

Social Support, Planning and Action Control in Self-Regulatory Health Behavior Processes

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

Abstract

The present thesis describes constructs and mechanisms of health behavior change, using physical activity, fruit and vegetable consumption, and hand hygiene as behavioral examples. The basic assumption is that motivational and volitional factors move people forward when it comes to develop behavioral intentions and to translate them into action. Among these factors, the present studies focus on perceived self-efficacy, planning, action control, and social support. To examine their interplay, five empirical investigations have been conducted in Costa Rica. The first three are longitudinal observation studies, and the last two are experimental intervention studies.

After an introduction section, Chapter 2 reports about a longitudinal study on changes in fruit and vegetable intake, in which the predictive value of dietary self-efficacy was mediated by intention levels. Moreover, an interaction between self-efficacy and social support was responsible for one's motivation to consume more fruit and vegetable.

A similar type of interaction between self-efficacy and social support was also found for levels of action control about one's ongoing physical activity, as reported in Chapter 3.

Action control has also been identified as a bridge between planning and physical activity in a different study (Chapter 4). A theory-based mediation chain emerged leading from intention via action planning, coping planning, action control to the behavioral outcome.

Previous constructs were further studied within an experimental design. A brief planning intervention to improve physical activity levels in young adults was partly successful, as reported in Chapter 5. Only those with low initial activity levels benefitted from the behavior change strategies, shedding light on stage-specific intervention issues.

Using a similar set of behavior change strategies for a different behavior, namely hand disinfection, another intervention was evaluated, as described in Chapter 6. Self-monitoring hand hygiene was improved, leading to plans for better hygiene, but the treatment did not produce significant changes in actual hygiene behaviors.

The concluding general discussion of the thesis summarizes the empirical findings in terms of the constructs and mechanisms of behavior change and highlights the roles that mediation and moderation may play in further observational and experimental investigations of changes in physical activity, fruit and vegetable consumption, and hand hygiene, and possibly other health behaviors.

Zusammenfassung

Die vorliegende Dissertation beschreibt Konstrukte und Mechanismen der Gesundheitsverhaltensänderung, wobei Verhaltensweisen wie körperliche Aktivität, Obst- und Gemüsekonsum und Handhygiene als Beispiele dienen. Die grundlegende Annahme ist, dass motivationale und volitionale Faktoren die Menschen vorwärts bewegen, wenn es darum geht, Verhaltensintentionen zu entwickeln und diese in Handlung umzusetzen. Von diesen Faktoren werden in der vorliegenden Arbeit vor allem die Selbstwirksamkeitserwartung, die Planung, die Handlungskontrolle und die soziale Unterstützung betont. Um deren Zusammenwirken zu untersuchen, wurden fünf Studien in Costa Rica durchgeführt. Die ersten drei sind längsschnittliche Beobachtungsstudien, die anderen beiden waren experimentelle Interventionen.

Nach einer allgemeinen Einführung wird im zweiten Kapitel eine Längsschnittstudie zum Obst- und Gemüsekonsum berichtet, in der der prädiktive Wert von Ernährungselbstwirksamkeit für die Ernährung durch die Intention mediiert wurde. Darüber hinaus erwies sich eine Interaktion zwischen Selbstwirksamkeit und sozialer Unterstützung als verantwortlich für die Motivation, mehr Obst und Gemüse zu konsumieren.

Eine ähnliche Interaktion zwischen Selbstwirksamkeit und sozialer Unterstützung auf das Niveau von Handlungskontrolle über körperliche Aktivität fand sich in einer weiteren Studie, die im Kapitel 3 berichtet wird.

Die Handlungskontrolle erwies sich auch als Vermittler zwischen Planung und körperlicher Aktivität in einer anderen Studie (siehe Kapitel 4). Eine theoriegerechte

Mediationskette trat auf, die von der Intention über Handlungsplanung, Bewältigungsplanung und Handlungskontrolle zum Verhalten führte.

Diese genannten Konstrukte wurden auch im Rahmen von experimentellen Forschungsversuchsplänen untersucht. Eine sparsame Planungsintervention zur Verbesserung des körperlichen Aktivitätsniveaus bei jungen Erwachsenen erwies sich zum Teil als erfolgreich, wie in Kapitel 5 berichtet wird. Diejenigen, die eingangs ein sehr niedriges Aktivitätsniveau hatten, profitierten von den eingesetzten Verhaltensänderungsstrategien, was wiederum ein Licht auf die Möglichkeit von stadienspezifischen Interventionen wirft.

Ähnliche Verhaltensänderungsstrategien wurden für ein ganz anderes Verhalten, nämlich Händedesinfektion, angewendet. Diese Interventionsstudie wird in Kapitel 6 beschrieben. Dabei wurde die Handlungskontrolle für das Desinfizieren der Hände erhöht, was wiederum zu besserer Planung von Handhygiene führte. Aktuelles Verhalten wurde durch diese Maßnahme nicht direkt gefördert, aber die Prädiktoren wurden beeinflusst.

Die abschließende allgemeine Diskussion der Dissertation fasst die empirische Befundlage zusammen, indem die Konstrukte und Mechanismen der Verhaltensänderung kritisch beleuchtet wurden. Dabei wird auf die besondere Rolle hingewiesen, welche Mediation und Moderation spielen können bei zukünftigen Studien, sei es im Längsschnitt oder experimentell, bei denen Veränderungen von Verhaltensweisen wie körperliche Aktivität, Obst- und Gemüsekonsum und Handhygiene angestrebt werden.

1

Introduction

Introduction

This dissertation aims to further understand the role of social support, planning and action control in health behavior processes. In order to do this, studies with three different behaviors were carried out, namely fruit and vegetable intake, physical activity and exercise, and hand disinfection behavior. These behaviors were all studied within a self-regulation framework.

Self-regulation involves psychological and behavioral processes related to successful goal pursuit including intention formation, behavior initiation and maintenance. It has been referred to those processes, internal and/or transactional, that enable an individual to guide his/her goal-directed activities over time and across changing circumstances or contexts (Karoly, 1993). In the chapters which compose this dissertation the general self-regulation perspective for health behavior comes back and forth, either related to intention formation or to behavior initiation and maintenance. However, the whole self-regulatory process points toward goal attainment, or behavior performance. Therefore, some basic remarks on what is understood as health behavior are necessary.

Health behavior

In the broadest terms, health behavior refers to a range of personal actions that influence health, disability, and mortality (Umberson, Crosnoe, & Reczek, 2010). There is a variety of health behaviors which contribute not only to promoting health but also to preventing different kinds of diseases. For instance, benefits for the behaviors studied in the present dissertation can be mentioned, namely physical activity and exercise, fruit and

vegetable intake, and hand hygiene. Physical activity and exercise foster cardiovascular fitness, positive emotional experiences, improved body self-concept, self-esteem, and quality of life, and it can have mood-brightening effects (Balady et al., 2007; Blair & Morris, 2009; Garber et al., 2011; Hardman & Stensel, 2009; Janssen & LeBlanc, 2010; WHO, 2010). Fruit and vegetable intake is associated with reductions in cardiac vascular disease, hypertension, Type-2 diabetes and protection from obesity, as well as increases in psychological well-being (Blanchflower, Oswald, & Stewart-Brown, 2013; Carter, Gray, Troughton, Khunti, & Davies, 2010; Slavin & Lloyd, 2012; Wang, Manson, Gaziano, Buring, & Sesso, 2012). Hand hygiene is mostly related to the prevention of infectious diseases, such as diarrhea and influenza (Freeman et al., 2014; Warren-Gash, Fragaszy, & Hayward, 2013). It is no coincidence that the World Health Organization provides guidelines on these behaviors: they are all relevant for human health (Pittet, Allegranzi, Boyce, & Pa, 2009; WHO, 2003, 2010).

All these behaviors can be differentiated based on characteristics such as rate, duration, latency, topography, and intensity (Shernoff & Kratochwill, 2003). However, in spite of the differences, they also might share common characteristics, and a conceptual core of psychological processes could give an account of their occurrence. Some of the most prominent psychological theories for understanding health behavior are briefly reviewed as follows.

Psychological conceptual frameworks for understanding health behavior

The social-cognitive theory (SCT) by Bandura (1977) represents one important attempt to explain changes in behaviors. It assumes that behavior is predicted by self-

efficacy as well as by outcome expectancies. Outcome expectancies are the person's estimate that a given behavior will lead to certain outcomes. Self-efficacy is the conviction that one can successfully execute the required behavior to produce outcomes. Higher efficacy expectations lead not only to goal setting and the initiation of behavior, but also to persistence and coping effort.

Another theory, which generated a wide range of research, is the Theory of Reasoned Action (Fishbein & Ajzen, 1975). It proposes that attitudes and subjective norms predict intentions, which subsequently predict behavior. The Theory of Planned Behavior (Ajzen, 1991) extends this framework by including perceived control as a predictor of intention as well as a more proximate predictor of behavior after intention. However, the emphasis of both theories is on the intention formation. As Sheeran (2002) has pointed out, the relationship between intention and behavior is far from perfect. This imperfect relationship has been coined as "the intention-behavior gap", and has become an increasing focus of subsequent research.

Recently, a discussion on limitations and needs of the TPB has taken place (Ajzen, 2014; Conner, 2014; Sniehotta, Pesseau, & Araújo-Soares, 2013). Certainly the notion of stage is missing in the TPB, and not much information on change processes is provided, but when studying health behavior and trying to develop useful knowledge for health policies one of the most relevant challenges is precisely to change people's unhealthy behaviors. Thus a distinction has to be made between classic continuum health behavior theories, such as the SCT and TPB and stage theories of health behavior change. Some have tried to extend the TPB, but they frequently do it by adding variables after intention, as if they were

implicitly recognizing that stages and a different concept of change were needed (Schwarzer, 2014).

An enlightening contribution to understanding behavior change and maintenance was provided by Heckhausen (1987) with the “Rubicon Model”, where he distinguishes between a pre-decisional mindset, with a deliberative orientation, and a post-decisional mindset, with an implementation orientation. These mindsets are also called, correspondingly, motivational and volitional. In this regard, Gollwitzer (1999) also makes a remarkable contribution, when he proposes the concept of implementation intentions, although he did not propose a new model. Implementation intentions contribute to understanding volitional processes. They are self-regulatory strategies in the form of “if-then” plans, which contribute to pursue a goal. The “if” represents a situational cue to be encountered, the “then” represents the behavioral response to that cue (e. g. “If I go to the supermarket, then I will buy some fruit”). Implementation intentions are more specific than goal intentions, because they define the situations where the behavior to reach the goal should be performed.

These notions of stage and change process are present in the Transtheoretical Model (Prochaska & DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992) as well, where five stages of behavioral change, rather than two, are proposed, namely, pre-contemplation, contemplation, preparation, action and maintenance. In each of these stages there is a specific configuration of psychological variables as well as a possibility of change defined by key variables, called in this theoretical context ‘processes of change’, such as ‘consciousness raising’, taking place in the early stages, or ‘contingency management’, taking place in the later stages. The concept of decisional balance is introduced too. It refers

to the individual's weighing of the pros and cons, the benefits of changing the behavior, and the costs of changing the behavior. It varies through the stages of change, with the cons outweighing the pros in the action and in the maintenance stages. Although heuristically provocative, this theory might be splitting hairs when trying to characterize and define limits between stages. Support for stage matched interventions and finer differentiations within volitional processes has been scarce (Bridle et al., 2005; Cahill, Lancaster, & Green, 2010; Schuz, Sniehotta, & Schwarzer, 2007).

An alternative and more parsimonious proposal is the Health Action Process Approach (Schwarzer, 2008), which retrieves several of the variables and concepts mentioned so far, but in a new framework which emphasizes volitional processes, where social resources and limitations are also taken into account (see Figure 1). In the motivational phase, action self-efficacy, outcome expectancies, and risk perceptions are expected to lead to the formation of a behavioral intention. Action self-efficacy consists of one's confidence in being capable of performing a difficult or novel behavior. Outcome expectancies are expectancies of the possible positive consequences of one's behavior. Risk perceptions refer to the awareness of possible negative consequences due to the non-performance of behavior. Intentions, which are at the top of the motivational processes, are personal goals, either self-imposed or other-imposed.

Once an intention is formed, cognitions and self-regulatory strategies on how to implement the intention and translate it into action are supposed to take place. This includes: 1) action planning, which involves how, when, how often and where to perform the target behavior; 2) coping planning, which involves what to do before expected difficulties to perform the target behavior; 3) action control, which involves *awareness of standards* of the behavior intended to be performed, *self-monitoring* of the actual behavior,

and *self-regulatory effort* to narrow the difference between the actual and the intended behavior; 4) coping self-efficacy, which are beliefs in the efficacy to deal with difficulties and; 5) resources and limitations from the context, which might facilitate or hinder health behaviors. In case of relapse, a recovery self-efficacy is also proposed, which contributes to resume the healthy behavior.

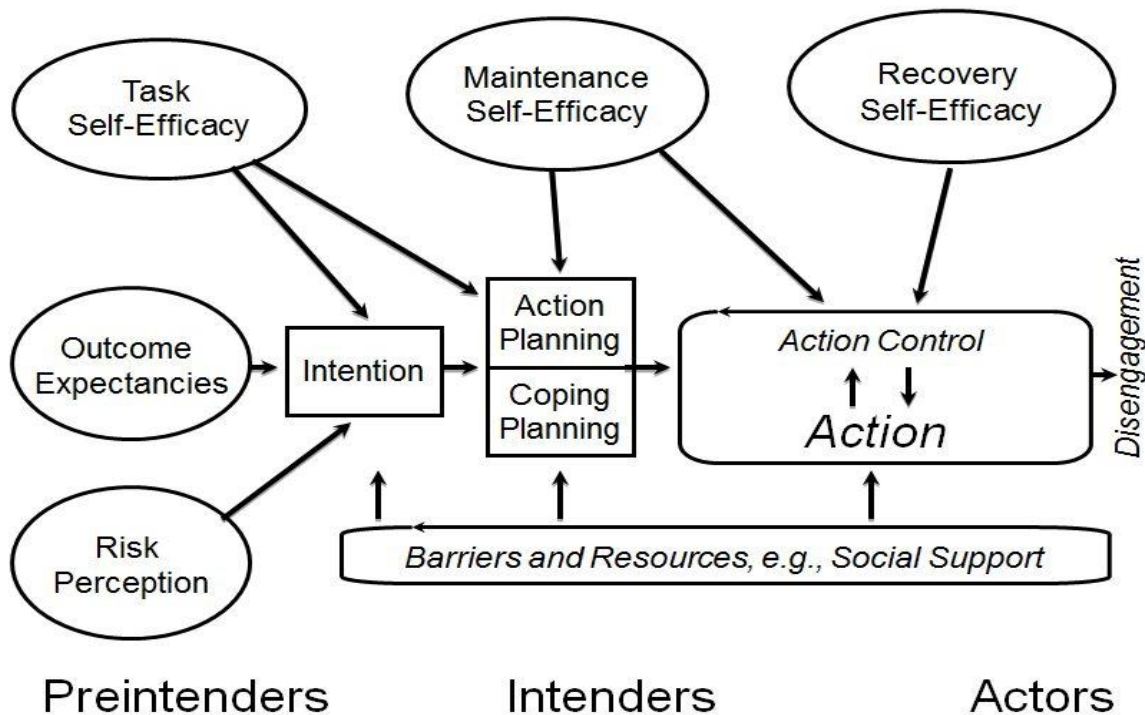


Figure 1. Health Action Process Approach, by Schwarzer (1992, 2008)

Given that it deals with the major issues involved in health behavior change, namely, motivation, initiation and maintenance, this is the main theoretical framework for the present dissertation. But the series of studies which constitute this document point to the further development of issues already mentioned in the HAPA. In this regard, the aim is to gain knowledge on two general aspects, which can be broadly described as: (1) the integration of social support in individual processes of behavioral change, and (2) the

mechanisms and sequence involved in self-regulation processes. These two aspects are presented in more detail below, as well as some considerations about how the HAPA would benefit from such studies.

The role of social support within motivational and volitional processes of health behavior

Literature shows that quantity and quality of social relationships are related to reduced mortality (Holt-Lunstad, Smith, & Layton, 2010; Schwarzer & Knoll, 2010) and, as mortality can be considered a gold standard in objective health-related measures (Quesnel–Vallée, 2007), this association speaks for the relevance of the social dimension of health processes. Social support is one of several social factors with a relationship to health (Berkman, Glass, Brissette, & Seeman, 2000; Schwarzer & Knoll, 2010; Uchino, 2009). It can be understood as a metaconstruct (Vaux, Riedel, & Stewart, 1987) involving many other concepts or dimensions. A basic distinction is the one between the social structure of networks and the functions of social support. It provides a more adequate framework for understanding the association of social support with health and health behavior.

Social network analysis “focuses on the characteristic patterns of ties between actors in a social system rather than on characteristics of the individual actors themselves and use these descriptions to study how these social structures constrain network member’s behavior” (Hall & Wellman, 1985, p. 26). A social network has characteristics like size or range, density, proximity, boundedness and reachability (Berkman et al., 2000).

On the other hand, social support can be characterized by its function, what encompasses instrumental and financial support, informational support, appraisal support and emotional support (Berkman et al., 2000). Instrumental support refers to the help or assistance with tangible means. Informational support is the provision of information to solve particular needs. Appraisal support is the help in decision making, giving appropriate feedback to decide which course of action to take. Emotional support is related to the amount of love and caring, sympathy and understanding. Emotional, appraisal and informational support are difficult to disaggregate in practice.

Berkman et al. (2000) distinguishes several pathways by which social support exerts its effect on health: the physiological pathways, the psychological pathways and the behavioral pathways. Among the physiological pathways, there are processes that involve social support and the immune system or cardiac reactivity. In psychological pathways, there are variables related with social support like self-efficacy, depression and stress. The behavioral pathways include behaviors like physical activity, smoking, treatment adherence, dietary behavior, etc. Given that the focus of the present dissertation is on motivational and volitional factors leading to health behavior, attention is paid to behavioral and psychological pathways.

A possible distinction is based on the directionality of social support: it can be either provided or received (Nurullah, 2012). Put differently, there are support providers and support recipients. Another common distinction is the one between perceived available support and actually received support (Schwarzer & Knoll, 2010). Perceived social support is the recipient's anticipated available support from their social network if needed. As it is a rather stable cognition, which resembles a personality disposition, it is hardly amenable to

interventions (Brand, Lakey, & Berman, 1995). Received social support, on the other hand, describes the recipient's report about support he or she received in the past. As received support can be prompted in interventions, it is a promising factor to be investigated. Received support is the one addressed in this dissertation, because it is less studied than perceived available support and, as its relationship to health seems contradictory, it needs further clarification (Nurullah, 2012).

Social resources and influences are not usually integrated into health behavior models. For instance, Ajzen (2011) recognizes that social support has not been part of the Theory of Planned Behavior, although he thinks it could somehow be incorporated. The Transtheoretical Model includes "helping relationship" (Prochaska & DiClemente, 1983), which corresponds to perceived social support, as one processes of change. In one early description of the HAPA model, contextual resources and barriers were explicitly included as having an influence on intention, planning, action control and action (Schwarzer, 1992). The specific nature of this influence is however not specified.

Several hypotheses or theoretical models have been formulated to give account of the relationship between received social support and health, well-being and health behaviors, usually within the context of stressful or adverse situations, and coping strategies (Abbey, Abramis, & Caplan, 1985; Barrera, 1986; Cutrona & Russell, 1990; Nadler & Fisher, 1986; Schröder, 1997; Walster, Hatfield, Walster, & Berscheid, 1978). They were not originally elaborated to deal with motivational and volitional processes of health behavior, and their integration in health behavior change models, such as the HAPA, has not yet been done. No study in this dissertation is focused on stress. However, there might be some similarities between stress coping and the HAPA, because stress coping also

presupposes self-regulation (Carver & Scheier, 1999), and goal pursuit includes coping with possible difficulties that could emerge between goal setting and goal attainment. For both cases, stress coping and health behavior change, personal and social resources can be used, and some proposals have been made on the relationship between these two kinds of resources. It has been argued that social support could carry a ‘self-threatening message’, suggesting that one is incapable of coping unaided (esteem threat hypothesis, Nadler & Fisher, 1986). Thus, personal resources may be reduced because of social support. It has also been proposed that, in order to be useful, the kind of social support given has to match the needs of the recipient (matching hypothesis, Cutrona & Russell, 1990).

A proposal which considers several possibilities is the one by Schröder (1997), elaborated in the context of coping with chronic illness. She is focused on interactions between personal and social resources, and recognizes three categories (see also Figure 2):

(a) *Compensation effects*: one of the resources is sufficient to produce an effect. When one kind of resource is low, the increase in the other compensates for it.

(b) *Interference effects*: one of the resources is sufficient and optimal to produce effects, but the presence of another resource produces interference. Put differently, when one kind of resource is high, the increase in the other one reduces its effect.

(c) *Synergistic effects*: when both resources optimize each other and their effects on an outcome variable.

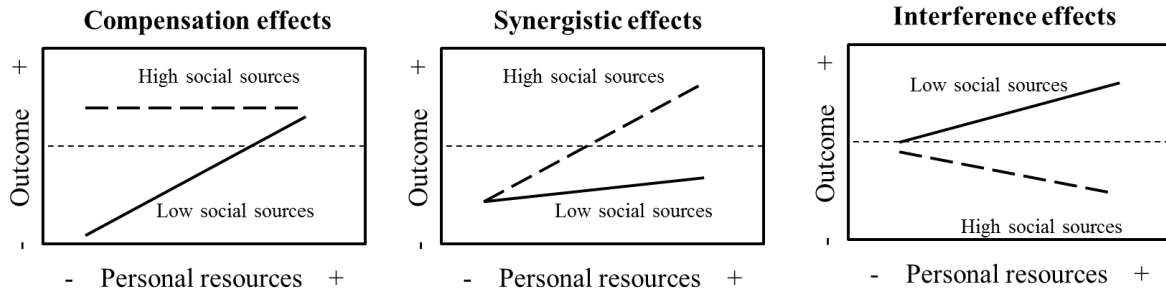


Figure 2. Possible effects of the interaction between personal and social resources on outcome variables (adapted from Schröder, 1997)

Social resources may not only affect motivational and volitional variables by interacting with personal resources. Single direct and indirect effects are also possible. For instance, self-efficacy could be influenced by verbal persuasion (Bandura, 1997), which can somehow be interpreted as social support. However, as pointed out by Davis, Campbell, Hildon, Hobbs, and Michie (2014), mainstream health behavior theories do not include (or are vague about) the role social variables may play.

This dissertation focuses on interactive relations between social support and a personal resource such as self-efficacy, and their effects on motivational and volitional variables.

Recent studies have also tried to integrate social support within motivational and volitional processes for smoking abstinence and a low fat diet (Ochsner et al., 2014; Scholz, Ochsner, Hornung, & Knoll, 2013). These recent findings are commented on in relation to our results in the discussion section of this dissertation.

Self-regulation strategies: planning and action control.

Intentions are not always translated into behavior. This discordance is known as the intention-behavior gap (Sheeran, 2002) and is a key issue in the study of volition. For instance, in the case of physical activity, it has been reported that 46% of intenders are not successful at following through with their behavior (Rhodes & de Bruijn, 2013). Planning has been proposed as a variable to bridge the intention-behavior gap (Sniehotta, Scholz, & Schwarzer, 2005) and, as mentioned before, can be conceptualized as *action planning* when plans for the initiation of a behavior are elaborated, or as *coping planning* when difficulties to perform the behavior are anticipated and coping strategies are elaborated (Carraro & Gaudreau, 2013; Kwasnicka, Pesseau, White, & Sniehotta, 2013; Sniehotta et al., 2005; Zhou, Jiang, Knoll, & Schwarzer, 2015, Zhou, Zhang, Knoll, & Schwarzer, 2015). So far, a large body of evidence has been accumulated that confirms the mediating role of both kinds of planning for a variety of health behaviors (for an overview see Hagger & Luszczynska, 2014). Thus, planning can be considered a straightforward way to help bridge the intention-behavior gap. The terms of planning and implementation intentions are often used interchangeably because both of them imply mental simulation: when individuals plan, they mentally simulate cues for action, and then, when situational cues are encountered, performance of behavior becomes more likely (Gollwitzer, 1999; Schwarzer, 2008), because a link cue-response is established.

Once a behavior is initiated is important to ensure it can be maintained. From initiation, by concrete plans, to maintenance, another gap is possible because individuals do not necessarily enact what planned. It has been called the plan-behavior gap (Sniehotta, 2009). Action control is the term coined to describe a more proximal self-regulation

variable (Sniehotta, Nagy, Scholz, & Schwarzer, 2006; Sniehotta et al., 2005). It is deeply rooted within the self-regulation framework, and actually consists of negative feedback (Carver & Scheier, 1998; Sniehotta et al., 2006), where incoming information is compared to individual standards and, when discrepancies are found, there is an effort to reduce them. Action control resembles the notion of a feedback loop, proposed by Carver and Scheier (1998), which consists of: (a) an input value gathered by an information collection function; (b) a standard value; (c) a comparator analyzing differences between input and standard; and (d) an output function aiming at reducing differences between input and standard (Carver & Scheier, 1998). In terms of the psychological construct of action control, the feedback loop has been conceptualized as being composed of three facets (Sniehotta et al., 2005) for the proximal self-regulation of behavior, namely: (1) a constant *awareness of standards*, (2) a *self-monitoring* of one's behavior, and a self-regulatory *effort* to reduce the discrepancy between current behavior and self-defined standards.

To summarize, once a goal has been set (motivation), standards or criteria for action need to be specified (planning, e.g. 'I want to exercise three times a week at the gym'). Moreover, these standards must be called up for the individual to be aware of them during the course of action and for them to be enacted in the future. This requires prospective memory (Scullin, McDaniel, & Shelton, 2013). Through a proximate self-regulation process that we call action control, standards are kept in mind; there is a self-monitoring of one's behavior; and, in case of discrepancy, an effort to reduce it. The discrepancies between one's action and standards could be reduced by means provided by action and coping plans (Sniehotta et al., 2006). Therefore, the different variables within the volitional process work complementarily. However, lack of awareness of standards or lack of self-

monitoring may lead to self-regulation failure (Baumeister, Heatherton, & Tice, 1994). Recent evidence supports the relevance of action control at the top of the volitional self-regulation process for health behaviors (Godinho, Alvarez, Lima, & Schwarzer, 2013; Parschau et al., 2013; Reyes Fernández, Montenegro-Montenegro, Knoll, & Schwarzer, 2014; Schwarzer, Antoniuk, & Gholami, 2014; Zhou, Sun, Knoll, Hamilton, & Schwarzer, 2015; Zhou et al., 2015).

The process of self-regulation, as described so far, assumes that when someone acts and maintains his or her behavior, he or she has already passed through a sequence of variables: intention has been elaborated, plans to act and cope with difficulties have been made, and action control has been carried out. Thus, it would be expected that the location of individuals within this process has some role when it comes to designing and implementing interventions. For models like the HAPA, which emphasize the change process and the existence of distinguishable mindsets, it has to be clear that even key variables, such as action planning, are not universally useful. Action planning initiates a target behavior. However, those who are already active would not benefit from it, since they have currently active self-regulatory strategies. Carraro and Gaudreau (2013), for instance, point out that the baseline activity level is a moderator of the effect of action planning interventions. Planning interventions among less active samples have larger effects ($\Phi = .63$) compared to general samples 53 ($\Phi = .17$). It could also be that active individuals have more positive experiences of physical exercise. As shown by Parschau et al. (2013), positive experiences have motivational and volitional effects. Thus, planning is a volitional variable possibly moderated by several psychological factors. How can planning be promoted, in which subgroups it occurs and who's behavior it impacts on is part of what

is examined in this dissertation. One understudied possibility is that planning could actually be promoted by a variable which is usually assumed to occur after planning, such as action control. Given that volitional self-regulation involves prospective memory, ulterior self-regulation strategies may have an impact on assumed earlier variables. In concrete, it can also be the case that changes in action control lead to changes in coping planning in order to either maintain or increase health behavior. Then, volitional variables should be understood as part of an overall self-regulation mechanism.

What so far emerged can be summarized in four points:

- 1) Social support may have a role in motivational along with volitional processes of health behavior change. By further clarifying this, knowledge for a better integration of social support within health behavior theories can be gained. The contribution of the interaction between personal and social resources in these processes deserves particular attention.
- 2) Although important for the behavior initiation, planning alone might not be sufficient: action control could be required and may be a key variable to bridge the intention-behavior gap. Thus, a sequence from intention, action planning, coping planning, action control and behavior is expected in the volitional processes.
- 3) Planning relevance for interventions is not universal. Initial activity levels may play a role: those who are not yet active enough benefit the most from action planning, because it contributes with behavior initiation.
- 4) Even though planning is usually hypothesized as preceding action control, the opposite is also plausible. Individuals may only require, via action control, a recall

to their previously elaborated plans, in order to increase or maintain some specific behavior.

These are the four guiding points of the road map of the dissertation. They are the very general ideas behind the studies carried out, which were elaborated more in detail and translated into specific hypotheses, data collection strategies and analysis techniques. A brief description of what awaits the reader in the following chapters is presented below.

Studies to be reported in this thesis

After the introduction, this dissertation presents a series of five empirical chapters. Some general details on the context of the studies included in those chapters need to be mentioned. They were conducted in Costa Rica, where average life expectancy was 79 years in 2012, and the main cause of death are diseases of the circulatory system (WHO, 2014). This underscores the pertinence of conducting studies on behaviors such as physical activity or dietary behaviors. We also wanted to study hand hygiene in students of health care disciplines, because poor hygiene habits are related to influenza and diarrhea (Freeman et al., 2014; Warren-Gash et al., 2013), and these infections are relevant among university students and in health care settings (Thumma, Aiello, & Foxman, 2009; Wilson, Jacob, & Powell, 2011).

Knowledge on health behavior is frequently based on American or European samples. There is a need of carrying out more studies on health behavior change in developing countries (Aboud & Singla, 2012). Conducting studies in Latin America is a

step towards examining assumptions of general explanatory mechanisms beyond cultural differences.

The chapters in this dissertation are organized in a sequence that deals with the topics grouped as presented in this section, starting with those focused on the role of social support within motivational and volitional health behavior processes, and continuing with those focused on planning and action control. However, they constitute independent chapters, which can be read separately.

As mentioned before in this introduction, in some of the earliest versions of the Health Action Process Approach, social support was explicitly placed as a resource influencing intention, planning, action control and action (Schwarzer, 1992). For the present dissertation the effect of the interactions of social support with personal resources on motivational and volitional variables are examined (see Figure 3). Thus, two longitudinal studies on the role of social support were carried out, one with fruit and vegetable intake as the outcome variable with a sample of university students (N = 473, further details in *chapter 2*), and another study with moderate physical activity as the outcome variable, and a sample of older adults (N = 54, further details in *chapter 3*). In both cases social support was hypothesized as a moderator interacting with self-efficacy to produce changes in mediator variables.

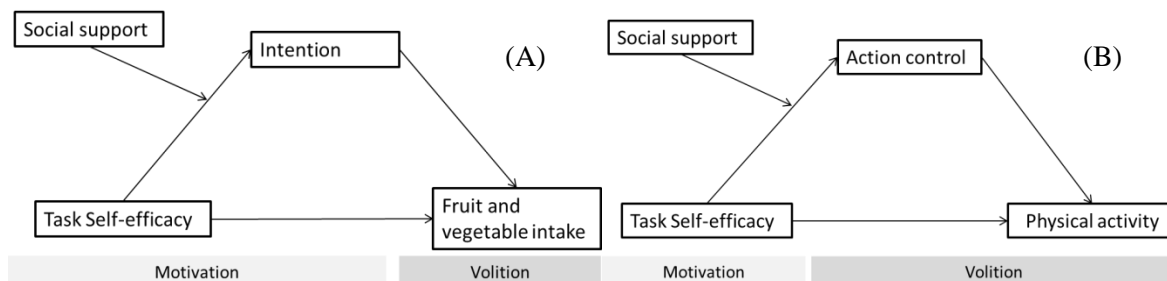


Figure 3. Models on the role of social support for motivational and volitional processes, examined in longitudinal studies reported in *chapter 2* and *chapter 3*.

We were also interested in further understanding the self-regulatory strategies that take part in the so called intention-behavior gap. Although planning is a key self-regulatory variable (Hagger & Luszczynska, 2014), it is not the only one to be taken into account. We examined then a serial mediation where a sequence from intention to action and coping planning, action control and behavior was hypothesized (see Figure 4). In order to do that, longitudinal data on physical exercise was collected in a sample of university students (N = 497, for further details consult *chapter 4*).

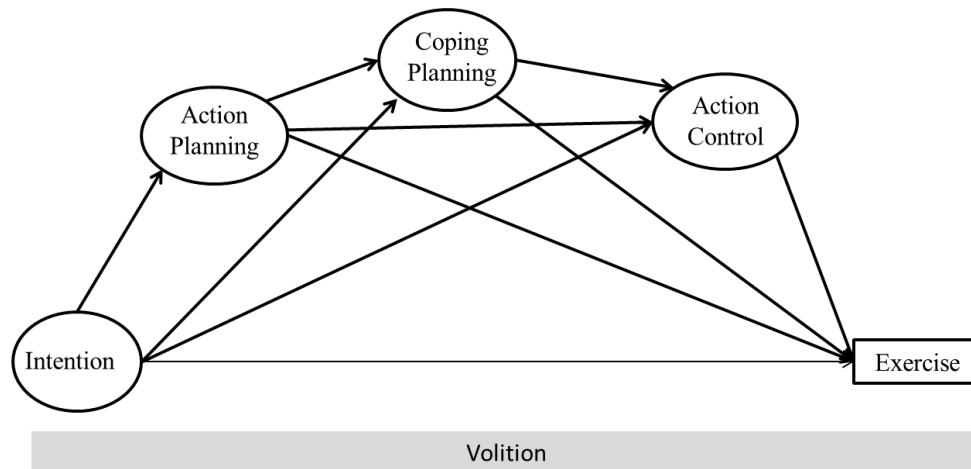


Figure 4. Model with the self-regulation sequence examined in *chapter 4*

Moreover, attention is also paid to action planning as an intervention variable. If planning contributes to increase or maintain behavior, then it would be helpful to know among whom it is useful. Therefore, a brief intervention study, where participants were assigned either to an active control or to an experimental condition (randomized controlled trial), was conducted with exercise as the outcome variable and a sample of university

students ($N = 486$, further details in *chapter 5*). Action Planning is supposed to contribute to the initiation of behavior. Thus, it was hypothesized that for already active participants, an action planning intervention would not exert any effect on behavior, but for inactive or less active participants, a planning intervention would contribute to increase their behavior. This hypothesis is depicted in Figure 5.

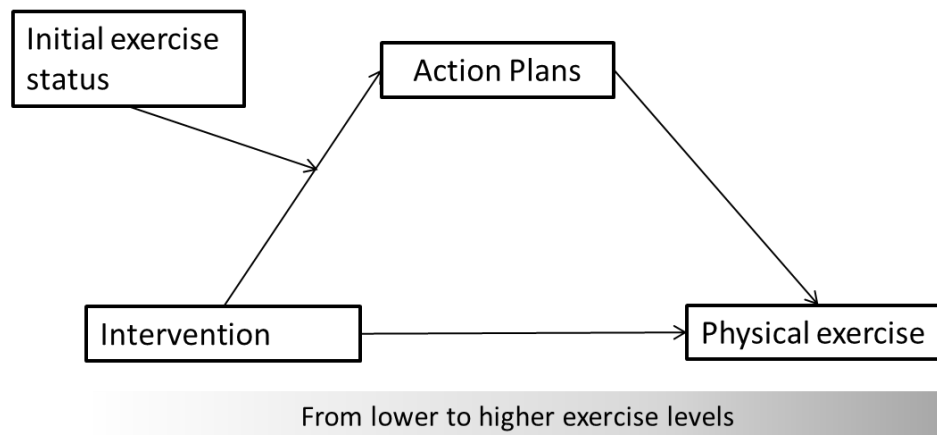


Figure 5. Model examined in *chapter 5*. Action planning intervention is expected to produce effects among participants whose initial exercise levels are lower.

Finally, we also wanted to examine the effects of a planning intervention on hand disinfection behavior, and particularly its consequences on self-regulatory variables. Thus, a brief coping planning intervention, where classroom was taken as the unit of cluster randomization, was carried out among 242 students (further details in *chapter 6*), where the sequence action control-coping planning was studied (see Figure 6).

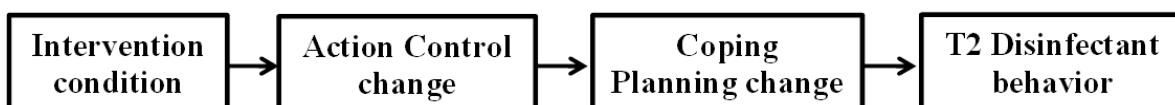


Figure. 6. Self-regulation sequence for disinfection behavior studied in *chapter 6*

As a concluding section, *chapter 7* summarizes the main findings, provides a general discussion where the hypothesis and results are contrasted and the limitations and implications are commented.

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2

Synergistic effects of social support and self-efficacy on dietary motivation predicting fruit and vegetable intake

Reyes Fernandez, B., Warner, L. M., Knoll, N., Montenegro Montenegro, E., & Schwarzer, R. (2015). Synergistic effects of social support and self-efficacy on dietary motivation predicting fruit and vegetable intake. *Appetite*, 87, 330-335.

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3

Self-efficacy, action control, and social support explain physical activity changes among Costa Rican older adults

Reyes Fernandez, B., Montenegro Montenegro, E., Knoll, N. & Schwarzer, R. (2014). Self-efficacy, action control, and social support explain physical activity changes among Costa Rican older adults. *Journal of Physical Activity & Health*, *11*, 1573-1578.

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4

Action control bridges the planning-behavior gap: A longitudinal study on physical exercise in young adults

Reyes Fernandez, B., Fleig, L., Godinho, C. A., Montenegro Montenegro, E., Knoll, N., & Schwarzer, R. (2015). Action control bridges the planning-behaviour gap: a longitudinal study on physical exercise in young adults. *Psychology & Health, 30*(8), 911-923.

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5

A brief action planning intervention increases physical exercise among less active young adults

Reyes Fernández, B., Luszczynska, A., Knoll, N., Montenegro-Montenegro, E., & Schwarzer, R.
(under review). A brief action planning intervention increases physical exercise among less
active college students. *Manuscript submitted for publication*

Abstract

Objective: Identifying the target group for which a planning intervention is most useful, based on initial physical exercise levels.

Participants: 486 students (mean age = 19, SD = 2.83) randomly assigned to an intervention (n = 248) or an active control condition (n = 238) were analyzed.

Methods: We compared an intervention on action planning for exercise with a control condition. Physical exercise was measured at baseline and one month later, and action planning was also measured at posttest. Repeated measures ANCOVA and conditional process analysis were used to evaluate intervention effects and working mechanisms.

Results: The intervention had an overall effect on exercise which was mainly due to the low exercisers for whom planning mediated between intervention and outcome.

Conclusion: The action planning intervention was beneficial for less active students. When designing self-regulatory exercise interventions, the initial exercise status should be taken into account.

A brief action planning intervention increases physical exercise among less active young adults

Introduction

Benefits from physical activity and exercise are well known but the majority of young adults do not adhere to a regular exercise regimen (Hallal et al., 2012). Exercise is a subset of physical activity, performed at higher intensity levels, which is done to improve or maintain fitness (Caspersen, Powell, & Christenson, 1985; Kilpatrick, Hebert, & Bartholomew, 2005). Thus, when it comes to fitness improvement, exercise may be more pertinent than physical activity. Young people who are less active, are at risk of developing short-term and long-term negative health consequences (Hallal, Victora, Azevedo, & Wells, 2006). The exercise patterns at early adulthood seem to be critical for the behavior and health in later life (Voss, Nagamatsu, Liu-Ambrose, & Kramer, 2011). The insufficient practice of exercise and physical activity has been explained, among others, by lack of motivation or lack of self-regulation (Parschau et al., 2014; Reyes Fernández, Montenegro-Montenegro, Knoll, & Schwarzer, 2014). However, the psychological process and the mechanisms leading to the practice of exercise need further study to design adequate interventions to increase and maintain physical exercise levels.

Among the psychological processes related to the practice of exercise, planning has been found effective and robust (Hagger & Luszczynska, 2014). Planning is a self-regulatory strategy that involves the anticipation of situational cues facilitating intended behavioral responses. It makes the cognitive representation of the anticipated situation more accessible and increases the availability of perceptual, attentional and mnemonic resources for initiating the behavior (Gollwitzer, 1999). Thus, planning helps to translate behavioral

intentions into the intended action. *Action planning* entails where, when, how often, and how a specific behavior is expected to be performed (Carraro & Gaudreau, 2014; Kwasnicka, Penseau, White, & Sniehotta, 2013; Sniehotta, Schwarzer, Scholz, & Schüz, 2005).

Empirical findings show the benefits of planning. As reported in a meta-analysis (Carraro & Gaudreau, 2014), there are effects of spontaneous action planning on physical activity (fixed: $\phi = .41$). There are also effects of experimentally induced action planning on physical activity. When focusing on planning interventions vs. neutral control conditions, the effect was medium-to-large (fixed: $\phi = .37$). However, when a multi-component intervention condition was compared with an active control condition, the effect was smaller (fixed: $\phi = .13$).

Analysing correlational studies, Carraro and Gaudreau (2014) point out the moderating role of the activity baseline level. There is a larger effect size (Qb/w (1) = 147.59, $p < .05$) of planning interventions among less active samples ($\Phi = .63$) compared to general samples ($\Phi = .17$). Therefore, tailoring interventions to the levels of past behavior might be useful. There is a theoretical rationale for this is that exercise beginners or less active persons may require more self-regulatory resources to increase their exercise levels. Action planning may be important in initiating a specific behavior, because by planning when, how, and where to exercise, the situational cues which activate cognitive resources and contribute to elicit the behavior are set (Sniehotta et al., 2005).

Taking the recommendations of the World Health Organization (2010) for the present study into account, we decided to set 75 minutes of weekly exercise as the threshold to categorize participants as being low or high in physical exercise. Those who exercise less

than 75 minutes a week may benefit the most from an action planning intervention, whereas those who already meet the exercise recommendations would not increase their exercise levels because action planning may not be appropriate.

Aims

This study examines whether a planning intervention increases exercise levels in young adults and whether there is a differential effect for subgroups of the sample. The following hypotheses were tested:

1. A planning intervention will lead to higher planning as well as actual exercise levels, compared to an active control condition.
2. This should be reflected by a mediation chain where the group assignment (intervention vs. control) affects later amounts of exercise via action planning.
3. The effect of the intervention on subsequent action planning could be moderated by exercise status. Less active individuals may increase their levels of action planning, and by this, also increase their exercise levels.

Method

Participants and procedure

A planning intervention to increase physical exercise levels among Costa Rican young adults was conducted from September to November 2013. The procedures and informed consent form were approved by the internal review board of the university.

Students of introductory courses in philosophy, communication and history were visited in their classrooms at the beginning of the semester and invited to take part in the

study. Although 701 students were originally eligible, 4 mentioned lack of interest or time. Thus, 697 were willing to participate and were individually randomized for allocation into the intervention or the control condition (see Figure 1). They remained blinded about their allocation throughout the study. Participants were instructed to stay in their classroom for specific dates in September 2013, where they gave informed consent. After that, they filled out the questionnaire with socio-cognitive variables, behavior self-report and demographic information, constituting the Time 1 (T1) measurement. The intervention was applied just after the pre-test, in form of information and planning worksheets. All queries made by participants were addressed individually by one member of the research team. They were also instructed not to talk to each other. Approximately one month later, 495 students attended the post-test session (Time 2, T2), and 486 of them provided complete answers (see Figure 1), yielding a drop-out rate of 30%. In addition to socio-demographic information (e.g., age, sex, marital status), physical exercise levels were reported at both points in time, and planning was reported at the posttest. Mean age of the sample was 18.74 years ($SD = 2.83$). Most of the students (98%) were single, and 53% of them were women.

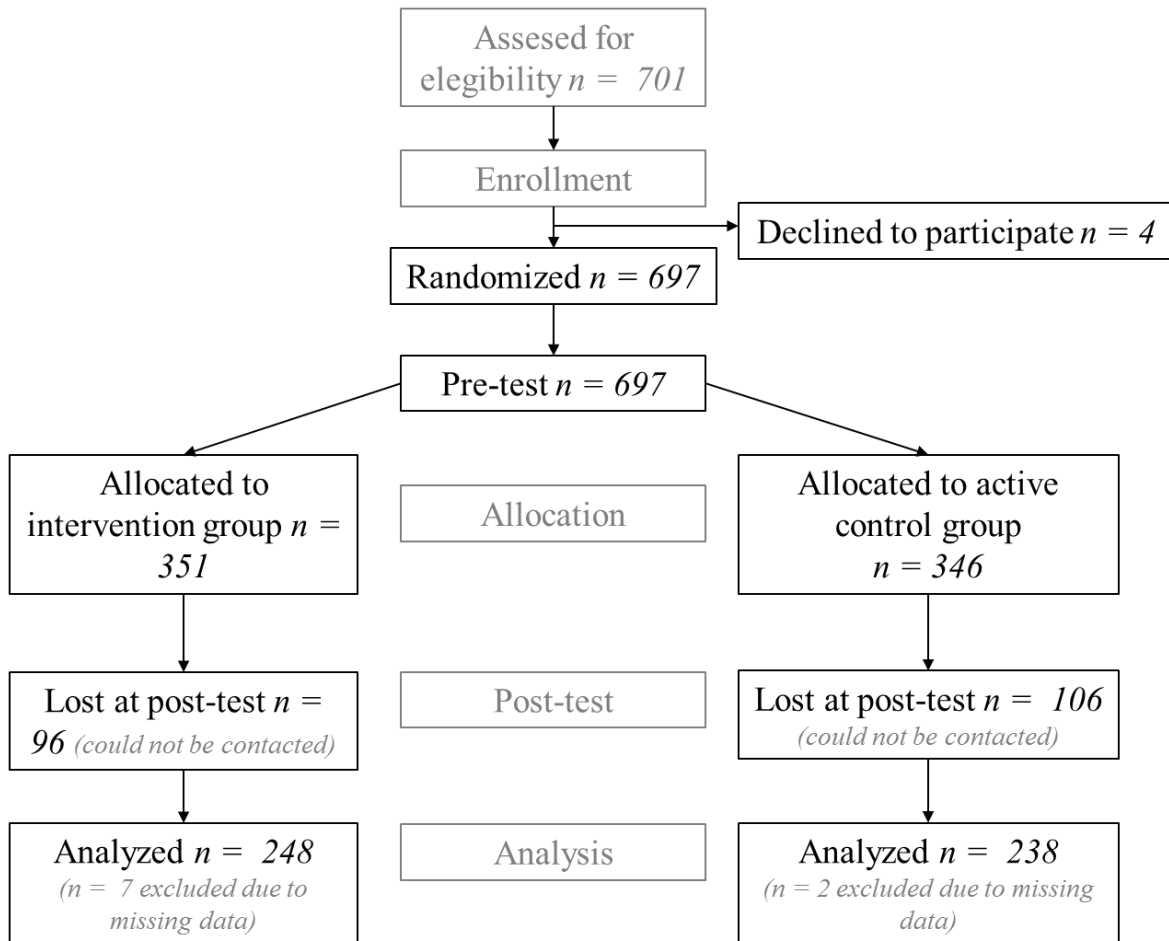


Figure 1. Flowchart with the number of participants who attended the intervention and control conditons.

Measures

Physical exercise was measured at Time 1 (T1) and at Time 2 (T2) with the open format question “During the last week, how many minutes per occasion did you practice physical exercise?”. Examples of exercise were also mentioned: aerobics, weight lifting, cycling, soccer, swimming, jogging. This measure was adapted from Warner, Ziegelmann, Schüz, Wurm, and Schwarzer (2011).

Action planning was measured at T2 on four-point scales, ranging from “not at all true” to “completely true”, by three items: (1) “I have already planned on which days I will exercise”, (2) “I have already planned where to practice exercise”, and (3) “I have already planned how to practice exercise and what kind of exercise to practice” (Cronbach’s $\alpha = .90$), adapted from Luszczynska and Schwarzer (2003).

Exercise status at T1 was defined by classifying participants as being low or high, based on the amount recommended by the World Health Organization. Weekly frequency of exercise was multiplied by minutes of exercise per occasion. Those who reported less than 75 minutes of weekly exercise were classified as having a low exercise status, whereas those performing more were classified as having a high exercise status.

Intervention and control conditions

Using a random digit generator, participants were randomly assigned to an intervention or a control condition and remained blinded about the allocation during the study. Those in the *exercise intervention condition* received a treatment package with behavior change techniques at the end of the pre-test session (Michie et al., 2011): in particular, they received information on the beneficial effects of exercise and were asked to think about them. Information was also provided on exercise recommendations by the World Health Organization (2010). Some examples of exercise were given and, finally, they were asked to generate their own action plans, namely to specify where, when, how often and how they would practice exercise.

Students in the *active control condition* received an intervention package on fruit and vegetable consumption at the end of the pre-test. Portions of fruit and vegetable were defined, the recommendation of the World Health Organization (2010) on the amount of

fruit and vegetable intake was provided, as well as information about the consequences of consuming fruits and vegetables. Finally, they had to generate action plans about when, where, and how to eat fruit and vegetables, as well as to think about the consequences of this behavior. To avoid contamination, all the participants were instructed to be focused on their questionnaires and remain silent until the end of the session.

Analytical procedure

Statistical analyses were performed with SPSS 22. Drop-out analyses were performed by means of t-tests for continuous variables and χ^2 for categorical variables, in order to compare the retained and lost samples at Time 2 (T2). Randomization checks were conducted between participants of the control and the intervention conditions. MANOVA was used to test the baseline differences for continuous variables and X^2 tests were used for categorical variables. To examine the intervention effects, a repeated measures analysis of variance was conducted, with physical exercise as the dependent variable, the experimental condition and exercise status as between-subjects factors, and sex and age as covariates.

Moreover, the PROCESS macro by Hayes (2012) was used to compute a simple mediation to predict exercise at T2, where exercise at T1 was specified as a covariate, intervention condition was the independent variable, and T2 action planning was the mediator. The bootstrap option of the macro for 5,000 resamples was chosen to test for statistical significance of the direct and indirect effects. To examine the role of exercise status, a moderated mediation model was specified with the very same mediation just described and an interaction between intervention condition and exercise status on T2 action planning.

Results

Drop-out analyses and randomization check

No differences were found between those who continued participation to the post-test and those who did not for baseline exercise, sex, and marital status. Those who continued were younger than those who dropped out, but the overall difference was small $F(1, 683) = 4.88, p = .02$, Cohen's $d = 0.17$, ($M_{\text{completers}} = 18.74, SD_{\text{completers}} = 2.82$; $M_{\text{non-completers}} = 19.27, SD_{\text{non-completers}} = 3.22$).

No baseline differences emerged between the two study conditions for age, exercise, sex, and marital status.

Table 1. Means and standard deviations (SDs) of exercise time (minutes per occasion) and planning in the intervention and control groups.

Variable / Group	Pre-test					Post-test				
	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>	<i>D</i>	<i>M</i>	<i>SD</i>	<i>T</i>	<i>p</i>	<i>d</i>
Minutes of physical exercise										
Intervention	52.97	32.58	.44	.66	0.04	51.97	34.97	1.74	.08	0.15
Control	51.65	33.48				46.54	33.49			
Action Planning										
Intervention	2.88	1.04	.49	.62	0.04	2.70	1.08	1.72	.08	0.15
Control	2.83	1.07				2.53	1.08			

Intervention effects

Table 1 summarizes means, standard deviations, and group comparison statistics. Repeated measures ANCOVA in the overall sample yielded an interaction between the

experimental condition and time, $F(1, 480) = 4.74, p = .03, \eta^2 = .01$. An interaction was also found between exercise status and time $F(1, 480) = 16.241, p < .01, \eta^2 = .03$. No interactions of time with age or sex emerged.

Because of the drop-out rate (30%), an intention-to-treat analysis (ITT) was conducted, in order to examine whether the intervention effects are confirmed under a different approach. Last Observation Carried Forward (LOCF) was used to deal with missing values. Concurring results on the interaction treatment and time were found: $F(1, 674) = 4.27, p = .04, \eta^2 = .006$; and on the interaction exercise status and time: $F(1, 674) = 15.814, p < .01, \eta^2 = .02$.

When analyzed separately by initial exercise status of participants, repeated measures ANCOVA showed an effect of the interaction between intervention condition and physical exercise over time in the subsample of low exercise participants, $F(1, 179) = 4.17, p = .04, \eta^2 = .02$, whereas no effect emerged in the subsample of high exercise participants. No interactions of time with age or sex emerged. Figure 2 depicts the intervention effects in the subsamples of low exercise and high exercise participants. This analysis was replicated using an intention-to-treat approach with the last-observation-carried-forward method.. Again, concurring results for the interaction between intervention and time were found in the low exercise group, $F(1, 246) = 4.33, p = .04, \eta^2 = .02$, as well as in the high exercise group (no effect).

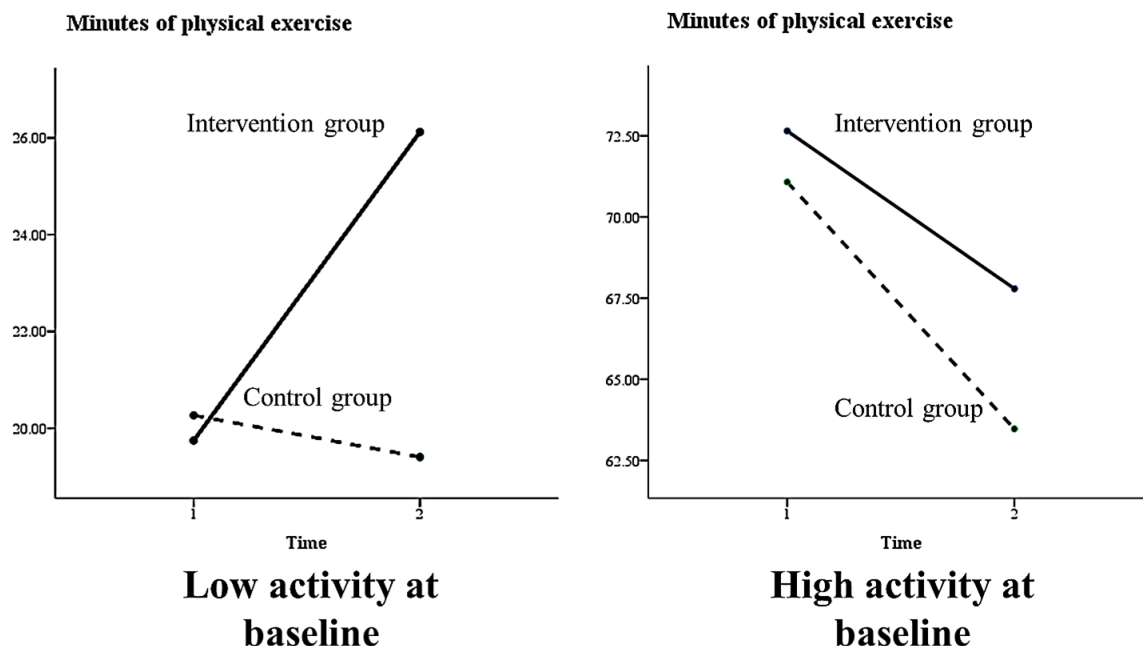


Figure 2. Effects of intervention condition on the amount of physical exercise performed per occasion at two points in time in the low exercise ($n = 188$) and high exercise ($n = 298$) subsamples.

Results of mediation and moderated mediation analyses

In order to test whether action planning was instrumental in the physical exercise changes, a simple mediation was specified with the experimental condition as the independent variable and T2 physical exercise as the dependent variable, with baseline exercise as the covariate and action planning as the mediator. An indirect effect emerged between intervention and exercise via action planning, $b = 1.17$, CI 95% [0.02, 2.62]. Figure 3 displays the mediation model with unstandardized parameter estimates. Intervention had a significant effect on action planning, which subsequently had an effect on T2 exercise ($R^2 = .58$), controlling for baseline exercise.

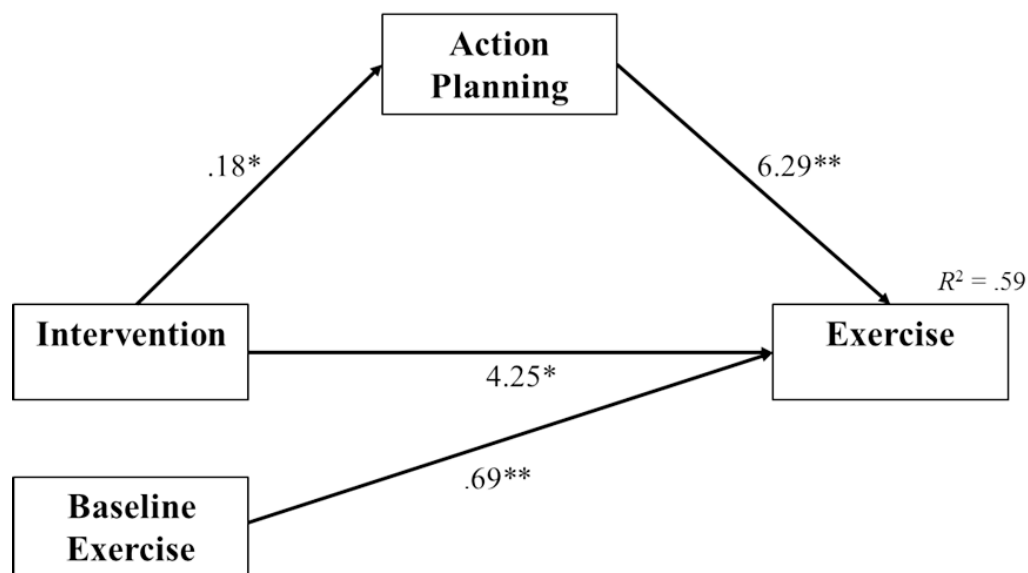


Figure 3. Effect of intervention on exercise via action planning, controlled by baseline exercise, bootstrapped with 5000 resamples. $N = 484$. Treatment = 1, control = 0. Parameters are unstandardized. * $p \leq .05$, ** $p < .01$.

To examine whether exercise status moderates the effect of the intervention on planning, a moderated mediation model was specified with exercise status as the putative moderator. An indirect effect emerged in the low exercise group, $b = 2.31$, CI 95% [0.58, 4.62], but no indirect effect was found in the high exercise group. The interaction term of intervention and exercise status was $b = -.31$, CI 95% [-.67, .04], showing that the more active they were, the less effective the intervention on planning was. Figure 4 displays separately the full model with planning as mediator among less active individuals and those who regularly engaged in physical exercise.

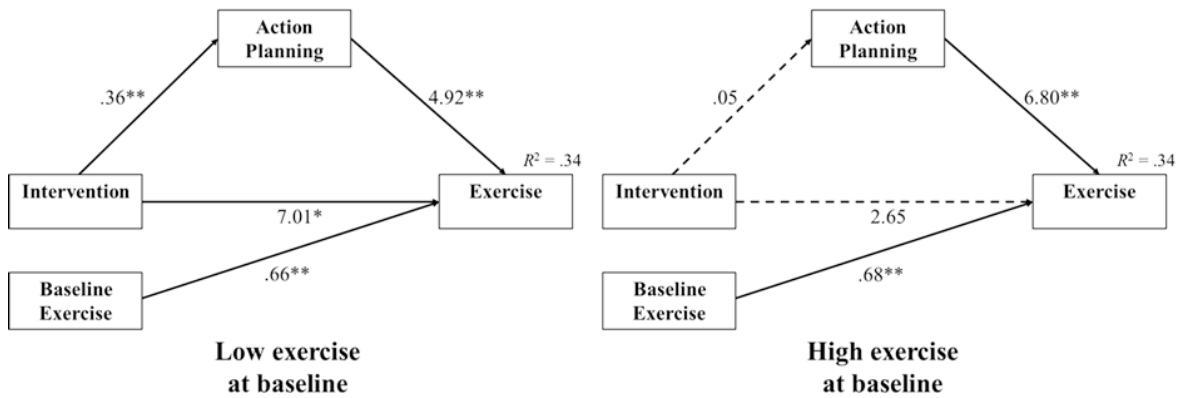


Figure 4. Indirect effect models for the low exercise subsample (left panel) and for the high exercise subsample (right panel), bootstrapped with 5,000 resamples. Treatment = 1, control = 0. Parameters are unstandardized. * $p \leq .05$, ** $p < .01$.

Discussion

In the experimental group that had received the planning intervention, students reported more minutes of exercise per occasion than in the control group, providing support for the first hypothesis. In the mediation analysis, the intervention condition exerted an indirect effect on exercise via action planning, which is evidence for the second hypothesis. However, this effect did not emerge in the subsample of participants who regularly engaged in physical exercise and already met the recommended levels of exercise per week at baseline. When specifying the initial exercise status as a moderator between intervention and action planning, an interaction was found, suggesting that students who already practiced the minimum amount of exercise (75 minutes per week) recommended by the WHO (2010) did not benefit from the planning intervention in terms of more planning and more exercise. Put differently, high exercise participants may not require further

instructions on how to plan. But among those who practiced less exercise, the intervention had an indirect effect on exercise via planning, supporting the third hypothesis. Action planning might be then a step towards attaining maintenance of regular physical exercise (Fleig et al., 2013a).

These findings emphasize the need of designing interventions and policies tailored to specific sub-groups of people. The tailoring can be done based on psychological factors, like those included in the Health Action Process Approach (Parschau et al., 2014; Schwarzer, 2008) or based on socio-demographic characteristics (Gellert, Ziegelmann, Krupka, Knoll, & Schwarzer, 2013). The present results underscore the opportunity of employing the initial exercise status as a criterion for tailoring interventions. Young adults who practice less exercise seem to benefit from a planning intervention, whereas such an intervention does not match the needs of individuals with higher practice levels of exercise. Regarding that, present results go in the same direction as previously reported findings in a meta-analysis on planning effects and on the moderating role of initial levels of behavior on planning interventions (Carraro & Gaudreau, 2014). This study also provides further evidence for the role of planning as a bridge from less to more active stages of exercise behavior.

One advantage of the initial exercise status as a tailoring criterion is its parsimonious assessment: people can be briefly asked whether or not they practice a minimum of 75 minutes of exercise weekly and then be allocated to one specific intervention group. Organizations and institutions concerned with the increase of exercise should focus their efforts on action planning interventions in individuals who do less exercise. In more active individuals, the aim of an intervention should not be to increase the

amount of exercise practiced, but to maintain it and to prevent injuries, and emphasize the appropriate execution of specific exercises.

One limitation of the study is that behavior was measured by self-report, although this assessment is the usual way in most studies, and it is generally assumed that the validity of activity self-report measures is satisfactory (Prince et al., 2008). Another limitation was the amount of drop-out, however only a very minor difference in age between completers and non-completers was found. Complementary analyses using an intention-to-treat approach, confirmed the present results, suggesting that the drop-out did not alter the findings.

Further research should be conducted on how the initial amount of exercise affects the effectiveness of planning interventions. Moreover, designs including more measurement points and follow-up booster sessions are desired. Exercise aims to improve fitness levels, and therefore requires the behavior to be maintained through an extended period of time. In that case, measurements on fitness levels should also be implemented. For those who already practice the minimal amount of exercise suggested by the World Health Organization (WHO, 2010), research on how to maintain their regular performance level and how to transform it into a sustained habit are particularly relevant (Fleig, Pomp, Schwarzer, & Lippke, 2013b).

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6

A brief planning intervention improves disinfection behaviour change strategies

Reyes Fernández, B., Lippke, S., Knoll, N., Blanca Moya, E., Schwarzer, R. (under review). A brief planning intervention improves disinfection behaviour change strategies. *Manuscript submitted for publication*

Abstract

Background: Examining a brief educational intervention addressing hand disinfection self-regulatory mechanisms, and evaluating which psychological mechanisms lead to more hand disinfection behaviour.

Methods: 242 students (mean age = 21 years, $SD = 3.9$) received either an experimental ($n = 190$) or a control condition on action control and planning ($n = 117$). Hand disinfection behaviour, coping planning, and action control were measured at baseline and six weeks later. We compared the experimental condition addressing planning to perform hand hygiene with a control condition. This was done applying repeated measures ANOVA. Additionally, working mechanisms were evaluated by means of mediation analysis.

Results: The intervention had an effect on action control, as shown by a time by treatment interaction. The direct effect of the intervention on behaviour was, however, non-significant. Changes in action control led to changes in coping planning. These social-cognitive changes mediated the effect of intervention on behaviour, after controlling for gender, baseline behaviour, and classroom, included as a cluster variable.

Conclusion: The intervention led to self-regulation changes which then produced change in behaviour. Results indicate the importance of planning for self-regulation and actual hygienic behaviour.

Keywords: Hand hygiene, psychological mechanisms, coping plans

Background

Hand hygiene contributes to reduced transmission of influenza and acute respiratory tract infection (Warren-Gash, Fragaszy, & Hayward, 2013) as well as diarrhoea and other infectious diseases (Freeman et al., 2014). Alcohol-based hand rubbing removes microorganisms effectively, requiring less time and irritating hands less often than hand washing does with other antiseptic agents and water (Picheansathian, 2004). Adequate hand hygiene is regarded as a key measure to prevent health-care associated infections (Pittet, Allegranzi, Boyce, & Pa, 2009). In spite of that, lack of disinfectant behaviours seems to be persistent among medical students (Scheithauer et al., 2012). Moreover, psychological mechanisms that lead to hand cleaning are not yet well understood (degli Atti et al., 2011). Previous studies have focused on hand hygiene behaviours, and not on the underlying psychological variables. Also, past research have been conducted among health care workers in hospital settings (Wilson, Jacob, & Powell, 2011), and other populations, such as *university students*. Thus, replicating effects from behaviour with psychological variables and in university studies deserve attention. Some evidence suggests that hand hygiene is less frequent among younger people (Bish & Michie, 2010). Moreover, studies report that hand hygiene among university students is performed less frequently than desired in key situations, such as before eating or after defecation (Mariwah, Hampshire, & Kasim, 2012; Rejeski et al., 2014; Thumma, Aiello, & Foxman, 2009).

The relevance of hand hygiene for students of health related disciplines is, then, twofold: (1) university campuses and student residences are places where infection transmission might occur more easily, and (2) the acquisition of disinfectant habits by

students might be crucial for their later behaviour in professional settings, where it has consequences not only for their own health but also for clients' health.

Given that hand hygiene is a phenomenon of behavioural nature, *psychological variables* should be taken into account when designing interventions: In previous studies, such interventions have been found to be efficient (e.g., Rejeski et al., 2014). To understand health behaviours from a psychological perspective, a psychological self-regulation framework provides the adequate approach. *Self-regulation* refers to any efforts undertaken in order to alter one's behaviour (Carver & Scheier, 1998; Kuhl & Beckmann, 1985). It involves *self-monitoring*, *awareness of standards*, and *effort*, which, working together have been conceptualized as *action control* (Sniehotta, Scholz, & Schwarzer, 2005). This factor of self-regulation is called action control, and is considered a proximal predictor of behaviour. However, it implies the recall of previously formulated plans.

Planning is another factor of self-regulation, and is a prospective psychological strategy. Planning is a mental simulation of linking concrete responses to future situations. Using this strategy, the ineffective, spontaneous reactions formed in-situ are replaced by planned responses, which include details of action implementation on how, when, how often and where to perform the intended behaviour, known as *action plans*. In addition, detailed strategies for coping with anticipated obstacles are known as *coping plans* (Sniehotta, Schwarzer, Scholz, & Schütz, 2005) and are important for behaviour change. When, as part of action control, awareness of standards is activated, then a recall takes place on how and under which circumstances coping strategies should be applied.

Broadly described, psychological variables involved in the health action process approach (HAPA, Schwarzer, 2008) can be classified as *motivational*, when they lead to

the elaboration of behavioural intentions, or *volitional*, when instructions and strategies on how to translate the intention into action take place. Within this theoretical framework, planning and action control are considered volitional variables, which may operate in a sequential manner, either planning preceding action control (Godinho, Alvarez, Lima, & Schwarzer, 2014) or action control preceding planning.

For the specific case of hand hygiene, motivational variables have been previously examined in the Costa Rican context (Gutiérrez-Doña, Renner, Reuter, Giese, & Schubring, 2012). However, the contribution of key volitional variables, and the relationships among them, needs to be further studied. Some studies have examined the role of planning in hand hygiene, although with a very restricted sample size (Erasmus et al., 2010), but to our knowledge the role of action control has not yet been explored.

Aims and hypotheses

This brief psychological intervention was designed to examine mechanisms that might play a role in changing hand disinfection behaviours. It was assumed that the health-enhancing behaviour might be somewhat improved as a result of the brief intervention and that self-regulatory variables, planning and action control, account for individual differences in behaviour. Therefore, the following hypotheses will be tested.

1. The intervention will increase disinfectant behaviour.
2. The intervention will produce changes in psychological variables, namely planning and action control.
3. Changes in planning and action control, specified as mediators, will explain individual differences in behaviour.

Methods

Participants and procedures

University students in Costa Rica (longitudinal sample, $N = 242$), mostly from health related disciplines (53%), took part in an educational experiment. Mean age was 21 years ($SD = 3.9$ years). Most participants were women (61%), single (97%), and the majority perceived their health as being good or excellent (78%). To avoid contamination between conditions, classroom groups were taken as randomization unit, assigned either to an experimental condition or to a control condition. Participants remained blind about their allocation condition during the study. The experiment and data collection was performed between March and November 2014.

The students filled out questionnaires at baseline and six weeks later. Those in the experimental condition received immediately after completing the questionnaire a task to work on behaviour change strategies.

The study procedures were approved by the ethics committee of Universidad de Costa Rica. Informed consent was provided by all participants before receiving the baseline questionnaires.

Measures

The study variables were disinfectant behaviour, coping planning, and action control, measured at baseline (Time 1; T1) and six weeks later (Time 2; T2). Disinfectant behaviour was measured by the item: "During the past week, I disinfected my hands with disinfectant". Responses followed a 5-point Likert scale, including "0-2", "3-4", "5-6", "7-9", and "10 or more", indicating the daily frequency of using disinfectant within one week.

Social-cognitive variables had a 4-point Likert scale response format. Coping planning was measured with three items, such as “To keep my habit in difficult situations, I made a concrete plan for disinfecting my hands, considering what to do when I'm in a hurry”. Cronbach's alpha was .82 at T1 and .88 at T2. Action control was measured with three items, such as “During the week, I watched consistently when, how often and how to disinfect my hands”. Cronbach's alpha was .78 at T1 and .81 at T2.

Change scores for the social-cognitive variables were computed by subtracting T1 scores from T2 scores.

Experimental and control conditions

Information on how to clean their hands, as well as when and in which situations it is needed was included in an experimental pamphlet, as well as a planning task where participants had to elaborate *action plans* on how often, when, where and how to clean their hands. In the planning task, participants also had to specify *coping plans*, in concrete, what to do to implement their plans in case difficulties appear. Participants in the experimental condition received, read and filled out the health education pamphlet just after completing the baseline questionnaire.

In the control condition, participants only completed the baseline questionnaire, without any further information pamphlet or task.

Analysis

Statistical analyses were performed with SPSS 22. Drop-out analyses were performed by means of t-tests for continuous variables and χ^2 for categorical variables, in

order to compare the retained and lost individuals at T2. Randomization checks were conducted between participants of the control and the experimental conditions. MANOVA was used to test the baseline differences for continuous variables and χ^2 tests were used for categorical variables. Intervention effects were examined by means of repeated measures ANOVA. Psychological mechanisms were assessed in terms of serial mediation with the SPSS macro PROCESS by Hayes (Hayes, 2012), where changes in action control and changes in coping planning were specified as sequential mediators between the intervention and T2 disinfection behaviour. The classroom was specified as a cluster variable, and gender and baseline behaviour were selected as covariates.

Results

Drop-out analysis and randomization checks.

Those who completed the study had slightly higher coping planning levels at baseline, $t(424) = -2.19, p = .03$, Cohen's $d = -.24$, ($M_{\text{completers}} = 2.27, SD_{\text{completers}} = 0.92$; $M_{\text{non-completers}} = 2.05, SD_{\text{non-completers}} = 0.88$). No baseline differences were found for gender, age, action control, and baseline hand hygiene behaviour between those who completed the study and those who did not.

Table 1.

Means and standard deviations (SDs) of disinfectant behaviour, action control and coping planning at pre-test and at post-test, and comparison between experiment conditions.

Measure- ment time	Variable	Condition	M	SD	T	<i>p</i>	<i>d</i>
Pre-test	Disinfectant Behaviour	Control	1.46	0.88	-2.662	.008	-.34
		Experimental	1.84	1.32			
	Action Control	Control	2.82	0.79	2.491	.013	.33
		Experimental	2.54	0.90			
	Coping Planning	Control	2.34	0.92	.562	.575	.07
		Experimental	2.27	0.95			
Post-test	Disinfectant Behaviour	Control	1.74	1.29	-1.700	.090	-.23
		Experimental	2.05	1.39			
	Action Control	Control	2.72	0.86	-.843	.400	-.20
		Experimental	2.89	0.84			
	Coping Planning	Control	2.33	1.00	-1.064	.288	-.13
		Experimental	2.46	0.94			

Note. Longitudinal sample $N = 242$. Listwise deletion. Bold numbers are used for variables where the comparison statistics are p (2-tailed) $< .05$.

Concerning the randomization, no differences at baseline were found for coping planning, age, and gender. However, for action control, the group which received the control condition presented slightly higher baseline levels than the group receiving the experimental condition ($M_{\text{control}} = 2.82$, $SD_{\text{control}} = 0.79$; $M_{\text{experiment}} = 2.54$, $SD_{\text{experiment}} = 0.90$; $F(1,240) = 6.205$, $p = .01$, Cohen's $d = 0.33$), and for hand hygiene behaviour, the group in the control condition reported lower levels than the group in the intervention condition ($M_{\text{control}} = 1.46$, $SD_{\text{control}} = 0.88$; $M_{\text{experiment}} = 1.84$, $SD_{\text{experiment}} = 1.32$; $F(1,240) = 5.918$, $p = .01$, Cohen's $d = 0.32$).

Experimental effects

Table 1 contains the means and standard deviations for each variable as well as group comparison statistics at T1 and T2 for both conditions. It shows that baseline differences between experimental and control group existed for behaviour (in favour of the experimental group) and action control (in favour of the control group). At follow up, differences between experimental and control group existed still in behaviour (in favour of the experimental group). The difference in action control was reversed but not statistically significant. Analysing time and interaction effects, the following patterns resulted. No interaction between treatment and time was found. However, there was an effect of time on behaviour, $F(1,243)= 7.74$, $p = .006$, $\eta^2= .03$. In other words, behaviour was increased in both groups significantly. For action control, there was an effect, as shown by the interaction between treatment and time, $F(1,243)= 11.01$, $p = .001$, $\eta^2= .04$. For coping planning no effect was found either for time or for the interaction of treatment and time, although the interaction term was marginally significant, $F(1,239)=2.96$, p (2-tailed) = .045, $\eta^2= .01$.

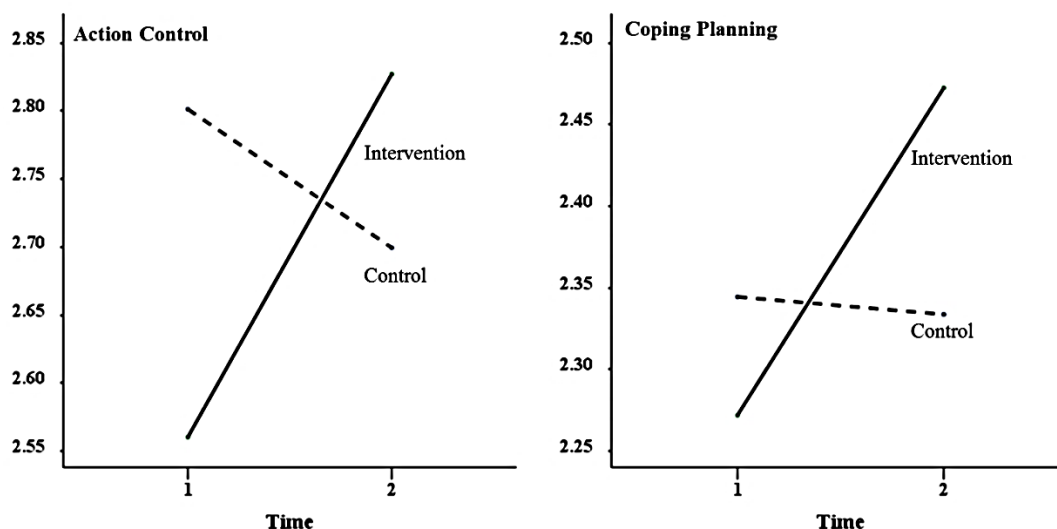


Figure 1. Levels of action control and coping planning in the two experimental conditions at two points in time.

The means in action control and coping planning for the two groups and at T1 and T2 are depicted in Figure 1. The response options for action control and for coping planning define that 3 is the threshold from which there is an agreement with the statements, namely, that action control has taken place and that plans were elaborated. As can be seen in Figure 1, the mean responses for both social-cognitive variables are not above 3. The Figure shows that the experimental group increased their means over time whereas the control group decreased or maintained its mean level. Thus, the experiment resulted in a clear increase in those variables in comparison to the control condition.

Mediation analysis

The serial mediation analysis addressed the question on how social-cognitive variables (operationalizing the behaviour change strategies) could contribute to understand

the working mechanisms underlying the experimental effects. Results are depicted in Figure 2.

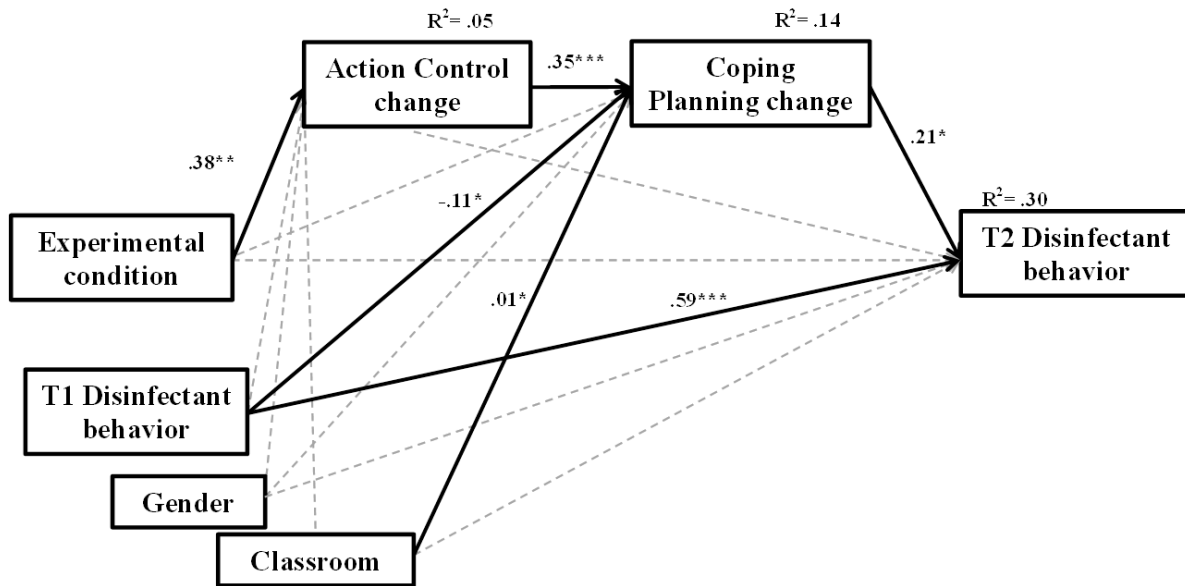


Figure 2. Indirect serial effects of the experimental condition on disinfectant behaviour via changes in action control and changes in coping planning, controlling for the effects of baseline behaviour, gender and cluster variable classroom on mediators and on the outcome. Unstandardized solution, bootstrapped with 5000 resamples. $N = 239$. $***p < .001$, $**p < .01$, $*p < .05$.

The experimental condition had an effect on the action control change score, $b = .38$, CI 95% [.15, .61]. Action control change had an effect on coping planning change, $b = .35$, CI 95% [.22, .48]. Subsequently, coping planning change had an effect on T2 disinfectant behaviour, $b = .21$, CI 95% [.04, .38].

Gender as a covariate and classroom as cluster variable had no effects on T2 behaviour. Baseline behaviour had an effect on coping planning change, $b = -.11$, CI 95% [-.21, -.02]. Classroom was significantly correlated with coping planning change, but smaller, $b = .01$, CI 95% [.00, .02]. The total indirect effect was $b = .08$, CI 95% [.00, .20], and the

indirect effect chain intervention → action control change → coping planning change → T2 behaviour was $b = .03$, CI 95% [.00, .08].

Discussion

Proper hand hygiene and disinfection behaviour is imperative for preventing the spread of different diseases. Previous studies have shown that most students do not perform the recommended behaviours at a sufficient level (Scheithauer et al., 2012). Therefore, this study investigated whether a brief planning intervention could increase social-cognitive predictors of disinfection behaviour and behaviour, too. The brief intervention produced changes in social-cognitive variables, confirming the regarding hypothesis (Hypothesis 2). It was sufficiently powerful to eliminate the difference found at baseline between conditions in action control. However, it was not sufficient to produce changes on behaviour over time, disproving the behavioural hypothesis (Hypothesis 1).

Social-cognitive variables stayed at a low and practically speaking at a “non-implementation level”. In the response format of the items used, a score of three or more means that the participant has elaborated plans or that he or she has performed action control strategies. Even though there was an increment in social-cognitive variables in the intervention condition, it did not surpass the minimum level of 3. Thus, on average changes in social-cognitive variables were not enough to produce changes in disinfectant behaviour over time.

Volitional variables, although frequently conceptualized in a temporal sequence, may work altogether as part of a self-regulatory mechanism and thus, some effects of putative posterior variables on putative precedent variables could be expected. This was

certainly found in the action control-planning relationship, where the former received effects from the last one, as suggested in the mediation analysis. By activating the self-regulatory strategies of action control, awareness of previously elaborated plans increases and then cue-response link may become stronger. Therefore an intervention on planning may increase planning via action control and, subsequently, behaviour, although these changes may not be sufficient to produce an interaction between time and treatment in disinfectant behaviour, as analysed with repeated measures ANOVA. However, there was certainly a mediation of social-cognitive variables between the intervention and disinfectant behaviour, confirming the regarding hypothesis (Hypothesis 3). Practically speaking, those study participants in the experimental group increasing action control and coping planning due to the intervention were also more likely to perform disinfection behaviour. This matched previous findings, that psychological interventions can change psychological outcomes and by these means also behaviour (e.g., Rejeski et al., 2014).

There are some limitations in the study. Assessments were self-reported, and disinfection behaviour was measured retrospectively. Retrospective methods are vulnerable to unintentional misreporting (e.g., due to recall errors). This could be overcome by using direct observation, where observers are selected and trained in order to produce valid data on quality and quantity of observations on hand hygiene behaviours on previously defined situations related with the health care process (Sax et al., 2009). However, such a measurement strategy is resource demanding and requires the existence of a closed setting, such as a hospital, where all possible occurrences of behaviour take place in a limited observable physical place. For university students, who could get in or out of the campus, this is hardly feasible.

Furthermore, the current study applied only a very brief intervention including only action planning and coping planning. In future studies, motivational constructs could be addressed (such as convincing students first, that disinfection behaviour is effective in preventing becoming ill) and other volitional variables (such as action control or self-efficacy).

In conclusion the present study explored the behaviour change strategies (planning and action control) that are supposed to translate intervention content into behavioural outcomes. The current intervention documented effects on these putative mediators but failed to result in visible changes in hand disinfection behaviours. This can be due to the parsimony of the treatment or to the sample of students as opposed to a sample of health care professionals. Recommendations from this study are: More brief planning interventions should be provided to change psychological mechanisms, which then make behaviour change more likely. Thus, to increase hand hygiene behaviour concrete planning of when, where and how to disinfect ones hands, and how to deal with barriers should be facilitated.

List of abbreviations

ANOVA	Analysis Of Variance
B	Unstandardized Coefficient
CI	Confidence Intervals
D	Cohen's d (Effect size)
e.g.	exempli gratia/ for example
F	F-statistic from F-test/ ANOVA
χ^2	Chi squared Test
η^2	Eta squared (Effect size)
M	Mean
MANOVA	Multiple Analyses Of Variance
N	Sample Size
P	p-Value
R ²	R squared (Explained Variance)

SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences software
T	t-Statistic from t-Test
T1	Measurement Point Time 1
T2	Measurement Point Time 2

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7

General Discussion

General Discussion

This dissertation aimed to further understand the role of social support, planning and action control in health behavior processes. The behaviors covered by the studies were fruit and vegetable intake, physical activity and exercise, and hand disinfection behavior. The samples included both young and older adults. The relevance of a healthy life style throughout the life span has been documented by a large body of empirical evidence (WHO, 2003, 2010). The findings highlight the applicability of the personal and social resources addressed. To facilitate the summary and discussion of findings, we classify them broadly into those concerning to the role of social support in health behavior processes and those concerning to self-regulation strategies, such as planning and action control.

Social support within motivational and volitional processes

Through the longitudinal studies reported in *chapters 2 and 3* of this dissertation, efforts were made to generate knowledge to better integrate social support within the motivational and volitional processes assumed by the HAPA. These studies were conducted with a sample of university students ($N = 473$, *chapter 2*) on fruit and vegetable intake, and with a sample of older adults ($N = 54$, *chapter 3*) on physical activity. Although in mainstream theories of health behavior, social support and contextual factors have been only vaguely included (Davis, Campbell, Hildon, Hobbs, & Michie, 2014), there is abundant evidence of the relevance of social factors for health behaviors (Darbes & Lewis, 2005; Gellert, Ziegelmann, Warner, & Schwarzer, 2011; Molloy, Dixon, Hamer, & Sniehotka, 2010). Thus, instead of theorizing individual self-regulatory variables and social factors as separated compartments of the health behavior process, integration is required.

In this regard, the reported studies made contributions concerning the understanding of how social and personal resources are integrated in motivational and volitional processes. As shown in *chapter 2*, by interacting with self-efficacy, received social support has an effect on intention, and thus plays a motivational role. The interplay of individual and social variables in this case led to a synergistic effect: as social support increased, the effect of self-efficacy on intention to consume fruit and vegetable became stronger.

The findings in *chapter 3* show that, by interacting with self-efficacy, received social support had an effect on action control, and thus played a volitional role too. Interestingly, the interaction here is with a motivational variable, but the effects are volitional. Paying attention only to the simple effects, self-efficacy and social support are positively associated to action control, but the effect of the interaction is negative: among those with less social support, the contribution of self-efficacy on action control is stronger. The interplay of individual and social factors is, in this case, compensatory. Then, *chapter 3* shows that self-efficacy can have an effect on a self-regulatory volitional variable, and how social support can moderate it.

Taken together, *chapter 2* and *3* show that social support interacted with self-efficacy and is beneficial either for the cognitive mediational variable or for health behaviors. In particular, social support synergistically moderates, and thus amplifies, the effects of self-efficacy in the onset of intentions and behavior. Social support also moderates in a compensatory way the onset of action control, besides the direct effect it could have.

One may wonder what these results mean in terms of social situational cues (Molloy et al., 2010). Persons with less personal resources (efficacy beliefs), would benefit the most from external social cues. Our results show that social support may lead to action control, and this suggests that social support provides cues for self-regulation.

These findings have to be interpreted under the light of recent studies on the role of social support within the HAPA. Scholz, Ochsner, Hornung, and Knoll (2013) found remarkable associations of social support with both, intention and low fat diet, even above the effects of several HAPA variables. Some important distinctions were made between instrumental and emotional support, and the role of sex was taken into account. For the prediction of intentions 12 months later, instrumental support was more beneficial for men than for women over and above individual self-regulation. Self-efficacy and positive outcome expectancies were associated with intention, but emotional support, and risk perceptions were not. For the prediction of dietary behavior at T2, effects of received instrumental support and action control emerged, but no effects of self-efficacy, intention and action planning were found. In the case of received emotional social support, only benefits for men were found, but not for women.

More recently, Ochsner et al. (2014) reported results on the role of social support within the HAPA. In this case the study was focused on volitional self-regulatory variables in smoking cessation. Social support moderated the association between volitional self-efficacy and smoking. It moderated the relationship between coping planning and smoking as well, however no moderation was found between action planning and smoking. Synergistic effects were found, given that high levels of the individual variables and social support were related to successful smoking cessation. Warner, Ziegelmann, Schüz, Wurm,

and Schwarzer (2011) have also reported synergistic effects of the interaction between self-efficacy and social support on physical exercise among older adults.

These results are somewhat concurring: within what can be considered a motivational process, social support was associated with the onset of intention in both, our findings (Reyes Fernandez, Warner, Knoll, Montenegro Montenegro, & Schwarzer, 2015b), and findings in other recent publications (Scholz et al., 2013), showing either direct associations or a moderation role. The distinctions between types of support, as well as differential effects by sex or gender, are aspects to take into account for future occasions. On the other hand, in what can be considered a volitional process, social support has shown effects on low-fat consumption behavior (Scholz et al., 2013), and has also shown synergistic effects when combined with self-efficacy and coping planning to predict smoking cessation Ochsner et al. (2014). Synergistic effects have also been found for physical exercise in older adults (Reyes Fernandez et al., 2015a). When moderation effects on a self-regulation variable are considered, it has been found that the interaction between self-efficacy and social support on action control led to compensation: those with low self-efficacy benefited the most from social support.

At first glance, then, received social support, although beneficial in motivational and volitional processes, may not have one single role or effect pattern, and its effect may vary depending on sex, type of support and behavior. From the categories of interaction effects provided by Schröder (1997), namely compensatory, synergistic and interference effects, the reported studies constitute examples for the first two. Future research has to examine how consistent the role of social support is for the different motivational and volitional variables, and among additional behaviors.

Self-regulation strategies: on the role of planning and action control.

The contribution of planning and action control was another issue addressed in this dissertation, reported specifically in *chapters 4, 5, and 6* for planning, and in *chapters 3, 4 and 6* for action control. *Chapter 3* has been already commented in this discussion section. Thus, *chapters 4, 5 and 6* are commented below.

When intention is not equipped with means to deal with obstacles, motivation alone does not suffice to change behavior, and therefore volitional strategies are needed. Planning, also known as ‘implementation intentions’ (Gollwitzer, 1999), has been pointed out as a key variable to bridge the so called intention-behavior gap (Sheeran, 2002; Sniehotta, Scholz, & Schwarzer, 2005). However, people who plan might not act or maintain behavior recently performed. Thus, there could be a narrower planning-behavior gap. For initiation and mostly for maintenance, action control might be crucial. In order to examine the contribution of planning and action control in the relationship between intention and physical exercise, a longitudinal study with university students ($N = 497$, *chapter 4*) was conducted and a serial mediation was carried out. The effects of intention, action and coping planning on behavior took place indirectly, via action control. The relevance of action control was then confirmed, because action control translated the effects coming from all these variables into behavior (Reyes Fernandez et al., 2015). Namely, when there is intention and when there are plans to perform a behavior, but there is no monitoring on current behavior, there is no awareness of standards and there is no self-regulatory effort, behavior might not take place.

This is of particular relevance if we take into account that some behaviors require regular performance to have an impact on health. These findings suggest that maintenance of behaviors requires constant proximate self-regulatory efforts, at least until a habit is

formed and less deliberative cognitions are needed (Fleig et al., 2013; Verplanken & Melkevik, 2008).

When interpreting these results it is useful to take into account the activity levels of the people, and particularly the stages proposed by Schwarzer (2008), who distinguishes between a motivational and volitional stage, and subdivides those in the volitional stage into the people who do not perform the target behavior yet, but intend to, called ‘intenders’, and those who perform the behavior, called ‘actors’, who might be looking for behavioral maintenance. It would be expected that some of the people with intentions were not actors, but the people who intend, plan and have higher action control should be actors. Thereafter, interventions on planning or action control are expected to be less useful for more active people, who would have high levels planning or action control.

To examine the effect of a planning intervention and its variation depending on initial exercise status, a study with university students ($N = 486$, *chapter 5*) was carried out. The brief intervention had overall effects, but the initial exercise level worked as a moderator: The intervention only increased exercise behavior among those with lower initial levels, and it was explained via action planning. This is congruent with what could be assumed based on the HAPA (Schwarzer, 2008).

These findings do not undermine the relevance of planning. Certainly planning is required to implement intentions, but if you are already active, planning where, when and how to perform a behavior do not add any useful information or strategy to increase behavior anymore.

How could the moderation be theoretically understood? As pointed out in the literature (Gollwitzer, 1999; Sniehotta, Schwarzer, Scholz, & Schüz, 2005), ‘if-then’ plans

contribute to set cue-response links. For action planning, the situational cues being defined are related to when, where and how to practice a behavior. For active participants action planning is redundant because they have already set these cue-response links. Although not measured, for some participants habituation might already have taken place, the cue-response is then automatic and therefore a conscious and deliberative strategy as planning is no longer needed (Verplanken & Orbell, 2003). Maybe a more refined intervention on action control would be useful for active persons, who are not yet habituated, but whose goals could point at improving performance or maintaining behavior in a long run.

Hagger and Luszczynska (2014) mention habit strength and cue accessibility (accessibility of the specified situation; Webb & Sheeran, 2007), among other variables, as possible moderators of the effect of planning interventions. The measurement of initial activity levels could be accompanied with some baseline assessment of habituation and cue accessibility to maximize intervention effects. Then, it might be possible to estimate the state of the cue-response links: for some people these links might not yet be established, for some other people it might be established, but still under conscious control, and for some other people it may be non-conscious and automatic.

When the cue-response links are not yet well established, plans could be forgotten and not applied. The role of action control has to be brought into discussion here again. As pointed out in *chapter 4*, action control can bridge the planning behavior gap. One possibility here is that action control contributes to making instructions contained in plans remain active.

In *chapter 6* the results of a cluster randomized intervention on hand disinfection behavior in university students ($N = 242$) were reported. The relationship between planning

and action control was examined once more. Interestingly, some indirect effect of the intervention on behavior was found, which worked inversely than usual: changes in action control led to changes in coping planning. Unfortunately, this was not enough to produce a significant change in behavior between conditions over time. However, it shed some light on self-regulation processes. Action control might increase the awareness of previously elaborated plans. For self-regulation of behavior prospective memory might be required, because it is the ability to remember to execute delayed intentions (Scullin, McDaniel, & Shelton, 2013). Goal intentions might be however too general, because they do not specify cue-response relationships. Therefore, health behavior may require prospective memory, not only of intention (Sniehotta, Nagy, Scholz, & Schwarzer, 2006), but also of specific plans, to be acted upon. Action control ensures in real time the performance of the instructions contained in intentions and plans. Thus, intentions, action control and plans should not be considered as separate variables, but as components of a general self-regulation mechanism, which has some memory requirements as well.

Personal and social resources of self-regulation working together

Summing up, the findings reported in the empirical chapters of this dissertation show a complementarity between social and personal resources of self-regulation. On the one hand, we found that social support plays motivational and volitional roles. In motivational processes it was found that it interacted synergistically with self-efficacy to increase intention. In volitional processes, it compensated for the lack of self-efficacy to produce action control. However, more research is required for a better understanding of the effects of the interplay between social support and personal resources on other variables

and behaviors from the Health Action Process Approach. On the other hand, concerning the intention-behavior gap and self-regulatory strategies, our observational and intervention studies provide further evidence of the contribution of spontaneous and experimentally induced planning. Even though these results are not completely comparable to those summarized by Carraro and Gaudreau (2013), because we also included action control in some studies, they certainly underscore the relevance of planning. However, planning seems not to work alone, but to require of action control. As seen, action control recalled coping plans to have an effect on behavior, and it also mediated the effects of intentions and plans on behavior. Thus, action control seems to be a variable at the top of the self-regulation process, and can be induced either by social or by personal resources.

Chapter	Aims & Hypotheses	Findings	Conclusions
2	<p>Self-efficacy predicts fruit and vegetable intake and intention.</p> <p>Intention is associated with fruit and vegetable intake and also mediates the effect of self-efficacy on fruit and vegetable intake.</p> <p>Social support not only predicts intention but is more strongly associated with intention if self-efficacy is above average as well – assuming a moderating effect. Put differently, supported individuals become intenders more easily and benefit more from being self-efficacious in terms of their fruit and vegetable intake.</p> <p>The study to address this is observational longitudinal.</p>	<p>Self-efficacy was positively associated with fruit and vegetable intake four weeks later, and intention mediated this process. Moreover an interaction between social support and self-efficacy on intention emerged.</p>	<p>The effect of self-efficacy on fruit and vegetable intake was fully mediated by the behavioral intention. Moreover, social support exhibited a moderating role within the motivational process: high social support appeared to accentuate the positive relationship between self-efficacy and dietary intention.</p>
3	<p>Self-efficacy predicts physical activity and action control.</p> <p>Action control predicts physical activity and explains the effect of self-efficacy on physical activity. This constitutes a mediation effect of action control between self-efficacy and physical activity.</p> <p>Received social support moderates the relationship between self-efficacy and action control. Individuals with lower levels of self-efficacy benefit more from social support than people with higher self-efficacy.</p> <p>The study to address this is observational longitudinal</p>	<p>Self-efficacy predicted physical activity and action control. Action control mediated between self-efficacy and physical activity. Social support was a moderator between self-efficacy and action control, pointing out a synergistic effect at the first stage of the mediating process.</p>	<p>The effect of self-efficacy on physical activity was partly explained by action control, providing evidence of action control as a proximal mediator of physical activity. Moreover, the moderator role of social support was confirmed: high social support appeared to compensate for low levels of self-efficacy.</p>
4	<p>Action planning, coping planning and action control mediate between intentions and physical exercise in a sequential order.</p> <p>Indirect effects of intentions on exercise via action control are higher than indirect effects via planning only.</p> <p>The indirect effects of intention via action planning or coping planning on physical exercise are fully mediated by action control.</p>	<p>A sequential mediation of action planning, coping planning and action control between intention and exercise was found. Indirect effects via merely action control were higher than effects merely via planning. Intention and planning were not directly related with exercise, but indirectly via action control.</p>	<p>Findings supported the theory-based sequential order for planning and action control as mediating antecedents of physical exercise. Moreover, action control bridged the planning-behavior gap. When young adults maintain their exercise levels, then this may be partly attributed to effective self-regulatory strategies.</p>

	The study to address this is observational longitudinal	Thus, a full mediation of action control between planning and behavior took place.	
5	<p>A planning intervention increases planning levels, particularly in less active individuals.</p> <p>This should be reflected by a mediation chain where the intervention has effects on the amounts of exercise later on via action planning.</p> <p>Moreover, in a mediation model, the effect of the intervention on subsequent action planning would be moderated by the levels of exercise at baseline.</p>	<p>The intervention had an overall effect on exercise levels. Splitting the sample into high and low baseline exercise level participants, the effect remained only for the less active subsample. Action planning mediated the effect of the intervention on exercise, and the baseline exercise level moderated this pathway.</p>	<p>Action planning appeared as a useful self-regulatory strategy for less active young persons. Therefore, the initial level of exercise should be taken into account when designing self-regulatory exercise interventions.</p>
6	<p>The intervention will increase disinfectant behavior.</p> <p>The intervention will produce changes in psychological variables, namely planning and action control.</p> <p>Changes in planning and action control, specified as mediators, will explain individual differences in behavior.</p>	<p>The brief intervention produced changes in social-cognitive variables.</p> <p>It was sufficiently powerful to eliminate the difference found at baseline between conditions in action control. However, it was not sufficient to produce changes on behavior over time.</p> <p>There was a mediation of social-cognitive variables between the intervention and disinfectant behavior, where actually changes in action control led to changes in coping planning.</p>	<p>The brief intervention produced changes in self-regulation strategies which were, however, not enough to produce changes at the behavioral level. Nevertheless, the baseline difference in action control was eliminated, and an increase in action control produced awareness of coping plans which had an effect on behavior.</p>

Table 1. Summary of hypotheses and main findings in the studies included in this dissertation

Implications

Implications at the theoretical and methodological level have to be mentioned, as well as possible research pathways in the future and implications for the practice. Some of them deal with important conceptual distinctions, and go beyond the empirical grounds of the studies reported, but should be considered for future research.

At the *theoretical level* several implications can be mentioned. One may wonder, for instance, what it means that the interaction between social support and self-efficacy, which corresponds to a pre-intentional stage, has an effect on a volitional variable without passing through intention, as reported in *chapter 3*. Part of the effect of motivational variables on volition might be direct and not via intention. In this case, the interpretation of the HAPA as an implicit stages model seems to prevail (Schwarzer, 2008). Future studies might include intention and a stage measure to better understand this. There is still much to be clarified concerning the way stages work, how are the relationships among variables within stages and between stages, and how exactly should a mind-set be to lead to a transition.

Chapter 4 shows how a sequence from intention, planning, and action control to behavior is possible, and suggests that action control is a key variable, carrying a summary of instructions to perform self-regulation on real time. However, based on *chapter 6*, not only a sequence from planning to action control is possible, but the inverse sequence too. Certainly these results need to be replicated, but if this alternative sequence is possible, one might wonder which other variables could be affected. Could an action control intervention increase also intention strength or stability? Could it affect action self-efficacy? Maybe effects in an alternative sequence are only possible within stages, suggesting the existence of hard stage limits. Sniehotta et al. (2006) have shown, for instance, how action control

predicts changes in intentions. Under which circumstances do these alternative sequences take place? It could be assumed that action control only recall intentions and plans among those who have elaborated them already in the past. It would be useful to distinguish between plan recall and plan elaboration, although this is a methodological and measurement challenge.

Along the present dissertation several conceptual equivalences have been assumed. We have taken implementation intentions and planning as meaning basically the same. Action and coping planning are only subtypes of planning. Moreover, we have used the terms ‘planning’ and ‘plan’ as equivalent. Other authors have recently created new terms, and used them as expressing the same, such as Carraro (2015) and the term ‘implementation plans’. However, this abundance of undifferentiated terms may lead to confusion. Sniehotta’s (2009) commentary on the need of disentangle constructs is worth for discussion here. Special attention deserves his distinction between provided and self-elaborated plans. From his perspective, in the tradition of implementation intentions research, plans are usually provided by the experimenter. However, in many studies on health behavior change *planning* refers to a task where participants are asked to elaborate their own plans. In both cases, there are instructions given by a researcher or experimenter, but in one of this cases plans are fully provided beforehand and in the other plans are self-elaborated. Sniehotta (2009) holds that self-elaborated plans create more variability than plans provided by others.

Carraro and Gaudreau (2013) also make an interesting distinction about the process of elaborating plans. They assume that, when correlational data is used and plans are only self-reported, then spontaneous planning takes place; while when findings are based on an

experiment, planning is induced. At a first glance, one could confuse the distinction posed by Sniehotta (2009) with that one by Carraro and Gaudreau (2013). Further conceptual refinement needs to be done. Both categories proposed by Sniehotta (2009) are ‘researcher induced plans’. Moreover, correlational data, classified by Carraro and Gaudreau (2013) as indicating spontaneous planning may reflect either self-made plans or plans elaborated with or by others (friends, relatives), something not necessarily addressed, measured and reported in studies. We consider that a distinction between four categories is more adequate to describe the planning process: (1) spontaneous ‘self-made’ plans, (2) spontaneous plans suggested by others, (3) researcher induced ‘self-made’ plans, and (4) researcher induced and fully provided plans. These distinctions point to only one question: who elaborates the plans? These categories implicitly recognize that a distinction between plans (product) and planning (process) must be done.

We want to go one step further. Given that when we measure plans/planning very few information on the plan characteristics is collected, it is unknown how much of a plan is a product of a new elaboration process, and how much is only a recall. Plans being used now might be a copy of previously elaborated plans, or they could be new and recently elaborated plans. Unfortunately, from our measures we do not know how much of the coping plans activated after action control, as reported in *chapter 6*, is a product of a new elaboration or is just a copy of previous plans. If action control has a self-regulatory function, it would be expectable that the feedback it provides contributes to adapt and reformulate plans. The circumstances under which action control may have an effect on other volitional variables, and the extent of these effects, needs to be further studied. For the study of the relationship between action control and volitional variables, the distinctions

between plans and planning, and its process of elaboration or recalling should be taken into account.

The role of social support within motivational and volitional processes, which, as seen in *chapters 2 and 3*, can be that of a moderator variable, might be clarified as the relationship between self-regulatory variables becomes better understood. Social support has shown effects on intentions and behavior above the effects of other HAPA variables (Scholz et al., 2013). It would be interesting to examine whether these effects are different for spontaneous versus experimentally induced self-regulation strategies, or for self-made versus strategies elaborated by others. When doing so, other social exchange constructs may be taken into account, such as social control or dyadic planning or, for those having a partner, relationship satisfaction (Berkman, Glass, Brissette, & Seeman, 2000; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011). Gender and specific subtypes of support should also be considered when examining these relationships between social support and health behavior models (Luescher et al., 2014; Scholz et al., 2013). Another possibility to take into account is a variation of social support based on activity levels. Just as planning strategies did not seem to be useful for highly active participants; social support may not be useful for active people, who might not profit from it either as a motivational resource or as a social cue resource. Research in this direction is required.

Some limitations are shared by the dissertation studies, concerning measurement and design issues. Self-report was used for all the behaviors studied, which may include some problems due to recall bias. Thus, objective measures are recommended for future research. Moreover, only two measurement times were included, even when some assumed relationships between variables would require more time to take place. From the

five studies, only two intervention studies were reported, and thus inferences on causality for the other three have to be taken carefully. All these limitations are already commented in their respective chapters. However, it is important to bring them into the discussion again when implications at the *methodological level* are to be mentioned. As pointed out in the introduction section, the Health Action Process Approach is a stage model of behavior change. Even though there was no measurement of stages in our studies, the idea of sequence in a theoretical meaningful direction, from motivation to volition and behavior, was there. However, with two measurement points some relationships can only be cross-sectionally analyzed. As pointed out by Gollob and Reichardt (1987) cross-sectional studies assume (1) that there are instantaneous effects, (2) that antecedent variables do not influence the examined phenomenon (variables which could be included as covariates if there were more measurement points), and (3) that the magnitude of effects is constant. Certainly, one could expect that in a health behavior change process not every effect is instantaneous, several variables could antecede several subsequent processes, and the magnitude of an effect might not be constant. Thus, cross-sectional data is not adequate for studying health behavior change theories. The more measurement points are collected, the less dependent is the analysis on these assumptions. Additionally, more measurement points open the possibility of looking for patterns of change.

However, even if data were longitudinal, one has to be careful with causal inferences. Stronger evidence for causality requires experimental designs. From five empirical chapters, only two report intervention results. Evidence of effects of action and coping planning either on behavior or other self-regulatory variables was found (*chapters 5 and 6* respectively), as expected from our theoretical assumptions. Nevertheless, for hand

disinfectant behavior, changes took place only at the level of self-regulatory strategies, and not at the level of behavior. The levels at which cognitive or self-regulatory variables lead to a behavioral change are not yet well known. The other empirical *chapters* (2 to 4) reported longitudinal studies whose results were based either on conditional indirect process analysis or on serial mediation analysis. They are informative, because they tell how one variable may affect another one and for whom this takes place. Moreover, they all provided bootstrapped confidence intervals for the direct and indirect effects reported. Confidence intervals are considered to be more informative than significance levels (Cumming, 2012). Additionally, bootstrapped confidence intervals do not require normality assumptions and are therefore adequate for conditional indirect models (Hayes, 2013). However, in spite of these methodological strengths, the relationships found between variables should also be tested experimentally so that stronger evidence for causal inferences can be collected. Full factorial experiments could be considered for these purposes. Also, more follow up measures could be useful to examine intervention effects over the time.

Some implications *at the level of future research topics* can also be mentioned. The studies conducted cover three behaviors examined among young university students and older adults in Costa Rica. Generally speaking, findings suggest that the HAPA works in this context too. Different sample subgroups and contextual variables could be explicitly studied. For instance, cultural differences for social support have been reported (Chen, Kim, Mojaverian, & Morling, 2012). Latin American cultures have been characterized as collectivistic (Gupta, Hanges, & Dorfman, 2002). Our findings on the motivational and volitional roles of social support might be somewhat influenced by these cultural

differences. Findings might vary not only compared to those based on European or American samples, but within Latin America, comparing for instance “mestizo” and indigenous patterns of social support. Research in this direction is needed.

Moreover, studies with different age samples, besides older and younger adults, would be useful to look for life span patterns of health behavior related cognitions and self-regulation (Gellert, Ziegelmann, Reuter, Wiedemann, & Schuz, 2009; Ziegelmann & Lippke, 2007). In our studies all participants were taking part in educational programs, and we could expect it provided them with similar setting characteristics. Samples from different settings have to be collected, and environmental characteristics should be taken into account, such as availability of resources, places or opportunities to perform studied health behaviors. Contextual variables are traditionally not included explicitly in mainstream health behavior theories (Davis et al., 2014). Other social exchange process could also be taken into account.

The role of action control, and particularly its effect on other self-regulatory variables, should be further studied. For this purpose, distinctions such as that one between planning and plans, spontaneous and experimentally induced plans, as well as between self-made plans or plans provided by others could be considered.

The integration of social sources within health behavior models requires also further research. If social support can lead to intention setting and action control, it can be somehow related with prospective memories and then with cue-response links. However, social cues are not usually included in measures of planning. Thus, the relationship of social support with different variables of the Health Action Process Approach has to be

further clarified, and these variables should be operationalized in order to contemplate possible social influences. More studies on the role of social support for HAPA variables would enable later on reviews and meta-analysis on this topic, for more sounding conclusions on this topic.

Some *implications for practice* should also be mentioned. Social support, self-efficacy, intention, action and coping planning, as well as action control are variables to be considered to improve health behaviors such as physical activity, hand hygiene and fruit and vegetable intake. Multiplier effects of social support should be taken into account. Given that social support seems to amplify motivation when interacting with self-efficacy, but also compensate lack of self-efficacy when it comes to increase volitional self-regulatory strategies, it is apparent that receiving support is beneficial, and then its inclusion in psychosocial interventions is recommended. Although literature shows that providing social support might be threatening for personal resources, if it is perceived as a message of lack of capacity for coping without aid (Nadler & Fisher, 1986), it is mainly advisable to provide support for health behaviors, either during motivational or during volitional processes. One should be careful, at the functional level, of identifying the support needs of the recipient. As shown in this dissertation, low efficacious persons deserve particular attention, as they would benefit the most from social support. Thus, before the implementation of interventions, screening strategies to assess personal and social resources are recommended. Such screening efforts could also be beneficial for the planning of public health policies.

Our results also point to the complementarity of planning and action control. When implementing interventions, elaboration of plans might not be enough to translate

intentions in behavior. More proximate self-regulatory strategies could be required. Monitoring of every day practices by means of a calendar can be helpful. Also, there can be an effect of social support on action control, as seen in chapter 3. Thus, instead of depending on a calendar, friends or relatives could help to monitor the performance of the target behavior. Initial activity status of participants should also be taken into account. For people who already have plans and are active, more specific intervention objectives could be elaborated.

Nevertheless, in spite of the research yet to be done, the studies reported in this dissertation constitute support for the HAPA as a sound model useful to understanding different behaviors in a different cultural context and among different age groups, and shed some light on how social support could be integrated in a health behavior theory.

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Curriculum Vitae

Benjamín Reyes Fernández

For reasons of data protection,
the curriculum vitae is not included in the online version

List of Publications

Journal articles

Under review in peer reviewed journals

- Reyes Fernández, B., Lippke, S., Knoll, N., Blanca Moya, E., Schwarzer, R. (under review). A brief planning intervention improves disinfection behaviour change strategies. *Manuscript submitted for publication*
- Reyes Fernández, B., Luszczynska, A., Knoll, N., Montenegro-Montenegro, E., & Schwarzer, R. (under review). A brief action planning intervention increases physical exercise among less active college students. *Manuscript submitted for publication*

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Erklärung

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

Benjamín Reyes Fernández

Berlin, April 2015