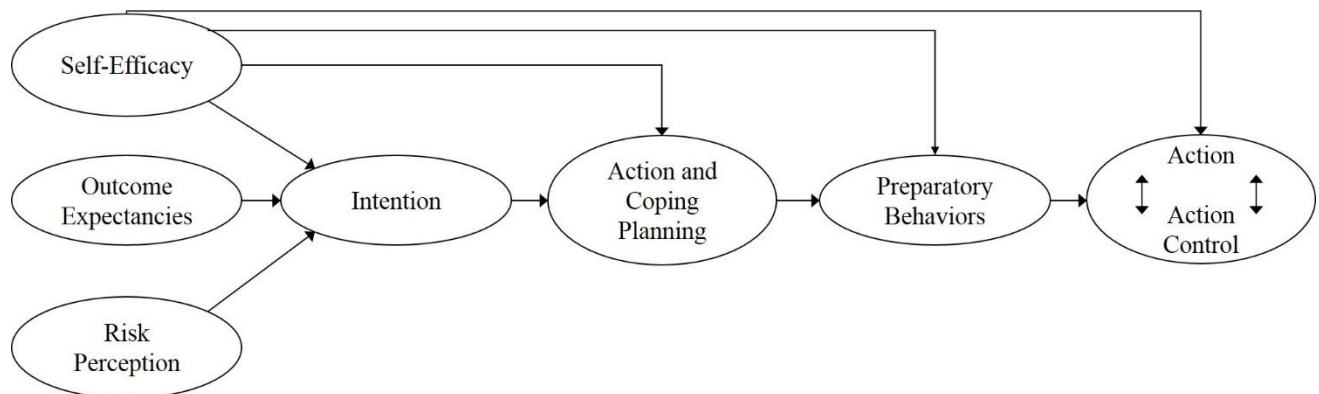


Figure 2. The health action process approach extended by preparatory behaviors.

In the first study (Chapter 2), the focus lies on the cognitive components of preparations (action and coping planning). Here, the effectiveness and working mechanisms of a stage-matched intervention that combined planning and self-efficacy increasing components were tested. The design was a post-test only comparison between intervention and control group. Individuals were randomized to the respective conditions. The specific hypotheses are:

- (1) Participants of a volitional intervention report higher levels of physical activity, action planning, coping planning, and volitional self-efficacy after three weeks as compared to participants in the waiting-list control condition.
- (2) Group differences in physical activity are mediated by differences in action planning, coping planning, and volitional self-efficacy.

The second study (Chapter 3) investigated the effects of an action control tool, i.e., pedometer, in a longitudinal design with two measurement points in time in university



students. Participants' choices to pick up or not to pick up the free pedometer were furthermore used as an indicator of their physical activity related preparatory behavior. The aim was to predict this preparatory behavior for physical activity with motivational factors assuming that self-efficacy and outcome expectancies serve as predictors for pedometer acquisition. Moreover, it was examined whether the pedometer has a beneficial effect on later physical activity. The hypotheses that guided this study are:

- (3) Exercise self-efficacy and outcome expectancies predict pedometer acquisition, i.e., individuals with high self-efficacy beliefs and high positive exercise outcome expectancies are more likely to pick up the pedometer.
- (4) Individuals who pick up the pedometer report higher activity levels than those who do not pick it up.

In the third study (Chapter 4), planning and preparatory behavior were tested simultaneously in a longitudinal online sample with three measurement points in time. The purpose was to examine the most proximal role of preparatory behaviors by investigating whether they explain how intention is translated into physical activity via planning. The hypotheses are as follows:

- (5) Planning mediates the relation between intention and physical activity.
- (6) Preparatory behaviors serve as mediator between planning and physical activity.
- (7) Planning and preparatory behaviors are sequential mediators of the relation between intention and physical activity.

The last study (Chapter 5) aimed at disentangling the role of preparatory behaviors, action planning, and self-efficacy as predictors of physical activity. The sample consisted of visitors of an open house university that were approached at two measurement points in time.

The hypotheses are:

- (8) Preparatory behaviors mediate between planning and physical activity (replication of hypothesis 6).
- (9) Self-efficacy moderates the mediation of preparatory behaviors between planning and physical activity as first stage moderator, i.e., the strength of the relationship between planning and preparatory behaviors depends on an individual's self-efficacy levels.
- (10) Self-efficacy moderates the mediation of preparatory behaviors between planning and physical activity as second stage moderator, i.e., the strength of the relationship between preparatory behaviors and physical activity depends on an individual's self-efficacy levels.

An overview of the studies presented in this thesis is displayed in Table 1.

Table 1

*Study Overview*

	<b>Design</b>	<b>Sample</b>	<b>Target group</b>	<b>Mode of assessment</b>	<b>Variables</b>	<b>Method</b>
<b>Chapter 2 (Hypotheses 1 &amp; 2)</b>	Intervention study, posttest only	883 participants, 68.9% women, mean age 43.2 years	Online population	Online intervention and online questionnaire	Self-efficacy, action planning, coping planning, physical activity	Chi-square test, multivariate analysis of variance, multiple mediation analysis
<b>Chapter 3 (Hypotheses 3 &amp; 4)</b>	Longitudinal study, 3 measurement points in time	142 participants, 70.6 % women, mean age 24.9 years	University students	Paper pencil questionnaires	Self-efficacy, outcome expectancies, pedometer acquisition, physical activity	Analysis of variance, moderated logistic regression, analysis of covariance
<b>Chapter 4 (Hypotheses 5, 6, &amp; 7)</b>	Longitudinal study, 3 measurement points in time	338 participants, 63.6 % women, mean age 41.5 years	Online population	Online questionnaires	Intention, action planning, coping planning, preparatory behaviors, physical activity	Structural equation modeling, multiple step mediation analysis
<b>Chapter 5 (Hypotheses 8, 9, &amp; 10)</b>	Longitudinal study, 2 measurement points in time	166 participants, 49.3% women, mean age 37.6 years	Visitors of an open university house	Online questionnaires	Self-efficacy, action planning, preparatory behaviors, physical activity	First and second stage moderated mediation analyses

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# Chapter 2

## **A Combined Planning and Self-Efficacy Intervention to Promote Physical Activity: A Multiple Mediation Analysis**

**Koring, M., Richert, J., Parschau, L., Ernsting, A., Lippke, S., & Schwarzer, R. (2012).** A combined planning and self-efficacy intervention to promote physical activity: A multiple mediation analysis. *Psychology, Health & Medicine, 17*(4), 488–498.

<http://dx.doi.org/10.1080/13548506.2011.608809>

# Chapter 3

## **Preparing for Physical Activity: Pedometer Acquisition as a Self- regulatory Strategy**

**Koring, M., Parschau, L., Lange, D., Fleig, L., Knoll, N., & Schwarzer, R. (2013).** Preparing for physical activity: Pedometer acquisition as a self-regulatory strategy. *Applied Psychology: Health and Well-Being*, 5(1), 136-147. <http://dx.doi.org/10.1111/aphw.12003>

*Health and Well-Being*, 5(1), 136-147. <http://dx.doi.org/10.1111/aphw.12003>



# Chapter 4

## Planning and Preparatory Actions

### Facilitate Physical Activity

### Maintenance

**Barz, M.,** Parschau, L., Warner, L. M., Lange, D., Fleig, L., Knoll, N., & Schwarzer, R. (2014). Planning and preparatory actions facilitate physical activity maintenance. *Psychology of Sport and Exercise, 15*(5), 516-520. <http://dx.doi.org/10.1016/j.psychsport.2014.05.002>

# Chapter 5

## **Self-Efficacy, Action Planning, and Preparatory Behaviors as Joint Predictors of Physical Activity**

**Barz, M., Lange, D., Parschau, L., Lonsdale, C., Knoll, N., & Schwarzer, R. (2015).** Self-efficacy, action planning, and preparatory behaviours as joint predictors of physical activity.

*Psychology & Health.* Advance online publication.

<http://dx.doi.org/10.1080/08870446.2015.1070157>

# **Chapter 6**

## **General Discussion**

## **General Discussion**

This thesis extended research on theories and interventions on health behavior change in the context of physical activity. The emphasis of this thesis lay on volitional factors such as self-efficacy, action planning, coping planning, preparatory behaviors, and action control that are supposed to facilitate the actual implementation of an intention into behavior. A special focus was on the distinction between cognitive and behavioral preparations for physical activity and how these two factors work in orchestration to predict physical activity. Cognitive preparations describe the process of action and coping planning whereby individuals are supposed to reach a certain level of readiness to start the behavior. Behavioral preparations refer to preparatory behaviors which comprise a wide range of possible behaviors, such as setting a date with a sports' partner or buying new sports' equipment. Preparatory behaviors are assumed to facilitate the engagement in the actual target behavior. Moreover, it was tested whether individuals who had more confidence in their ability to pursue a health behavior despite barriers (i.e., self-efficacy) also showed higher engagement in cognitive and behavioral acts of preparation.

### **Chapter 2: Is a Combined Self-Efficacy and Planning Intervention Effective in Increasing Physical Activity Levels?**

In the second chapter of this thesis, the cognitive component (action planning and coping planning) of the preparation for physical activity is investigated in an intervention study. In particular, it was examined whether the health action process approach (HAPA, Schwarzer, 1992, 2008) proves beneficial for designing interventions. Moreover, it was tested, which ingredients of the intervention might be able to explain an intervention effect. Therefore, the volitional components of the HAPA (Schwarzer, 1992, 2008) were used as a framework for

the development of a stage-specific intervention for intenders aiming at increasing physical activity. Several intervention strategies that are supposed to stimulate action planning, coping planning, and self-efficacy were derived from the taxonomy of behavior change techniques by Michie et al. (2011). For the action planning part, individuals were first asked to *set a graded task*, i.e., they were prompted to break down their physical activity goal into smaller tasks that are easier to achieve. Moreover, an action planning sheet was used, where the participants were invited to specify when, where, and how to be physically active. For coping planning, *barrier identification* was addressed. In line with Michie et al. (2011) individuals were prompted to reflect on potential obstacles and to find solutions to overcome these barriers. In order to increase self-efficacy, the participants were prompted to *focus on past successes*. Individuals were asked to list previous successes they achieved in performing physical activity. Three weeks after the intervention, higher levels of physical activity were observed in the intervention group as compared to the control group. Moreover, levels of action planning, coping planning, and self-efficacy increased in the intervention group. To test whether differences in physical activity could be attributed to the volitional intervention components, a multiple mediation model was specified with intervention group as independent variable, self-efficacy, action and coping planning as simultaneous mediators and physical activity as dependent variable. The three facets of the intervention turned out to mediate between treatment condition and physical activity. The strongest relation was found between treatment groups and coping planning pointing to the fact that coping planning was manipulated very successfully. The relation between treatment groups and self-efficacy was significant but weak confirming the challenge in prompting self-efficacy beliefs (Williams & French, 2011). The effects of the intervention components on physical activity were similar regarding their size, indicating that each facet contributed independently and with a similar impact to changes in physical activity levels. When it comes to planning interventions,

research suggests that self-efficacy not only operates as a mediator but also as a moderator of the association between planning and behavior (Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011). Moreover, also correlational studies found synergistic effects of self-efficacy and planning (Lippke, Wiedemann, Ziegelmann, Reuter, & Schwarzer, 2009; Luszczynska et al., 2010), indicating that planning is especially beneficial for individuals that have confidence in their own abilities to be physically active. Thus, as these two factors work in orchestration and the effects of planning depend on levels of self-efficacy beliefs, it can be recommended to address both concepts simultaneously in an intervention.

It can be speculated that individuals who take part in a planning intervention are encouraged to make more use of spontaneous planning in their daily life and, thus, manage to act upon their intention to be physically active regularly. In line with the review by Kwasnicka, Penseu, White, and Sniehotta (2013), the inclusion of both planning components, namely action planning and coping planning as defined in the HAPA (Schwarzer, 1992, 2008), might have particularly contributed to the effectiveness of the intervention. It can be assumed that individuals profit especially from planning when they also visualize impediments and possibilities to overcome them in the course of changing their physical activity levels.

Several points can be concluded from the first study: (1) Cognitive preparations for physical activity with both facets of action and coping planning seem to be useful for increasing physical activity levels. (2) The simultaneous stimulation of planning and self-efficacy beliefs seems to be beneficial for physical activity promotion. (3) The HAPA (Schwarzer, 1992, 2008) is suited as framework for designing volitional interventions.

### **Chapter 3: Who Prepares for Physical Activity?**

The second study, presented in Chapter 3, analyzed the effects of an action control tool (pedometer) to increase physical activity as well as the effects of a very specific preparatory behavior, namely the acquisition of a free pedometer. Preparatory behaviors and action control might be regarded as the most imminent antecedents of behavior initiation (Barz et al., 2014; Reyes Fernandez et al., 2015, Sniehotta, Scholz, & Schwarzer, 2005).

Therefore, as compared to the study in Chapter 2, the predictors of physical activity are considered to be even more proximal than planning and self-efficacy. Furthermore, two possible motivational predictors of pedometer usage were tested, namely self-efficacy and outcome expectancies.

In line with other research that investigates the relation between outcome expectancies and behavior (Wilcox, Castro, & King, 2006), this thesis found that only self-efficacy beliefs could predict the acquisition of the free pedometer, indicating that individuals with lower levels of self-doubts concerning their ability to change their physical activity were more interested in the use of the pedometer (i.e., picked up a free pedometer).

Controlling for levels of self-efficacy, it was found that individuals who collected the free pedometer reported higher levels of physical activity one week later. It can be assumed that this preparatory behavior supported an increase in physical activity via the stimulation of action control mechanisms. A pedometer is particularly useful for monitoring one's physical activity levels, i.e., step counting. In case of impending failure to reach one's self-set goal, it is also likely that user's self-regulatory effort is increased. Behavioral self-monitoring and self-regulatory effort constitute two of the action control facets defined by Sniehotta et al. (2005).

This study corroborates the importance of self-efficacy during the behavior change process, as it does not only affect the behavior directly, but also through self-regulatory

processes (in this case preparatory behaviors and action control). Furthermore, picking up the pedometer was associated with increased levels of physical activity. Assuming that individuals that picked up the pedometer also used it, it can be speculated that the pedometer supported individuals in increasing their levels of physical activity.

#### **Chapter 4: Planning and Preparatory Behaviors Bridge the Intention Behavior-Gap**

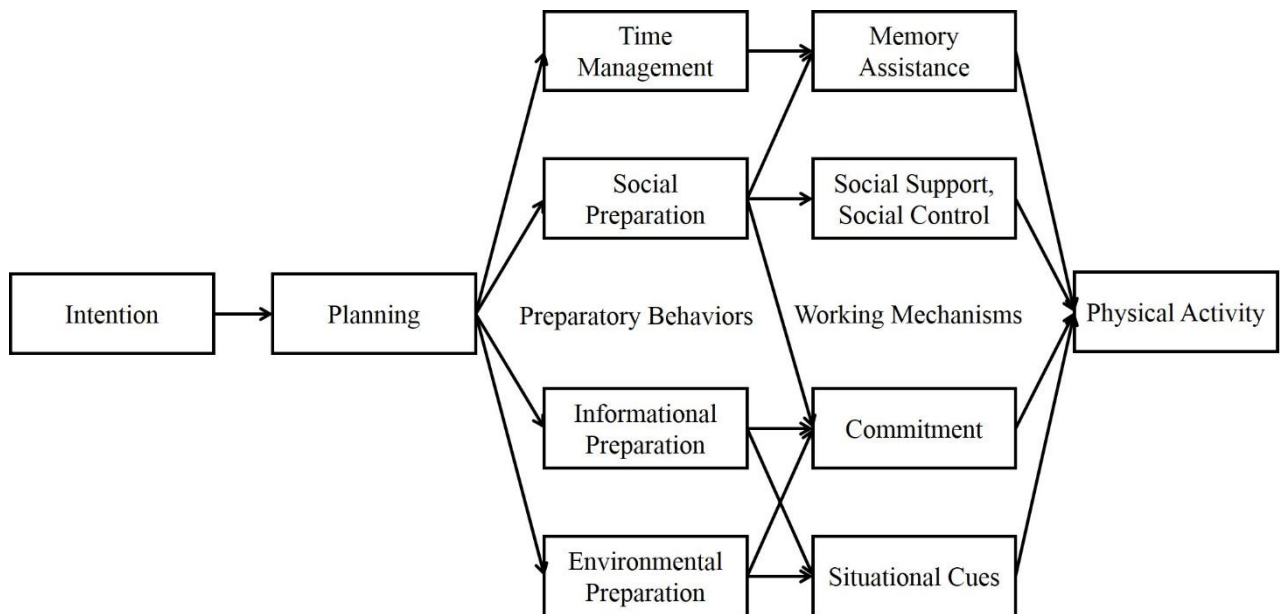
In Chapter 4, research on the cognitive and the behavioral components of preparations were merged insofar as planning and preparatory behaviors were investigated as joint predictors of physical activity. The study presented in Chapter 4 investigated the question of whether planning and preparatory behaviors explain how intentions are translated into behavior. A special focus lay on the hypothesis that preparatory behaviors might serve as a working mechanism of planning. In a first step, it was tested whether planning mediates between intention and physical activity. This assumption was confirmed and replicates findings of previous studies (e.g., Carraro & Gaudreau, 2012).

In a second step, it was investigated whether preparatory behaviors mediated between planning and physical activity. This was done in order to explore the working mechanism of planning. Preparatory behaviors were found to mediate the planning-physical activity relationship demonstrating evidence for the proposed mechanism. Moreover, a multiple step mediation with planning and preparatory behaviors as sequential mediators between intention and physical activity indicated that these two factors are at least partially mediating the intention-physical activity association.

Depending on the preparatory behavior under consideration, its effect might unfold in very different ways (compare Figure 1). As described in Chapter 3 it might be action control processes that are stimulated by preparatory behaviors. However, also an increase in



commitment, social support, social control or assisted memory performance might underlie the preparatory behaviors' effectiveness.



*Figure 1.* Different kinds of preparatory behaviors and supposed working mechanisms.

Thus, one can conclude (1) that preparatory behaviors are very immediate predictors of physical activity, (2) that they might be instigated by planning processes (3) that together with planning they might explain how intentions are translated into physical activity and (4) that their respective working mechanisms might be manifold.

### **Chapter 5: Who Benefits from Preparatory Behaviors for Physical Activity?**

In Chapter 5, the role of preparatory behaviors for physical activity was further explored. First, the results of the study presented in Chapter 4 were replicated. Thus, preparatory behaviors were once more tested as a mediator of the planning-physical activity chain. The results confirmed the importance of preparatory behaviors in the physical activity context indicating that they might be as useful as for other behavioral domains such as for safer sex (Carvalho, Alvarez, Barz, & Schwarzer, 2015).

Second, another research question of the study was whether some individuals benefitted more from preparatory behaviors than others. Therefore, interactive effects of self-efficacy and preparatory behaviors were tested. Self-efficacy has been shown to moderate the effects of several different kinds of self-regulatory strategies, such as planning (Lippke et al., 2009; Luszczynska et al., 2010) or action control (Parschau et al., 2013), i.e., individuals with high self-efficacy beliefs profit more from planning and action control strategies as compared to individuals with lower levels of self-efficacy. Therefore, the research question was whether the performance or the utility of preparatory behaviors depended on levels of self-efficacy.

Two moderated mediation analyses were conducted with planning as independent variable, preparatory behaviors as mediator, physical activity as dependent variable and self-efficacy as moderator of this mediation. The first moderated mediation included an interaction of planning and self-efficacy on preparatory behavior, testing whether individuals with high self-efficacy beliefs were more likely to engage in preparatory behaviors. The results from this model suggest that levels of self-efficacy were not predictive for the performance of preparatory behaviors. The second moderated mediation comprised an interaction between preparatory behaviors and self-efficacy on physical activity. It investigated the question of whether individuals with certain levels of self-efficacy benefitted more from the performance of preparatory behaviors than others. This interaction was significant, indicating that especially individuals with lower levels of self-efficacy profited from preparatory behaviors. This is interesting for two reasons: (1) Meta-analytic studies have shown that it is very challenging to change an individual's self-efficacy beliefs (e.g., Williams & French, 2011), as it seems to be a relatively stable characteristic; (2) the other self-regulatory strategies (e.g., planning and action control) that are moderated by self-efficacy beliefs have all proven to be a beneficial strategy for individuals with high self-efficacy beliefs (Gutiérrez-Doña, 2009; Lippke et al., 2009; Luszczynska et al., 2010; Parschau et al., 2013; Richert et al., 2010).

Thus, this thesis found first evidence for a strategy (i.e., the performance of preparatory behaviors) that helps individuals with low self-efficacy beliefs to increase their physical activity. It seems as though merely cognitive preparation, such as action planning, is insufficient for individuals with self-doubts. However, a behavioral preparation that might lead to social assistance, a strong commitment to the plan, a reduction of barriers or that involve situational cues seems to be an effective strategy for individuals that are unconfident about whether they can achieve their physical activity goal. Situational cues from preparatory behaviors might occur for example, when a sports' bag is packed at an early stage and is placed at the front door. Such a cue might differ from a situational cue of an action plan, which typically comprises a certain time or place that should elicit the behavior of the plan. Situational cues from preparatory behaviors might provide more personal valence as some effort (packing of the bag) that has already been investigated is supposed to pay off. These advantages of preparatory behaviors might compensate for a lack of confidence in one's own abilities and thus facilitate behavior initiation in these individuals.

Table 1  
*Summary of the Results*

Chapter	Aims	Findings	Conclusions
2	Investigation of the effectiveness and the working mechanisms of a combined planning and self-efficacy intervention to promote physical activity as compared to a waiting-list control condition.	The intervention resulted in significantly more physical activity, higher levels of action planning, coping planning, and self-efficacy beliefs. Action planning, coping planning, and self-efficacy mediated between the intervention and physical activity.	The study shows that the volitional intervention successfully fostered physical activity. The increase in physical activity levels can be attributed to the active ingredients of the intervention, namely action planning, coping planning, and self-efficacy beliefs.
3	Prediction of a specific preparatory behavior for the performance of physical activity (acquisition of self-regulatory tool, a pedometer) and investigation of whether the pedometer acquisition has a facilitating effect on subsequent physical activity.	In contrast to outcome expectancies, self-efficacy beliefs predicted the preparatory behavior. The preparatory behavior was associated with higher levels of physical activity at follow up.	Pedometer acquisition constitutes both, a preparatory behavior and a self-regulatory strategy that is predicted by self-efficacy. Positioned between planning and physical activity, the pedometer acquisition is a very proximal predictor of the behavior.
4	Examination of the role of preparatory behaviors in the physical activity context, replicating the mediational role of planning between intention and physical activity, testing whether preparatory behaviors might constitute a working mechanism of planning.	An indirect effect of intention on physical activity was found via planning and preparatory behaviors. Planning also mediated between intention and preparatory behaviors and preparatory behaviors mediated between planning and physical activity.	Individuals who are motivated to be physically active are likely to make a plan, and if they do so, they are motivated to perform preparatory behaviors, resulting in a higher likelihood to perform physical activity.
5	Disentangling the role of preparatory behaviors, action planning, and self-efficacy as predictors of physical activity. Testing self-efficacy as moderator of the mediation of planning, preparatory behaviors, and physical activity.	Preparatory behaviors mediated between action planning and physical activity. A significant interaction of self-efficacy and preparatory behaviors on physical activity was found, indicating that individuals with little self-efficacy beliefs benefit more from preparations performed for their physical activities.	The study adds to the knowledge on the role of preparatory behaviors for physical activity. Furthermore, the interaction indicates that the performance of preparatory behaviors might be particularly beneficial for individuals afflicted by self-doubts.

## Implications

### Theoretical Implications

In four different studies, this thesis tested the predictive value of cognitive and behavioral preparations for physical activity. From a theoretical point of view, the first study underscored the importance of the distinction between the two planning facets, namely action planning and coping planning. Moreover, it also pointed to the usefulness of the HAPA (Schwarzer, 1992, 2008) for designing interventions, as the volitional intervention proved effective in increasing physical activity. Apart from evaluating the effects of an action control tool (i.e., pedometer), the second study provided first hints for the importance of preparatory behaviors in physical activity by testing a specific preparatory action.

Testing the utility of the construct of preparatory behaviors in the physical activity domain, was one focus of this thesis. Therefore, it was tested whether a distinction between cognitive and behavioral preparations added to the prediction of physical activity. The studies presented in Chapter 4 and 5 provided first evidence for the usefulness of this distinction. As preparatory behaviors were examined within the HAPA (Schwarzer, 1992, 2008), it seems appropriate to suggest an integration of preparatory behaviors into this model of behavior change. In a recent commentary by Schwarzer (2013) on a debate about barriers to health behavior theory development and modification (Head & Noar, 2013), Schwarzer suggested to understand health behavior theories as frameworks to predict and modify health behaviors. Furthermore, these theories should rather be considered as starting points for research as single experiments cannot prove their validity. Schwarzer (2013) suggested to add constructs to existing theories and to refine established constructs instead of creating new theories. Since the first publication on the HAPA (Schwarzer, 1992), it has been extended by several predictors. For example, Sniehotta, Scholz, and Schwarzer (2005) added action control to the

model. Action control is regarded as a self-regulatory strategy that guides the process between behavior initiation and behavior maintenance. Furthermore, the planning construct has been subdivided into the two components of action planning and coping planning (Sniehotta, Schwarzer, Scholz, & Schüz, 2005). Additionally, compensatory health beliefs (Berli, Loretini, Radtke, Hornung, & Scholz, 2014) and positive exercise experience (Parschau et al., 2014) have been tested within the framework of the HAPA.

However, for preparatory behaviors to become an inherent part of health behavior theories, more studies need to replicate and expand these findings. Firstly, it would be necessary to cross-validate the preparatory behavior scale used in the present studies. Secondly, it is important to test preparatory behaviors in a nested structural equation model with all other HAPA-variables, in order to see if the predictive value of the behavior is improved. In this thesis, only small parts of the HAPA were tested due to limitations in samples and study designs. However, in order to evaluate the general applicability of a “new” construct, testing it within the entire theory is important. Doing so would allow testing interactive effects of the theories’ constructs and preparatory behaviors and more possible mediation processes. Moreover, it can be investigated whether some of the motivational components (such as outcome expectancies) of the HAPA (Schwarzer, 1992, 2008) are directly related to preparatory behaviors. In addition, also the link between preparatory behaviors and other self-regulatory strategies might be tested. In Chapter 4, action planning and coping planning were employed as a combined planning construct when testing their association with preparatory behaviors. However, it would be interesting to see whether action planning and coping planning stimulate preparatory behaviors in a similar manner, or whether one of these two planning components has a predominant association with preparatory behaviors.

Furthermore, it should also be tested whether planning really precedes preparatory behaviors. For some preparatory behaviors, such as signing up for a sport's class or gathering information on sport's competitions, it is also conceivable that planning follows preparatory behaviors, as the preparatory behavior might be a precondition in order to generate a concrete action plan.

An association that has not been tested in this thesis is a possible relationship between preparatory behaviors and action control processes. As both can be regarded as very proximal predictors of behavior initiation and behavior maintenance, it would be essential to investigate how they work in orchestration in the physical activity domain. The question arises whether they are rather sequential or simultaneous mediators between planning and physical activity or whether action control is another moderator of the planning-preparatory behaviors-physical activity chain. It can be assumed that action control might function as a first stage moderator of the above-named mediation, i.e., individuals that regularly use action control strategies, such as self-monitoring or self-regulatory effort, might be more likely to perform preparatory behaviors. The reason for this might be that individuals with high levels of action control are more conscientious in the implementation of their plans in order to antagonize a possible imbalance between actual and target state.

### **Strength and Limitations - Methodological Implications**

Several methodological implications for future studies can be derived from the strengths and limitations of the present thesis.

**Sample.** Each study of this thesis was conducted with a different sample. Two samples were obtained from online populations (Chapter 2 and Chapter 4), one study consisted of university students (Chapter 3) and the last study was conducted with visitors of an open house university (Chapter 5). Whereas the study with university students was a convenience

sample, as students were approached during their courses, the other three samples comprised individuals with special interests in health and/or psychological topics. Participants of the two online studies were recruited via media campaigns on New Year's resolutions. The visitors of the open house university were recruited with the cover story of a study on happiness research. The recruitment strategies implemented might be responsible for some of the special characteristics of the samples that might undermine the generalizability of the effects that were found.

In three of the four studies female participants considerably outnumbered male participants (64% - 71% women). Only the open house university sample had an equal distribution of sex (49.3% women). It is known, that men tend to be less interested in programs concerning their health (Sieverding, Matteredne, & Ciccarello, 2010). Thus, recruitment strategies should be developed that increase the attractiveness of participating in health psychological studies for men.

Another limitation of the present studies is that participants reported quite high rates of physical activity at each measurement point in time. The original target groups of health psychological research are individuals that do not reach the recommendations for physical activity of health institutes (e.g., the American Heart Association, Haskell et al., 2007). Thus, processes of behavior change were studied in individuals that are relative successful in acting upon their intentions in this thesis. One can justify the use of such samples with the following rationale: The first step is to understand how health behavior change mechanisms work in active participants. Then, in a second step, the effective mechanisms can be adopted to inactive participants in order to test whether they can be supported in changing their health behaviors with the same behavior change strategies. Moreover, effects might also be underestimated because the variance of change in individuals that are already active might be lower than in sedentary participants.



The third disadvantage of the non-representative samples in this thesis is the rather high level of participants' education. Irrespective of the fact, that this is a well-known problem in psychological studies (Henrich, Heine, & Norenzayan, 2010) the high level of education qualifies the generalizability of this thesis' findings.

Dropout rates range from 69% (first online sample) to 29% (university students). Even though for most study variables no differences were found between individuals that dropped out of the studies and individuals that completed all assessments, high dropout rates might bias the interpretability of the study results. In two studies, where differences between the two groups were found, the respective study variables were included as control variables into the models (Chapter 4, baseline physical activity levels; Chapter 5, age) in order to minimize a possible bias (Graham, 2009). In order to reduce high attrition rates, future studies might want to use (better) incentives (such as financial reimbursement or the participation in a lottery for some kind of gifts) in order to motivate individuals to complete all assessment points.

Ideally, the studies' findings should be replicated with large random samples that are representative of the German population with only small dropout rates. A special focus should lie on the question whether the results hold equally true for men, for inactive individuals, and for individuals with lower levels of education.

**Design.** All studies in this thesis realized longitudinal designs, with an exception for the intervention study. The intervention measured the social-cognitive variables and physical activity only once but implemented a three weeks interval between intervention and posttest. In order to assess change in cognitions and behavior, longitudinal designs are pivotal. To capture sustained behavior change, large intervals between measurement points are optimal. However, studies with smaller time intervals, as realized in diary studies (e.g., Luescher et al., 2015; Ram, Gerstorf, Lindenberger, & Smith, 2011), yield more reliable results of relations between cognitions and behavior from one measurement point to another. Furthermore,

fluctuations in behavior and its antecedents can be assessed. In sum, more measurement points in time, no matter what the interval is, provide more in-depth information on how and why people change. At best, a longitudinal design that combines daily measures and long term behavior change assessment should be implemented in future studies.

When analyzing mediation processes, the state of the art is to have as many measurement points in time as sequential predictors plus one measurement point in time for the outcome (the MacArthur approach: Kraemer, Kiernan, Essex, & Kupfer, 2008). Thus, when implementing a simple mediation, three measurement points in time should be realized. Accordingly, a multiple step mediation with two sequential mediators should ideally have four measurement points in time. This could not be realized in the current thesis. However, if possible baseline behavior and previous social-cognitions were controlled for to model change in the respective variables.

Another interesting point would be to test the effects of preparatory behaviors on physical activity in an experimental study (see Table 2). In order to test this, the following design would be ideal: An intervention with four conditions, namely (1) an action planning intervention, (2) a preparatory behavior planning intervention, (3) a combined action planning and preparatory behavior planning intervention, and (4) a control group. According to the results of this thesis, it seems likely, that all intervention groups score higher with regard to preparatory behaviors and physical activity at follow-up assessments. As these interventions can be classified as volitional interventions, the effects are supposed to be moderated by levels of intention. This means that especially individuals with high levels of physical activity intentions would profit from the interventions. When analyzing the results of the first group (the mere action planning condition), it could be tested whether preparatory behaviors are stimulated by action planning. Thus, the effects of the action planning conditions should be (sequentially) mediated by increases in action planning and preparatory behaviors. With the

planning of preparatory behavior condition it could be tested, whether action planning is necessary in order to increase physical activity levels or whether the mere planning of preparatory behaviors is sufficient. It can be assumed that the planning of preparatory behavior condition is especially fruitful for individuals that already have high levels of action planning and for individuals with self-doubts, i.e., low self-efficacy beliefs. However, for individuals who did not plan prior to the preparatory behavior intervention, the instruction to generate a plan for preparatory behaviors might not be sufficient. The effect should primarily be mediated by increases in preparatory behaviors.

Table 2

*Expected Results of an Action Planning and Preparatory Behavior Planning Intervention*

<b>Outcome</b>	<b>Experimental condition</b>	<b>Physical activity planning condition</b>	<b>Preparatory behavior planning of condition</b>	<b>Combined planning condition</b>	<b>Control group condition</b>
<b>Action planning</b>		Increase	Increase	Small Increase/ Stagnation	Stagnation
<b>Preparatory behaviors</b>		Increase	Increase	Increase	Stagnation
<b>Physical activity</b>		Increase	Increase*	Increase	stagnation

*Note.* \*Moderated by levels of action planning and self-efficacy.

The highest benefit could be expected in the combined action planning and preparatory behavior planning group, as this condition should be beneficial for several groups of individuals: For individuals who form action plans, for those who do not, as well as for individuals with higher and lower levels of self-efficacy beliefs. The effects of the combined

intervention should also be mediated by increases in action planning and preparatory behaviors. In this case, a simultaneous mediation might fit the data better than a sequential mediation, as both kinds of planning are stimulated at the same point in time. However, such a complex design requires a large sample size, especially when moderate or small effect sizes are supposed to be detected. Moreover, study results would also depend on the kind of control group that is used (e.g., waiting-list control group, motivational intervention as control group, action planning intervention for a different health behavior as control group).

In order to evaluate the applicability of the HAPA (Schwarzer, 1992, 2008) for designing interventions more comprehensively, a matched-mismatched design comparing a motivational and a volitional intervention should be realized. Thus, a precondition would be to have a sample with approximately equally distributed non-intenders and intenders. The sample would be randomized to the two intervention conditions. The results would be expected to be as follows: For non-intenders the motivational intervention would be more beneficial with regard to increased intention and forward stage-transition as compared to the volitional intervention. Behavior change should only marginally occur for non-intenders. For ‘intenders’ the volitional intervention should be more beneficial with regard to increased behavior, self-regulation, and forward stage-transition as compared to the motivational intervention. In this thesis, only the stage-specific volitional intervention for intenders could be realized.

**Measurement.** The operationalizations applied in the studies of this thesis included self-report measures with the exception of the preparatory behavior of picking up a pedometer assessed in Chapter 3 which was objectively measured. Self-report measures are prone to biases (Nicaise, Marshall, & Ainsworth, 2011) that happen as a result of deficits in attention and memory processes (Johnson & Fendrich, 2005) and shifts of the frame of references or social desirability (Brenner & DeLamater, 2014). The possibilities of assessing cognitions objectively are limited. However, as suggested by Hart, Ainsworth, and Tudor-Locke (2011)

for the assessment of physical activity it would be preferable to use objective measures, such as data from pedometers, accelerometers or other wearable e-health devices (e.g., fitbit, jaw bone) in order to validate the self-reported data. Provided that data protection is ensured, the access to an individuals' online calendar could facilitate the evaluation of their planning activities. Also as suggested in the previous section, daily measures of cognitions and behavior might reduce biases due to forgetting as the information that is recalled is more recent as compared to a self-report of the whole past week.

Another problem with the measurement of social cognitive variables has been outlined by Rhodes, Blanchard, Matheson, and Coble (2006): Owing to multicollinearity of the variables defined in health behavior change models, some of the variables might not possess discriminant validity. Therefore, items should be chosen carefully with regard to potential conceptual overlap in the constructs. In this thesis, this is especially true for some items of the preparatory behavior scale that was developed in a pilot study of the study presented in Chapter 4. For this reason some items of the initial scale such as "I have entered my sport's dates into my calendar" have not been used in the thesis' studies. Such an item represents strictly speaking a preparatory behavior. However, from a conceptual point of view it is also very close to action planning.

Overall, the validity and the reliability of the preparatory behavior scale should be further investigated.

**Statistical analyses.** Three of the studies used mediation analyses. Mediation analyses are the methods of choice in order to understand processes of behavior change. Multiple mediation models with simultaneous mediators as applied in Chapter 2 are often used in intervention studies that test the active ingredients of the different intervention components. Or generally speaking, if multiple mechanisms of a process are assumed such a mediation should be preferred (Hayes, 2013). The multiple mediation model can be regarded as superior

to a simple mediation model, as the simple mediation model often represents an oversimplification of the complex processes of health behavior change. An assumption of simultaneous multiple mediator models is that no mediator causally influences another (Hayes, 2013). However, this requirement is rarely met. Often, mediators that are investigated as processes of health behavior change are interrelated over and above the common cause they share. In such cases, Hayes (2013) suggest to use sequential multiple mediation, like applied in Chapter 4, in order to test whether planning and preparatory behaviors are sequential mediators between intention and physical activity.

Due to the contingent nature of diverse psychological processes, Hayes (2013) further recommends to use moderated mediation analysis in order to investigate whether indirect effects apply differently under different conditions. In this thesis, moderated mediation was employed in order to test whether preparatory behaviors mediate between planning and physical activity similarly for individuals with different levels of self-efficacy.

The study presented in Chapter 4 used structural equation modeling with latent constructs instead of manifest data modeling. The advantage of structural equation modeling is that measurement errors are reduced (Fornell & Larcker, 1981). Thus, it is recommended to use structural equation modeling instead of manifest models if possible. However, modeling interactions with structural equation models is still uncommon (Leite & Zuo, 2011), although several methods testing latent interaction are available by now. Therefore, it can be suggested to test preparatory behaviors for physical activity and possible moderators with structural equation models in future work.

### **Practical Implications**

Given that the results of this thesis can be replicated and the role of preparatory behaviors for physical activity can further be consolidated, several practical implications can be derived from this thesis.

The intervention study, in Chapter 2, suggests that interventions promoting physical activity should implement several volitional strategies in conjunction with each other. It seems likely that the combination of self-efficacy enhancing methods and the prompting of action plans and coping plans is a promising approach to increase physical activity levels among intenders.

Moreover, the behavior change techniques (Michie et al., 2011) used in this study to address the different volitional strategies can be recommended for future health behavior change interventions. Action planning interventions might use strategies of *goal setting* so that individuals set a specific physical activity goal that can be approached by concrete action plans. In this study, it was recommended to *set graded tasks*, i.e., to specify a number of sub goals of the superior goal and to impose a deadline on oneself for the achievement of goals. As many individuals are familiar with the use of online calendars, it seems to be useful to provide a planning sheet that resembles online calendars and that can be printed out by participants. Also, it can be recommended to assist individuals in *barrier identification* and *problem solving*. Individuals were provided with examples for coping plans prior to the invitation to define and to find solutions that help to overcome these barriers.

In this study, self-efficacy was successfully increased with the help of role models that described their own way of initiating and maintaining physical activity levels, and also how they coped with barriers and relapses. Additionally, the *focus on past successes* might have contributed to the intervention's effectiveness of enhancing self-efficacy beliefs (Warner et al., 2014).

As demonstrated in Chapter 3, apart from self-efficacy enhancing strategies and instructions on planning, action control tools seem to be promising gadgets that facilitate individuals' maintenance of physical activity. Nowadays, pedometers are inexpensive, especially because most smartphones offer free step counting applications. This makes them very interesting for national or international health promoting campaigns with large target groups. Recently new devices, the so called fitness bracelets, have come into fashion. Fitness bracelets are more expensive than pedometers. However, they are supposed to provide more reliable data on the physical activity performed and some also offer to track one's sleep patterns, heart rate or blood pressure. This additional information might help to analyze intra-individual associations between physical activity and health (van Dyck et al., 2013).

In line with the results of Chapter 4 and 5, it can be recommended to extend planning interventions by preparatory behavior planning components, as it might provide additional benefits with regard to enhanced physical activity levels. The instructions might be as follows: After participants have generated action plans, they are invited to think of possible preparations they need to perform before they can comply with their action plan or that facilitate the execution of the plan. The preparations, they come up with, should than be planned in a when, where, and how manner. Ideally, the action plan and the plan for the preparatory behavior should be issued to participants to take home.

If tailoring of an intervention is possible, the planning intervention might not only be offered to intenders, but also to participants with lower levels of self-efficacy beliefs.

This thesis extends the literature on the beneficial effects of action planning, coping planning, action control, and self-efficacy on physical activity. Additionally, this thesis integrates the construct of preparatory behaviors in to the HAPA (Schwarzer, 1992, 2008). It furthers our understanding of the volitional processes that lead to behavior change, because preparatory behaviors were determined as working mechanism of how planning translates into



physical activity. Moreover, a subgroup of individuals, namely individuals afflicted with self-doubts, was identified for whom preparatory behaviors for physical activity may be most beneficial.

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**Curriculum Vitae**

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*For reasons of data protection, the curriculum vitae is not included in this version.*

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**Publikationen:**

- Barz, M.,** Lange, D., Parschau, L., Lonsdale, C., Knoll, N., & Schwarzer, R. (2015). Self-efficacy, action planning, and preparatory behaviours as joint predictors of physical activity. *Psychology & Health*. Advance online publication. doi:10.1080/08870446.2015.1070157
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- Parschau, L., **Barz, M.**, Richert, J., Knoll, N., Lippke, S., & Schwarzer, R. (2013). *Physical activity of obese individuals: Testing the Health Action Process Approach.* Posterpräsentation auf der 27. Konferenz der European Health Psychology Society, in Bordeaux, Frankreich.
- Koring, M.**, Parschau, L., Fleig, L., Lange, D., & Schwarzer, R. (2012). *Planung und vorbereitendes Handeln überbrücken die Intentions-Verhaltenslücke.* Vortrag auf dem

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**Erklärung zur Dissertation**

Hiermit versichere ich, dass ich die vorgelegte Arbeit selbständig verfasst habe. Andere als die angegebenen Hilfsmittel habe ich nicht verwendet. Die Arbeit ist in keinem früheren Promotionsverfahren angenommen oder abgelehnt worden.

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Milena Barz

Berlin, April 2015