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# The Role of Depressive Symptoms in the Process of Health Behavior Change

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# Abstract

Health behaviors such as physical exercise and a healthy diet are essential for the primary and secondary prevention of chronic diseases. Common theories use social-cognitive variables to predict the adoption and maintenance of health behaviors, particularly self-regulatory strategies. One factor, however, that might further explain why some individuals fail to engage in health behaviors is a person's affective state, e.g., the experience of depressive symptoms. The incident of depressive symptoms is increasing across the globe and these symptoms might interfere with central determinants of the engagement in health behaviors. So far research has given little attention to the role of depressive symptoms in the process of health behavior change. This thesis aims to close this gap.

This dissertation investigates *whether* poor health behaviors are associated with depressive symptoms. Because it is well known that exercise improves both mental and physical health, an emphasis is placed on the adoption and maintenance of physical exercise. Given the central role of social-cognitive variables for engagement in exercise, it is examined *how* depressive symptoms conflict with these psychological determinants. Finally, the question is raised whether a self-regulatory intervention can *promote* exercise in individuals with and without depressive symptoms.

Results from this dissertation provide evidence that depressive symptoms are associated with frequent alcohol consumption, facets of unhealthy dieting, as well as with poor levels of exercise. Moreover, findings reveal that depressive symptoms interfere with the psychological mechanisms of exercise engagement: Less positive outcome expectancies regarding exercise and a lack of positive exercise experience seem to partly explain why individuals with depressive symptoms are less likely to perform the behavior. Further, depressive symptoms were found to hamper the use of self-regulatory strategies. Results also suggest that individuals with depressive symptoms do not benefit from a common exercise self-regulation intervention in the same way that individuals without depressive symptoms do.

From a theoretical point of view, this thesis shows that, in addition to social-cognitive variables, a person's negative affective state predicts processes of health behavior change. Practically, findings indicate that depressive symptoms should be recognized within primary and secondary care settings, and that unhealthy habits need to be addressed in this target group specifically. Health behavior interventions might benefit from paying attention to particular needs of individuals with depressive symptoms, e.g., by considering their fewer self-regulatory resources.

# Zusammenfassung


## Depressive Symptome und ihre Bedeutung bei dem Prozess der Gesundheitsverhaltensänderung

Die Krankheitslast in industrialisierten Ländern des 21. Jahrhundert ist gekennzeichnet durch nicht übertragbare, chronische Krankheiten, wie Herz-Kreislauf- und Muskelskeletterkrankungen (Vavken & Dorotka, 2011; Weltgesundheitsorganisation; WHO, 2008). Wissenschaftliche Studien zeigen, dass ein gesunder Lebensstil einen entscheidenden Einflussfaktor für die Entwicklung und den Verlauf dieser Krankheiten darstellt (Fisher et al., 2011). Sich gesund zu verhalten, wie z.B. regelmäßig körperlich aktiv zu sein und sich gesund zu ernähren, ist für die meisten Menschen jedoch eine schwierige Aufgabe. Im Fokus der Wissenschaft steht daher seit einiger Zeit die Frage, was Menschen dazu bringt gesund zu leben bzw. was sie davon abhält und wie ein gesunder Lebensstil gefördert werden kann. Die Disziplin der Gesundheitspsychologie untersucht psychologische Determinanten, die eine Aufnahme und Aufrechterhaltung von Gesundheitsverhaltensweisen erklären und fördern können. Bisherige Theorien und empirische Studien haben vor allem herausgestellt, dass sozial-kognitive Determinanten relevant dafür sind, ob Menschen gesundheitlich aktiv sind (Armitage & Conner, 2000). Wichtige sozial-kognitive Determinanten sind zum Beispiel Ergebniserwartungen in Bezug auf ein konkretes Gesundheitsverhalten (Bandura, 1997; Schwarzer, 2008), die Intention das Verhalten auszuführen, wie auch selbstregulative Strategien, um eine Absicht in Verhalten umzusetzen (Schwarzer, 2008). Letztlich haben auch Erfahrungen mit dem Gesundheitsverhalten einen Einfluss darauf, ob Menschen regelmäßig aktiv werden (Fuchs, Göhner & Seelig, 2011; Rothman, 2000). Da neueste Erkenntnisse aus der Forschung vor allem die Wichtigkeit von selbstregulativen Prozessen, wie Handlungsplanung und Handlungskontrolle für die Ausübung von Gesundheitsverhalten in den Vordergrund stellt (Hagger, 2010), zielen Interventionen häufig auf die Förderung von selbstregulativen Fähigkeiten ab (z.B. Knittle, Maes & de Gucht, 2010).

Zusätzlich zu den chronischen körperlichen Erkrankungen wird weltweit eine rasante Zunahme von depressiven Symptomen verzeichnet (WHO, 2012). Der Anstieg von depressiven Symptomen ist in zweierlei Hinsicht besorgniserregend: Menschen mit depressiven Symptomen leiden nicht nur unter schwerwiegenden psychischen Belastungen, sondern auch ihr körperlicher Gesundheitszustand verschlechter sich oft (Moussavi, Chatterji, Verdes, Tandon, Patel & Ustun, 2007). Insbesondere wurden depressive Symptome mit der Prävalenz, der Entwicklung und dem Verlauf von chronischen Krankheiten in Zusammenhang gebracht (Katon, 2011). Auf der einen Seite können chronische Krankheiten depressive Symptome durch biologische Veränderungen und die psychologische Krankheitsbelastung evozieren. Die Prävalenz von depressiven Symptomen ist daher bei chronisch Kranken höher als in der Allgemeinbevölkerung (Katon, 2011). Auf der anderen Seite begünstigen depressive Symptome den negativen Verlauf von chronischen Krankheiten. Es wird angenommen, dass ungesunde Verhaltensweisen, wie zum Beispiel mangelnde körperliche Aktivität oder häufiger Alkoholkonsum, maßgeblich dafür verantwortlich sind, dass sich der physische Zustand von Personen mit depressiven Symptomen verschlechtert (Katon, 2011). Bisherige Forschung hat allerdings wenig Augenmerk darauf gerichtet, welche besonderen Schwierigkeiten Menschen mit depressiven Symptomen haben, gesundheitlich aktiv zu werden.

Folgende Forschungsfragen stehen daher im Fokus dieser Arbeit: Vor dem Hintergrund, dass depressive Symptome mit der Entwicklung von chronischen Krankheiten in Zusammenhang stehen, wird zunächst untersucht, *ob* depressive Symptome mit einem ungesunden Lebensstil in der normalen Bevölkerung einhergehen (1). Weil depressive Symptome zudem mit einem schlechten Verlauf von chronischen Krankheiten assoziiert sind, wird in einem zweiten Teil dieser Arbeit der Zusammenhang von einem gesunden Lebensstil und depressiven Symptomen bei medizinischen Rehabilitationspatienten in den Vordergrund gestellt (2). Konkreter wird der Frage nachgegangen, *wie* depressive Symptome sozial-

kognitive Determinanten, die für die Ausübung von Gesundheitsverhalten entscheidend sind, beinträchtigen und mit ihnen interagieren (2a). Schließlich ist es notwendig zu untersuchen, ob Interventionen Gesundheitsverhalten bei Personen mit depressiven Symptomen *fördern* können (2b).

Die Forschungsfragen dieser Arbeit werden in unterschiedlichen Stichproben und im korrelativen wie auch experimentellen Rahmen untersucht. Im ersten Teil dieser Arbeit werden Zusammenhänge zwischen depressiven Symptomen und verschiedenem Gesundheitsverhalten in einer besonderen Bevölkerungsstichprobe, der multiethnischen Population von Hawaii (USA), untersucht. Im zweiten Teil dieser Arbeit wird der gesunde Lebensstil von orthopädischen und kardiologischen Rehabilitationspatienten ergründet. Vor dem Hintergrund, dass körperliche Aktivität positive Effekte auf die körperliche und psychische Gesundheit hat (Fisher et al., 2011; Conn, 2010), wird der Fokus der Arbeit auf dieses Gesundheitsverhalten gesetzt. Es wird untersucht, welche Rolle Handlungsergebniserwartungen und Erfahrungen mit körperlicher Aktivität wie auch selbstregulative Strategien dabei spielen, dass Personen mit depressiven Symptomen Probleme haben, regelmäßige körperliche Aktivität auszuüben. Abschließend wird evaluiert, ob die Effektivität einer Intervention zur Förderung von körperlicher Aktivität durch depressive Symptome bei Teilnehmern beeinträchtigt wird.

Die einzelnen Kapitel dieser Dissertation können wie folgt zusammengefasst werden:

Im *Kapitel 1* wird der theoretische Hintergrund der Dissertation dargestellt und Forschungsfragen und Hypothesen aus Theorien und bisherigen empirischen Untersuchungen hergeleitet.

In den *Kapiteln 2-5* werden die vier empirischen Studien dieser Arbeit wiedergegeben.

Die empirische Untersuchung in *Kapitel 2* prüft, ob depressive Symptome mit häufigem Alkoholkonsum, Rauchen, körperlicher Aktivität und dem Ernährungsstil (Fast Food und Soft Drink Konsum, Fettkonsum wie auch Obst- und Gemüsekonsum), Stress und

dem subjektiven Gesundheitszustand in einer allgemeinen Bevölkerungsstichprobe zusammenhängen. Die Ergebnisse dieser Querschnittsstudie zeigen, dass Personen mit mehr depressiven Symptomen häufiger Alkohol trinken wie auch mehr Fast Food und fettiges Essen zu sich nehmen als Personen mit weniger depressiven Symptomen. Zusätzlich wird deutlich, dass erhöhter Stress und ein schlechter subjektiver Gesundheitszustand mit depressiven Symptomen einhergehen. Diese Studie dokumentiert also, dass depressive Symptome mit einem ungesunden Lebensstil in der Bevölkerung einhergehen und somit die Entwicklung von chronischen Krankheiten begünstigen können.

In *Kapitel 3* wird der Frage nachgegangen, ob depressive Symptome bei medizinischen Rehabilitationspatienten dazu führen, dass sie sechs Wochen nach der Rehabilitation weniger körperliche Aktivität ausüben und welche Bedeutung in diesem Zusammenhang positive Handlungsergebniserwartungen und positive Erfahrungen mit körperlicher Aktivität haben. Die Befunde dieser Längsschnittuntersuchung zeigen, dass Patienten mit stärkeren depressiven Symptomen nach der Rehabilitation weniger körperlich aktiv sind, geringere positive Handlungsergebniserwartungen im Bezug auf körperliche Aktivität haben und weniger positive Erfahrungen mit körperlicher Aktivität berichten als Personen mit weniger depressiven Symptomen. Eine multiple Mediationsanalyse verdeutlicht, dass depressive Symptome über einen sequenziellen Pfad von weniger positiven Erwartungen über weniger positive Erfahrungen zu geringerer körperlicher Aktivität führen. Das bedeutet, dass weniger positive Erwartungen weniger positive Erfahrungen fördern und diese mit weniger Verhalten einhergehen. Negative Denkmuster bei Personen mit depressiven Symptomen scheinen somit ungünstig auf sozial-kognitive Determinanten der Gesundheitsverhaltensausübung zu wirken.

*Kapitel 4* widmet sich der Frage, ob depressive Symptome mit selbstregulativen Prozessen, die zentral für die Ausübung von Gesundheitsverhalten sind, interferieren. Im Detail wird in einer Längsschnittstudie untersucht, ob depressive Symptome den Prozess

hemmen, dass eine Intention zur Ausübung von körperlicher Aktivität über Handlungskontrolle in Verhalten umgesetzt wird. Eine moderierte Mediationsanalyse zeigt, dass Personen mit weniger depressiven Symptomen ihre Intention zur Ausübung von körperlicher Aktivität nach der Rehabilitation mit Hilfe von Handlungskontrolle in Verhalten umsetzen. Personen mit mehr depressiven Symptomen gelingt dies jedoch nicht. Durch diese Ergebnisse wird deutlich, dass das Erleben von depressiven Symptomen essentielle selbstregulative Prozesse zur Ausübung von Gesundheitsverhalten behindert.

In *Kapitel 5* wird schließlich der Frage nachgegangen, ob eine gewöhnliche computergestützte Intervention zur Förderung von selbstregulativen Kompetenzen die körperliche Aktivität von Rehabilitationspatienten mit und ohne depressive Symptome gleichermaßen fördern kann. In der Intervention werden Teilnehmer dazu angeleitet, erstens detaillierte Handlungspläne für die Zeit nach der Rehabilitation zu erstellen und zweitens ihre Handlungskontrolle durch die Anwendung von Bewegungstagebüchern zu erhöhen. Die Evaluation des Interventionseffektes sechs Wochen nach der Rehabilitation zeigt, dass Teilnehmer ohne depressive Symptome ihr Verhalten durch die Selbstregulationsintervention steigern. Teilnehmer mit depressiven Symptomen in der Interventionsgruppe hingegen verringern ihre körperliche Aktivität. Eine gewöhnliche Intervention scheint somit nicht ausreichend zu sein, um die körperliche Aktivität von Personen mit depressiven Symptomen effektiv zu fördern.

In *Kapitel 6* werden die vier empirischen Studien zusammenfassend diskutiert, Limitationen der Studien aufgeführt und Implikationen für zukünftige Forschung und die Praxis erörtert.

Die empirischen Befunde dieser Dissertation untermauern, dass depressive Symptome in der allgemeinen Bevölkerung, als auch bei Personen mit chronischen Krankheiten mit schlechtem Gesundheitsverhalten einhergehen. Des Weiteren wird gezeigt, dass depressive Symptome mit zentralen Prozessen der Gesundheitsverhaltensänderung interferieren und

Personen mit depressiven Symptomen nicht von einer gewöhnlichen Gesundheitsverhaltensintervention profitieren. Insgesamt unterstreicht diese Arbeit daher, dass depressive Symptome ein Risiko bergen, ungesund zu leben. Vor dem Hintergrund, dass depressive Symptome rasant ansteigen (WHO, 2012), ist es wichtig, dass zukünftige Forschung und Praxis die Befunde dieser Arbeit aufgreifen und weiter vertiefen.

Aus den Ergebnissen dieser Arbeit können folgende Implikationen abgeleitet werden: Aus theoretischer Perspektive wird deutlich, dass ein negativer affektiver Zustand zusätzlich zu sozial-kognitiven Variablen erklären kann, warum es Personen nicht gelingt gesundheitlich aktiv zu werden. Gesundheitspsychologische Theorien sollten daher den Einfluss von negativem Affekt stärker berücksichtigen (Kleinert, Golenia & Lobinger, 2007). Weiterhin wird aus den Befunden dieser Dissertation deutlich, dass spezielle Programme zur Förderung von Gesundheitsverhalten für Personen mit depressiven Symptomen entwickelt werden müssen. Die Ergebnisse dieser Arbeit legen nahe, dass maßgeschneiderte Interventionen (Kreuter, Strecher & Glassman, 1999; Vickers, Nies, Patten, Dierkhising & Smith, 2006), welche die Schwierigkeiten von Personen mit depressiven Symptomen (z.B. geringe selbstregulative Kapazitäten und wenig positive Erfahrungen mit körperlicher Aktivität) im besonderen Maße berücksichtigen, konzeptioniert und auf ihre Effektivität hin evaluiert werden sollten. Um den Einfluss von depressiven Symptomen auf sozial-kognitive Determinanten für die Ausübung von Gesundheitsverhalten zu verringern, sollte auch geprüft werden, ob Programme effektiver sind, wenn sie zusätzliche Interventionskomponenten anbieten, die auf die Reduzierung von depressiven Symptomen abzielen (Hollon, Stewart & Strunk, 2006). Besonders bei Personen mit chronischen Krankheiten und komorbiden depressiven Symptomen kann ein integriertes Management von depressiven Symptomen und der chronischen Krankheit sinnvoll sein (Detweiler-Bedell, Friedman, Leventhal, Miller & Leventhal, 2008). Die Effektivität von maßgeschneiderten Programmen und integrierten Ansätzen gilt es in der Zukunft systematisch zu untersuchen. Nur durch die Entwicklung von

effektiven Interventionen können Personen mit depressiven Symptomen nachhaltig unterstützt werden einen gesunden Lebensstil aufzubauen.

# Referenzen

Armitage, C. J. & Conner, M. (2000). Social cognition models and health behavior: A structured review. *Psychology & Health*, 15, 173.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Detweiler-Bedell, J. B., Friedman, M. A., Leventhal, H., Miller, I. W., & Leventhal, E. A. (2008). Integrating co-morbid depression and chronic physical disease management: Identifying and resolving failures in self-regulation. *Clinical Psychology Review*, 28, 1426-1446.

Fisher, E. B., Fitzgibbon, M. L., Glasgow, R.E., Haire-Joshu, D., Hayman, L. L., Kaplan, R. M., Nanney, M. S., & Ockene, J. K. (2011). Behavior matters. *American Journal of Preventive Medicine*, 40, 15-30.

Fuchs, R., Göhner, W., & Seelig, H. (2011). Long-term effects of a psychological group intervention on physical exercise and health: The MoVo concept. *Journal of Physical Activity and Health*, 8, 794-803

Hagger, M. (2010). Editoral: Self-regulation: an important construct in health psychology research and practice. *Health Psychology Review*, 4, 57-65

Katon, W. J. (2011). Epidemiology and treatment of depression in patients with chronic medical illness. *Dialogues In Clinical Neuroscience*, 13, 7-23.

Kleinert, J., Golenia, M. & Lobinger, B. (2007). Emotionale Prozesse im Bereich der Planung und Realisierung von Gesundheitshandlungen. *Zeitschrift für Sportpsychologie*, 14, 4-50.

Knittle, K., Maes, S., & de Gucht, V. (2010). Psychological interventions for rheumatoid arthritis: Examining the role of self-regulation with a systematic review and meta-analysis of randomized controlled trials. *Arthritis Care & Research*, 62, 1460-1472.

Kreuter, M.W., Strecher, V. J., & Glassman, B. (1999). One size does not fit all: The case for tailoring print materials. *Annals of Behavioral Medicine*, 21, 276-283.

Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology*, 19, 64-69.

Vavken, P. & Dorotka, R. (2011). Burden of musculoskeletal disease and its determination by urbanicity, socioeconomic status, age, and sex: Results from 14,507 subjects. *Arthritis Care & Research*, 63, 1558-1564.

Vickers, K. S., Nies, M. A., Patten, C. A., Dierkhising, R., & Smith, S. A. (2006). Patients with diabetes and depression may need additional support for exercise. *American Journal of Health Behavior*, 30, 353-362.

# 1

# Introduction

# Introduction

The burden of diseases in highly industrialized countries is dominated by non-communicable chronic health conditions such as cardiovascular and musculoskeletal diseases (Vavken & Dorotka; 2011; World Health Organization; WHO, 2008). Chronic diseases are the leading cause of disabilities in the United States (McKenna, Michaud, Murray, & Marks, 2005), a fact that also holds true for the population in Germany. Due to cardiovascular and musculoskeletal diseases, nearly one million German adults participated in medical rehabilitation in 2010 (Deutsche Rentenversicherung, DRV, 2012). This astonishingly large number of individuals suffering from chronic diseases results in high costs for societies.

Health behaviors play a crucial role in the "development, prevention, treatment, and management of the preventable manifestations of diseases" (Fisher et al., 2011, pp. 15). The process of health behavior change has therefore been extensively studied. Research has specified the importance of social-cognitive determinants for the adoption and maintenance of health behaviors (Armitage & Conner, 2000; Schwarzer, 2011). Among others, the role of self-regulation for health behavior change has become a main focal point of research (Hagger, 2010) and intervention practice (e.g., Knittle, Maes, & de Gucht, 2010).

In addition to chronic diseases, depressive symptoms represent a primary health risk for individuals. Depressive symptoms are currently the fourth leading contributor to the global burden of diseases worldwide, and prognoses suggest that depressive symptoms will reach second place in the year 2020 (WHO, 2012). During the last 10 years, mental health problems have become the leading reason for premature retirement in Germany (Bundespsychotherapeutenkammer, 2011). From a public health perspective, an increase of depression is alarming as the experience of depressive symptoms implies not only a decrease in psychological well-being, but also a higher prevalence of chronic diseases (Moussavi, Chatterji, Verdes, Tandon, Patel, & Ustun, 2007). Less engagement in health behaviors might partly explain the link between depressive symptoms and chronic diseases (Katon, 2011).

Depressive persons might be at a particular risk of developing chronic diseases due to engagement in health risk behaviors (Katon, 2011). Thus, it is important to illuminate which health behaviors are related to depressive symptoms in rather physically healthy individuals, for example in the general population. Further, depressive symptoms might lead to a worse course of chronic diseases due to health risk behaviors (Katon, 2011). Hence, the link between depressive symptoms and health behaviors is also important in individuals with chronic diseases. From a health psychology perspective, it is crucial to profoundly understand why persons dealing with depressive symptoms fail to adapt and maintain health behaviors. The questions to consider include, how do depressive symptoms interfere with the psychological mechanisms of health behavior change? What are specific problems that these individuals face? Can interventions promote health behavior change in persons suffering from depressive symptoms? Thus far, research has given little attention to these questions. This thesis aims to close this gap.

Taking into account the central role of health behaviors for the prevention and treatment of chronic diseases, this thesis focuses on the link between depressive symptoms and health behaviors in different samples of individuals. First, it is investigated *whether* depressive symptoms are associated with several health behaviors in a general population sample. Due to the high prevalence of depressive symptoms in individuals with chronic diseases, the focus is then shifted to persons with chronic diseases, i.e. medical rehabilitation patients. Because it is well known that exercise improves both mental and physical health (Conn, 2010; Fisher et al., 2011), an emphasis is placed on the adoption and maintenance of exercise in medical rehabilitation patients. In more detail, the questions of *how* depressive symptoms interfere with social-cognitive determinants of exercise, and whether a self-regulatory intervention can *promote* exercise in persons with depressive symptoms are considered.

## Health Behaviors as a Key in Primary and Secondary Prevention of Chronic Diseases

Performing physical exercise on a regular basis, healthy dieting, reduced alcohol consumption, as well as not smoking, represent important health behaviors. Numerous studies have revealed that these behaviors are essential for the primary and secondary prevention of chronic diseases (Fischer et al., 2011). Within secondary prevention of cardiovascular diseases (Taylor et al., 2004) and orthopedic health problems (Conn, Hafdahl, Minor, & Nielsen, 2008; Henchoz & Kai-Lik So, 2008), exercise was found to improve health outcomes to a particularly high degree. Therefore, regular exercise performance has become an indispensable component of disease management in orthopedic and cardiac rehabilitation (e.g., American Academy of Orthopedic Surgeons, 2009; European Society of Cardiology, 2007). Nevertheless, adhering to exercise recommendations beyond the hospital setting poses a major challenge for most rehabilitation patients (e.g., Reuter, Ziegelmann, Lippke, & Schwarzer, 2009). Due to the fact that individuals experiencing large difficulties in adopting and maintaining a healthy lifestyle, the psychological processes of health behavior change need be understood.

## The Process of Health Behavior Change

The discipline of health psychology addresses psychological processes that are able to explain engagement in health behaviors. Numerous theories have been postulated that refer to the importance of social-cognitive predictors for the adoption and maintenance of health behaviors (Armitage & Conner, 2000).

In theory, social-cognitive factors that may improve motivation, and those that predict actual behavior performance are distinguished (Heckhausen, 1991; Schwarzer, 2011). Within the motivational phase of health behavior change, among other variables, *outcome expectancies* are important (Bandura, 1997; Schwarzer, 2008). In the volitional phase, self-regulatory strategies are essential for translating *intentions* for behavior change into actual behavioral performance. In the last few decades, research in health psychology has

increasingly pointed towards the central role of self-regulatory processes for health behavior change (Norman, Abraham, Conner, 2002). Self-regulation is defined as any effort an organism undertakes to alter its own response (Carver & Scheier, 1998), and is of importance during non-routinized goal-directed behavior. Self-regulation is also referred to as "the exercise of control over oneself, especially with regard to bringing the self into line with preferred (thus, regular) standards" (Vohs & Baumeister, 2004, pp.2). Two core self-regulatory strategies are *action planning* and *action control* (Hagger, 2010). However, a further predictor in the volitional phase might be *outcome experiences* (Fuchs, Göhner, & Seelig, 2011; Rothman, 2000).

In the following, motivational and volitional social-cognitive constructs, which are subject of this thesis, are introduced in more detail.

***Social-Cognitive Determinants of Health Behavior Change***

*Outcome expectancies* are generally defined as expectations that a certain outcome will follow a given behavior (e.g., "If I engage in exercise on a regular basis, then I will improve my health"). Outcome expectancies can refer to social, physical, and emotional aspects (Schwarzer, 2008). Theories, such as the health action process approach (HAPA; Schwarzer, 2008) and the social-cognitive theory (SCT; Bandura, 1997), conceptualize outcome expectancies as a substantial determinant in the motivational phase of health behavior change. Meta-analytic findings have shown that positive outcome expectancies are a predictor for physical exercise behavior (Williams, Anderson, & Winett; 2005). However, outcome expectancies might affect behavior indirectly via other social-cognitive variables.

*Behavior intentions* refer to personal goals and reflect the overall effort a person wants to invest in pursuing a specific behavior (Hagger, 2010). Intentions are strongly correlated with self-regulation (Hagger, 2010), and can be either self-imposed or imposed by others (Schwarzer, 2008). Within the SCT (Bandura, 1997), intentions are specified as direct predictors of behavior. Intentions, however, do not guarantee the implementation of behavior

(Sheeran, 2002). Self-regulatory strategies, such as action planning, represent more proximal predictors of behavior (Schwarzer, 2008).

*Action planning* includes details of action implementation (Gollwitzer & Oettingen, 2011; Schwarzer, 2008). In other words, action planning refers to what, when, and where a behavior is to be performed. The HAPA posits that intentions are translated into behavior via such detailed planning (Schwarzer, 2008). Empirical evidence has documented this mediating role of planning (e.g., Conner, Sandberg, & Norman, 2010; Lippke, Ziegelmann, & Schwarzer, 2004a; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). It should be noted, however, that planning is a prospective strategy (i.e., ex-situ strategy), as plans are generated before a situation is encountered.

In contrast to planning, *action control* becomes relevant during behavioral enactment, and is therefore referred to as an in-situ strategy. Action control subsumes three facets: (1) awareness of standards, (2) self-monitoring, and (3) self-regulatory effort (Sniehotta, Scholz, & Schwarzer, 2005). Standards (i.e., goals) guide the direction of a behavior, and need to be permanently present. Memory processes constantly activate these standards and attention is required to focus on them. Self-monitoring refers to the continuous comparison of ongoing behavior and set goals. With the help of mental feedback loops discrepancies are detected and behavior can be adapted. Finally, self-regulatory effort is needed to adhere to one's standards. Previous studies have proven the efficiency of action control in translating intentions into behavior (Scholz, Nagy, Göhner, Luszczynska, & Kliegel, 2009; Sniehotta et al., 2005).

*Outcome experiences* reflect personal consequences of a particular behavior (Fuchs, et al., 2011), for example "When I was physically active, I felt free of worries afterwards". Outcome experiences can also be divided into social, physical, and emotional experiences (Fleig, Lippke, Pomp, & Schwarzer, 2011). Within the motivation volition process model (MoVo process model; Fuchs et al., 2011) and the framework of behavior maintenance (Rothman, 2000), experiences are assumed to be important for the maintenance of behavior.

Although this construct has been minimally investigated so far, some research indicates the predictive value of positive experiences for the maintenance of exercise (Fleig et al., 2011).

To conclude, theory and empirical research have exposed a broad range of valuable determinants for health behavior change. This thesis focuses on the interplay of motivational and volitional factors in the process of health behavior change regarding exercise. Specifying theoretical determinants of health behavior change presents a first step. In a second step, interventions need to be designed to address those determinants.

### *Self-Regulatory Interventions*

Existing theories specify health behavior change determinants that are targeted by health behavior change techniques in interventions (Michie et al., 2011). Meta-analyses (e.g., Knittle et al., 2010) provide solid documentation showing the benefits of promoting self-regulatory strategies for health behavior change. Further, practical guidelines (e.g., for orthopedic and cardiac rehabilitation; Reese, Jäckel, Mittag, et al., 2012a, 2012b) explicitly include recommendations that foster self-regulatory strategies in order to promote exercise. Common self-regulatory strategies involve prompting individuals to generate detailed behavior plans (in order to enhance the use of planning) and to self-monitor behavior via diaries (in order to increase action control; Michie et al., 2011). Generating behavioral plans (e.g., Gollwitzer & Sheeran, 2006; Lippke, Ziegelmann, & Schwarzer, 2004b) and self-monitoring behavior (Schüz, Sniehotta, & Schwarzer, 2007; Sniehotta et al., 2005) have been proven to facilitate behavior change.

In sum, the significance of social-cognitive predictors for health behavior change has been well documented. A person's affective state, however, might be a further predictor for engagement in health behavior (Kleinert, Golenia, & Lobinger, 2007). A wide spread affective state is the experience of depressive symptoms (WHO, 2012). Depressive symptoms were found to be adversely associated with health behaviors (e.g., Strine et al., 2008). Much

less is known, however, about how depressive symptoms interfere with the adoption and maintenance of health behavior. Therefore, this thesis aims to shed light on these processes.

**Depressive Symptoms**

Depression can be described as a "loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration" (WHO, 2012). Depression includes changes in emotions, cognitions, behavior, and physiology and is described as an affective disorder (Diagnostic and Statistical Manual of Mental Disorders; DSM, 2000). However, this thesis regards depressive symptoms (measured via a screening instrument), rather than depression as a clinical state (clinical diagnosis).

Depressive symptoms have been found to be negatively linked to different health indicators, such as high levels of stress (Hammen, 2009) and a person's health status (Howren, & Suls, 2011; Moussavi et al., 2007). However, particular attention has been given to the association of depressive symptoms and chronic diseases.

**Depressive Symptoms and Chronic Diseases**

In his framework of depression and chronic disease, Katon (2011) posits that the relationship between depressive symptoms and chronic diseases is complex and bidirectional.

One the one hand, suffering from chronic diseases is associated with biological changes, functional impairment, and the burden of various symptoms. Thereby, chronic diseases may precipitate the experience of depressive symptoms. Individuals with chronic disease were found to have two to three times rates of depressive symptoms than individuals without chronic diseases (Katon, 2010). The prevalence of depressive symptoms in individuals with cardiovascular diseases varies between 16% and 23% (Musselmann, Evans, Nemeroff, 1998). About 16% of persons with musculoskeletal pain were found to report depressive symptoms (Magni, Marchetti, Moreschi, Mersky, & Luchini, 1993). Nickision, Boards, and Kay (2009) further reported that 50% of orthopedic patients undergoing surgery suffered from depressive symptoms during their rehabilitation stay.

One the other hand, depressive symptoms may lead to the development and progression of chronic diseases through behavioral risk factors, such as health behaviors. Health behaviors, therefore, need be investigated closely in different samples of depressive individuals, e.g., in the general population and in individuals with chronic diseases.

**Associations Between Depressive Symptoms and Health Behaviors**

Studies of different populations have revealed that depressive symptoms are negatively related to physical exercise, and are positively associated with alcohol consumption and smoking (e.g., Strine et al., 2008), as well as unhealthy eating habits (Shi, Taylor, Wittert, Goldney, & Gill, 2010; Woo, Lynn, Lau, et al., 2006). One goal of this thesis is to investigate whether depressive symptoms are also related to health behaviors in the multiethnic population of Hawai'i (USA).

Links between depressive symptoms and health behaviors have been further reported in individuals with chronic disease conditions, such as in individuals with diabetes. Individuals with diabetes and minor or major depressive symptoms were likely to show poor adherence to physical exercise engagement and healthy dieting, and were less likely to quit smoking (Egede, Ellis, & Grubaugh, 2009; Lin et al., 2004). This thesis aims to broaden the understanding of links between depressive symptoms and physical exercise in orthopedic and cardiac rehabilitation patients. When taking the benefits of different health behaviors into consideration, exercise might be of particular relevance for individuals dealing with depressive symptoms as exercise improves both physical (Fisher et al., 2011) and psychological health (Conn, 2010).

**A Focus on Physical Exercise in Individuals with Depressive Symptoms**

The majority of research on exercise and depression has regarded depressive symptoms as an outcome by studying if and how exercise affects depressive symptoms. There are numerous studies in the field of clinical psychology that have shown the positive effect of exercise on clinical (Daley, 2008) and non-clinical depression (Conn, 2010). Many

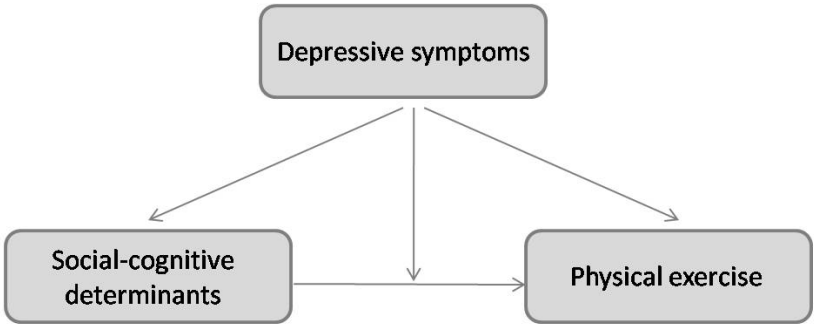
studies on health behaviors have also considered depressive symptoms as an outcome of health behavior engagement and interventions rather than as a predictor for behavior engagement (e.g., Knittle et al., 2010; Scholz, Knoll, Sniehotta, & Schwarzer, 2006). Exercise is thought to influence mental health through biological, psychological, and psychosocial mechanism (Daley, 2008).

In contrast, the effect of depressive symptoms on exercise engagement, that is the risk of persons with depressive symptoms developing habits such as sedentary behavior, has received less attention. One systematic review of longitudinal studies (Roshanaei-Moghaddam, Katon, & Russo, 2009) underpinned the role of depression in a decline of subsequent exercise behavior. However, aside of the fact that depressive symptoms may cause a reduction of physical exercise levels, mechanisms that explain this path have rarely been studied (Roshanaei-Moghaddam et al., 2009). Given the many benefits of exercise for individuals suffering from depressive symptoms and the necessity to promote exercise in samples of individuals with a high prevalence of depressive symptoms (i.e., individuals with chronic diseases) it is of paramount importance to investigate the ways in which depressive symptoms interfere with exercising.

**Depressive Symptoms' Interference with the Adaption and Maintenance of Physical Exercise**

Because social-cognitive determinants are crucial for the process of health behavior change, this dissertation concentrates on how depressive symptoms affect social-cognitive processes, and thereby interfere with the adoption and maintenance of exercise (*Figure 1*).

*Figure 1*. Theoretical overview of the interplay between depressive symptoms, social-cognitive determinants, and physical exercise behavior.




In the following, two perspectives of how depressive symptoms interfere with the social-cognitive processes of health behavior change are focused on. First, the role of negative thinking as a key feature of the depressive state, (Beck, 1974) and how this might affect positive outcome expectancies and experiences regarding exercise is elucidated. Second, in view of the fact that persons with depressive symptoms may have limited self-regulatory resources (Tice & Bratslavsky, 2000), the interference of depressive symptoms with psychological processes of intention formation, planning, and action control is elaborated.

***Does Negative Thinking Affect Social-Cognitive Determinants of Physical Exercise Behavior? Expectancies and Experiences in Individuals with Depressive Symptoms***

In accordance with Beck's cognitive theory of depression (1974), individuals with depressive symptoms are characterized by negative thinking. Negative schemata are predominant in individuals suffering from depressive symptoms and entail a "bias towards attending to, encoding and retrieving schema-consistent (i.e., negative information) at the expense of positive or neutral information" (Dozois & Beck, 2008, pp. 122). Negative schemata further lead to a negative perspective about the self, the future, and the environment (Beck, 1974).

Individuals with depressive symptoms usually report a reduced anticipation of positive events (Bjärehaed, Sarkohi, & Andersson, 2010; MacLeod & Byrne, 1996), and fewer

*positive outcome expectancies* regarding future events (Lecci, Karoly, Briggs, & Kuhn, 1994). A study by Vickers, Nies, Patten, Dierkhising, and Smith (2006) revealed that less positive outcome expectancies regarding exercise are also likely in people experiencing depressive symptoms.

Fewer recalls of autobiographical *positive experiences* were also found in individuals reporting depressive symptoms compared to individuals reporting no depressive symptoms (e.g., MacLeod, Tata, Kentish, & Jacobsen, 1997). In the behavioral domain of exercise, individuals dealing with depressive symptoms were found to report fewer positive experiences in terms of less enjoyment and positive mood, low levels of energy, and fatigue (Blackwood, MacHale, Power, Goodwin, & Lawrie, 1998; Rosqvist et al., 2009; Sigmon, Schartel, Boulard, & Thorpe, 2010; Weinstein, Deuster, Francis, Beadling, & Kop, 2010).

Research in different psychological fields has further revealed that expectancies might affect personal experiences (e.g., Oswald & Grosjean, 2004). Taking into account the assumptions that expectancies exert influence on people's perception and interpretation of information, and that negative thinking is predominant in individuals with depressive symptoms, it is likely that few positive expectancies regarding exercise lead to fewer positive experiences in persons with depressive symptoms.

Positive outcome expectancies and positive outcome experiences represent social-cognitive determinants for the adoption and maintenance of exercise (Bandura, 1997; Schwarzer, 2008). Negative thinking of individuals experiencing depressive symptoms might tarnish positive outcome expectancies and positive experiences regarding exercise and explains why depressive symptoms correlate with less engagement in exercise. In addition to the feature of negative thinking, individuals reporting depressive symptoms were found to have few self-regulatory capacities (e.g., Stordal et al., 2004).

### *Depression Management and Exercise Management: A Conflict of Resources?*

### *A Closer Look at Intention, Planning, and Action Control in Individuals with Depressive Symptoms*

The strength and energy model (Baumeister, Muraven, & Tice, 2000; Hagger, Wood, Stiff, & Chatzisarantis, 2010) posits that self-regulatory energy is required to engage in self-regulation tasks, for example to use self-regulatory strategies (e.g., action planning). According to this theoretical framework, self-regulatory energy constitutes a global energy and a limited resource. It is global in the sense that the energy is utilized on self-regulated tasks across all different domains of actions. It is limited in the sense that if energy is used up in one domain, then it can lead to self-regulatory failure in other behavior domains. The regulation of health behavior represents one of many behaviors that require self-regulation energy. Negative affect regulation, i.e., regulation of depressive symptoms, further requires self-regulatory resources (Tice & Bratslavsky, 2000). The regulation of negative affect refers to the control of negative emotional expressions (e.g., repress negative feelings, or hide negative facial expressions), or to down-regulate negative affect (e.g., substitute positive thoughts for the negative thoughts, or distract oneself from negative thoughts; Tice & Bratslavsky, 2000). When it comes to the allocation of limited self-regulatory resources, people usually prioritize the goal of feeling better, and thereby neglect other self-regulatory tasks (Tice, Bratslavsky, Baumeister, 2001). Consequently, persons with emotional distress might fail to engage in physical exercise (Oaten & Cheng, 2005).

The formation of *behavioral intentions* (i.e, setting a goal) reflects a first step in the motivational phase of health behavior change. However, if people have reduced self-regulatory energy, then demanding goals might become unimportant due to cost that come up for remaining resources (Martin Ginis & Bray, 2010; Hagger et al., 2010). As a result, individuals with depressive symptoms might be less likely to set exercise goals. This assumption is in line with theories of depression. Beck (cognitive theory of depression; 1974)

refers to avoidance of and withdrawal from goals in individuals suffering from depressive symptoms. Neuropsychologists characterize individuals with depressive symptoms by an underactive behavioral approach system, i.e., individuals show a lower tendency towards action (Schneider, 2006).

In the volitional phase of behavior action, detailed behavior *planning* and *action control* is required. Depleted resources among persons with depressive symptoms might also interfere with the use of these regulatory strategies. Further, empirical studies have shown that individuals experiencing depressive symptoms have impaired cognitive functions in the domains of attention and executive control (e.g., Ottowitz, Dougherty, & Savage, 2002; Stordal et al., 2004). Such cognitive impairments can interfere with focusing on health behavior goals, planning activities, as well as monitoring and organizing behavior.

In sum, there is evidence that depressive symptoms may hamper self-regulation regarding exercise.

Due to an interference of depressive symptoms with exercise engagement, interventions that promote exercise need to become a focus of attention. Therefore, this thesis aims to further investigate whether a self-regulatory intervention can enhance exercise in individuals with depressive symptoms.

### *Are Common Self-Regulatory Interventions Effective for Increasing Exercise in Individuals with Depressive Symptoms?*

Exercise interventions that target at improving self-regulatory strategies were found to be useful for achieving behavior change in individuals (Knittle et al., 2010; Sniehotta et al., 2005). However, aside from studies that have proven the benefits of self-regulatory interventions, there are also interventions that have failed to increase exercise behavior (e.g., Huisman, Gucht, Maes, Schroevers, Chatrou, & Haak, 2009). The success of an intervention (i.e., the effectiveness) might partly depend on characteristics of the treated sample, e.g., whether individuals experience more or less depressive symptoms. Given limited self-

regulatory capacities in individuals dealing with depressive symptoms (Tice & Bratslavsky, 2000), depressive symptoms may moderate effects of interventions. Individuals with chronic disease and comorbid depressive symptoms need to manage their physical and psychological condition and are therefore regarded as complex patients with less available self-regulatory resources (Detweiler-Bedell, Friedman, Leventhal, Miller, & Leventhal, 2008; Katon et al., 2010). If the twofold burden on these individuals is not taken into account, then the interventions might be less successful (Detweiler-Bedell et al., 2008). Thus, it is questionable whether individuals with depressive symptoms benefit from a common self-regulatory intervention.

Considering the initial empirical evidence on links between depressive symptoms and health behaviors, present knowledge can be expanded by investigating these associations in further populations. Research can also be enriched by investigating in more detail how depressive symptoms and social-cognitive determinants of health behavior change interact. Moreover, common health behavior change interventions should be explicitly evaluated in terms of whether individuals with depressive symptoms benefit from such interventions.

**Research Aims and Outline of the Chapters**

The goal of this dissertation is to illuminate how depressive symptoms interfere with a healthy lifestyle. In more detail it aims to investigate the three main questions. First, it is explored *whether* depressive symptoms are associated with different health behaviors in a multiethnic population. Further, the focus is set on physical exercise in individuals with chronic diseases. The second question of this thesis refers to *how* depressive symptoms interfere with psychological processes of exercise engagement in medical rehabilitation patients. Finally, the last question raised is whether a standard intervention is effective in *promoting* exercise in medical rehabilitation patients, with and without depressive symptoms.

The overall structure of the four empirical chapters of this dissertation is as follows: In *Chapter 2,* a study is presented that investigates associations between depressive symptoms

and exercising, dieting, alcohol consumption, smoking, self-assessed health status, and perceived stress in the adult population of the US-state of Hawai'i. In *Chapters 3, 4,* and *5,* studies are presented that were conducted in an orthopedic and cardiac rehabilitation setting in Germany. In *Chapter 3,* the path from depressive symptoms to exercise behavior is investigated by testing positive outcome expectancies and positive experience as sequential mediators. Further, it is tested whether depressive symptoms interfere with the self-regulation strategy of action control when translating intentions into exercise (*Chapter 4*). Next, it is examined whether individuals with depressive symptoms benefit from an exercise self-regulation intervention that addresses action planning and action control, in the same way that individuals without depressive symptoms do (*Chapter 5*). For an overview of the samples and study designs, as well as social-cognitive determinants and behaviors that were focused on in each study see *Table 1*. A general discussion of the four chapters, limitations of the thesis and implications for future research are provided in *Chapter 6*.

*Table 1.* Overview of the empirical studies regarding their design and sample, as well as social-cognitive determinants and health behaviors that are focused on.

| | Sample | Design | Social-cognitive determinants | Health Behavior |
|---|---|---|---|---|
| Study 1 *(Chapter 2)* | Population | Observational | - | Physical exercise, dieting, alcohol consumption, smoking |
| Study 2 *(Chapter 3)* | Medical rehabilitation | Observational | Positive outcome expectancies, Positive outcome experiences | Physical exercise |
| Study 3 *(Chapter 4)* | Medical rehabilitation | Observational | Intention, Action control, Planning | Physical exercise |
| Study 4 *(Chapter 5)* | Medical rehabilitation | Experimental | Action control, Planning | Physical exercise |

# References

American Academy of Orthopedic Surgeons (2009). *Lower Pain Exercise Guide.* Retrieved from http://orthoinfo.aaos.org/topic.cfm?topic=A00302

Armitage, C. J. & Conner, M. (2000). Social cognition models and health behavior: A structured review. *Psychology & Health*, 15, 173.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: Freeman.

Baumeister, R. F., Muraven, M., & Tice, D. M. (2000). Ego depletion: A resource model of volition, self-regulation, and controlled processing. *Psychological Bulletin*, 18, 130-150.

Beck, A.T. (1974). The development of depression. A cognitive model. In R.J. Friedman & M.M. Katz (Eds.), *The psychology of depression* (pp.3-28). New York: Wiley

Berlin, I., Covey, L. S., & Glassman, A. H. (2009). Smoking and depression: A co-morbidity. *Journal of Dual Diagnosis*, 5, 149-158.

Bjärehaed, J., Sarkohi, A., & Andersson, G. (2010). Less positive or more negative? Future-directed thinking in mild to moderate depression. *Cognitive Behavior Therapy*, 39, 37-45.

Blackwood, S. K., MacHale, S. M., Power, M. J., Goodwin, G. M., & Lawrie, S. M. (1998). Effects of exercise on cognitive and motor function in chronic fatigue syndrome and depression. *Journal of Neurology, Neurosurgery & Psychiatry*, 65, 541-546.

Boden, J.M. & Fergusson, D.M. (2011). Alcohol and depression. *Addiction*, 106, 906-914.

Bundespsychotherapeutenkammer (2011). *Frührenten aufgrund psychischer Erkrankung nehmen immer mehr zu*. Retrieved from http://www.bptk.de/aktuell/einzelseite/artikel/fruehrenten.html

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge University Press.

Conn, V.S. (2010). Depressive symptom outcomes of physical activity interventions: Meta-analysis findings. *Annals of Behavioral Medicine*, 39, 128-138

Conn, V. S., Hafdahl, A. R., Minor, M. A., & Nielsen, P. J. (2008). Physical activity interventions among adults with arthritis: Meta-analysis of outcomes. *Seminars in Arthritis and Rheumatism*, *37*, 307-316.

Conner, M., Sandberg, T., & Norman, P. (2010). Using action planning to promote exercise behavior. *Annals of Behavioral Medicine*, 40, 65-76.

Daley, A. J. (2008). Exercise and Depression: A Review of Reviews. *Journal of Clinical Psychology in Medical Settings,* 15, 140-147.

Deutsche Rentenversicherung Bund (2012). Rehabericht 2012. Retrieved from http://www.deutsche-rentenversicherung.de/SharedDocs/de/Navigation/Formulare_Publikationen/publikationen/reha_jahrebericht_node.html

Detweiler-Bedell, J. B., Friedman, M. A., Leventhal, H., Miller, I. W., & Leventhal, E. A. (2008). Integrating co-morbid depression and chronic physical disease management: Identifying and resolving failures in self-regulation. *Clinical Psychology Review*, 28, 1426-1446.

*Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revison* (*DSM-IV-TR*). 4th ed. Washington, DC: American Psychiatric Association; 2000.

Dozois, D. J. A. & Beck, A.T. (2008). Cognitive Schemata, Believes and Assumptions. In K.S. Dobsen & D.J.A. Dozois (Eds.), *Risk factors in depression* (pp.121-143). Amsterdam; Boston, Elsevier/Academic.

Egede, L. E., Ellis, C., & Grubaugh, A. L. (2009). The effect of depression on self-care behaviors and quality of care in a national sample of adults with diabetes. *General Hospital Psychiatry*, 31, 422-427.

European Society of Cardiology (2007). *ESC clinical practice guidelines*. Retrieved from http://www.escardio.org/knowledge/guidelines/CVD_Prevention_in_Clinical_Practice.htm

Fisher, E. B., Fitzgibbon, M. L., Glasgow, R.E., Haire-Joshu, D., Hayman, L. L., Kaplan, R. M., Nanney, M. S., & Ockene, J. K. (2011). Behavior matters. *American Journal of Preventive Medicine,* 40, 15-30.

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Exercise maintenance in rehabilitation. How experience can make a difference. *Psychology of Sport and Exercise*, 12, 293-299.

Fuchs, R., Göhner, W., & Seelig, H. (2011). Long-term effects of a psychological group intervention on physical exercise and health: The MoVo concept. *Journal of Physical Activity and Health*, 8, 794-803

Gollwitzer, P. M. & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, 38, 96-119.

Hagger, M. (2010). Editoral: Self-regulation: an important construct in health psychology research and practice. *Health Psychology Review*, 4, 57-65

Hagger, M., Wood, C.W., Stiff, C., & Chatzisarantis, N.L.D. (2010). Self-regulation and self-control in exercise: The strength-energy model. *International Review of Sport and Exercise Psychology*, 3, 62-86.

Hammen, C. (2009) Stress and depression. *Annual Review of Clinical Psychology,* 1, 293-319.

Heckhausen, H. (1991). *Motivation and action*. Berlin: Springer.

Henchoz, Y., & Kai-Lik So, A. (2008). Exercise and nonspecific low back pain: A literature review. *Joint Bone Spine*, *75*, 533-539.

Howren, M. B. & Suls, J. (2011). The symptom perception hypothesis revised: Depression and anxiety play different roles in concurrent and retrospective physical symptom reporting. *Journal of Personality and Social Psychology*, 100, 182-195.

Huisman, S., Gucht, V. de, Maes, S., Schroevers, M., Chatrou, M., & Haak, H. (2009). Self-regulation and weight reduction in patients with type 2 diabetes: A pilot intervention study. *Patient Education Counseling*, 75, 84-90.

Katon, W. J. (2011). Epidemiology and treatment of depression in patients with chronic medical illness. *Dialogues In Clinical Neuroscience*, 13, 7-23.

Katon, W. J., Lin, E.H. B., Von Korff, M., Ciechanowski, P., Ludman, E., Young, B., Rutter, C., Oliver, M., & McGregor, M. (2010). Integrating depression and chronic disease care among patients with diabetes and/or coronary heart disease: the design of the TEAMcare study. *Contemporary Clinical Trials,* 31, 312-322.

Kleinert, J., Golenia, M. & Lobinger, B. (2007). Emotionale Prozesse im Bereich der Planung und Realisierung von Gesundheitshandlungen. *Zeitschrift für Sportpsychologie*, 14, 4-50.

Knittle, K., Maes, S., & de Gucht, V. (2010). Psychological interventions for rheumatoid arthritis: Examining the role of self-regulation with a systematic review and meta-analysis of randomized controlled trials. *Arthritis Care & Research*, 62, 1460-1472.

Lecci, L., Karoly, P., Briggs, C., & Kuhn, K. (1994). Specificity and generality of motivational components in depression: A personal projects analysis. *Journal of Abnormal Psychology*, 103, 404-408.

Lin, E. H. B., Katon, W., Von Korff, M., Rutter, C., Simon, G. E., Oliver, M., Ciechanowski, P., Ludman, E. J., Bush, T., & Young, B. (2004). Relationship of depression and diabetes self-care, medication adherence, and preventive care. *Diabetes Care*, 27, 2154-2160.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004a). Behavioral intentions and action plans promote physical exercise: A longitudinal study with orthopedic rehabilitation patients. *Journal of Sport & Exercise Psychology*, 26, 470-483.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004b). Initiation and maintenance of physical exercise: Stage-specific effects of a planning intervention, *Research in Sports Medicine*, 12, 221-240.

MacLeod, A. K., & Byrne, A. (1996). Anxiety, depression, and the anticipation of future positive and negative experiences. *Journal of Abnormal Psychology*, 105, 286-289.

MacLeod, A.K., Tata, P., Kentish, J., & Jacobsen, H. (1997). Retrospective and prospective cognitions in anxiety and depression. *Cognition & Emotion*, 11, 467-479.

Magni, G., Marchetti, M., Moreschi, C., Merskey, H., & Luchini, S. R. (1993). Chronic musculoskeletal pain and depressive symptoms in the national health and nutrition examination I. Epidemiologic follow-up study. *Pain*, 53, 163-168.

Martin Ginis, K. A. & Bray, S. R. (2010). Application of the limited strength model of self-regulation to understanding exercise effort, planning and adherence. *Psychology & Health*, 25, 1147-1160.

McKenna, M.T., Michaud, C.M., Murray, C.J. & Marks, J.S. (2005). Assessing the burden of disease in the United States using disability-adjusted life years. *American Journal of Preventive Medicine*, 28, 415-423,

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology & Health*, 26, 1479-1498.

Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V., & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: Results from the World Health Surveys. *The Lancet*, 370, 851-858.

Musselman, D.L., Evans, D.L., & Nemeroff, C.B. (1998). The relationship of depression to cardiovascular disease: epidemiology, biology, and treatment. *Advances in Mind-Body Medicine*, 4, 580-592

Nickision, R.S., Boards, T.N., & Kay, P.R. (2009). Post-operative anxiety and depression level in orthopoedic surgery: A study of 56 patients undergoing hip or knee arthoplastry, *Journal of Evaluation in Clinical Practice*, 15, 307-310.

Norman, P., Abraham, C., Conner, M. (2002). Review of 'Understanding and changing health behaviour. From health beliefs to self-regulation'. *Journal of Health Psychology*, 7, 737-739.

Oaten, M., & Cheng, K. (2005). Academic examination stress impairs self-control. *Journal of Social and Clinical Psychology*, 24, 254-279.

Oswald, M.E., & Grosjean S. (2004). Confirmation Bias. In R.F. Pohl (Ed), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory* (pp. 79-96). Hove, UK: Psychology Press.

Ottowitz, W. E., Dougherty, D. D., & Savage, C. R. (2002). The neural network basis for abnormalities of attention and executive function in major depressive disorder: implications for application of the medical disease model to psychiatric disorders. *Harvard Review of Psychiatry*, 10, 86-99.

Reese, C., Mittag, O., Bengel, J., Deck, R., Ehlebracht-König, I., Faller, H., Fleig, L., ... & Worringen, U. (2012a). *Praxisempfehlungen für psychologische Interventionen in der Rehabilitation: Chronische Rückenschmerzen.* [Practical guidelines for psychological interventions in rehabilitation: chronic back pain]. Retrieved from http://www.uniklinik-freiburg.de/aqms/live/Praxisempfehlungen/Orthopaedie.pdf

Reese, C., Mittag, O., Bengel, J., Deck, R., Ehlebracht-König, I., Faller, H., Fleig, L., … & Worringen, U. (2012b). *Praxisempfehlungen für psychologische Interventionen in der Rehabilitation: Koronare Herzerkrankung.* [Practical guidelines for psychological interventions in rehabilitation: coronary heart disease]. Retrieved from http://www.uniklinik- freiburg.de/aqms/live/Praxisempfehlungen/Kardiologie.pdf

Reuter, T., Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2009). Long-term relations between intentions, planning, and exercise: A 3-year longitudinal study after orthopedic rehabilitation. *Rehabilitation Psychology*, 54, 363-371.

Roshanaei-Moghaddam, B., Katon, W. J., & Russo, J. (2009). The longitudinal effects of depression on physical activity. *General Hospital Psychiatry*, 31, 306-315.

Rosqvist, E., Heikkinen, E., Lyyra, T.-M., Hirvensalo, M., Kallinen, M., Leinonen, R., …& Rantanen, T. (2009). Factors affecting the increased risk of physical inactivity among older people with depressive symptoms. *Scandinavian Journal of Medicine & Science in Sports*, 19, 398-405.

Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology*, 19, 64-69.

Schneider, W. X. (2006). Action control and its failure in clinical depression: A neurocognitive theory. In N. Sebanz (Ed) & W. Prinz, *Disorders of volition* (pp. 275-306). Cambridge: MIT Press.

Scholz, U., Knoll, N., Sniehotta, F. F., & Schwarzer, R. (2006). Physical activity and depressive symptoms in cardiac rehabilitation: Long-term effects of a self-management intervention. *Social Science & Medicine*, 62, 3109-3120.

Scholz, U., Nagy, G., Göhner, W., Luszczynska, A., & Kliegel, M. (2009). Changes in self-regulatory cognitions as predictors of changes in smoking and nutrition behavior. *Psychology and Health*, 24, 545-561.

Schüz, B., Sniehotta, F. F., & Schwarzer, R. (2007). Stage-specific effects of an action control intervention on dental flossing. *Health Education Research*, 22, 332-341.

Schwarzer, R. (2011). Health behavior change. In H.S. Friedman (Ed.), *Oxford handbook of health psychology* (pp.591-611). New York: Oxford University Press.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1-29.

Schwarzer R., Luszczynska, A., Ziegelmann, J.P., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: Thee longitudinal studies in rehabilitation, *Health Psychology*, 27, 54-63.

Sheeran, P. (2002). Intention-behavior relations: A conceptual and empirical review. *European Review of Social Psychology*, *12*, 1-36.

Shi, Z., Taylor, A.W., Wittert, G., Goldney, R., Gill, T.K. (2010) Soft drink consumption and mental health problems among adults in Australia, *Public Health Nutrition*, 13, 1073-1079.

Sigmon, S. T., Schartel, J. G., Boulard, N. E., & Thorpe, G. L. (2010). Activity level, activity enjoyment, and weather as mediators of physical health risks in seasonal and non-seasonal depression. *Journal of Rational-Emotive & Cognitive Behavior Therapy*, 28, 42-56.

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behavior-gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, 20, 143-160.

Sniehotta, F. F., Scholz, U., Schwarzer, R., Fuhrmann, B., Kiwus, U., & Völler, H. (2005). Long-term effects of two psychological interventions on physical exercise and self-regulation following coronary rehabilitation. *International Journal of Behavioral Medicine*, 12, 244-255.

Strine, T.W., Mokdad, A.H., Dube, S.R., Balluz, L.S., Gonzalez, O., Berry, J.T., Manderscheid, R., Kroenke, K. (2008). The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *General Hospital Psychiatry*, 30, 127-137.

Stordal, K. I., Lundervold, A.J., Egeland, J., Mykletun, A., Asbjornsen, A., Landro¸, N. I., Roness, A., Rund, B. R., Sundet, K., Oedegaard, K. J., &Lund, A.( 2004). Impairment across executive functions in recurrent major depression. *Nordic Journal of Psychiatry*, 58, 41-47.

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: Systematic review and meta-analysis of randomized controlled trials. *The American Journal of Medicine*, *116*, 682-692.

Tice, D. M., & Bratslavsky E. (2000). Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychological Inquiry*, 11, 149-159.

Tice, D.M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it! *Journal of Personality and Social Psychology*, 80, 53-67.

Vavken, P. & Dorotka, R. (2011). Burden of musculoskeletal disease and its determination by urbanicity, socioeconomic status, age, and sex: Results from 14,507 subjects. *Arthritis Care & Research*, 63, 1558-1564.

Vickers, K. S., Nies, M. A., Patten, C. A., Dierkhising, R., & Smith, S. A. (2006). Patients with diabetes and depression may need additional support for exercise. *American Journal of Health Behavior*, 30, 353-362.

Vohs, K. D. & R. F. Baumeister (2004). Understanding self-regulation. In R.F. Baumeister & K.D. Vohs (Eds), *Handbook of self-regulation: Research, theory, and applications* (pp. 1-9). New York: Guilford Press.

Weinstein, A., Deuster, P., Francis, J., Beadling, C., & Kop, W. (2010). The role of depression in short-term mood and fatigue responses to acute exercise. *International Journal of Behavioral Medicine*, 17, 51-57.

Williams, D. M., Anderson, E. S., & Winett, R. A. (2005). A review of the outcome expectancy construct in physical activity research. *Annals of Behavioral Medicine*, 29, 70-79.

Woo, J., Lynn, H., Lau, W.Y., Leung, J., Lau, E., Wong, S.Y.S., & Kwok, T. (2006) Nutrient intake and psychological health in an elderly Chinese population, *International Journal of Geriatric Psychiatry*, 21, 1036-1043.

World Health Organization (2008). *10 facts about the global burden of disease*. Retrieved from http://www.who.int/features/factfiles/global_burden/en/index.html

World Health Organization (2012). *Depression*. Retrieved from: http://www.who.int/mental_health/management/depression/definition/en/

# 2

# Associations of Depressive Symptoms with Health Behaviors, Stress, and Self-assessed Health Status in Hawai'i. A Population Study

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# Abstract

*Background*. The aim of this cross-sectional study was to examine how depressive symptoms are associated with health behaviors, stress, and self-assessed health status in the population of Hawai'i.

*Methods*. Randomized phone calls were made using Computer Assistant Telephone Interviews. A regression analysis with depressive symptoms as the outcome and socio-demographic variables, health behaviors, stress, and health status as predictors was conducted in 1483 adults.

*Results*. Depressive symptoms were associated with stress (β=.32), alcohol consumption (β =.19), health status (β = -.10), fast food consumption (β =.06), avoidance of fat (β = -.06), and fruit and vegetable consumption (β =.06). Moreover, depressive symptoms were linked to being female (β =.06), being single (β = -.06), and being Caucasian compared to being Native Hawaiian (β=-.06) or Japanese (β =-.08). The overall explained variance was 22%.

*Conclusion*. Depressive symptoms correlate with health behaviors and might be considered as a risk for chronic diseases.


*Keywords*. lifestyle, depression, adults, United States, health behaviors, Hawai'i

# Introduction

The World Health Organization (WHO) has identified that in 2020 depressive disorders will reach the 2nd place on the list of global burden diseases[1]. This is alarming because the experience of depressive symptoms indicates not only a decline in psychological well-being. Depressive symptoms are also associated with health behaviors[2] and further health indicators[3,4]. A healthy lifestyle was found to prevent the onset of chronic diseases (e.g., diabetes or heart diseases)[5]. A link between depressive symptoms and an unhealthy lifestyle such as heavy alcohol use, poor diet, and lack of physical activity may indicate the need for physicians and therapists to consider not only the depressive symptoms but also health behaviors. Studies that investigated such associations in the population in Hawai'i are lacking. Thus, this study aims to close this gap.

## Associations of Depressive Symptoms with Health Behaviors, Stress, and Self-assessed Health Status

Negative links between depressive symptoms and self-assessed health status have been documented[4,6]. Meta-analytic findings also indicated associations between depressive symptoms and perceived stress[3]. Studies reported a negative relationship between depressive symptoms and physical activity[2,4]. Research has also revealed a link between depressive symptoms and different facets of healthy eating. Depressive symptoms were negatively associated with fruit and vegetable consumption in some studies[7,8] ,whereas other researchers found no associations[9]. Moreover, previous studies revealed a high level of fast food intake7, fat intake[8] and soft drink consumption[10] in depressive individuals. Numerous studies reported an association of depressive symptoms and smoking and alcohol consumption[2,6,11].

The relationship between depressive symptoms, stress, and health status might be reciprocal, e.g., psychological distress leads to a lower health status and poor health increases psychological distress[12]. Similar to health behaviors, depressive symptoms might foster unhealthy behaviors, e.g., due to an interference of depressive symptoms with self-regulation

processes which are fundamental for the adoption and maintenance of health behaviors[13]. However, some health behaviors in turn affect depressive symptoms: E.g., physical activity might decrease depressive symptoms through psychological (e.g., self-efficacy, distraction) and physiological mechanisms[14]. Heavy drinking was found to increase depressive symptoms through learned helplessness and low self-efficacy[15]. Alcohol in turn might be used as a self-medication for depression[11]. Few studies have investigated mechanisms between depressive symptoms and health behaviors. Before exploring these mechanisms in more depth in our target population, it is necessary to look at associations of depressive symptoms and health behaviors

**Associations of Depressive Symptoms with Health Behaviors, Stress, and Self-assessed Health Status in Hawai'i**

Depressive disorders in Hawai'i are somewhat common with a state specific prevalence rate of 8.3%[16]. A survey from the Hawai'i Department of Health (DOH)[16] exposed that depressive symptoms are associated with chronic diseases (obesity, diabetes, and heart attack). Results also indicated a negative link between depressive symptoms and self-assessed health status. Further, the report revealed that depressive symptoms were related to physical inactivity and smoking in Hawai'i. No link was found between depressive symptoms and alcohol consumption by the DOH. The association of depressive symptoms and smoking was also found in a sample of only native Hawaiians[17]. Regarding dieting behavior, Chai et al.[18] recently reported that fruit and vegetable consumption was not associated with mental health in adults on Hawai'i. However, not many studies have considered associations of depressive symptoms with health behaviors, stress, and self-assessed health status in Hawai'i.

Going beyond the survey of the DOH[16] we included additional diet-specific behaviors as well as indicators for perceived stress. Moreover, by using a different method this study evaluated associations of depressive symptoms and several health behaviors, stress, and self-assessed

health status simultaneously and thereby sheds light on the question of whether the variables differ in their contribution to explain depressive symptoms.

### Research Question and Hypotheses

The aim of this study was to explore how health behaviors, stress, and self-assessed health status are associated with depressive symptoms in adults in Hawai'i. More precisely, we hypothesized that individuals with more depressive symptoms show poorer fruit and vegetable consumption, less avoidance of fat, a higher intake of soft drinks and fast food than those with fewer symptoms. We expected that depressive symptoms are negatively associated with physical activity and positively linked to smoking and alcohol consumption. Finally, we presumed that individuals with more depressive symptoms report higher levels of stress and poorer self-assessed health status.

## Method

### Procedure and Participants

A cross-sectional random-digit-dialing telephone survey that collected data from a stratified sample of adults living in Hawai'i was evaluated. Phone calls were made across all Hawaiian Islands using a computer assisted telephone interviewing system (CATI) during spring and summer 2006. To avoid selection bias, the household member who had the last birthday was asked to answer the survey questions. Verbal consent was acquired by the interviewer before the survey was conducted. Individuals were thanked for their time and participation at the end of the survey. On average telephone interviews were 22.8 minutes (*SD* = 7.5) long. The survey was approved by the University of Hawai'i at Manoa institutional review board.

1514 individuals participated in the survey. 31 individuals were excluded due to missing values on socio-demographic variables. The final sample comprised 1483

participants. 127 participants were screened positive on depressive symptoms. Socio-demographic characteristics are depicted in *Table 1*.

Table 1. *Socio- demographics in N= 1483 Hawaiian residents.*

| Variables | |
|---|---|
| Sex: *n* (%) | Female = 830 (56.0) |
| Education: *n* (%) | No high school degree = 505 (34.1)<br>High school degree = 978 (65.9) |
| Age: *mean* (*SD*) | 51.4 (16.2) |
| Partner status: *n* (%) | No partner = 540 (36.4)<br>Partner = 943 (63.6) |
| Ethnic group: *n* (%) | Caucasian = 603 (40.7)<br>Hawaiian = 280 (18.9)<br>Chinese = 36 (2.4)<br>Filipino = 157 (10.6)<br>Japanese = 239 (16.1)<br>Other = 168 (11.3) |
| Island of residence: *n* (%) | Hawai'i = 326 (22.0)<br>Kauai = 289 (19.5)<br>Lanai = 23 (1.6)<br>Maui = 357 (24.1)<br>Molokai= 30 (30.8)<br>Oahu = 458 (30.9) |

**Measures**

*Depression symptoms* were measured with the Patient Health Questionnaire (PHQ-2)[19]. The PHQ-2 assesses depressed mood over the previous two weeks with two items: "Have you often been bothered by feeling down, depressed, or hopeless?" and "Have you often been bothered by little interest or pleasure in doing things?" Response scales range from "not at all" (0), "on some days" (1), "more than half of the days" (2), and "nearly every day"

(3). Responses were aggregated and depression severity ranged from 0-6. The PHQ-2 has a sensitivity of 83% and a specificity of 92% for major depression[19].

*Fruit and vegetable consumption* was measured with two questions[20]: "On average, how many servings of fruit do you usually eat per day?" and "On average, how many servings of vegetables do you eat per day?". Portions of fruit and vegetables were summarized. The two-item questionnaire had demonstrated high specificity in previous studies; over 3/4 of participants who reported low intake also had bio-markers below the upper third of the distribution.[20]

To assess *fat intake*, participants were asked about a conscious effort to avoid foods that are high in fat. Answer categories ranged from "never" (1) to "always" (5). Another item assessing *fast food consumption* was "How often do you eat at fast food restaurants, drive-ins, or lunch wagons?" Response categories were "almost never" (1), "a few times a year" (2), "1 - 3 times a month"(3), "1 - 2 times a week" (4), "3 - 5 times a week" (5), and "almost every day" (6). *Soft drink consumption* was measured by asking "How often do you drink regular soft drinks, soda, or pop (do not include diet soda)?" Response options were "never" (1), "1 time per month or less" (2), "2 - 3 times per month" (3), "3 - 4 times per month" (4), "1 - 2 times per week" (5), "5 - 6 times per week" (6), and "everyday" (7). A second item asked for the amount of soda at each time the person drinks soda. Response categories were: "Less than 12 oz or less than 1 can or bottle" (1), "12-16 oz or 1 can or bottle" (2), and "more than 16 oz or more than 1 can or bottle" (3). Items were adapted from the Behavioral Risk Factor Surveillance System Survey Questionnaire[21]. These items are routinely tested to ensure adequate reliability and validity before their use in the field.[21]

*Physical activity* was measured with the International Physical Activity Questionnaire (IPAQ)[22]. Mild, moderate, and vigorous activities in the prior week were assessed. Participants stated on how many days and for how long they were active with regard to each

category. Each score was the number of sessions per week multiplied by minutes per session. Finally, scores were summarized.

*Smoking behavior* was assessed with the item "Are you currently a smoker?". Answer categories were "yes"or"no"[23].

*Alcohol consumption* was assessed with one item adapted from the Alcohol Use Disorders Identification Test (AUDIT)[24]. The item was "How often do you have a drink containing alcohol?" with the response categories "never" (0), "monthly or less" (1), "2-4 times a month" (2), "2-3 times a week" (3), "4 or more times a week" (4).

*Perceived Stress* was assessed with the four item version of the Perceived Stress Scale (PSS)[25]. Following the stem "In the last month", items were worded (1) "How often have you felt that you were unable to control the important things in your life?", (2) "How often have you felt confident about your ability to handle your personal problems?", (3) "How often have you felt that things were going your way?", and (4) "How often have you felt difficulties were piling up so high that you could not overcome them?". The response scale ranged from "never" (0) to "very often" (5). Items were aggregated in a way that stress severity ranged from 0-20.

*Self-assessed health status* was assessed with one item "In general, would you say your health is…" with a response scale from "poor" (1) to "excellent" (6). Self-assessed health status is known to be reliable and responsive to change[26].

**Data Analysis**

Missing values occurred less than 5% of the time for any variable. Missing values for health behaviors, stress, self-assessed health status, and depressive symptoms were imputed using the Expectation Maximization (EM) algorithm. A hierarchical regression analysis with the continuous depression score as the dependent variable was conducted. In a first step, depressive symptoms were predicted by socio-demographic variables, i.e., sex, educational background, partner status, ethnic group (dummy coded with Caucasians as the reference

group), and age. In a second step, the outcome was predicted by all variables of the first step and health behaviors, stress, and self-assessed health status. Analyses were conducted with SPSS 17.

# Results

## Descriptive Results

Correlations are depicted in *Table 2* and *3*. Depressive symptoms were positively correlated with soft drink consumption, fast food consumption, stress, alcohol consumption, and smoking. Negative associations were found between depressive symptoms and the avoidance of fat and self-assessed health status.

Table 2.*Correlations, means, and SD of depressive symptoms, self-assessed health status, and perceived stress in N = 1483 adults in Hawai'i.*

| | Depressive symptoms | Self-assessed health status | Perceived stress |
|---|---|---|---|
| *M (SD)* | .62 (1.2) | 3.4 (1.1) | 4.0 (3.0) |
| *Range* | 0 - 6 | 1 – 5 | 0 - 15 |
| Depressive Symptoms | 1 | -.22** | .38** |
| Self-assessed health status | | 1 | -.28** |
| Perceived stress | | | 1 |

*Note*. **$p \leq .01$, * $p \leq .05$

Table 3.*Correlations, means and SD of depressive symptoms and health behaviors in N = 1483 adults in Hawai'i.*

| | Depressive symptoms | Amount soft drinks | Frequency soft drinks | Frequency fast food | Avoiding fat | Frequency alcohol | Smoking status | Physical activity | Amount fruit/ veget. |
|---|---|---|---|---|---|---|---|---|---|
| *M (SD)* | 0.62 (1.2) | 1.4 (0.5) | 2.7 (2.1) | 3.0 (1.5) | 3.7 (1.2) | 1.3 (1.4) | Smoker | 681.7 (775.7) | 5.0 (2.4) |
| *Range* | 0 - 6 | 1-3 | 1 - 7 | 1 – 6 | 1 - 5 | 0 - 4 | *n* = 201 (13.6%) | 0 – 5580.0 | 0 - 14 |
| Depressive Symptoms | 1 | .10** | .07** | .12** | -.18** | .24** | .07** | -.03 | -.02 |
| Amount soft drinks | | 1 | .43** | .30** | -.28** | .25** | .15** | -.03 | -.18** |
| Frequency soft drinks | | | 1 | .27** | -.17** | .23** | .07** | .00 | -.13** |
| Frequency fast food | | | | 1 | -.21** | .17** | .04 | -.04 | -.14** |
| Avoiding fat | | | | | 1 | -.22** | -.11** | .05 | .18** |
| Frequency alcohol | | | | | | 1 | .21** | .26** | -.10** |
| Smoking status | | | | | | | 1 | .04 | -.12** |
| Physical activity | | | | | | | | 1 | .17** |
| Amount Fruit/veget. | | | | | | | | | 1 |

*Note*. **$p \leq .01$, * $p \leq .05$

**Regression Analysis**

When entering demographic variables to the regression equation in a first step, the model showed a significant prediction of depressive symptoms, $F(9, 1473) = 5.9$, $p \leq .001$.Variables accounted for 4% of the variance in depressive symptoms. Lower education, younger age, being single, and being Caucasian compared to being Japanese predicted depressive symptoms. In a second step, health behaviors, stress, and self-assessed health were additionally used for the prediction. The further variables significantly improved the model, $F(19, 1463) = 21.2$, $p \leq .001$, and explained additional variance, $F_{change}(10, 1463) = 33.9$, $p \leq .001$. Results of the second model indicated that a high level of perceived stress explained the largest amount of variance in depressive symptoms, followed by alcohol consumption. Furthermore, being single, being female, and being Caucasian compared to being Japanese or Native Hawaiians predicted depressive symptoms significantly. Reporting higher fast food consumption, reporting less avoidance of fat, eating more fruits and vegetables, and a poorer self-assessed health status were also associated with depressive symptoms. In the second step, all variables accounted for 22% of the variance. $R^2\Delta$ from step one to step too was 18%. All coefficients are reported in Table 4.

Table 4. *Hierarchical regression model in N = 1483 adults in Hawai'i.*

| | Step 1 | | | Step 2 | | |
|---|---|---|---|---|---|---|
| | *B* | *SE* | *β* | *B* | *SE* | *β* |
| Education | -.27 | .07 | -.11*** | -.09 | .06 | -.04 |
| Sex | .03 | .06 | .01 | .14 | .06 | .06* |
| Age | -.01 | .00 | -.08*** | .00 | .00 | .04 |
| Partner status | -.22 | .06 | -.09*** | -.15 | .06 | -.06** |
| Hawaiian | -.02 | .09 | -.01 | -.19 | .08 | -.06* |
| Chinese | -.20 | .20 | -.03 | -.26 | .18 | -.03 |
| Filipino | -.03 | .11 | -.01 | -.14 | .10 | -.04 |
| Japanese | -.19 | .09 | -.06* | -.25 | .08 | -.08** |
| Other ethnic group | -.03 | .11 | -.01 | -.07 | .10 | -.02 |
| Amount soft drinks | | | | .05 | .06 | .02 |
| Frequency soft drinks | | | | -.00 | .02 | -.01 |
| Fast Food | | | | .05 | .02 | .06* |
| Avoiding fat | | | | -.06 | .03 | -.06** |
| Health status | | | | -.11 | .03 | -.10*** |
| Perceived stress | | | | .13 | .01 | .32*** |
| Physical activity | | | | -5.9 | .00 | -.04 |
| Amount fruit/veget. | | | | .03 | .01 | .06* |
| Smoking dichotom | | | | -.00 | .09 | .00 |
| Frequency alcohol | | | | .12 | .02 | .19*** |
| $R^2$ | | .04 | | .22 | | |
| *F* | | 5.9 | | 21.2 | | |
| $\Delta R^2$ | | | | .18 | | |
| ΔF | | | | 33.9 | | |

*Note.* *** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$

# Discussion

Not surprisingly, analyses revealed that depressive symptoms were associated with some socio-demographic variables. A lower education and younger age were associated with depressive symptoms if only demographic variables were considered. Being single and female, and being Caucasian compared to being Native Hawaiian or Japanese were associated with depressive symptoms while accounting for health behaviors, perceived stress, and self-assessed health status. This underlines the relevance of demographic variables for the prevalence of depressive symptoms. However, previous studies in Hawai'i found no differences of current depression rates in men and women[16]. Furthermore, studies found that native Hawaiians have the highest current depression rate, whereas this study indicated that Caucasians were most likely to report depressive symptoms. Differences of this study and the earlier findings might be a result of different depression screeners (PHQ-2 vs. PHQ-8). Different depression rates between Caucasians and other ethnical groups might also be biased by the depression screener. The applied instrument does not take a cultural variation of depressive symptoms into account[27]. In line with common findings we found that singles were more likely to have depressive symptoms than individuals with a partner[16].

Further, our results revealed that health behaviors, stress, and self-assessed health were valuable to predict depressive symptoms in addition to socio-demographic variables. A high level of perceived stress was strongest associated with depressive symptoms. This strong association is in line with previous meta-analytic findings[3] and strengthens the need for addressing stress management in individuals reporting depressive symptoms.

Results further indicated that depressive symptoms are associated with the frequency of alcohol consumption. This is in line with meta-analytic findings that have proven a moderate to strong linkage between major depression and alcohol use disorders[11]. Studies

suggest that the link might be mediated through social, economic, genetic, and physiological factors[11].

The association of self-assessed health status and depressive symptoms corroborates previous studies in Hawaiian and non-Hawaiian samples[4,16]. Self-assessed health status is a strong predictor of mortality and is therefore worth to assess when assessing and promoting the health status in depressive individuals.

Similar to previous studies, we found that depressive symptoms were predicted by frequent visits of fast food locations[7] and less avoidance of fatty foods8. Results are in line with the assumption that people increase carbohydrate-rich and fatty foods when experiencing depressive symptoms. Carbohydrate-rich food might decrease bad mood[28]. Soft drink consumption was not a relevant predictor for depressive symptoms compared to other predictors. However, there was a significant bivariate correlation of soft drink consumption and depressive symptoms in the expected direction[10]. Not in line with our hypothesis and prior studies is that a higher level of fruit and vegetable consumption predicted depressive symptoms[7,8]. However, as there was no bivariate significant correlation between depressive symptoms and fruit and vegetable consumption, the interpretation of the effect within the regression analysis is difficult. The significance of the predictor in the regression might reflect a suppressor effect. One might assume that there was no negative association of depressive symptoms and fruit and vegetable intake because there is a comparatively high fruit and vegetable consumption on the Hawaiian islands compared to other US-states.

Contrary to previous findings[2,16], no significant link was found between depressive symptoms and physical activity in the Hawaiian population. Nevertheless, a trend could be observed. Similar, smoking status was marginally correlated with depressive symptoms, but it did not predict depressive symptoms when considering all predictors. However, associations between depressive symptoms and some health behaviors might be underestimated in the current study, as the majority of depressive individuals (PHQ $\geq$ 3) reported no severe

depressive symptoms (scores of 3 or 4). Severely depressed individuals might be less likely to respond to random digit dial surveys. Further, the applied depression screener might have affected the strength of associations.

**Outlook**

Future research and practice need to address the findings. Replication studies might use a broader depression screener, e.g. the Center of Epidemiological Studies Depression Scale (CES-D)[29] . The CES-D takes possible ethnical differences of perceiving depressive symptoms into account. Associations of depressive symptoms and health behaviors should also be examined in clinical samples of depressive individuals in order to confirm general patterns. A broader assessment of depressive symptoms might reveal stronger associations with health behaviors, stress, and health status. Additionally, mechanisms between depressive symptoms and considered variables need to be investigated. Studies could focus on mediators like self-efficacy or self-regulation[13,15].

If results are confirmed, structural changes in primary care might be required. Depression assessment needs to be systematically included in primary care screenings. Primary care reaches the majority of target population persons, but the rate of missed diagnoses counts 50%[30]. In particular, individuals who are at a high risk for depression need to be screened - for instance those having no partner, experiencing stressful life events, having alcohol problems, or reporting a poor health status. Those who score high on depression screeners might be referred to undergo further depression diagnostics. Empirically-based psychological treatments (e.g., cognitive - behavioral therapy) need to be provided to treat depressive symptoms. Our results confirmed that stress management is necessary to address in depressive individuals. Patients who are screened positive for depression should also be screened for health risk behaviors. To address health behaviors in depressive individuals, integrated approaches that combine psychotherapy and the management of health behaviors might be useful.

**Limitations**

Study limitations need to be recognized. First, many of the scales used short screening items. While these items have good validity in large population samples, further studies might be complemented by an extended screening questionnaire or clinical interview. Moreover, as mentioned before, the CES-D[29] might be a more suitable depression screener for ethnically diverse samples. Second, some items (nutrition, alcohol consumption) were assessed without a particular time frame, whereas depressive symptoms were considered within the last two weeks. Third, we investigated associations within a cross-sectional design. To draw causal conclusions longitudinal studies are required. Finally, some associations were rather small. However, they were in expected directions.

**Conclusions**

Our study suggests that depressive symptoms are associated with perceived stress, alcohol consumption, dieting, and self-assessed health status in Hawaiian adults. Thus, depressive symptoms might be considered as a risk for the development of chronic diseases. Future research and practice need to address those associations as well as investigate mechanisms that further explain these links.

# References


1. World Health Organization. Mental Health: Depression. 2011. http://www.who.int/mental_health/management/depression/definition/en/. Assessed March 13, 2012.
2. Strine TW, Mokdad AH, Dube SR, Balluz LS, Gonzalez O, Berry JT, Manderscheid R, Kroenke K. The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *Gen Hosp Psychiatry*. 2008; 30(2): 127-137.
3. Burke HM, Davis MC, Otte C, & Mohr DC. Depression and cortisol responses to psychological stress: A meta-analysis. *Psychoneuroendocrinology*, 2005, 30(9): 846-856.
4. Katon W, Richardson L, Russo J, McCarty CA, Rockhill C, McCauley E, Richards J, Grossman DC. Depressive symptoms in adolescence: the association with multiple health risk behaviors. *Gen Hosp Psychiatry*. 2010; 32(3): 233-239.
5. Tanaka H, Sasazawa Y, Suzuki S, Nakazawa M, Koyama H. Health status and lifestyle factors as predictors of depression in middle-aged and elderly Japanese adults: A seven-year follow-up of the Komo-Ise cohort study. *BMC Psychiatry*, 2011; 11(20): 1-10.
6. Fisher EB, Fitzgibbon ML, Glasgow RE, Haire-Joshu D, Hayman LL, Kaplan RM, Nanney MS, & Ockene JK. Behavior matters. *Am J Prev Med*. 2011; 40 (5): 15-30.
7. Liu C, Xie B, Chou C-P, Koprowski C, Zhou D, Palmer P, Sun P. Perceived stress, depression and food consumption frequency in the college students of China seven cities. *Physiol Behav*. 2007; 92 (4): 748-754.
8. Woo J, Lynn H, Lau WY, Leung J, Lau E, Wong SYS, Kwok T. Nutrient intake and psychological health in an elderly Chinese population, *Int J Geriatr Psychiatry*. 2006; 21(11): 1036-1043.
9. Fulkerson JA, Sherwood NE, Perry CL, Neumark-Sztainer D, Story M. Depressive symptoms and adolescent eating and health behaviors: A multifaceted view in a population-based sample. *Prev Med*. 2004; 38(6): 865-875.
10. Shi Z, Taylor AW, Wittert G, Goldney R, Gill TK. Soft drink consumption and mental health problems among adults in Australia, *Public Health Nutr*. 2010; 13(7): 1073-1079.

11. Boden JM & Fergusson DM. Alcohol and depression. *Addiction*. 2011, 106(5): 906-914.
12. Cappeliez P, Sèvre-Rousseau S, Landreville P, Préville M et al. Physical health, subjective health, and psychological distress in older adults: Reciprocal relationships concurrently and over time. *Aging Int*. 2004; 29(3): 247-266.
13. Tice DM, & Bratslavsky E. Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychol Inq*. 2000; 11: 149-159.
14. Daley A. Exercise and depression: A review of reviews. *J Clin Psychol Med S*. 2008; 15(2) :140–147.
15. Sitharthan G, Hough MJ, Sitharthan T & Kavanagh DJ. The Alcohol Helplessness Scale and its prediction of depression among problem drinkers. *J Clin Psychol*, 2001; 57(12): 1445-1457.
16. Hawai'i State Department of Health. Hawaii Behavioral Risk Factor Surveillance System. Prevalence of anxiety and depression among Hawaii's adults. 2006. http://hawaii.gov/health/statistics/hhs/brfss/index.html. Assessed March 12, 2012.
17. Kaholokula JK, Grandinetti A, Crabbe KM., Chang HK, Kenui CK. Depressive symptoms and cigarette smoking among native Hawaiians. *Asia Pac J Public Heath. 1999*; 11(2): 60-64.
18. Chai W, Nigg CR, Pagano IS, Motl RW, Horwath C, Dishman RK. Associations of quality of life with physical activity, fruit and vegetable consumption, and physical inactivity in a free living, multiethnic population in Hawai'i: a longitudinal study. *Int J Behav Nutr Phy*. 2010; 7: 83-89.
19. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Med Care.* 2003; 41(11): 1284-1294.
20. Cappuccio FP, Rink E, Perkins-Porras L, McKay C, Hilton S, &Steptoe A. Estimation of fruit and vegetable intake using a two-item dietary questionnaire: a potential tool for primary health care workers. *Nutr Metab Cardiovasc Dis*. 2003; 13(1): 12-9
21. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Questionnaire. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention
22. Craig CL, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003; 35(8): 1381-1395.

23. Yeager DS, Krosnick JA. The validity of self-reported nicotine product use in the 2001-2008 National Health and Nutrition Examination Survey. *Med Care*. 2010; 48 (12), 1128-32.
24. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro, MG. AUDIT: The Alcohol Use Disorders Identification Test, guidelines for use in primary care, WHO Department of Mental Health and Substance Dependence, Department of Mental Health and Dependence. 2001. http://www.who.int/substance_abuse/publications/alcohol/en/. Assessed March 12, 2012
25. Cohen S, Williamson G. Perceived stress in a probability sample of the United States. In Spacapam S, Oskamp S (Eds.). *The social psychology of health: Claremont Symposium on applied social psychology.* Newbury Park, CA: Sage. 1988.
26. Crossley T, Kennedy S. The reliability of self-assessed health status. *J Health Econ.* 2002. 21(4): 643–658.
27. Kanazawa A., White PM., & Hampson SE. Ethnic variation in depressive symptoms in a community sample in Hawai'i. *Cult Divers Ethnic Minor Psychol*. 2007; 13(1): 35-44.
28. Markus R, Panhuysen G, Tuiten, A, & Koppeschaar H. Effects of food on cortisol and mood in vulnerable subjects under controllable and uncontrollable stress. *Physiol Behav*. 2000; 70(3-4), 333-342.
29. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. *App Psych Meas.* 1977; 1(3): 385-401.
30. Lecrubier Y. Prescribing patterns for depression and anxiety worldwide. *J Clin Psychiatry*. 2002; 62(13): 31-36.

# 3

# Depressive Symptoms Interfere with Post-Rehabilitation Exercise: Outcome Expectancies and Experience as Mediators

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# Abstract

*Background*. The aim of the study was to examine the relationship between depressive symptoms and physical exercise by unveiling how outcome expectancies regarding exercise and positive exercise experience could mediate between depressive symptoms and exercise.

*Method*. A longitudinal study included 178 cardiac and orthopedic rehabilitation patients in Germany. Patients responded to psychometric scales at two points in time with a six-week interval, assessing depressive symptoms (Time 1), outcome expectancies regarding exercise (Time 1), exercise experiences (Time 2), and exercise behavior (Times 1 and 2).

*Results*. Depressive symptoms were negatively related to physical exercise ($r$ = -.18), to positive outcome expectancies ($r$ = -.23), and to positive exercise experiences ($r$ = -.26). In a multiple-step mediation model, expectancies and experiences mediated between depressive symptoms and exercise. In total, 15% of the exercise variance was accounted for.

*Conclusion*. Outcome expectancies and a lack of positive experience seem to partly explain why depressed individuals are less likely to exercise.


*Keywords*: Germany; physical exercise; depressive symptoms; cardiac and orthopedic patients; mediation; outcome expectancies; exercise experiences

# Introduction

A large number of orthopedic and cardiac patients fail to maintain prescribed physical exercise after discharge from the rehabilitation (Dorn, Naughton, Imamura, & Trevisan, 2001). Prevalence rates of depressive symptoms in medical rehabilitation patients are high (e.g., Howard, Ellis, Khaleel, Gatchel, & Bucholz, 2010; Hunt-Shanks, Blanchard, & Reid, 2009; Rutledge et al., 2006) and depressive symptoms are negatively associated with exercise (e.g., Goodwin, 2003). Studies found reduced adherence to exercise recommendations in depressive individuals (Gonzalez et al., 2007; Wing, Phelan, & Tate, 2002; Ziegelstein et al., 2000). However, advantages of exercise are twofold in particular for persons experiencing depressive symptoms: Exercise fosters physical health (e.g., Yusuf et al., 2004) and alleviates depressive symptoms (e.g., Phillips, Kiernan, & King, 2003).

While many studies report negative relations between depressive symptoms and physical exercise (e.g., Goodwin, 2003), less evidence exists on processes that explain this link. As social-cognitive variables are major determinants of exercise (Van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009), it seems useful to investigate how depressive symptoms interfere with these determinants. Exercise-specific positive outcome expectancies (e.g., Bandura, 2004) and positive exercise experiences (e.g., Fuchs, Göhner, & Seelig, 2011) are substantial predictors of exercise. Depressive symptoms are negatively associated with both determinants (Rosqvist et al., 2009; Vickers et al., 2006). Moreover, research has shown that expectancies themselves predict the evaluation of experiences (e.g., Oswald & Grosjean, 2004), especially in depressive individuals (Beck, 1967). Therefore, this study investigates whether depressive symptoms lead to a lack of exercise through a sequential pathway from outcome expectancies to experiences.

## Outcome Expectancies and Experiences in Health Behavior Change

*Outcome expectancies* are generally defined as an expectation that an outcome will follow a given behavior. A systematic review by Williams, Anderson, and Winett (2005) revealed that outcome expectancies are a core construct in physical activity research. Different models of health behavior change, such as the health action process approach (HAPA; Schwarzer, 2008) and the social-cognitive theory (SCT*;* Bandura, 2004) include outcome expectancies as a predictor of health behavior. The models conceptualize outcome expectancies as a distal predictor that affects behavior indirectly via other social-cognitive determinants. One of those mediators might be one's experience with previous exercise.

*Exercise experiences* reflect personal experiences and appraisals regarding exercise behavior (Fuchs et al., 2011), e.g. to feel free of worries during exercise. Fuchs et al. (2011) found that less pain during exercise was associated with more exercise in rehabilitation patients. Brassington, Atienza, Perczek, DiLorenzo and King (2002) revealed that experiences predicted exercise adherence in healthy adults. Positive exercise experiences were also found to predict post-rehabilitation exercise (Fleig, Lippke, Pomp, & Schwarzer, 2011).

## Depression Symptoms and Their Associations with Outcome Expectancies and Exercise Experiences

Studies revealed a negative link between depressive symptoms and the anticipation of positive events (Bjärehaed, Sarkohi, & Andersson, 2010; MacLeod & Byrne, 1996) and positive outcome *expectancies* in different behavior domains (Lecci, Karoly, Briggs, & Kuhn; 1994). Exercise-specific positive outcome expectancies were also found to be low in depressive persons (Vickers et al., 2006).

Previous research has demonstrated that depressive individuals make fewer recalls of positive *experiences* than non-depressive individuals (e.g., MacLeod, Tata, Kentish, & Jacobsen, 1997). In the behavioral domain of exercise, findings revealed that depressive symptoms are linked to less positive exercise experiences, i.e., less enjoyment and positive

mood, and lower levels of energy and more fatigue (Blackwood, MacHale, Power, Goodwin, & Lawrie, 1998; Rosqvist et al., 2009; Sigmon, Schartel, Boulard, & Thorpe, 2010; Weinstein, Deuster, Francis, Beadling, & Kop, 2010).

Thus, there is evidence that depressive symptoms are negatively related to exercise-specific positive outcome expectancies and positive exercise experiences.

### Positive Expectancies Predict Positive Experiences

Expectancies might not only predict behavior but also guide the perceptions of subjective evaluation of one's behavior. Research in different psychological fields revealed a fundamental role of expectancies on human's perception and interpretation of experiences (Kirsch, 1997; Oswald & Grosjean, 2004). Through hypothesis-driven (i.e, expectation-driven perception) positive expectancies might lead to more positive experiences. However, especially depressive individuals are likely to focus on information which verifies their negative thoughts and cognitions (Beck, 1967, 1974; Giesler, Josephs, & Swann 1996). Thus, it might be that low levels of positive outcome expectancies regarding exercise in depressive individuals lead to fewer positive exercise experiences. In a further step, this might interfere with the engagement in exercise.

### Aims and Hypothesis

The aim of the present study was to investigate whether positive outcome expectancies regarding exercise and positive exercise experience mediate the relationship from depressive symptoms to exercise behavior. We hypothesized that depressive symptoms predict less exercise behavior through a sequential pathway from low levels of positive outcome expectancies to few positive exercise experiences.

## Method

### Participants and Procedure

Study participants were recruited in two orthopedic rehabilitation clinics (one in-

patient and one out-patient) and one in-patient cardiac rehabilitation clinic. The average duration of the rehabilitation stay was 23.4 days (*SD* = 3.4). During the rehabilitation stay, all individuals participated in a regular clinic program that comprised a complex regimen of physiotherapy and different fitness training. Exercise therapy was supervised by sport therapists and the medical team during the rehabilitation stay. Individuals were recommended to engage in regular moderate or vigorous exercise after discharge by the clinic staff (3 x 40 minutes for cardiac and 2 x 20 minutes for orthopedic). Exercise after rehabilitation was no longer supervised by the clinic.

Patients were asked to fill out a computer-based questionnaire regarding exercise at the end of their rehabilitation stay (T1). At baseline, *N* = 241 patients participated in the study. Six weeks after rehabilitation, all patients were contacted a second time (T2), and assessments were conducted via Computer-Assisted Telephone Interviews (CATI).

Ethical approval was granted by the Ethics Commission of the German Association of Psychology (Deutsche Gesellschaft für Psychologie, DGPs).

About 80% (*n* = 195) of the baseline sample participated in the second assessment (T2). In subsequent data analyses, *n* = 17 cases were excluded due to missing values on the model variables. Thus, the final sample consisted of 178 persons (73.85%; *n* = 54 cardiac and *n* = 124 orthopedic patients).

Mean age of the longitudinal sample was 48.18 years (*SD* = 9.96; *range*: 22 – 76 years), and the sample consisted of more women (57.3%) than men. Of all participants, 76.4% were living with a partner, and 67.4% had at least one child. About 65.2% reported having a high school degree and 80.9% were employed.

**Measures**

*Self-reported exercise* was measured retrospectively, regarding the four weeks prior to rehabilitation and 6 weeks after rehabilitation (regarding the last four weeks) with two items adapted from Lippke, Ziegelmann and Schwarzer (2005). Items considered the frequency of

(1) fitness training and (2) strength training. Answers could be given on a 5-point Likert scale with the anchors “not at all” (1), “less than once per week for 40 [20] minutes” (2), “at least once per week for 40 [20] minutes” (3), “at least three [two] times per week for 40 [20] minutes” (4), and “five times per week for 40 [20] minutes or more” (5) (in this study the intercorrelation of the two items was $r = .46$).

*Positive Outcome Expectancies* were assessed at T1 with a scale adapted from Schwarzer, Luszczynska, Ziegelmann, Scholz and Lippke (2008) and Lippke et al. (2005). The stem “If I would be physically active I expect that…” was followed by five experiences: (1) “…it will have a positive impact on my health”, (2)”… I will feel better afterwards”, (3) “…I will feel more flexible afterwards”, (4)“…it will have a positive impact on my appearance”, (5)“…I will get to know other people.” Response categories ranged from (1) “I totally disagree” to (6) “I totally agree" (*Cronbach’s alpha* for these items in this study = .66).

*Positive Exercise Experiences* were measured at T2 with the Exercise Experiences Scale (EES, Fleig et al., 2011). The stem “When I was physically active I experienced that…” was followed by five positive experiences: (1) “…it had a positive impact on my health”, (2) ”… I felt better afterwards”, (3) “…I felt more flexible afterwards”, (4)“…it had a positive impact on my appearance”, (5) “…I got to know other people.” Response categories ranged from (1) “I totally disagree” to (6) “I totally agree". (*Cronbach’s alpha* for these items in this study = .70).

*Depressive symptoms* were measured at T1 with the PHQ-2 (Kroenke, Spitzer, & Williams, 2003). The PHQ-2 assesses depressed mood over the past two weeks. The two items were “Have you often been bothered by feeling down, depressed, or hopeless?” and “Have you often been bothered by little interest or pleasure in doing things?”. Response scale ranges from “not at all” (0), “on some days” (1), “more than half of the days” (2), and “nearly every day” (3) (intercorrelation of the two items in this study $r =. 57$). Responses are aggregated and depression severity ranged from 0 to 6.

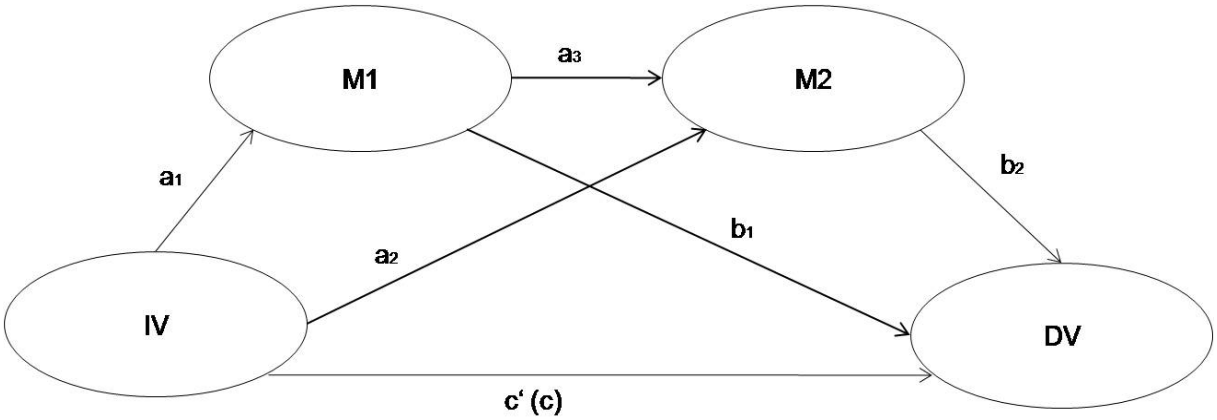
**Analytic Procedure**

A multiple step mediation analysis was conducted to test the hypothesis. Within a three step mediation model a dependent variable (*DV*) is regressed on an independent variable (*IV*) via a chain of two sequential mediators (*M1* and *M2*). An *IV* predicts *M1* in the first step, *M1* predicts *M2* in a second step, and *M2* predicts the *DV* in the third step. In our model depressive symptoms represented the *IV* and exercise behavior the *DV*. Outcome expectancies were the first mediator and experiences were the second mediator.

The macro *MED3C* (Hayes, Preacher, & Meyers, 2010) was used to run the analysis. When running the macro, one multiple step mediation and two single mediations are tested (1. *IV→M1→M2→DV*, 2. *IV→ M1→ AV*, and 3. *IV→M2→AV*). Six path coefficients (*c'*, *a1*, *a2*, *a3*, *b1*, *b2*), three specific indirect effects (one for each of the three mediation models: 1. *a1a3b2,* 2. *a1b1,* 3. *a2b2*), and the total indirect effect (sum of all three specific indirect effects) are estimated. The coefficient *c* is the effect from the *IV* on the *DV* without mediators. The theoretical model is depicted in Figure 1.

Estimates of all paths were calculated by using ordinary least square regressions. The indirect effects were tested via a bootstrapping procedure with 5,000 resamples. For all calculations, variables were *z*-standardized.

Figure 1. *The theoretical multiple step mediation model.*




*Note*: The model includes six path coefficients *(a1, a2, a3, b1, b2, c')* and the total effect (*c*).

# Results

## Attrition Analysis

The original sample at T1 ($N = 241$) differed from the longitudinal sample ($N = 178$; 73.85%; of the original sample) regarding the severity of depressive symptoms ($M_{\text{T1 sample}} = 1.42$; $M_{\text{longitudinal sample}} = 1.02$; $t = 2.07$; $p = .04$). Thus, more depressive symptoms at T1 were linked to a drop out at T2. However, separate attrition analyses for cardiac and orthopedic patients revealed that the drop out was only associated with depressive symptoms within the group of orthopedic patients ($M_{\text{T1 sample}} = 1.48$; $M_{\text{longitudinal sample}} = 1.03$; $t = 2.06$; $p = .04$) and not within the group of cardiac patients ($M_{\text{T1 sample}} = 1.30$; $M_{\text{longitudinal sample}} = 0.98$; $t = 0.81$; $p = .41$).

## Preliminary Results

Depressive symptoms at T1 were negatively related to outcome expectancies T1, experience T2, and exercise T2. Outcome expectancies T1 correlated with experience T2 and behavior at baseline and T2. Experiences were related to behavior at T1 and behavior T2. Baseline exercise and follow-up exercise were positive associated. All correlations are presented in Table 1.

Table 1. *Means (M), Standard Deviations (SD), and Intercorrelations for Depressive Symptoms T1, Exercise Outcome Expectancies T1, Exercise Experience T2, Physical Exercise at Baseline and T2 in N = 178 Rehabilitation Patients.*

| Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| *M* | 1.02 | 4.44 | 3.91 | 1.78 | 2.46 |
| *(SD)* | 1.22 | 0.92 | 1.05 | 0.83 | 1.01 |
| *Range* | 0-6 | 1-6 | 1-6 | 1-4 | 1-5 |
| 1.Depressive Symptoms T1 | 1 | | | | |
| 2. Exercise Outcome Expectancies T1 | -.23** | 1 | | | |
| 3. Exercise Experience T2 | -.26** | .37** | 1 | | |
| 4. Physical Exercise Baseline | .01 | .23** | .19* | 1 | |
| 5. Physical Exercise T2 | -.18** | .23** | .30** | .24** | 1 |

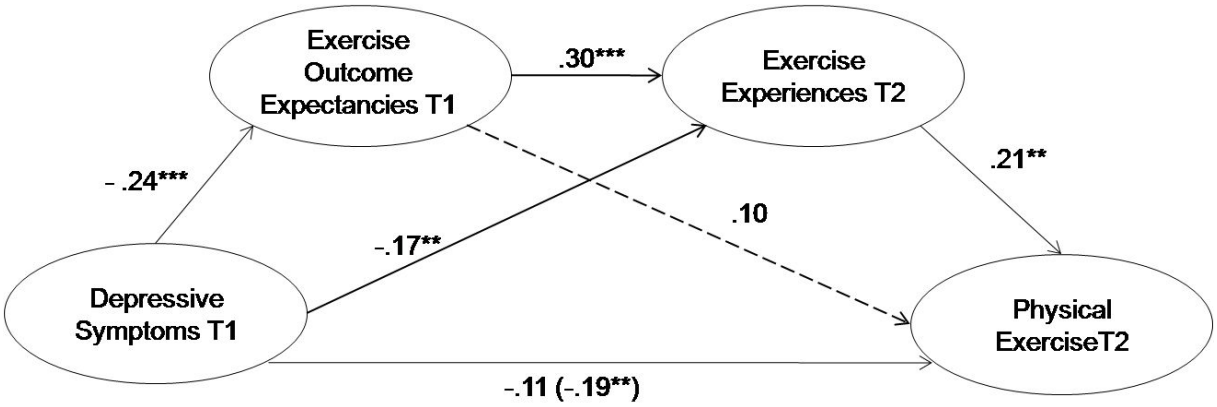
*Note.* *$p \leq .05$, ** $p \leq .01$.

**Multiple-Step Mediation Analysis**

As can be seen in Figure 2, depressive symptoms T1 were negatively associated with outcome expectancies at T1 (*a1* = -.24; $p \leq .001$). Outcome expectancies T1 predicted experience T2 (*a3* = .30; $p \leq .001$). Moreover, experiences T2 were significantly associated with exercise T2 (*b2* = .21; $p \leq .01$). The total effect from depressive symptoms T1 to exercise T2 was *c* = -.19 ($p \leq .01$). The c path became non-significant when the mediator variables were included in the model (*c'* = .11, *p* = .12). This refers to a full mediation effect. The specific indirect effect from depressive symptoms through outcome expectancies and experiences on behavior was significant (*a1a3b2* = -. 01; *CI* = -.10 to -.01). The specific

indirect effect through outcome expectancies only was not significant, whereas the specific indirect effect through experiences only was significant (*a2b2* = - .04; *CI* = -.10 to -. 01). The total indirect effect was -.08 (*CI* = -.15 to -.03). All effects emerge over and above the covariates (medical condition, sex, and exercise at baseline). Moreover, all model variables accounted for 15% of the variance in behavior T2.

Figure 2. *The multiple step mediation model in N = 178 rehabilitation patients.*




*Note*: The model is controlled for sex, medical condition, and baseline physical exercise; reported coefficients are betas; in brackets is the total effect; *** $p \leq .001$; ** $p \leq .01$.

# Discussion

We tested whether depressive symptoms predict less exercise behavior through a sequential path from low levels of exercise-specific positive outcome expectancies and lack of positive exercise experiences.

### How Depressive Symptoms Interfere with Exercise Behavior: A Pathway Including Outcome Expectancies and Experiences

Findings support our hypothesis. Results revealed that depressive symptoms were negatively associated with outcome expectancies. Outcome expectancies predicted experiences and finally experiences themselves were positively associated with exercise behavior. Thus, the interplay of outcome expectancies and experiences might help to explain

why depressive symptoms interfere with exercise behavior after rehabilitation. Additionally, experiences alone explained the path from depressive symptoms to behavior.

Results are in line with the study by Vickers et al. (2006) revealing a negative association of depressive symptoms and exercise-specific positive outcome expectancies. Our data also integrate well with previous studies that reported low scores regarding anticipated positive life events in depressive individuals (Bjärehaed et al., 2010; MacLeod & Byrne, 1996) and a negative link between depressive symptoms and positive outcome *expectancies* with regard to general future goals (e.g., Lecci et al., 1994). Our study adds to these findings by pointing out the negative link of depressive symptoms and positive outcome expectancies in the domain of physical exercise.

The present findings are also in line with previous findings showing that depressive symptoms are associated with less positive exercise *experiences*. Earlier studies found that depressive individuals reported less enjoyment from physical activities (Rosqvist et al., 2009; Sigmon et al., 2010) and less positive mood and energy through exercise (Blackwood et al., 1998; Weinstein et al., 2010) compared to non-depressive individuals. Our study results confirm a negative association of depressive symptoms with positive exercise experiences within a sample of orthopedic and cardiac rehabilitation patients. The link of depressive symptoms and positive exercise experiences is also in line with research demonstrating that depressive individuals make fewer recalls of positive experiences compared to non-depressive individuals (e.g., MacLeod, Tata, Kentish, & Jacobsen, 1997).

To sum up, negative thinking in persons with depressive symptoms (Beck, 1967, 1974) seem to affect exercise-specific expectancies and experiences as well.

The effect from outcome *expectancies* on *experiences* demonstrates that expectancies partly affect experiences in the behavioral domain of exercise. Expectation-driven perception has been identified in different domains of psychological and physiological reactions before. An interesting phenomenon that demonstrates how expectancies can shape experiences is the

confirmatory bias (Oswald & Grosjean, 2004). Expectation-driven perception might be particularly likely in depressive individuals as those individuals have a disposition to validate their negative thoughts and cognitions. Cognitive fallacies guide their interpretation and evaluation of experiences (e.g., Beck, 1967, 1974). Depressive individuals verify their negative cognitions by choosing negative over positive information, and by doing so, they might foster their intrapsychic coherence (Giesler et al., 1996).

In addition to the multiple step mediation effect, results revealed that e*xperiences* alone mediated the relationship between depressive symptoms and behavior, whereas outcome expectancies did not function as a single mediator. In other words, a lack of positive experiences is a more proximal predictor for physical exercise than outcome expectancies. This underlines the importance of experiences in the process of health behavior change (Fleig et al., 2011; Fuchs et al., 2011). The fact that outcome expectancies did not mediate the relationship between depressive symptoms and exercise alone is in line with theories (e.g., HAPA, SCT) postulating that outcome expectancies are a distal predictor of behavior (Bandura, 2004; Schwarzer, 2008).

**Implications**

Results indicate that fostering positive outcome expectancies and positive experiences might be useful to support medical rehabilitation patients with depressive symptoms to adopt and maintain post-rehabilitation exercise.

Proven techniques to increase outcome *expectancies* are to provide information about consequences of exercise and to balance pros and cons with regard to the target behavior (Abraham & Michie, 2008). Depressive rehabilitation patients should acknowledge positive consequences of exercise on a physical and psychological level. With regard to fostering positive *experiences,* our study suggests that one way to increase positive experiences might be to promote positive outcome expectancies. Other options to promote positive exercise experiences might be to let individuals self-select their level of exercise intensity to avoid

anxiety, overexertion, and frustration (Weinstein et al., 2010) and to set goals that are attainable (Scholz, Knoll, Sniehotta, & Schwarzer; 2006). Techniques to acknowledge experiences might be to encourage individuals to recall experiences or to use a diary (Fleig et al., 2011). Within a rehabilitation placement, clinic staff might also provide positive feedback on exercise accomplishments to raise awareness on positive experiences (Fuchs et al., 2011).

**Limitations**

Study limitations need to be recognized. First, the study lacks objective data regarding exercise behavior. However, there is evidence that self-reports of exercise are sufficiently valid measures (e.g., Miller, Freedson, & Kline, 1994). Second, depressive symptoms were measured by a two-item scale. A broader assessment of depression symptoms and a distinction between clinical and non-clinical depressed individuals might be more satisfactory. A wider assessment of depressive symptoms might also increase the effect from depressive symptoms on physical exercise. Third, the used Exercise Experiences Scale mainly focused on cognitive aspects of exercise experiences. Emotional experiences (e.g., feeling less hopeless or less sad) would be useful to access as well. Fourth, orthopedic rehabilitation patients were more likely to drop out of the study if they reported more depressive symptoms during rehabilitation. Thus, the effect of depressive symptoms on physical exercise might be underestimated in our study. An increase of the participation rate of depressive individuals in follow-up studies is desirable. Fifth, our research design covered only a short time period after discharge from rehabilitation. Moreover, it is preferable to measure each variable at a different point in time when specifying a multiple step analysis. Finally, to draw causal conclusions, experimental research designs are required.

**Conclusions**

Our study suggests that depressive symptoms lead to less exercise through a pathway that includes outcome expectancies and experiences. Results might shed light on how depressive symptoms interfere with exercise via social-cognitive determinants. Understanding

social-cognitive processes that explain the interference of depressive symptoms with exercise aids to tailor exercise interventions to the needs of depressive individuals and support them in an appropriate way. Fostering exercise-specific positive outcome expectancies and positive experiences might enable depressive individuals increasing their physical exercise.

# References

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology*, 3, 379- 387.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, 31,143-164.

Beck, A.T. (1967). *Depression clinical, experimental, and theoretical aspects*. New York, USA: Harper & Row.

Beck, A.T. (1974). The development of depression. A cognitive model. In Friedman, R.J. & Katz, M.M. (Eds.), *The psychology of depression* (pp.3-28). New York: Wiley

Bjärehaed, J., Sarkohi, A., & Andersson, G. (2010). Less positive or more negative? Future-directed thinking in mild to moderate depression. *Cognitive Behavior Therapy*, 39, 37-45.

Blackwood, S. K., MacHale, S. M., Power, M. J., Goodwin, G. M., & Lawrie, S. M. (1998). Effects of exercise on cognitive and motor function in chronic fatigue syndrome and depression. *Journal of Neurology, Neurosurgery & Psychiatry*, 65, 541-546.

Brassington, G. S., Atienza, A. A., Perczek, R. E., DiLorenzo, T. M., & King, A. C. (2002). Intervention-related cognitive versus social mediators of exercise adherence in the elderly. *American Journal of Preventive Medicine*, 23, 80-86.

Dorn, J., Naughton, J., Imamura, D. A. I., & Trevisan, M. (2001). Correlates of compliance in a randomized exercise trial in myocardial infarction patients. *Medicine & Science in Sports & Exercise*, 33, 1081-1089.

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Exercise maintenance in rehabilitation. How experience can make a difference. *Psychology of Sport and Exercise*, 12, 293-299.

Fuchs, R., Göhner, W., & Seelig, H. (2011). Long-term effects of a psychological group intervention on physical exercise and health: The MoVo concept. *Journal of Physical Activity and Health*, 8, 794-803

Giesler, R. B., Josephs, R. A., & Swann, Jr. W. B. (1996). Self-verification in clinical depression: The desire for negative evaluation. *Journal of Abnormal Psychology*, 105, 358-368.

Gonzalez, J. S., Safren, S. A., Cagliero, E., Wexler, D. J., Delahanty, L., Wittenberg, E., Blais, M. A., Meigs, J. B., & Grant, R. W. (2007). Depression, self-care, and medication adherence in type 2 diabetes. *Diabetes Care* 30, 2222-2227.

Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine*, 36, 698-703.

Hayes, A. F., Preacher, K. J., & Myers, T. A. (2010). Mediation and the estimation of indirect effects in political communication research. In Erik. P. Bucy, & R. Lance Holbert (Eds), *Sourcebook for political communication research: Methods, measures, and analytical techniques*. New York: Routledge.

Howard, K. J., Ellis, H. B., Khaleel, M. A., Gatchel, R. J., & Bucholz, R. (2010). Psychosocial profiles of indigent patients with severe osteoarthritis requiring arthroplasty. *The Journal of Arthroplasty*, doi:10.1016/j.arth.2010.03.002.

Hunt-Shanks, T., Blanchard, C., & Reid, R. (2009). Gender differences in cardiac patients: A longitudinal investigation of exercise, autonomic anxiety, negative affect and depression. *Psychology, Health and Medicine,* 14, 375-385.

Kirsch, I. (1997). Response expectancy theory and application: A decennial review. *Applied & Preventive Psychology*, 6, 69-79.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care*, 41, 1284-1294.

Lecci, L., Karoly, P., Briggs, C., & Kuhn, K. (1994). Specificity and generality of motivational components in depression: A personal projects analysis. *Journal of Abnormal Psychology*, 103, 404-408.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2005). Stage-specific adoption and maintenance of physical activity: Testing a three-stage model. *Psychology of Sport and Exercise*, 6, 585-603.

MacLeod, A. K., & Byrne, A. (1996). Anxiety, depression, and the anticipation of future positive and negative experiences. *Journal of Abnormal Psychology*, 105, 286-289.

MacLeod, A.K., Tata, P., Kentish, J., & Jacobsen, H. (1997). Retrospective and prospective cognitions in anxiety and depression. *Cognition & Emotion*, 11, 467-479.

Miller, D. J., Freedson, P. S., & Kline, G. M. (1994). Comparison of activity levels using the Caltrac accelerometer and five questionnaires. *Medicine and Science in Sports and Exercise*, 26, 376–382.

Oswald, M.E., & Grosjean S. (2004). Confirmation Bias. In: R.F. Pohl (Ed), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory*. Hove , UK: Psychology Press.

Phillips, W. T., Kiernan, M.. & King, A. C. (2003). Physical Activity as a Nonpharmacological Treatment for Depression: A Review. *Complementary Health Practice Review,* 8, 139-152.

Rosqvist, E., Heikkinen, E., Lyyra, T.-M., Hirvensalo, M., Kallinen, M., Leinonen, R., …& Rantanen, T. (2009). Factors affecting the increased risk of physical inactivity among older people with depressive symptoms. *Scandinavian Journal of Medicine & Science in Sports*, 19, 398-405.

Rutledge, T., Reis, V. A., Linke, S. E., Greenberg, B. H., & Mills, P. J. (2006). Depression in heart failure: a meta-analytic review of prevalence, intervention effects, and associations with clinical outcomes. *Journal of the American College of Cardiology*, 48, 1527-1537.

Scholz, U., Knoll, N., Sniehotta, F. F., & Schwarzer, R. (2006) Physical activity and depressive symptoms in cardiac rehabilitation: Long-term effects of a self-management intervention. *Social Science & Medicine*, 62, 3109-3120.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1-29.

Schwarzer, R., Luszczynska, A., Ziegelmann, J. P., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: Three longitudinal studies in rehabilitation, *Health Psychology*, 27, 54-63.

Sigmon, S. T., Schartel, J. G., Boulard, N. E., & Thorpe, G. L. (2010). Activity level, activity enjoyment, and weather as mediators of physical health risks in seasonal and nonseasonal depression. *Journal of Rational-Emotive & Cognitive Behavior Therapy*, 28, 42-56.

Van Stralen, M. M., De Vries, H., Mudde, A. N., Bolman, C., & Lechner, L. (2009). Determinants of initiation and maintenance of physical activity among older adults: A literature review. *Health Psychology Review*, 3, 3147-207.

Vickers, K. S., Nies, M. A., Patten, C. A., Dierkhising, R., & Smith, S. A. (2006). Patients with diabetes and depression may need additional support for exercise. *American Journal of Health Behavior,* 30, 353-362.

Weinstein, A., Deuster, P., Francis, J., Beadling, C., & Kop, W. (2010). The role of depression in short-term mood and fatigue responses to acute exercise. *International Journal of Behavioral Medicine*, 17, 51-57.

Williams, D. M., Anderson, E. S., & Winett, R. A. (2005). A review of the outcome expectancy construct in physical activity research. *Annals of Behavioral Medicine*, 29, 70-79.

Wing, R.R., Phelan, S., & Tate, D. (2002) The role of adherence in mediating the relationship between depression and health outcomes. *Journal of Psychosomatic Research*, 53, 877-81.

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanos, F., … & Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Casecontrol study. *Lancet*, 364, 937-952.

Ziegelstein, R.C., Fauerbach, J. A., Stevens, S. S., Romanelli, J., Richter, D. P., & Bush, D. E. (2000). Patients with depression are less likely to follow recommendations to reduce cardiac risk during recovery from a myocardial infarction. *Archives of Internal Medicine*, 160, 1818-1823.

# 4

# Synergistic Effects of Intention and Depression on Action Control: Longitudinal Predictors of Exercise after Rehabilitation

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Synergistic effects of intention and depression on action control: Longitudinal predictors of exercise after rehabilitation. *Mental Health and Physical Activity, 2*, 78-84. http://dx.doi.org/10.1016/j.mhpa.2010.09.005

# Abstract

*Objective.* Physical exercise is part of orthopedic and cardiac rehabilitation. Although intentions might be high, many patients fail to adopt or maintain exercise after discharge from rehabilitation because of self-regulatory failure. This might be due to depressive symptoms. Therefore, this study investigates whether depressive symptoms affect the translation of exercise intentions via action control into exercise.

*Design.* At the beginning of rehabilitation, intention, action control, depressive symptoms, and exercise behavior were assessed in 277 orthopedic and cardiac patients. Exercise was reassessed 6 weeks after discharge from rehabilitation.

*Methods.* Mediation and moderated mediation analyses were conducted. It was tested whether action control translates the effect of exercise intentions on subsequent behavior. In addition, it was examined whether this mediation was affected by levels of depressive symptoms.

*Results.* Action control worked as a mediator between exercise intentions and behavior. Moreover, levels of depressive symptoms moderated this mediation. The mediation effect only materialized within the subgroup of patients lower on depressive symptoms.

*Conclusion.* Patients with higher depressive symptoms may fail to use appropriate self-regulatory strategies for exercise. Future research should examine whether depressed individuals can benefit from action control interventions and identify which strategies are most beneficial for individuals with depressive symptoms.


*Keywords*. Depressive symptoms; physical exercise; action control; self-regulation; moderated mediation; rehabilitation patients

# Introduction

Regular physical exercise has been found to support physical health. Research provides clear evidence for the positive impact of exercise on cardiovascular mortality and morbidity (e.g., Sesso, Paffenbarger, & Lee, 2000; Yusuf et al., 2004) as well as for the treatment of cardiovascular diseases (Jolliffe et al., 2001; Taylor et al., 2004). Engaging in exercise also serves as primary (e.g., Henchoz & Kai-Lik So, 2008) and secondary prevention for orthopedic health issues (Conn, Hafdahl, Minor, & Nielsen, 2008; Iwamoto, Takeda, & Ichimura, 2001; Metsios et al., 2008) such as arthritis, osteoarthritis, osteoporosis, and nonspecific lower back pain. Consequently, exercise has been established as a major treatment component in cardiac and orthopedic rehabilitation (e.g., European Society of Cardiology, 2007 and American Academy of Orthopedic Surgeons, 2009). Continuous and regular exercise is indispensable for long-term recovery (Göhner & Schlicht, 2006; Haskell et al., 1994).

Adhering to behavior recommendations beyond the rehabilitation setting poses a major challenge for patients. Therefore, it is important to understand the psychological mechanisms that foster successful adoption and maintenance of exercise into everyday life (Biddle & Fuchs, 2009). Self-regulatory strategies of action control have been found to help patients translate their exercise intentions into behavior after rehabilitation discharge (e.g., Sniehotta, Nagy, Scholz, & Schwarzer, 2006). However, a barrier might be the high prevalence of depressive symptoms among rehabilitation patients (e.g., Riddle, Wade, & Jiranek, 2010; Rutledge, Reis, Linke, Greenberg, & Mills, 2006).

There is accumulating evidence referring to self-regulation failure in depressed individuals (e.g., Detweiler-Bedell, Friedman, Leventhal, Miller, & Leventhal, 2008). Therefore, the current paper addresses the question as to whether depressive symptoms affect the process of action control with regard to exercise. Exercise is an indispensible component

within disease management in rehabilitation and provides a non-pharmacological treatment to decrease depressive symptoms (Mead et al., 2009). Investigating the relationship between depressive symptoms and self-regulation with regarding to exercise is important because it will allow the development of interventions specifically targeted at patients with depressive symptoms.

**Action Control Bridges the Gap Between Exercise Intention and Exercise Behavior**

A high percentage of orthopedic and cardiac patients fail to maintain prescribed exercise levels after rehabilitation discharge (Burke, Dunbar-Jacob, & Hill, 1997; Dorn, Naughton, Imamura, & Trevisan, 2001; Sluijs, Kok, & Van der Zee, 1993). A majority of patients report having intentions to perform recommended exercise, but are unsuccessful in implementing their intentions in everyday life (Johnston, Johnston, Pollard, Kinmonth, & Mant, 2004). People do not always behave in line with their intentions. This divergence is called the 'intention-behavior-gap' (Sheeran, 2002). Approximately, 47% of individuals report having an intention for a particular behavior but do not show performance in accordance with their intentions (Sheeran, 2002). Consequently, the lack of explained variance in behavior suggests that intention is not the only predictor of behavior.

Self-regulatory strategies have been found to bridge the gap between intention and exercise behavior (e.g., Lippke, Ziegelmann, & Schwarzer, 2004; Luszczynska et al., 2010; Sniehotta, Scholz, & Schwarzer, 2005a). Self-regulation is defined as any effort by an organism to alter its own response (Carver & Scheier, 1998; Tice & Bratslavsky, 2000). Such a process takes place during non-routinized directed behavior and "implies modulation of thought, affect, behavior, or attention via deliberate or automated use of specific mechanisms and supportive metaskills" (Karoly, 1993, p. 25). The current study focuses on the self-regulation construct of action control.

Action control includes three cognitive self-regulatory facets: *awareness of standards*, *self-monitoring*, and *self-regulatory effort* (Sniehotta et al. 2005a). *Awareness of standards*

represents a precondition to any self-regulated behavior. Standards define how things should be, commonly in terms of a goal (e.g., I want to be physically active for at least 3 times a week). Standards need to be present during self-regulatory processes to be aware of where the person wants to go. Memory processes activate set standards in a person's awareness. *Self-monitoring* describes the process of comparing the standards with the actual behavior and implies positive and negative feedback loops as described in cybernetic regulation models (Carver & Scheier, 1998). During an efficient self-regulatory process, negative discrepancy between standards and actual behavior results in attempts to adjust behavior in order to achieve the previously set standards. Positive feedback, on the other hand, confirms that no further regulation is required and that the person is on track. Finally, s*elf-regulatory effort* is needed to adhere to one's standards and goals. The three dimensions subsumed under the construct of action control are highly intercorrelated (Sniehotta et al., 2006).

Several findings underline the central role of action control within the process of translating intentions for different health behaviors into performance. Scholz, Nagy, Göhner, Luszczynska, and Kliegel (2009) found that changes in action control were associated with changes in intention and behavior in the domains of nutrition and smoking. Likewise, Sniehotta et al. (2005a; 2006) revealed that action control mediated the relationship between exercise intention and subsequent exercise behavior in two longitudinal studies with cardiac rehabilitation patients. In a randomized controlled trial with regard to an action control intervention, action control predicted dental hygiene behavior in participants who had high intentions (Schüz, Sniehotta, & Schwarzer, 2007). In a similar way, it has been shown that an intervention targeted at increasing action control explained exercise behavior in cardiac rehabilitation patients six weeks after discharge (Sniehotta et al., 2005b).

**Are Depressive Symptoms Related to Action Control Failure?**

Depressive symptoms are widespread among cardiac (Robinson, 2003; Rutledge et al., 2006) and orthopedic (Howard, Ellis, Khaleel, Gatchel, & Bucholz, in press; Magni,

Marchetti, Moreschi, Merskey, & Luchini, 1993; Riddel et al., 2010) rehabilitation patients. Common depressive symptoms are hopelessness, sadness, fatigue, avolition, concentration difficulties, and cognitive dysfunctioning (Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revision, APA, 2000).

There are several ways in which depressive symptoms and difficulties in action control with regard to exercise can be linked. There is increasing empirical evidence that depressive symptoms are associated with cognitive impairment. Strong cognitive deficits in the domains of attention, executive functioning, short and long term memory are observable in individuals with depressive symptoms (e.g., Burt, Zembar, & Niederehe, 1995; Ottowitz et al., 2002; Paelecke-Habermann, Pohl, & Leplow, 2005; Veiel, 1997). In particular, executive functions guide non-routine behavior by high-level control operations, such as organizing and structuring of behavior, solving problems, generating, and executing plans (Baddeley & Logie, 1999). Action control requires executive functioning with regard to monitoring one's behavior and having standards and goals. Thus, it seems likely that patients with depressive symptoms would experience difficulties in action control processes with regard to exercise.

Another explanation as to why individuals experiencing depressive symptoms might show impairments in self-regulation processes is offered by the Strength and Energy Model (Baumeister, Muraven, & Tice, 2000). According to this model, regulation is a global energy and constitutes a limited resource. The energy is utilized on self-regulated tasks across different domains of actions. The use of self-regulation depletes the source over time and if the energy is consumed in one domain it can lead to failure in other domains (Hagger, Wood, Stiff, & Chatzisarantis, 2010). Stress, fatigue, and emotion regulation, that constitute common depressive symptoms, facilitate self-regulation failure (Baumeister & Heartherton, 1996; Muraven, Tice, & Baumeister, 1998; Tice & Bratslavsky, 2000). Moreover, demands on self-regulatory energy are high in individuals who suffer from both a chronic physical disease and psychological distress (Detweiler-Bedell et al., 2008). Individuals need their self-regulatory

energy for managing both impairments. Consequently, this may make it difficult to initiate and sustain a new behavior.

Thus, there is some evidence that lead to the assumption that individuals with depressive symptoms might have difficulties with action control in the domain of exercise. There is a high prevalence of depressive symptoms in orthopedic and cardiac rehabilitation patients. A failure of action control in those patients could interfere with successful maintenance of exercise behavior after discharge. If depressive symptoms affect how action control mediates the intention- exercise relationship, depressive symptoms would function as a moderator of such a mediation. To our knowledge, no previous study has investigated whether depressive symptoms moderate the intention-action control- exercise relationships in rehabilitation patients.

### Aims of the Study

The present study aims to investigate the interplay of action control, intention, exercise behavior, and depressive symptoms in a sample of cardiac and orthopedic rehabilitation patients. Our hypothesis was that the effect of exercise intention on exercise behavior mediated by action control would be moderated by the level of depressive symptoms. In other words, the successful mediation from intention via action control to behavior depends on levels of depressive symptoms. The more depressive symptoms are reported, the less likely patients may be to translate their intention via action control into behavior.

## Method

### Participants and Procedure

Study participants were recruited at two orthopedic rehabilitation clinics (one in-patient and one out-patient) and one in-patient cardiac rehabilitation clinic. Rehabilitation included exercise therapy supervised by sport therapists and the medical team as well as exercise counseling. Individuals were recommended to engage in regular moderate or vigorous exercise after discharge by the clinic staff (3 x 40 minutes for cardiac / 2 x 20

minutes for orthopedic).

Patients were asked to fill out a computer-based questionnaire regarding exercise at the beginning of their rehabilitation stay. After providing informed consent $N = 446$ patients participated in the study. About six weeks after rehabilitation (about 9 weeks after measurement-point T1) patients were contacted a second time (T2), and assessments were conducted via Computer-Assisted Telephone Interviews (CATI). Ethical approval for the study was granted from the Ethics Commission of the German Association of Psychology (Deutsche Gesellschaft für Psychologie, DGPs).

About 67% (N=290) of the baseline sample participated in the second assessment (T2). In subsequent data analyses, $n = 13$ cases were excluded due to missing values on relevant variables. Thus, the final sample consisted of 277 persons (62%; $n = 66$ cardiac and $n = 211$ orthopedic patients).

Mean age of the total sample was 49 years ($SD = 9.9$; age range: 22–76 years), and the sample consisted of more women (54.2%) than men. Of all participants, 77.3% were living with a partner, and 74% had at least one child. A total of 90.3% had German as their mother tongue. School-leaving qualification was distributed as follows: 27.2% obtained a higher educational entrance qualification, 48.6% finished 10$^{th}$ grade, 14.8% finished 9$^{th}$ grade, and 1.7% did not have any school degree. About 76.2% of the sample was employed.

Differences between the two rehabilitation groups were found regarding gender (cardiac sample: male = 59.8%; orthopedic sample: male = 40.7%; $\chi^2 = 11.60$; $df = 1$, $p < .01$), school-leaving qualification (cardiac sample: no school education = 3.1%, 9$^{th}$ grade = 25.8%, 10$^{th}$ grade = 53.6%, higher educational entrance qualification = 17.5%; orthopedic sample: no school education = 1.6%, 9$^{th}$ grade = 13.4%, 10$^{th}$ grade = 51.6%, higher educational entrance qualification = 33.4%; $\chi^2 = 14.22$, $df = 3$; $p < .01$), and with regard to performed exercise concerning the four weeks prior to rehabilitation (cardiac sample: $M = 1.74$; orthopedic sample $M = 2.30$; $t = -5.34$; $p < .01$). Thus, the cardiac sample consisted of more men than

women, differed with regard to the educational background, and performed relatively less goal behavior prior to rehabilitation compared to the orthopedic sample. Both patient groups reported low to moderate levels of exercise prior to rehabilitation.

***Attrition Analysis***

The original sample at T1 ($N = 446$) differed from the longitudinal sample ($N = 277$) in the number of reported depressive symptoms (T1 sample: $M = 2.62$; T2 sample: $M = 1.93$; $t = 3.28$; $p < .01$). Thus, participants reporting fewer depressive symptoms at T1 were more likely to remain in the study.

***Measures***

*Self-reported exercise* was measured at Time 1 and Time 2 with a scale adapted from Lippke, Ziegelmann, and Schwarzer (2005). Items considered two domains of activities. Firstly, patients rated their fitness activities (e.g., using an exercise bike) and, secondly, their strength training (training muscle strength, e.g., on machines) over the last four weeks (at T1 the time span concerned the four weeks prior to the rehabilitation, whereas T2 referred to the four weeks after the rehabilitation). Exercise was described as done outside of work duties, intentionally, and at least at an exhausting level. Participants rated the amount of activities on each domain on a 5-point scale: “not at all” (1), “less than once per week for 40 [20] minutes” (2), “at least once per week for 40 [20] minutes” (3), “at least three [two] times per week for 40 [20] minutes” (4), and “five times per week for 40 [20] minutes or more” (5).

*Intention* to perform exercise was also assessed using a scale adapted from Lippke et al. (2005). The intention items were formulated analogue to the behavior items. This kind of analogue assessment of intention and behavior has been suggested by Nigg (2005). At T1, patients indicated the amount of fitness activities and strength training they were intending to perform in the four weeks after rehabilitation. Response categories were: “not at all” (1), “less than once per week for 40 [20] minutes” (2), “at least once per week for 40 [20] minutes” (3), “at least three [two] times per week for 40 [20] minutes” (4) and “five times per week for 40

[20] minutes or more" (5).

*Action Control* was assessed with a 6-item scale comprising three facets of the action control process (Sniehotta et al., 2005a): self-monitoring (Items a and b), awareness of standards (Items c and d), and self-regulatory effort (Items e and f). The items were introduced by the request "Think about the last four weeks when answering the following questions". Statements read: (a) "I consistently monitored myself whether I exercised frequently enough", (b) "I consistently monitored when, where, and how long I exercised", (c) "I have always been aware of my prescribed training program", (d) "I often had my exercise intention on my mind", (e) "I really tried hard to exercise regularly", and (f) "I took care to train as much as I intended to do". Answers could be given on a 6-point Likert scale with the anchors "not at all true" (1) to "totally true" (6). Internal consistency in terms of Cronbach's α was .86.

*Depressive symptoms* were measured at T1 by using the 2-item version of the Patient Health Questionnaire (PHQ-2; Kroenke, Spitzer, & Williams, 2003). The PHQ-2 assesses the frequency of depressed mood and anhedonia over the past 2 weeks. The two items were "Have you often been bothered by feeling down, depressed, or hopeless?" and "Have you often been bothered by little interest or pleasure in doing things?". The response scale ranges from "not at all" (0), "on some days" (1), "more than half of the days" (2), and "nearly every day" (3). The correlation between the two items was .99. Responses were aggregated in a way that depression severity ranged from 0-6. All items were translated from German.

**Data Analytic Plan**

The study examines mediation and moderation hypotheses. Mediation analyses identify mechanisms of influence and address questions of how and why an effect occurs (Cerin, in press). Mediation effects are expressed in indirect effects. Moderated mediation analysis tests whether the mediating process depends on values of another variable, a moderator variable (Muller, Judd, & Yzerbyt, 2005). A moderated mediation effect is

expressed in a conditional indirect effect. We tested whether the effect of intention (*IV, independent variable*) through action control (*M, Mediator*) on exercise behavior (*DV, dependent variable*) was conditional on levels of depressive symptoms (*W, moderator*).

The '*Moderated Mediation Macro'* by Preacher, Rucker, and Hayes (2007) was used to conduct the analyses. The macro is a syntax for testing moderated mediation. Estimates of all paths within the moderated mediation analysis are calculated by using OLS (Ordinary Least Square) regressions. The conditional indirect effect was tested via a bootstrapping procedure with 5,000 resamples. The bootstrapping procedure is a non-parametric method for assessing indirect effects (Preacher et al., 2007). This procedure treats the study sample as a pseudo-population and calculates statistical parameters for testing the conditional effect by multiple resampling of the data. The procedure overcomes several problems of non-normally distributed data. The Johnson-Neyman technique was used to determine regions of significance of the conditional indirect effect (Preacher et al., 2007). For all calculations, variables were z-standardized (Aiken & West, 1991).

A moderated mediation model was specified in which depressive symptoms affect the path from intention to action control (*W* operates on the path from *IV* to *M*). A model in which *W* affects the path between *IV* and *M* would be expressed in an interaction between *IV* and *W*. Thus, the interaction term of intention x depressive symptoms was tested.

The moderated mediation model is tested in two steps. First, a mediator variable model is calculated in which *M* is predicted by the covariates, *IV*, *W*, and *IV* x *W*. In a second step the dependent variable model is calculated in which the *DV* is predicted by the covariates, *M, W*, *IV*, and *IV* x *W*. Thus, in the first step, action control was regressed on the covariates, intention, depressive symptoms, and intention x depressive symptoms. In the second step, exercise T2 was regressed on the covariates, intention, depressive symptoms, action control, and intention x depressive symptoms. Baseline exercise and recruitment site (cardiac in-patient clinic, orthopedic out-patient clinic, and orthopedic in-patient clinic) were

included as covariates. Recruitment site was dummy coded with the cardiac in-patient clinic as the reference category. Thus, two dummy variables were included in the analyses (D1 = cardiac in-patient clinic vs. orthopedic out-patient clinic; D2 = cardiac in-patient clinic vs. orthopedic in-patient clinic).

# Results

## Correlations

Means, standard deviations, and intercorrelations of all variables used in the moderated mediation model are depicted in Table 1. Intention for exercise was significantly associated with exercise T2. Action control was positively associated with intention and behavior T2. Depressive symptoms were negatively associated with action control. Moreover, exercise at baseline was correlated with exercise at T2.

*Table 1.* Means (*M*), Standard Deviations (*SD*), and Intercorrelations for Intention T1, Action Control T1, Depressive Symptoms T1, and Physical Exercise at T1 and T2 in *N*= 277 Rehabilitation Patients.

| Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| *M* | 2.50 | 3.25 | 1.94 | 2.20 | 2.47 |
| *(SD)* | (0.92) | (1.37) | (1.94) | (0.79) | (1.05) |
| *Range* | 1-5 | 1-6 | 0-6 | 1-5 | 1-5 |
| Intention T1 | 1 | | | | |
| Action Control T1 | .18** | 1 | | | |
| Depressive Symptoms T1 | -.04 | -.10* | 1 | | |
| Physical Exercise T1 | .34** | .23** | .01 | 1 | |
| Physical Exercise T2 | .32** | .20** | -.01 | .21** | 1 |

*Note.* *$p$<.05 ** $p$< .01.

**Mediation and Moderation Analyses**

First, action control was regressed on the covariates (recruitment site and exercise at baseline), intention, depressive symptoms, and the interaction between intention and depressive symptoms. Intention ($B$= .16, $p$ < .01) and intention x depressive symptoms ($B$ = -.13, $p$ < .05) predicted action control over and above exercise at baseline ($B$ = .17, $p$ < .01) and recruitment site (D1: $B$ = .33; D2: $B$ = .17, $p$ < .05), accounting jointly for 7% of the variance in action control. The significant interaction between intention and depressive symptoms confirmed the hypothesized moderated meditation effect. Figure 1 displays the interaction effect between depressive symptoms and intention on action control. The interaction graph illustrates that high levels of intention were associated with high levels of action control. Moreover, an increase of depressive symptoms led to a decrease in the effect of intentions on action control.

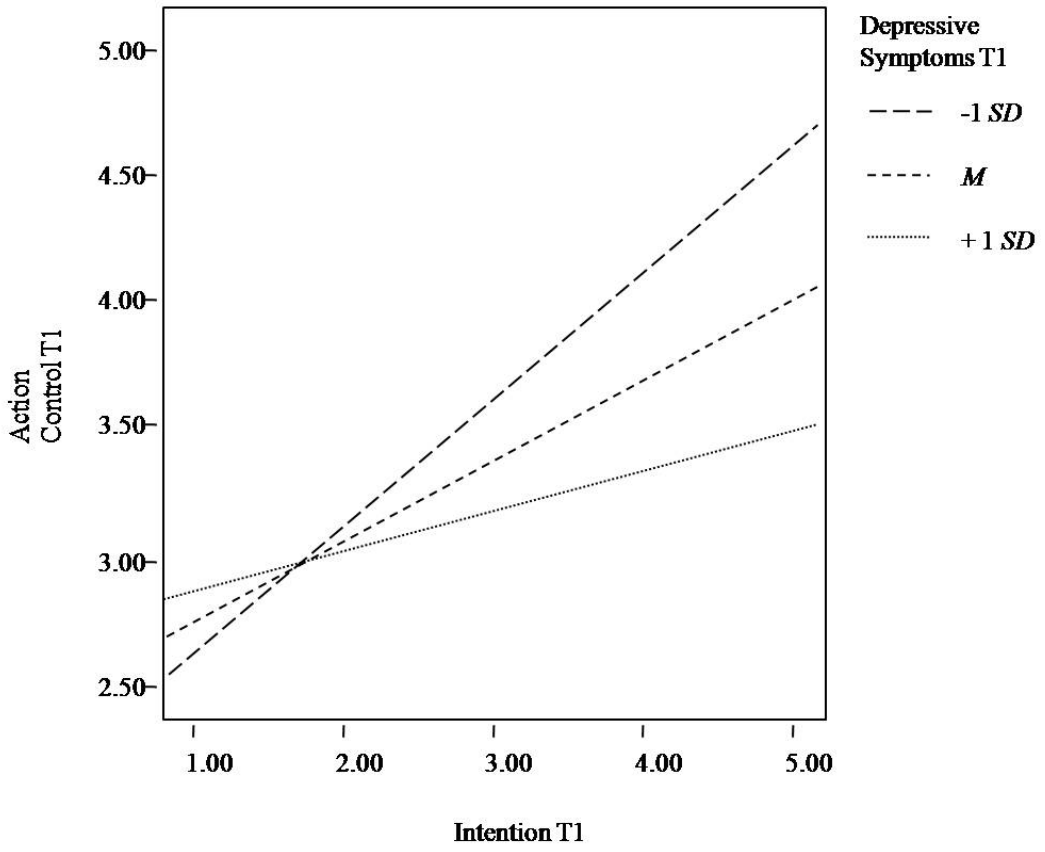



*Figure 1.* Interaction of intention and depressive symptoms on action control. Action control T1 is regressed on intention T1. Three regression lines display the effect on the level of the mean, *1 SD* above the mean, and 1 *SD* below the mean of depressive symptoms.

In a second step, exercise T2 was regressed on the covariates (exercise at baseline, recruitment site), intention, depressive symptoms, action control, and depressive symptoms x intention. Action control ($B$ = .17, $p$ < .01), and intention ($B$ = .30, $p$ < .01) predicted exercise at T2 over and above recruitment site (D1: $B$ = .33, $p$ < .01; D2: $B$ = .27, $p$ < .01). The variables accounted for 12 % of the variance in exercise T2. Figure 2 displays path coefficients for the moderated mediation model.

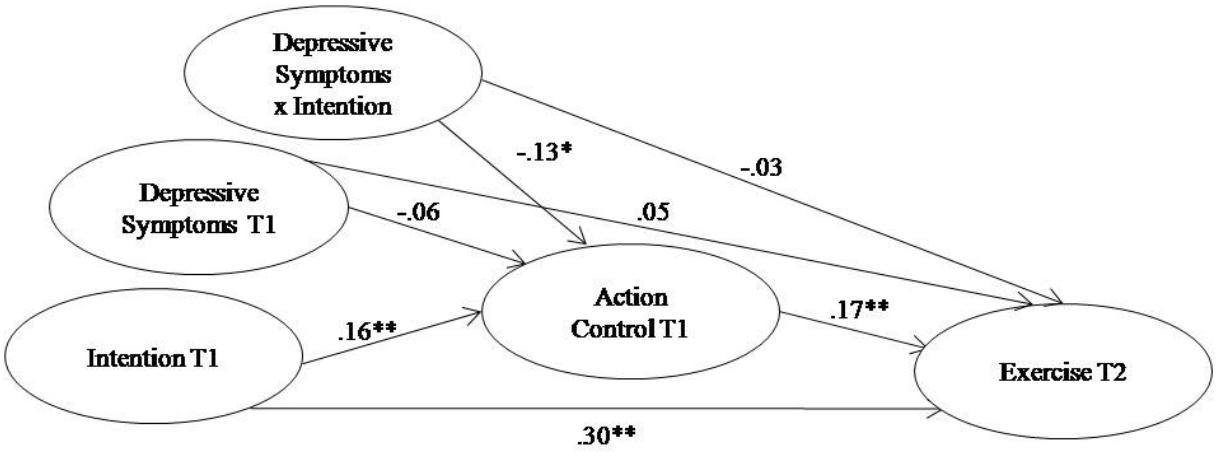



*Figure 2.* Results of regression analyses for moderated mediation ($N$=277). Controlled for recruitment site and exercise T1.
*$p$ <.05 **$p$ <.01.

The conditional indirect effect emerged significant with regard to the mean of depressive symptoms and *1 SD* below the mean, in contrast to non-significance at *1 SD* above the mean (see Table 2). In other words, the effect of exercise intention via action control on exercise was only substantiated in individuals with fewer depressive symptoms. The size of the conditional indirect effect increased with lower levels of depressive symptoms. Figure 3 depicts confidence interval bands of the conditional indirect effect. The Johnson-Neyman technique was applied to identify in more detail the values of depressive symptoms for which the mediation effect reached significance. Significance tests with regard to the conditional indirect effect were run on the whole range of values of the moderator. Results revealed that

depression scores up to a z-value of -0.06 (equal to a depression score of 2.1, $p = .05$) led to a significant mediation, whereas z-scores above -0.06 (depression scores from 2.2 to 6) led to non-significant *p*-values.

Table 2. *The Conditional Indirect Effect at Specific Values of the Moderator (Depressive Symptoms).*

| Depressive Symptoms *(z-score)* | *Conditional indirect effect* | *SE* | *p* | *LL CI* | *UL CI* |
|---|---|---|---|---|---|
| -1.08 *(-1 SD)* | 0.05 | .02 | .03 | 0.10 | 0.00 |
| -0.14 *(Mean)* | 0.03 | .02 | .05 | 0.06 | 0.00 |
| 0.81 *(+1 SD)* | 0.01 | .02 | .50 | -0.02 | 0.04 |

*Note*. *LL CI* and *UL CI* = lower and upper level of confidence interval for α = .05.
*$p < .05$.

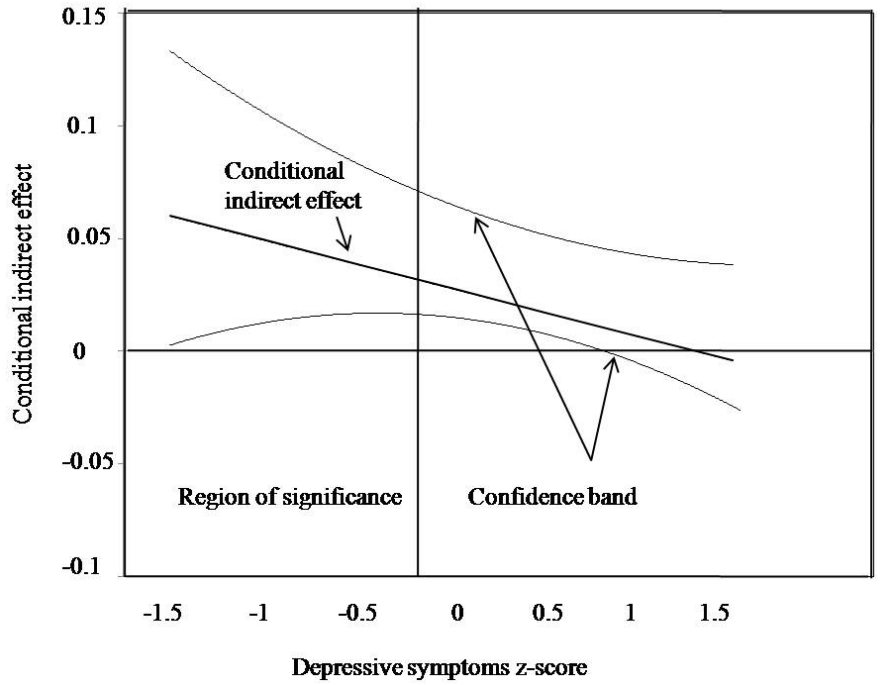



*Figure 3.* The size of the conditional indirect effect with a 95%- confidence band. The smaller the value of the moderator (depressive symptoms), the larger the size of the mediation effect from intention through action control on exercise behavior.

# Discussion

The aim of this study was to investigate whether depressive symptoms affect the successful application of action control with regard to exercise in patients after their rehabilitation. We hypothesized that action control works as a mediator between exercise intention and behavior and that this mediation is moderated by the level of depressive symptoms.

Findings supported our hypothesis. Action control mediated the effect of exercise intention on behavior and the mediation depended on levels of reported depressive symptoms. In accordance with our assumptions, patients with none or few depressive symptoms were using action control to translate their intention into exercise behavior. In contrast, for patients with high depressive symptoms this translation did not materialize. Depressive symptoms moderated the path from intention to action control which implies that patients with more depressive symptoms failed in translating their intentions into action control.

The revealed mediation from intention via action control on exercise behavior is consistent with previous findings among cardiac patient samples (Sniehotta et al., 2005a; Sniehotta et al., 2006). To our knowledge, this is the first study replicating these findings in a combined sample of cardiac and orthopedic patients. The moderation of depressive symptoms with regard to the intention-action control-behavior relationship is also in line with previous studies reporting deficits in the domains of attention and executive functioning within samples of depressed individuals (Ottowitz et al., 2002; Paelecke-Habermann et al., 2005). Attention and executive functions are required for successful action control. Results can also be interpreted within the framework of the Strength and Energy Model (Baumeister et al., 2000). Rehabilitation patients suffering from depressive symptoms might have limited self-regulatory resources to be invested into exercise goal attainment. Fatigue and stress (key depressive symptoms) are likely to deplete a person's global self-regulation energy (Baumeister & Heartherton, 1996; Muraven et al., 1998; Tice & Bratslavsky, 2000). In

addition, the use of self-regulatory energy in one domain (e.g., managing depressive symptoms) can challenge self-regulation in other domains (e.g., self-regulation with regard to exercise).

There are several implications of our findings. First, the intention–action control–behavior relationship underlines the central role of action control for translating exercise intention into behavior within different types of rehabilitation patients. Consequently, interventions to increase exercise should promote action control (Schüz, Sniehotta, and Schwarzer, 2007; Sniehotta et al., 2005b). Our results also show that interventions targeting action control should be provided to different subgroups of patients. To enhance action control persons might be asked to keep a record of their exercise by using a calendar (Abraham & Michie, 2008). Individuals could tick every day they exercised according to their goals and standards. Thus, they would be able to identify discrepancies between their goals and their actual behavior (Schüz et al., 2006).

Second, results support the assumption that patients reporting higher depressive symptoms show difficulties in the process of action control with regard to exercise. It seems that these patients have substantial difficulties using action control strategies while translating their exercise goals into behavior. Future research should address via experimental studies whether depressive patients can benefit from action control interventions to increase exercise. When designing action control interventions for patients with depressive symptoms it might be beneficial integrating disease and depression management to avoid self-regulation depletion and to make the treatments synergistic (Detweiler-Bedell et al., 2008). Additionally, further research is required to explore which strategies with regard to exercise behavior are particularly beneficial for patients reporting depressive symptoms. External strategies to increase exercise such as social support (e.g., Woodgate, et al., 2007) or social control (e.g., Lewis & Butterfield, 2007) might be investigated in samples of individuals with depressive symptoms. Finally, when investigating which strategies are helpful for increasing exercise

behavior in depressed patients, future studies should consider a distinction between individuals having a clinical diagnosis and patients who report depressive symptoms.

Study limitations should be recognized when interpreting the reported findings. First, the study lacks objective data with regard to exercise behavior. Objective measures for exercise behavior, for instance, by using pedometers or accelerometers, may be preferable. Second, depressive symptoms were measured by a two-item scale. A broader assessment of depression symptoms and a distinction between clinical and non-clinical depressed individuals would be more satisfactory. Third, our study design covered only a short time period after discharge from rehabilitation (i.e., 6 weeks). Follow-up measures should be included in future studies. Also, as the physical activity data was discrete and ordinal, it might be worthwile to consider other analytical procedures in future studies such as ordinal logistic regressions. Another limitation is the systematic drop-out of participants. Patients who reported more depressive symptoms at T1 were less likely to participate in the second assessment. However, if they would have remained in the study we would assume a similar moderated mediation effect.

To conclude, our study suggests that action control is a possible mediator for translating exercise intentions into behavior. We demonstrated the mechanisms in three different rehabilitation samples. In addition, this study revealed that a successful application of action control with regard to exercise depends on the level of reported depressive symptoms. Rehabilitation patients higher in depressive symptoms seemed to fail when translating their exercise intention into action control.

Future research needs to investigate whether patients with depressive symptoms can benefit from action control interventions and which strategies are most helpful for individuals with depressive symptoms. Addressing these questions can lead to a better understanding with regard to designing tailored interventions for exercise promotion among individuals with depressive symptoms.

# References

Abraham, C., & Michie, S. (2008*).* A taxonomy of behavior change techniques used in interventions. *Health Psychology 3*, 379-387.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting Interactions.* Thousand Oaks, CA: Sage.

Baddeley, A. D., & Logie, R. H. (1999). Working memory: The multiple-component model. In A. Miyake, & P. Shah, (Eds.). *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28-61). New York, NY: Cambridge University Press.

Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. psychological inquiry. *An International Journal for the Advancement of Psychological Theory*, *7*, 1-15.

Baumeister, R. F., Muraven, M., & Tice, D. M. (2000). Ego depletion: A resource model of volition, self-regulation, and controlled processing. *Social Cognition*, *18*, 130-150.

Biddle, S. J. H. & Fuchs, R. (2009). Exercise psychology: A view from Europe. *Psychology of Sport and Exercise*, *10*, 410-419.

Burke, L. E., Dunbar-Jacob, J. M., & Hill, M. N. (1997). Compliance with cardiovascular disease prevention strategies: a review of the research. *Annals of Behavioral Medicine*, *19*, 239-263.

Burt, D. B., Zembar, M. J., & Niederehe, G. (1995). Depression and memory impairment: A meta-analysis of the association, its pattern, and specificity. *Psychological Bulletin*, *117*, 285-305.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York, NY: Cambridge University Press.

Cerin, E. (in press). Ways of unraveling how and why physical activity influences mental health through statistical mediation analyses. *Mental Health and Physical Activity,* In Press. Doi: 10.1016/j.mhpa.2010.06.002

Conn, V. S., Hafdahl, A. R., Minor, M. A., & Nielsen, P. J. (2008). Physical activity interventions among adults with arthritis: Meta-analysis of outcomes. *Seminars in Arthritis and Rheumatism*, *37*, 307-316.

Detweiler-Bedell, J. B., Friedman, M. A., Leventhal, H., Miller, I. W., & Leventhal, E. A. (2008). Integrating co-morbid depression and chronic physical disease management:

Identifying and resolving failures in self-regulation. *Clinical Psychology Review*, *28*, 1426-1446.

*Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revison* (*DSM-IV-TR*). 4th ed. Washington, DC: American Psychiatric Association; 2000.

Dorn, J., Naughton, J., Imamura, D. A. I., & Trevisan, M. (2001). Correlates of compliance in a randomized exercise trial in myocardial infarction patients. *Medicine & Science in Sports & Exercise*, *33*, 1081-1089.

European Society of Cardiology (2007). *ESC clinical practice guidelines*. Retrieved from http://www.escardio.org/knowledge/guidelines/CVD_Prevention_in_Clinical_Practice.htm

Göhner, W., & Schlicht, W. (2006). Preventing chronic back pain: evaluation of a theory-based cognitive-behavioral training programme for patients with subacute back pain. *Patient Education And Counseling*, *64*, 87-95.

American Academy of Orthopedic Surgeons (2009). *Lower Pain Exercise Guide.* Retrieved from http://orthoinfo.aaos.org/topic.cfm?topic=A00302

Hagger, M., Wood, C., Stiff, C., & Chatzisarantis, N. L. D. (2010). Self-regulation and self-control in exercise: the strength-energy model. *International Review of Sport and Exercise Psychology*, *3*, 208-238.

Haskell, W. L., Alderman, E. L., Fair, J. M., Maron, D. J., Mackey, S. F., Superko, H. R., … Krauss, R. M. (1994). Effects of intensive multiple risk factor reduction on coronary atherosclerosis and clinical cardiac events in men and women with coronary artery disease. The Stanford Coronary Risk Intervention Project (SCRIP). *Circulation*, *89*, 975-990.

Henchoz, Y., & Kai-Lik So, A. (2008). Exercise and nonspecific low back pain: a literature review. *Joint Bone Spine*, *75*, 533-539.

Howard, K. J., Ellis, H. B., Khaleel, M. A., Gatchel, R. J., & Bucholz, R. (in press). Psychosocial profiles of indigent patients with severe osteoarthritis requiring arthroplasty. *The Journal of Arthroplasty*. Advance online publication. doi:10.1016/j.arth.2010.03.002

Iwamoto, J., Takeda, T., & Ichimura, S. (2001). Effect of exercise training and detraining on bone mineral density in postmenopausal women with osteoporosis. *Journal of Orthopedic Science*, *6*, 128-132.

Johnston, D. W., Johnston, M., Pollard, B., Kinmonth, A. L., & Mant, D. (2004). Motivation is not enough: Prediction of risk behavior following diagnosis of coronary heart disease from the theory of planned behavior. *Health Psychology*, *23*, 533-538.

Jolliffe, J.A., Rees, K., Taylor, R. S., Thompson, D., Oldridge, N., & Ebrahim, S. (2001). Exercise-based rehabilitation for coronary heart disease. *Cochrane Database of Systematic Reviews, 1*. doi:10.1002/14651858.CD001800

Karoly, P. (1993). Mechanisms of self-regulation: a systems view. *Annual Reviews of Psychology*, *44*, 23-52.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care*, *41*, 1284-1294.

Lewis, M. A., & Butterfield, R. M. (2007). Social control in marital relationships: Effect of one's partner on health behaviors. *Journal of Applied Social Psychology*, *37*, 298-319.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004). Behavioral intentions and action plans promote physical exercise: A longitudinal study with orthopedic rehabilitation patients. *Journal of Sport & Exercise Psychology*, *26*, 470-483.

Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2005). Stage-specific adoption and maintenance of physical activity: testing a three-stage model. *Psychology of Sport and Exercise*, *6*, 585-603.

Luszczynska, A., Cao, D. S., Mallach, N., Pietron, K., Mazurkiewicz, M., & Schwarzer, R. (2010). Intentions, planning, and self-efficacy predict physical activity in Chinese and Polish adolescents: Two moderated mediation analyses. *International Journal of Clinical and Health Psychology*, *10*, 265-278.

Magni, G., Marchetti, M., Moreschi, C., Merskey, H., & Luchini, S. R. (1993). Chronic musculoskeletal pain and depressive symptoms in the national health and nutrition examination I. Epidemiologic follow-up study. *Pain*, *53*(2), 163-168.

Mead, G. E., Morley, W., Campbell, P., Greig, C. A., McMurdo, M. E. T., & Lawlor, D. A. (2009). Exercise for depression. *Mental Health and Physical Activity, 2*, 95-96.

Metsios, G. S., Stavropoulos-Kalinoglou, A., Veldhuijzen van Zanten, J. J. C. S., Treharne, G. J., Panoulas, V. F., Douglas, K. M. J., … Kitas, G. D. (2008). Rheumatoid arthritis, cardiovascular disease and physical exercise: a systematic review. *Rheumatology*, *47*, 239-248.

Miller, J., Freedson, P. S., & Kline, G. M. (1994). Comparison of activity levels using the Caltrac(R) accelerometer and five questionnaires. *Medicine & Science in Sports & Exercise*, *26*, 376-382.

Muller, D., Judd, C. M., & Yzerbyt, V. Y. (2005). When moderation is mediated and mediation is moderated. *Journal of Personality and Social Psychology*, 89, 852-863.

Muraven, M., Tice, D. M., & Baumeister R. F. (1998). Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology*, *74*, 774-789.

Nigg, C. R. (2005). There is more to stages of exercise than just exercise. *Exercise and Sport Sciences Reviews*, *33*, 32-35

Ottowitz, W. E., Dougherty, D. D., & Savage, C. R. (2002). The neural network basis for abnormalities of attention and executive function in major depressive disorder: Implications for application of the medical disease model to psychiatric disorders. *Harvard Review of Psychiatry*, *10*, 86-99.

Paelecke-Habermann, Y., Pohl, J., & Leplow, B. (2005). Attention and executive functions in remitted major depression patients. *Journal of Affective Disorders*, *89*(1-3), 125-135.

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, *42*, 185-227.

Riddel, D. L., Wade, J. B., & Jiranek, W. A. (2010). Major depression, generalized anxiety disorder, and panic disorder in patients scheduled for knee arthroplasty. *The Journal of arthroplasty*, *25*, 581-588.

Scholz, U., Nagy, G., Göhner, W., Luszczynska, A., & Kliegel, M. (2009). Changes in self-regulatory cognitions as predictors of changes in smoking and nutrition behavior. *Psychology and Health*, *24*, 545-561.

Schüz, B., Sniehotta, F. F., & Schwarzer, R. (2007). Stage-specific effects of an action control intervention on dental flossing. *Health Education Research*, *22*, 332-341.

Sesso, H. D., Paffenbarger, R. S., & Lee, I. M. (2000). Physical activity and coronary heart disease in men: The Harvard Alumni Health Study. *Circulation 102*, 975-980.

Sheeran, P. (2002). Intention-behavior relations: A conceptual and empirical review. *European Review of Social Psychology*, *12*, 1-36.

Sluijs, E. M., Kok, G. J., & Van der Zee, J. (1993). Correlates of exercise compliance in physical therapy. *Physical Therapy*, *73*, 771-782.

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005a). Bridging the intention-behavior-gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, *20*, 143-160.

Sniehotta, F. F., Scholz, U., Schwarzer, R., Fuhrmann, B., Kiwus, U., & Völler, H. (2005b). Long-term effects of two psychological interventions on physical exercise and self-regulation following coronary rehabilitation. *International Journal of Behavioral Medicine*, *12*, 244-255.

Sniehotta, F. F., Nagy, G., Scholz, U., & Schwarzer, R. (2006). The role of action control in implementing intentions during the first weeks of behavior change. *British Journal of Social Psychology*, *45*, 87-106.

Robinson, R. G. (2003). Poststroke depression: prevalence, diagnosis, treatment, and disease progression. *Biological Psychiatry*, *54*, 376-387.

Rutledge, T., Reis, V. A., Linke, S. E., Greenberg, B. H., & Mills, P. J. (2006). Depression in heart failure: A meta-analytic review of prevalence, intervention effects, and sssociations with clinical outcomes. *Journal of the American College of Cardiology*, *48*, 1527-1537.

Tawashy, A. E., Eng, J. J., Lin, K. H., Tang, P. F., & Hung, C. (2008). Physical activity is related to lower levels of pain, fatigue and depression in individuals with spinal-cord injury: a correlational study. *Spinal Cord*, *47*, 301-306.

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *The American Journal of Medicine*, *116*, 682-692.

Tice, D. M., & Bratslavsky E. (2000). Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychological Inquiry*, *11*, 149-159.

Veiel, H. O. F. (1997). A preliminary profile of neuropsychological deficits associated with major depression. *Journal of Clinical and Experimental Neuropsychology*, *19*, 587-603.

Vickers, K. S., Nies, M. A., Patten, C. A., Dierkhising, R., & Smith, S. A. (2006). Patients with diabetes and depression may need additional support for exercise. *American Journal of Health Behavior*, *30*, 353-362.

Wing, R. R., Phelan, S., & Tate, D. (2002). The role of adherence in mediating the relationship between depression and health outcomes. *Journal of Psychosomatic Research*, *53*, 877-881.

Woodgate, J., Brawley, L. R., & Shields, C. A. (2007). Social support in cardiac rehabilitation exercise maintenance: Associations with self-efficacy and health-related quality of life. *Journal of Applied Social Psychology*, *37*, 1041-1059.

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanos, F., … Lisheng, L. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *Lancet*, *364*, 937-952.

# 5

# The Effect of a Self-Regulation Intervention on Physical Exercise is Moderated by Depressive Symptoms: A Study in Orthopedic Rehabilitation

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (submitted for publication). The effect of a self-regulation intervention on physical exercise is moderated by depressive symptoms: A study in orthopedic rehabilitation.

# Abstract

*Objective*. This study investigated whether a computer-based self-regulation intervention increases physical exercise in patients with or without depressive symptoms.

*Design*. A total of 361 orthopedic rehabilitation patients, 36 of them with depressive symptoms, were recruited in Germany in 2009 and 2010. In a quasi- experimental study, individuals were allocated to either a computer-based self-regulation intervention or an online questionnaire. Exercise was measured at the beginning of rehabilitation and six weeks after rehabilitation. Depressive symptoms were assessed at the end of rehabilitation. An analysis of covariance was conducted, controlling for exercise baseline and sex.

*Results*. A main effect for depressive symptoms ($F$ (1, 355) = 8.5; $p$ = .004; partial $\eta^2$ = .02) and a marginal interaction of intervention x depressive symptoms were found ($F$ (1, 355) = 3.3; $p$ = .069; partial $\eta^2$ = .01).

*Conclusions*. Results indicate that the self-regulation exercise intervention in an orthopedic rehabilitation setting was only effective in non-depressed individuals. Future research should examine how health behavior change programs can be designed more effectively for individuals with depressive symptoms.


*Keywords*. Physical exercise, depression, self-regulation intervention, rehabilitation

# Introduction

Regular exercise is required for a long-term recovery of the physical condition of orthopedic rehabilitation patients. Nevertheless, a high percentage of patients fail to maintain prescribed exercise levels after discharge from rehabilitation[1]. Some interventions targeting self-regulation techniques (i.e., action planning) have been successful in promoting exercise among orthopedic patients after rehabilitation[2]. However, some self-regulation interventions have failed too[3]. One reason for a lack of effectiveness of a self-regulation intervention might be that not everyone benefits from such interventions, e.g. depressive patients.

A large number of patients with orthopedic health problems experience depressive symptoms[4]. Previous research has shown that depressive symptoms interfere with self-regulation processes regarding disease management[5]. Common self-regulation interventions are not tailored to the situation of depressive individuals. As a consequence, these patients might not benefit from such an intervention in the same way as non-depressive individuals do. Therefore, this study investigates whether an exercise self-regulation intervention is as effective in patients who report depressive symptoms as those reporting no symptoms.

## Self-regulation Interventions Promote Post-Rehabilitation Exercise

Self-regulation is a process in which individuals try to exert control over their own thoughts, feelings, impulses, and performances. Two self-regulatory strategies that foster exercise are action planning and action control. Observational studies[6, 7, 8] and intervention studies[2, 9, 10, 11, 12] have proven the beneficial effects of these strategies to uphold regular exercise. However, some studies found no effect of action planning or action control on exercise behavior[3,13]. This raises the question for potential moderators. Studying moderators reveals whether intervention effects are associated with characteristics of participants.

## A Conflict of Resources? Why Depressive Symptoms May Interfere with Exercise-Related Self-Regulation

A theoretical framework that might explain an interference of depressive symptoms with self-regulation processes is the strength and energy model[14].Within this paradigm, self-regulation is assumed to be a global energy that is utilized on self-regulated tasks across different domains of actions. Self-regulation is conceptualized as a limited source. If the energy is used up a person reaches a state of ego-depletion. Strong usage of self-regulation in one action domain can cause self-regulation failure in other domains[14]. Symptoms of depression, stress, fatigue and negative emotion demand lots of self-regulation energy and thus facilitate ego-depletion[14]. If individuals with depressive symptoms have depleted resources they might struggle to adopt self-regulation strategies regarding exercise behavior[5]. Common self-regulation interventions do not consider the parallel management of depressive symptoms and health behavior[5] and are therefore not tailored to the particular situation of depressive individuals. Differential effects of such self-regulation interventions in depressive and non-depressive rehabilitation patients might be likely.

## Aims

The objective of this study was to investigate whether a computer-based self-regulation intervention during rehabilitation is effective in promoting post-rehabilitation exercise in patients with and without depressive symptoms. We expected that the effectiveness of the intervention is moderated by depressive symptoms, i.e., that individuals without depressive symptoms respond better to the intervention (i.e., have a higher increase in behavior after rehabilitation) in comparison to those screened positive on depressive symptoms.

# Method

## Participants and Procedure

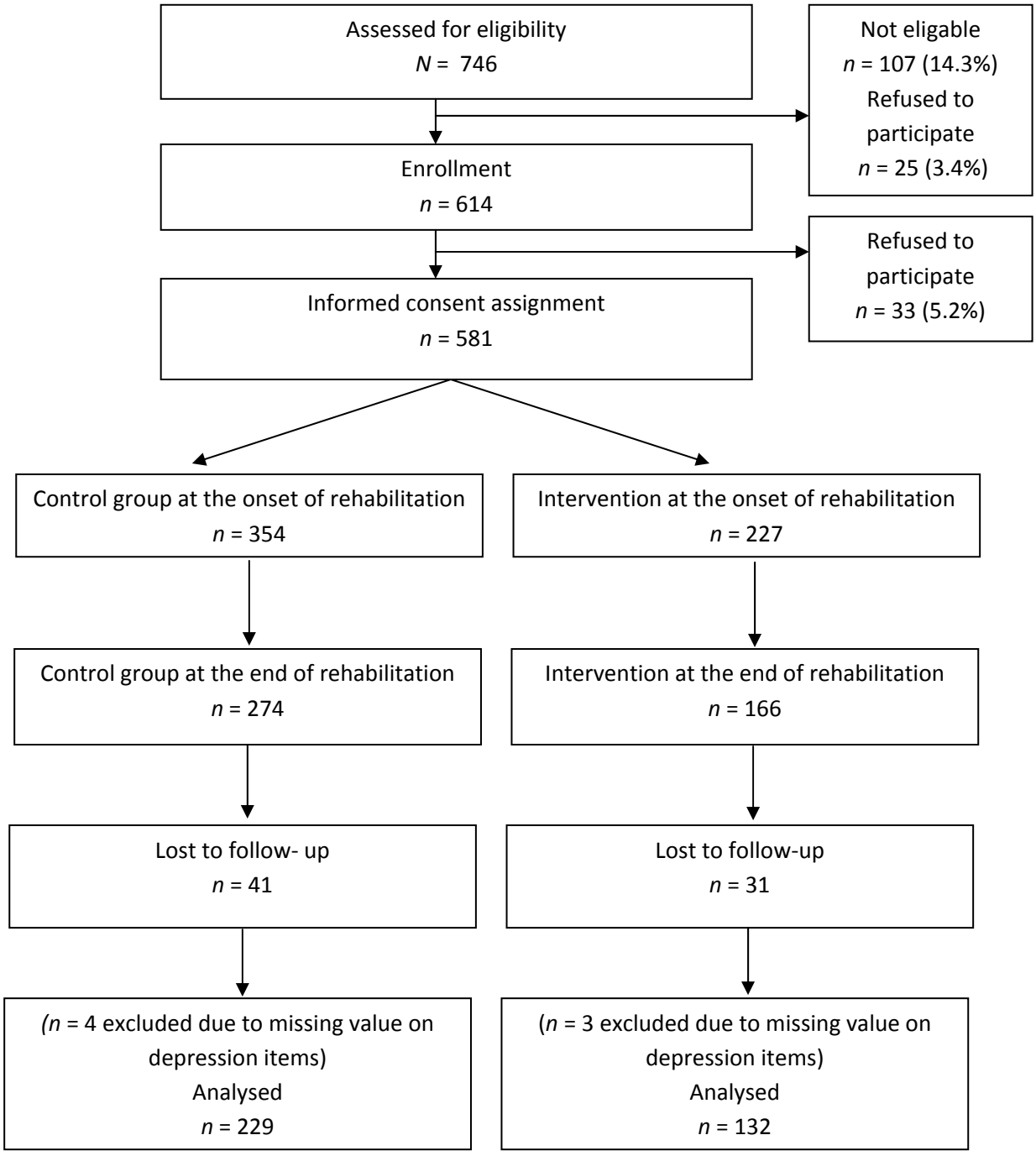
Study participants were recruited at the onset of their rehabilitation in two orthopedic rehabilitation clinics in Germany between 2009 and 2010. The regular clinic program comprised a complex regimen of medical and physiotherapeutic therapies. A self-regulatory online intervention was provided to prepare rehabilitation patients to perform exercise on a regular basis after discharge. Trained project workers informed the patient about the study and patients were asked to sign an informed consent. Participants were then randomly allocated to an intervention or control group and received either an online questionnaire followed by a computer-based exercise intervention or an online questionnaire only (see Figure 1).

A questionnaire or/and the intervention were provided at the beginning (Time 1; T1) and at the end of their rehabilitation stay (Time 2; T2). About six weeks after rehabilitation (Time 3; T3), patients were contacted a third time and assessments were conducted via Computer-Assisted Telephone Interviews (CATI). Ethical approval was granted by the Ethics Commission of the German Psychological Association.

At T1, 581 patients participated in the study. At the end of the rehabilitation (T2), 440 patients (75.7% of T1) took part, and a total of 63.3% of the baseline sample participated in the assessment at T3. A total of 7 individuals were excluded due to missing values on the depression items. The longitudinal sample (T1, T2, T3) consisted of 361 persons (see Figure 1).

Mean age of the longitudinal sample was 48.4 years (*SD* = 10.0; age range: 21 – 76 years), and the sample consisted of more women (64.8%) than men. Of all participants, 73.4% were living with a partner, and 66.8% reported to have a high school degree.

*Figure 1.* Flowchart of participants progress through the study phases.




*Note*. [a]Excluded as inclusion criteria were not met (i.e., being capable of exercising on their own, able to fill out a computer-based questionnaire, being not too handicapped to write and having sufficient literacy); [b]Refused to participate and did not show up at the appointment; [c]Refused to participate due to time constraints, concerns regarding protection of data privacy, and other reasons not communicated to study assistant. The study was conducted in Germany between 2009 – 2010.

Out of the final sample, *n* = 325 (90.0%) scored negative and *n* = 36 (10.0 %) scored positive on depressive symptoms. The control group comprised 207 patients without depressive symptoms and 22 (10.6% of the control group) with depressive symptoms. In the intervention group, 118 were screened negative on depressive symptoms and 14 were screened positive (11.9% of the intervention group).

**The Self-regulation Intervention**

The online intervention consisted of two units that were delivered at the beginning and end of the rehabilitation stay. Within both units, patients were asked to generate up to five post-rehabilitation exercise ideas (e.g., swimming, running). Furthermore, the treatments focused on the formation of up to five post-rehabilitation action plans[15]. Additionally, the second intervention addressed the volitional strategy of action control. A diary to self-monitor one's home-based physical exercise was handed out[12]. On average, participants in the intervention group spent 36.1 minutes (*SD* = 10.1) on the questionnaire and the intervention at T1 and 36.0 minutes (*SD* = 9.7) with the program and the questionnaire at T2.

**Measures**

*Depressive symptoms* were measured at the end of rehabilitation (T2) by the 2-item version of the Patient Health Questionnaire (PHQ-2)[16]. The PHQ-2 assesses the frequency of depressed mood and anhedonia over the past two weeks. The two items were "Have you often been bothered by feeling down, depressed, or hopeless?" and "Have you often been bothered by little interest or pleasure in doing things?". Responses ranged from "not at all" (0), "on some days" (1), "more than half of the days" (2), and "nearly every day" (3). The correlation between the two items was .54. Responses were aggregated, and, according to Kroenke, Spritzer, and William (2003), those who had a score of three and higher were categorized as patients with depressive symptoms. Löwe, Kroenke, and Gräfe[17] found the PHQ-2 to have a sensitivity of 79% and a specificity of 86% for any depressive disorder.

*Physical exercise* considering the effort of exercise was measured at the beginning of the rehabilitation stay and six weeks after rehabilitation with the Godin Leisure-Time Exercise Questionnaire (GLTEQ)[18]. The scale has been used in a rehabilitation setting before[6]. At T1 rehabilitation patients were asked how much exercise they had performed prior to rehabilitation. Six weeks after rehabilitation (T3), exercise in the last four weeks was assessed. Each time, participants indicated how often per week and how long per session they performed moderate and strenuous physical exercise. Total physical exercise was the number of sessions per week multiplied by minutes per session.

### Analytic Procedure

To test the effect of the intervention and depressive symptoms, as well as the interaction of intervention and depressive symptoms on physical exercise T3, an analysis of covariance (*ANCOVA*) with the covariates exercise T1 and sex was conducted.

## Results

### Attrition Analysis

The original sample at T1 ($N = 581$) differed from the longitudinal sample at T3 ($N = 361$) with regard to age ($M_{T1\ sample} = 48.3$; $M_{longitudinal\ sample} = 45.9$; $t = -2.8$; $p = .01$). Thus, individuals who continued the participation in the study were younger than those who dropped out. No differences were found with regard to gender, occupational status, high school degree, and partner status ($p$'s $> .05$) between the T1 and the T3 sample. Neither differed samples with regard to depressive symptoms at T2 ($\chi^2 = 0.11$, $p = .73$) or physical exercise prior to rehabilitation ($t = 0.57$; $p = .57$)

### Preliminary Results

Means of exercise T1 and exercise T3 are depicted in Table 1. Overall, non-depressive individuals increased their levels of exercise, in particular individuals in the intervention

group. Depressive individuals rather decreased their level of exercise within the control and intervention group.

*Table 1*. Physical exercise means and SDs in 361 orthopedic rehabilitation patients.

| | | Exercise T1 *mean* (*SD*) | Exercise T3 *mean* (*SD*) | *n* |
|---|---|---|---|---|
| Intervention Group | Non-depressive patients | 173.0 (140.0) | 250.4 (167.3) | 118 |
| | Depressive patients | 183.7 (151.5) | 127.4 (164.0) | 14 |
| | Total | 174.1 (140.3) | 237.4 (170.6) | 132 |
| Control Group | Non-depressive patients | 108.4 (130.0) | 148.8 (135.6) | 207 |
| | Depressive patients | 140.8 (179.3) | 126.7 (158.1) | 22 |
| | Total | 111.5 (135.3) | 146.7 (137.7) | 229 |
| Total | Non-depressive patients | 131.9 (163.9) | 185.7 (155.6) | 325 |
| | Depressive patients | 157.5 (168.1) | 127.0 (158.08) | 36 |

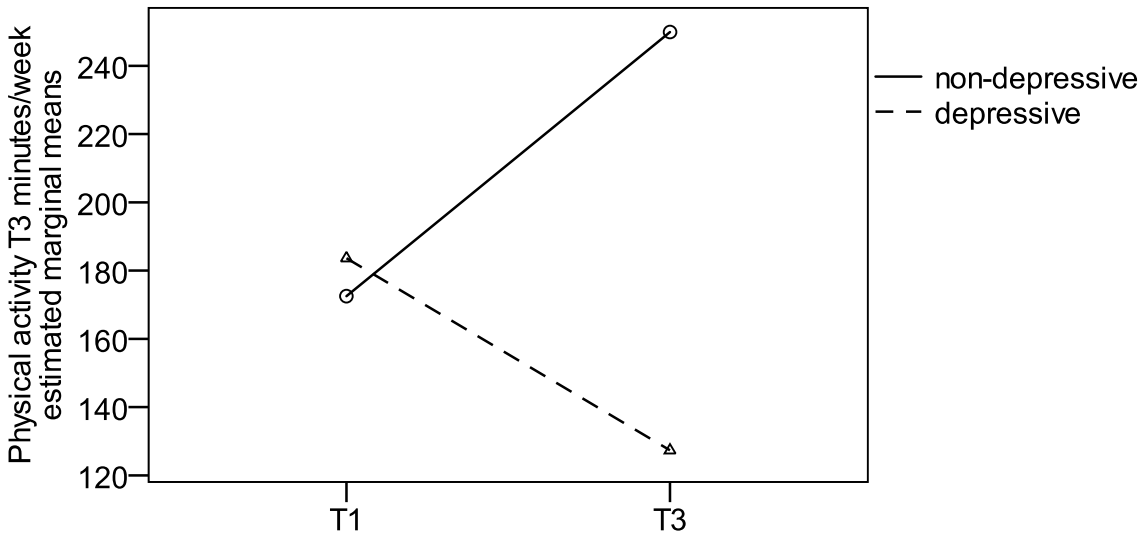
*Note*. Statistics are reported in the text below. T1 = Time 1; T3 = Time 3

**Main Effect and Interaction Effect**

The *ANCOVA* (covariates: exercise prior to rehabilitation and sex) revealed one significant main effect and a marginal significant interaction effect: Depressive symptoms ($F$ (1, 355) = 8.5; $p$ = .001; partial $\eta^2$ = .02) predicted exercise T3 significantly. No main effect was found for the intervention condition ($F$ (1, 355) = 2.1, $p$ = .15). However, results also revealed a marginal significant interaction of intervention x depressive symptoms ($F$ (1, 355)

= 3.3; $p$ = .069; partial; $\eta^2$ = .01). Additionally to the main effect and the interaction effect, exercise prior to rehabilitation (covariate) predicted exercise after rehabilitation ($F$ (1, 355) = 16.1; $p \leq .001$; $\eta^2$ = .04). Figure 2 illustrates that individuals without depressive symptoms in the intervention group reported the higher levels of exercise compared to depressive individuals in the intervention group.

*Figure 2.* Estimated marginal means of physical exercise T3 are depicted for depressive and non-depressive individuals in the intervention group.




*Note*. Individuals without depressive symptoms in the intervention group increased their levels of exercise 6 weeks after rehabilitation, whereas individuals with depressive symptoms did not.

# Discussion

This study aimed to investigate whether a common computer-based self-regulation intervention during orthopedic rehabilitation is effective in promoting exercise after rehabilitation in patients with or without depressive symptoms. We hypothesized that depressive symptoms may moderate the effectiveness of the self-regulation intervention, i.e.,

that a common self-regulation intervention is more effective in increasing exercise in non-depressive than in depressive individuals.

**Depressive Symptoms Moderate the Effectiveness of an Exercise Self-Regulation Intervention**

The overall (in the intervention and control group) negative effect of depressive symptoms on exercise is in line with previous research[19,20]. Our study adds to these findings by replicating this negative link with regard to post-rehabilitation exercise in a sample of orthopedic patients. As regular exercise training is essential for orthopedic patients and depressive symptoms are highly prevalent in this target group[4], it is important to consider that depressive symptoms might interfere with the engagement in exercise after rehabilitation.

Findings further indicate that the self-regulation intervention enhanced post-rehabilitation exercise only in non-depressive participants. The marginal effect of the treatment in non-depressive individuals is in line with previous studies demonstrating the benefit of self-regulation interventions to increase exercise[10,11,12]. Substantial self-regulatory strategies are to set specific goals (e.g., I want to go swimming on a regular basis", to make a detailed action plan (when, where, and how will I exercise) and to monitor one's own behavior (e.g., with a help of an exercise diary). However, depressive patients in the intervention group did not increase their exercise levels six weeks after rehabilitation via the intervention. They exercised less than non-depressive individuals in the intervention group. This is in line with the assumption that depressive individuals have fewer capabilities to implement goals and plans regarding health behavior due to depleted resources[5,14]. The treatment was not tailored to their particular situation, as it did not address the burden of a management of depressive symptoms and exercise. Further, our intervention asked individuals to set up to five exercise ideas and make up to five exercise plans. Thus, the intervention might have been overwhelming for patients with depressive symptoms. Less ambitious goals might avoid frustration and thus produce more positive feelings in depressive

individuals[21]. Moreover, goal achievement was found to have a positive effect on depressive symptoms[22]. A decrease of depressive symptoms and positive experiences with exercise might later enhance the engagement in exercise. Further, one could presume that external strategies (e.g., social support, social control) are more beneficial for depressive individuals to increase their exercise. Such strategies might require less self-regulatory effort and thus consider depleted resources. However, studies on these questions are missing. One might also question whether the mode of our intervention was suitable to support depressive participants. Although, there is some evidence for the effectiveness of computer-based intervention in the field of psychotherapy[23], not everyone favors and benefits from computer-based treatments. Most computer-delivered treatments fail to address non-specific treatment factors (e.g., empathy). Such non-specific factors contribute to the effects of face-to-face psychotherapy to a valuable degree[23]. Exercise interventions for depressive individuals might also benefit from such non-specific factors. Additionally, depressive individuals may benefit from more regular contact. Our intervention was delivered twice during rehabilitation. To foster exercise in depressive individuals more intensive interventions might be helpful, e.g. frequent brief contacts[24]. Finally, one could assume that depressive individuals need additional psychotherapeutic support to engage in exercise. Integrated approaches that address depressive symptoms and health behavior simultaneously, rather than an exercise intervention alone, might be advantageous for depressive individuals. Such approaches combine elements from cognitive behavior therapy and health behavior change programs in a way that depression and exercise management becomes synergistic[25]. Integrated approaches have been effective in reducing depressive symptoms and problematic substance consume[24,26]. Such approaches were also found to be superior to serial (first treating depressive symptoms and then addressing health behavior) or parallel treatments (two distinct treatments at the same time[27]. However, research on integrated approaches for the promotion of exercise in persons with comorbid depressive symptoms is required.

**Outlook**

Advantages of exercise are twofold in particular for persons experiencing depressive symptoms: exercise fosters physical health and also alleviates depressive symptoms[28]. . Therefore, these individuals should not be neglected when designing exercise promotion programs in rehabilitation patients. Future research needs to focus on the development and evaluation of appropriate exercise programs for rehabilitation patients with depressive symptoms. One focus might be on integrated approaches that address exercise behavior and depressive symptoms. Moreover, exercise programs could be more tailored to the particular situation of depressive individuals. Further, studies need to test whether some health behavior change strategies are superior to others in increasing exercise in depressive patients (self-regulatory strategies vs. more external strategies). Future research might also evaluate effects regarding different modes (computer vs. face-to-face) and intensities (frequency of contacts) of exercise programs for depressive individuals. By addressing these questions, more appropriate interventions to support depressive individuals to engage in exercise may be developed.

**Limitations**

Some limitations need to be addressed. First, the interaction effect was only marginal significant. This might be due to the small sample size. Replications of the findings in similar samples are required. Second, participation rates of depressive individuals were low in our study compared to actual prevalence of depressive symptoms in orthopedic rehabilitation. This might be due to the fact that participation was voluntary. An increase of the participation rate of depressive individuals in future studies is desirable. Third, depressive symptoms were assessed with a brief screening instrument. A wider assessment of depressive symptoms, as well as a distinction between clinical and non-clinical depressive symptoms would be preferable. Differential effects in clinical samples and non-clinical samples are likely. Fourth, the assessment of self-regulation energy (i.e., ego depletion) would be helpful to strengthen

theoretical assumptions. Thus, future studies need to replicate the findings and include measures of ego-depletion.

**Conclusion**

The self-regulation intervention seemed effective in increasing post-rehabilitation exercise among patients without depressive symptoms, but not among depressive participants. A self-regulation exercise intervention which is not tailored to the needs of individuals with depressive symptoms might not be effective in increasing post-rehabilitation exercise in these patients.

If we want to support patients with depressive symptoms to engage in regular exercise, research is required to clarify how exercise programs for this target group can be designed effectively. Future research might compare the effectiveness of different health behavior change techniques that are most beneficial for individuals with depressive symptoms. Moreover, integrated approaches that address the management of health behavior and depressive symptoms in concert, i.e., by integrating exercise programs and cognitive behavior therapy, might be considered in the future.

# References


1. Reuter, T., Ziegelmann, J. P., Lippke, S., & Schwarzer, R. (2009). Long-term relations between intentions, planning, and exercise: A 3-year longitudinal study after orthopedic rehabilitation. *Rehabil Psychol*, 54, 363-371.
2. Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004a). Initiation and maintenance of physical exercise: Stage-specific effects of a planning intervention. *Res Sports Med*, 12, 221-240.
3. Huisman, S., Gucht, V. de, Maes, S., Schroevers, M., Chatrou, M., & Haak, H. (2009). Self-regulation and weight reduction in patients with type 2 diabetes: A pilot intervention study. *Patient Educ Couns*, 75, 84-90.
4. Lloyd, C., Waghorn, G., & McHugh, C. (2008). Musculoskeletal disorders and comorbid depression: Implications for practice, *Aust Occup Ther J*, 55, 23–29, doi: 10.1111/j.1440-1630.2006.00624.x
5. Detweiler-Bedell, J. B., Friedman, M. A., Leventhal, H., Miller, I. W., & Leventhal, E. A. (2008). Integrating co-morbid depression and chronic physical disease management: identifying and resolving failures in self-regulation. *Clin Psychol Rev*, 28, 1426-1446.
6. Lippke, S., Ziegelmann, J. P., & Schwarzer, R. (2004b). Behavioral intentions and action plans promote physical exercise: A longitudinal study with orthopedic rehabilitation patients. *J Sport Exercise Psy,* 26, 470-483.
7. Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behavior gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychol Health*, 20, 143-160.
8. Ziegelmann, J. P., Luszczynska, A., Lippke, S., & Schwarzer, R. (2007). Are goal intentions or implementation intentions better predictors of health behavior? A longitudinal study in orthopedic rehabilitation. *Rehabil Psychol*, 52, 97-102.
9. Frates, E.P., Moore, M.A., Lopez, C.N. & McMahon, G.T (2011) Coaching for Behavior Change in Physiatry. *Am J Phys Med & Rehab*, 12, 1074-1082.
10. Fuchs, R., Göhner, W., & Seelig, H. (2011). Long-term effects of a psychological group intervention on physical exercise and health: The MoVo concept. *J Phys Act Health*, 8, 794-803

*11.* Latimer, A. E., Martin Ginis, K. A., & Arbour, K. P. (2006). The efficacy of an implementation intention intervention for promoting physical activity among individuals with spinal cord injury: A randomized controlled trial. *Rehabil Psychol, 51,* 273-280.

12. Sniehotta, F. F., Scholz, U., Schwarzer, R., Fuhrmann, B., Kiwus, U., & Völler, H. (2005). Long-term effects of two psychological interventions on physical exercise and self-regulation following coronary rehabilitation. *Int J Behav Med*, 12, 244-255.
13. Sniehotta, F. F., Gorski, C., & Araujo-Soares, V. (2010). Adoption of community-based cardiac rehabilitation programs and physical activity following phase III cardiac rehabilitation in Scotland: A prospective and predictive study. *Psychol Health*, 25, 839-854.
14. Hagger, M.S., Wood, C., Stiff, C., & Chatzisarantis, N.L. (2010). Ego depletion and the strength model of self-control: A meta-analysis. *Psychol Bull*, 136, 495-525.
15. Prestwich, A., Lawton, R., & Conner, M. (2003). The use of implementation intentions and decisional balance sheet in promoting exercise behavior. *Psychol Health*, 18, 707-721.
16. Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The patient health questionnaire-2: Validity of a two-item depression screener. *Med Care*, 41, 1284e1294.
17. Löwe, B., Kroenke, K., & Gräfe, K. (2005). Detecting and monitoring depression with a 2-item questionnaire (PHQ 2). *J Psychosom Res*, 58, 163-171.
18. Godin, G., & Shephard, R.J., 1985. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*, 10, 141-146.
19. Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Prev Med*, 36, 698-703.
20. Strine, T.W., Mokdad, A. H., Dube, S.R., Balluz, L.S., Gonzalez, O., Berry, J. T., Manderscheid, R., & Kroenke, K. (2008). The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *Gen Hops Psychiatry*, 30, 127-137.
21. Conn, V.S. (2010). Depressive symptom outcome of physical activity interventions: Meta-analysis findings. *Ann Behav Med,* 39, 128-138
22. Scholz, U., Knoll, N., Sniehotta, F. F., & Schwarzer, R. (2006). Physical activity and depressive symptoms in cardiac rehabilitation: Long-term effects of a self-management intervention. *Soc Sci & Med*, 62, 3109-3120.
23. Proudfoot, J.G. (2004). Computer-based treatment for anxiety and depression: is it feasible? Is it effective? *Neurosci Biobehav R*, 28,353–363

24. Kay-Lambkin, Frances J., Baker, A. L., Lewin, T. J., & Carr, V. J. (2009). Computer-based psychological treatment for comorbid depression and problematic alcohol and/or cannabis use: a randomized controlled trial of clinical efficacy. *Addiction*, 104, 378-388.
25. McGale, N., McArdle, S. & Gaffney, P. (2010) Exploring the effectiveness of an integrated exercise/CBT intervention for young men's mental health. *Brit J Health Psych*, 16, 457-471.
26. Cinciripini, P.M, Blalock, J.A., Minnix, J.A., Robinson, J.D., Brown, V.L., Lam, C., Wetter, D.W., et al. (2010). Effects of an intensive depression-focused intervention for smoking cessation in pregnancy. *J Consult Clin Psychol,* 78: 44-54.
27. Carroll S., Hides L., Catania L., Mathias S., Greenwood-Smith C., & Lubman D. (2009). Integrated cognitive behaviour therapy for co-occurring substance misuse and major depression: Lessons from a youth mental health service. *Australas Psychiatry*, 17, 365-70.
28. Phillips, W. T., Kiernan, M., & King, A. C. (2003). Physical activity as a nonpharmacological treatment for depression: A review. *Complement Health Pract Rev,* 8, 139-152.

# 6

# General Discussion

# General Discussion

Health behaviors are essential for the prevention and treatment of the common chronic diseases such as cardiovascular and musculoskeletal diseases of the 21st century. However, individuals often fail to engage in a healthy lifestyle. Social-cognitive variables are used to predict individual success in adopting and maintaining health behaviors (Armitage & Conner, 2000; Schwarzer, 2011) and interventions that focus on self-regulation have been established (e.g., Knittle, Maes, & de Gucht, 2010). One under investigated factor, however, that might further explain why some persons fail to engage in health behavior is a person's affective state (Kleinert, Golenia, & Lobinger, 2007). A negative affective state with rising relevance worldwide is the experience of depressive symptoms (WHO, 2012). Depressive symptoms are positively associated with the prevalence, development, and progression of chronic diseases (Katon, 2011; Moussavi, Chatterji, Verdes, Tandon, Patel, & Ustun, 2007). To better understand why depressive symptoms lead to the development of chronic diseases, it is important to investigate *whether* health risk behaviors are associated with depressive symptoms in rather physically healthy individuals (e.g., in the general population). Further, in light of the fact that depressive symptoms are associated with a progression of chronic health conditions (Katon, 2011) the link between health behaviors and depressive symptoms in individuals with chronic diseases needs to be closely investigated. When assuming a negative link between depressive symptoms and health behaviors, it is of paramount importance to understand *how* depressive symptoms interfere with the adoption and maintenance of health behaviors. Finally, it is necessary to focus on the question of whether interventions can *promote* health behaviors in individuals suffering from depressive symptoms.

The goal of this thesis was, therefore, to advance research and practice on the role of depressive symptoms in health behavior change. Taking into account the central role of health behaviors for the prevention of chronic diseases, this thesis began by investigating the associations between depressive symptoms and different health behaviors in a population

sample. Next, due to a high prevalence of depressive symptoms in individuals with chronic disease, the focus was shifted to individuals in medical rehabilitation. Because of the well known mental and physical benefits of exercise, an emphasis was placed on the engagement of physical exercise. It was examined *how* depressive symptoms interfere with social-cognitive determinants of exercise, and whether a common intervention can *promote* exercise in individuals with and without psychological symptoms.

In more detail, the chapters of this thesis included the following empirical studies: In *Chapter 2*, a study was presented that aimed to examine whether depressive symptoms are associated with exercise behavior, alcohol consumption, smoking, and facets of a healthy diet (i.e., fast food intake, soft drink consumption, and avoidance of fat intake) in the population of adults in Hawai'i (USA). Further, links between depressive symptoms, perceived stress, and subjective health (i.e., self-assessed health status) were evaluated. Results revealed links between depressive symptoms and alcohol consumption, diet, perceived stress, and self-assessed health status. The studies in *Chapters 3*, *4* and *5* investigated how depressive symptoms are associated with exercise in orthopedic and cardiac rehabilitation patients in Germany. The study in *Chapter 3* examined which psychological factors explain why depressive symptoms lead to lower exercise rates in orthopedic and cardiac rehabilitation patients, by studying social-cognitive determinants as mediators. Findings indicated that depressive symptoms lead to a decline in exercise due to lower levels of positive outcome expectancies and fewer positive experiences. The empirical research presented in *Chapter 4* investigated whether depressive symptoms interfere with the use of the self-regulatory strategy of action control regarding exercise in orthopedic and cardiac rehabilitation patients. Results showed that individuals with depressive symptoms did not apply action control to translate their intentions into post-rehabilitation exercise. In *Chapter 5,* a study was presented in which the effectiveness of a self-regulatory exercise intervention in an orthopedic

rehabilitation setting was evaluated. It was tested whether both individuals with and without depressive symptoms benefit from a common self-regulation exercise intervention. Findings indicated that only individuals without depressive symptoms increased their exercise after participating in the intervention. An overview of the different study aims, results, and conclusions is provided in *Table 1*.

In the following, a discussion of all empirical studies (*Chapters 2-5*) is provided. Next, implications for further research are given. Finally, suggestions for practical implications are presented.

*Table 1.* Summary of the empirical studies of this thesis.

| **Study Title (Chapter)** | **Aim** | **Findings** | **Conclusion** |
|---|---|---|---|
| Associations of Depressive Symptoms and Health Behaviors, Stress, and Self-assessed Health Status in Hawai'i. A Population Study (*Chapter 2*) | Test associations of depressive symptoms with exercise, diet, alcohol consumption, smoking, stress, and self-assessed health status. | Depressive symptoms were associated with stress, alcohol consumption, health status, fast food consumption, and avoidance of fat. | Individuals with depressive symptoms are at a high risk to develop chronic diseases. Mechanisms between depressive symptoms and health behaviors need to be examined. |
| Depressive Symptoms Interfere with Post-Rehabilitation Exercise: Outcome Expectancies and Experience as Mediators (*Chapter 3*) | Examine effect from depressive symptoms on exercise. Unveiling mediation mechanisms of outcome expectancies and experience. | Depressive symptoms were negatively related to behavior, positive outcome expectancies, and positive experiences. Expectancies and experiences as sequential mediations between depressive symptoms and exercise. | Few positive outcome expectancies and a lack of positive experience explain why individuals with depressive symptoms exercise less. Interventions might address positive expectancies and experiences. |
| Synergistic Effects of Intention and Depression on Action Control: Longitudinal Predictors of Exercise after Rehabilitation (*Chapter 4*) | Test whether depressive symptoms interfere with self-regulation strategies regarding exercise. Examining whether depressive symptoms moderate the intention-action control-behavior relation. | Mediation Intention-Action Control- Behavior. Depressive symptoms moderated mediation. Mediation materialized only within individuals low on depressive symptoms. | Individuals with depressive symptoms failed to use self-regulatory strategies. Studies should test whether individuals dealing with depressive symptoms benefit from self-regulation interventions. |
| The Effect of a Self-Regulation Intervention on Physical Exercise is Moderated by Depressive Symptoms: A Study in Orthopedic Rehabilitation (*Chapter 5*) | Test whether a computer-based self-regulation intervention increases exercise in individuals with and without depressive symptoms. | Main effect depressive symptoms. Interaction intervention effect and depressive symptoms. | A common self-regulation intervention was only effective in individuals without depressive symptoms. Appropriate interventions for individuals with depressive symptoms need to be developed. |

**Depressive Symptoms are Negatively Associated with the Engagement in Different Health Behaviors**

Previous studies have shown that depressive symptoms are associated with a poor engagement in health behaviors in several populations (e.g., Strine et al., 2008) and in individuals with chronic disease, such as diabetes (e.g., Lin et al., 2004). Studies of this thesis further documented a link between depressive symptoms and health behaviors within a multiethnic population (adult population of the US- state Hawai'i), and in individuals in orthopedic and cardiac rehabilitation.

The study presented in *Chapter 2* revealed that adults in Hawai'i with more depressive symptoms reported higher alcohol consumption, ate more fast food, and showed less avoidance of fat, than adults with less depressive symptoms. Links between depressive symptoms and alcohol consumption as well as facets of healthy dieting integrate well with previous findings from other population samples (e.g., Strine et al., 2008; Woo et al., 2006). High levels of perceived stress, and a poor self-assessed health status in Hawaiian adults with more depressive symptoms, underpin that decrements in physical health are likely to be found in individuals dealing with depressive symptoms.

Contrary to previous studies in Hawaiian and non-Hawaiian samples (Berlin, Covery, & Glassman, 2009; Hawai'i Department of Health, 2005), smoking status was not found to be associated with depressive symptoms. Moreover, no clear link between depressive symptoms and physical exercise emerged. However, a trend was observed for this relation. A negative link between depressive symptoms and physical exercise has been previously documented in both Hawaiian (Hawai'i Department of Health, 2005) and non-Hawaiian populations (Goodwin, 2003; Strine et al., 2008). Links between depressive symptoms and health behaviors might have been underestimated in the presented study for two reasons: First, the documented findings were based on data from a voluntary telephone survey. Individuals with severely depressive symptoms might be less likely to take part in such a survey. Second,

cultural differences in the expression of depressive symptoms might be very likely in the population that has been studied, but these were not taken into consideration. The applied depression measurement assessed the facets of hopelessness, sadness, and loss of pleasure and interest (Kroenke, Spitzer, Williams, 2003). A common expression of depressive symptoms through somatic symptoms, or feelings of social distance (e.g., predominant in Asian populations), was not accounted for by the measurement (Kanazawa, White, & Hampson, 2007). Thus, individuals with depressive symptoms may not have been thoroughly identified.

Nevertheless, the findings presented in *Chapter 2* revealed that depressive symptoms are linked to some health risk behaviors in the population. As health behaviors represent a key for the prevention of chronic diseases (Fisher et al., 2011), experiencing depressive symptoms might be regarded as a risk for developing chronic diseases (Katon, 2011).

Health behaviors are also indispensable for the treatment of chronic diseases. Given the mental (Conn, 2010; Daley, 2008) and physical benefits (Fisher et al., 2011) of exercise, this dissertation focused further on exercise engagement in individuals with a chronic disease. The studies in C*hapters 3* and *5* revealed that depressive symptoms lead to poor levels of post-rehabilitation exercise in orthopedic and cardiac patients. The negative link between depressive symptoms and exercise in individuals with chronic diseases are in line with results from previous studies (Lin et al., 2004; Ziegelstein et al., 2000). However, findings of this thesis indicate that only patients with higher levels of depressive symptoms at the end of their rehabilitation reported poorer levels of exercise after discharge from the hospital. Contrarily, the study in C*hapter 4* revealed that depressive symptoms at the beginning of rehabilitation are not predictive for post-rehabilitation exercise. This might be due to the fact that depressive symptoms are reduced during the rehabilitation stay (Bönisch et al., 2011; Egger, Schmid, Walker Schmid, Saner, & von Känel, 2008). To conclude, it seems that in particular depressive symptoms at the end of rehabilitation treatment present a risk for poor engagement in post-rehabilitation exercise. In order to accurately promote exercise in individuals with

depressive symptoms, it is first necessary to understand their difficulties regarding the adoption and maintenance of exercise.

## Depressive Symptoms Interfere with Processes of Health Behavior Change. A Closer Look at Engagement in Exercise

This thesis investigated how depressive symptoms interact with social-cognitive determinants in the health behavior change process regarding exercise. Studies in *Chapters 3* and *4* examined how depressive symptoms are related to motivational (outcome expectancies, intention) and volitional (outcome experiences, planning, action control) predictors of exercise and how depressive symptoms affect the interplay of these variables. In the following, the results of the studies in *Chapter 3* and *4* are discussed.

### *Lower Levels of Positive Outcome Expectancies and Fewer Positive Outcome Experiences Partly Explain the Link Between Depressive Symptoms and Exercise*

Theories, such as the health action process approach (HAPA; Schwarzer, 2008) and the social cognitive theory (SCT; Bandura, 1997), posit that positive outcome expectancies are fundamental for the adoption of health behavior. Moreover, the motivation volition process model (MoVo process model; Fuchs, Göhner, & Seelig, 2011), and Rothman's framework of behavior maintenance (Rothman, 2000), highlight the role of positive outcome experiences for repeated engagement in health behavior. In individuals with depressive symptoms, however, negative thinking about the self, the future, and the environment is predominant (Beck, 1974). Accordingly, the study presented in *Chapter 3* indicated that this negative outlook tarnishes positive outcome expectancies and positive experiences regarding exercise. Results revealed that depressive symptoms were associated with lower levels of positive outcome expectancies regarding exercise, and fewer positive exercise experiences. Negative links between depressive symptoms and positive outcome expectancies regarding future events (e.g., Lecci, Karoly, Briggs, & Kuhn, 1994), as well as a poor recall of positive experiences regarding general life experiences in individuals with depressive symptoms (e.g.,

MacLeod, Tata, Kentish, & Jacobsen, 1997) have been documented in previous research. Such patterns seem to hold true for cognition regarding exercise.

Findings further indicate that the path between depressive symptoms and exercise is explained by a sequential effect from lower levels of positive outcome expectancies to fewer positive experiences, and through experiences themselves. Cognitive bias might explain that expectancies exert influence on experiences. Expectancies affect the search, the processing, and the evaluation of information in all individuals (e.g., Oswald & Grosjean, 2004). Negative schemata predominantly direct the way individuals suffering from depressive symptoms search for, interpret, and memorize information (Dozois & Beck, 2008). Less attention is given to positive aspects, and negative automatic thoughts might decrease the likelihood of perceiving the positive aspects of exercise. In complex situations, individuals with depressive symptoms were found to often focus on one negative aspect of the entire situation (Dozois & Beck, 2008). A recent study exposed that most people underestimate how much they enjoy exercise because they think about the unpleasant feelings in the beginning of an exercise session (Ruby, Dunn, Perrino, Gillis, & Viel, 2011). Individuals suffering from depressive symptoms might explicitly focus their attention on such adverse aspects of exercise, leaving no attention for the positive aspects. Further, low fitness levels and reduced physical energy in individuals (Egger et al., 2008) might increase the likelihood of experiencing low levels of energy and fatigue (e.g., Weinstein, Deuster, Francis, Beadling, & Kop, 2010).

In sum, lower levels of positive expectancies regarding exercise, and thus few positive experiences with exercise, seem to significantly explain why individuals with depressive symptoms tend to have low exercise engagement. In addition to symptoms of negative thinking, individuals with depressive symptoms were found to have impaired self-regulatory functioning (e.g., Stordal et al., 2004). Thus, a lack of self-regulation might further explain the link between depressive symptoms and exercise.

***Individuals with Depressive Symptoms Fail to Use the Self-regulatory Strategy of Action Control***

Self-regulation is crucial for translating intentions into behavior (Hagger, 2010). Action control represents one important self-regulatory strategy. This theoretical construct subsumes the following facets: awareness of standards, monitoring behavior, and self-regulatory effort (Sniehotta, Scholz, & Schwarzer, 2005; Sniehotta et al., 2005). According to the strength and energy model of self-regulation (Baumeister, Muraven, & Tice, 2000; Hagger, Wood, Stiff, & Chatzisarantis, 2010), sufficient self-regulatory resources are required for one to be able to apply self-regulatory strategies. Self-regulation is described as a global and a limited resource. A constant effort towards regulation of depressive symptoms can exhaust self-regulatory resources, and thereby increase the likelihood of self-regulatory failure in other behavioral domains (Tice & Bratslavsky, 2000), such as adoption and maintenance of exercise. Evidence for the theoretical assumption that depressive symptoms interfere with self-regulatory processes can be taken from results presented in *Chapter 4*. Findings revealed that medical rehabilitation patients with depressive symptoms did not use the self-regulatory strategy of action control to translate their intentions into exercise behavior. Demands on self-regulatory resources might be especially high in individuals with chronic disease (i.e., orthopedic and cardiac rehabilitation patients) and comorbid depressive symptoms (Detweiler-Bedell, Friedman, Leventhal, Miller, & Leventhal, 2008). In this target group, self-regulatory energy is required for disease management (usually encompassing several health behaviors, such as exercise behavior, quitting smoking, medication adherence) and depression management (i.e., regulation of negative affect). Depression and chronic medical conditions were found to have unique and additive effects on patients' functioning (Wells et al., 1989). Findings are further in line with empirical studies documenting impaired cognitive functions in the domains of attention, executive function, and memory in individuals experiencing depressive symptoms (e.g., Ottowitz, Dougherty, & Savage, 2002; Stordal et al.,

2004). Cognitive deficits might hamper the attention on exercise goals, the monitoring of behavior, and the continual adoption of the behavior. Deficits in self-regulation can also explain why people with depressive symptoms are likely to show more health risk behaviors than poor exercise engagement, such as unhealthy dieting and frequent alcohol consumption (see *Chapter 2*).

However, contrary to the previous hypothesis, findings in *Chapter 4* showed that medical rehabilitation patients with more depressive symptoms did not report lower levels of intentions. This is not in line with the assumption that individuals suffering from depressive symptoms generally show avoidance of and withdrawal from goals (Beck, 1974; Schneider, 2006). The results might be explained, however, by the specific sample that was investigated, as medical rehabilitation patients are particularly prone to report a motivation to exercise (Johnston, Johnston, Pollard, Kinmonth, & Mant, 2004).

Nevertheless, depressive symptoms interfered with the use of a core self-regulatory strategy. Given the interference of depressive symptoms with self-regulatory functioning, the question emerges regarding whether individuals with depressive symptoms benefit from a common self-regulatory intervention.

**A Common Self-Regulatory Intervention Did Not Promote Exercise Behavior in Individuals with Depressive Symptoms**

Research has indicated that self-regulatory skills can be improved via training (Baumeister, Gailliot, DeWall, & Oaten, 2006; Oaten, & Cheng, 2005). Many interventions that target self-regulatory strategies have been successful in changing behavior (e.g., Gollwitzer & Sheeran, 2006; Schüz, Sniehotta, & Schwarzer, 2007). The study presented in *Chapter 5,* however, showed that a volitional intervention that targeted planning and action control (by prompting the generation of detailed behavior plans and by promoting behavioral self-monitoring with a diary), increased post-rehabilitation exercise in rehabilitations patients without depressive symptoms but not in those with depressive symptoms. Thus, the provided

self-regulatory intervention did not seem to reduce self-regulatory difficulties in depressive individuals. One might assume that individuals with depressive symptoms planned less, and had difficulties setting realistic plans, or adhering to plans. Further, individuals dealing with depressive symptoms might have not self-monitored their exercise behavior with the help of a diary.

Nevertheless, self-regulation interventions were found to have positive effects on depressive symptoms (Knittle et al., 2010). Hence, self-regulatory interventions may not be without value for individuals suffering from depressive symptoms per se. The provided intervention in the study presented in *Chapter 5* might have been less appropriate for participants with depressive symptoms. The intervention did not take into account the eventual difficulties faced by individuals dealing with depressive symptoms. The planning part of the intervention was very extensive, i.e., individuals were prompted to generate up to five exercise ideas and detailed plans to carry out these ideas. This may have been overwhelming for participants with less self-regulatory resources available. Interventions that prompt individuals to generate one plan for a favorite exercise idea (e.g., Fuchs et al., 2011) might be less demanding and a more fruitful strategy for individuals with depressive symptoms. However, there are further factors that should be considered when interpreting the missed intervention effect in individuals with depressive symptoms. First, the intervention was delivered via a computer program. Meta-analytic findings revealed that health behavior interventions which involved more personal contact have been more effective than those with less personal contact (Fjeldsoe et al., 2011). In particular individuals with depressive symptoms might benefit more from personal assistants that encourage and support them. Second, the intervention study provided in *Chapter 5* included two intervention units (one at the beginning and one at the end of rehabilitation). More frequent support might also be advantageous for individuals experiencing depressive symptoms (Hampel, Graef, Krohn-Grumberghe, & Tlach, 2009). Finally, individuals with depressive symptoms might require

additional psychological support, such as psychotherapeutic techniques to cope with their depressive symptoms while undertaken exercise goals (Hollon, Stewart, & Strunk, 2006). Such support that improves depressive symptoms may enhance self-regulatory capabilities for engagement in exercise.

In sum, the four empirical chapters of this thesis revealed that depressive symptoms are adversely linked to several health behaviors and important determinants of exercise engagement. Further, results revealed that it remains questionable whether a common self-regulatory intervention is sufficient to increase exercise in individuals with depressive symptoms.

## Further Directions and Implications for Research

Several recommendations for future research can be derived from the strength and limitations of this dissertation. In the following paragraphs, methodological, theoretical, and practical implications are outlined.

### *Methodological Implications*

*Measures*

Studies presented in this thesis measured depressive symptoms with the two item version of the Patient Health Questionnaire (PHQ-2, Kroenke et al., 2003). The depression screener covered the two major symptom groups of a major depression: Depressed mood and diminished interest and pleasure (DSM, 2000). Further criteria for the presence of depressive symptoms are, for instance, the experience of psychosomatic problems and disturbances in sleep (DSM, 2000). Although the PHQ-2 has a sensitivity of 83% and a specificity of 92% for major depression (Kroenke et al., 2003), it might be that links between depressive symptoms, health behaviors, and determinants of health behavior change were underestimated in the presented studies. Future studies may apply broader depression screeners that address more facets of depressive symptoms, e.g., Becks Depression Inventory (BDI; Beck, Steer, & Brown, 1996) or the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff,

1977). When choosing an instrument to measure depressive symptoms, the ethnic background of participants should be taken into consideration (see *Chapter 2*). A potential cultural variation of expressing depressive symptoms might be accounted for with the CES-D (Radloff, 1977).

This thesis refers to the concept of self-regulatory energy. This theoretical construct should be empirically assessed in future studies. One option to measure self-regulatory energy is via self-reports, such as with the Self-Control Capacity Scale (SCCS, Bertrams, Unger, & Dickhäuser, 2011). The scale includes items such as "I have a lot of energy" or "I feel mentally exhausted". Further, objective measures might be used to assess facets of self-regulation. The stroop test, or working with unsolvable anagrams are common objective measures of self-regulatory strength (for an overview, see Hagger et al., 2010).

The measurements of behaviors in the empirical studies of this dissertation were based on self-reports. Objective measure of exercise through pedometers (Kang, Marshall, Barreira, & Lee, 2009) or accelerometers (Taraldsen, Chastin, Riphagen, Vereijken, & Helbostad, 2012) can resolve problems of under- or overestimation and are recommended. Other health behaviors besides exercise could be objectively measured via third person observations (Yang, McEvoy, Wilson, Levin, & Rose, 2003).

This thesis did not analyse objective health indicators. To further test links between depressive symptoms, health behaviors, and the development and progression of chronic diseases (Katon, 2011), the assessment of disease indicators (e.g., disease diagnosis) is required.

*Sample*

Samples of this dissertation were unique. The study in *Chapter 2* investigated the multiethnic adult population in Hawai'i, and the studies in *Chapters 3, 4*, and *5* were conducted in orthopedic and cardiac rehabilitation settings in Germany. To generalize findings of this thesis, results need to be replicated in other population samples, and in

individuals with other physical health conditions. Further, findings of this dissertation based on adults in middle age. Future study might also consider whether the interplay between depressive symptoms and the engagement health behaviors hold true for other age groups.

Considering the clinical cut-off of the PHQ-2, the study in *Chapter 5* revealed that approximately 10% of the medical rehabilitation patients screened positive for depressive symptoms. Previous research has reported much higher rates of depression in samples of individuals with chronic diseases. The relatively low rate of participants with depressive symptoms in this study might have resulted from two aspects: First, the depression screener might have not been optimal to detect depressive symptoms. Second, study participation was optional for medical rehabilitation patients and individuals with depressive symptoms might have been less likely to participate. Therefore, future studies in a medical rehabilitation setting should aim at accurately recruiting more individuals suffering from depressive symptoms.

Further, the study presented in *Chapter 3 and 4* revealed that persons with depressive symptoms were more likely to drop-out of the study. Thus, reported results might have underestimated effects between depressive symptoms and processes of health behavior change.

*Study Design*

Longitudinal studies of this dissertation (*Chapters 3*, *4*, and *5*) tested the effect from baseline depressive symptoms on exercise 6-9 weeks later. Future studies might include additional measurement-points. One the one hand, it might useful to examine whether depressive symptoms lead to a decline in health behavior over a longer period of time, e.g., by including follow-up measures at 6-12 months after rehabilitation. On the other hand, short-time effects of depressive symptoms on exercise engagement could also be regarded. Depressive mood during the day might immediately lead to disengagement from exercise goals on the same day. To evaluate short-term effects, daily assessments are recommended.

*Methods of Analysis*

To further consolidate the assumption that depressive symptoms lead to the development and progression of chronic disease (Katon, 2011) through health risk behaviors, longitudinal studies should assess depressive symptoms, health behaviors, and objective health indicators across several measurement-points in time. One the one hand, health risk behaviors might be strictly tested as factors that explain the onset of chronic diseases in individuals dealing with depressive symptoms. On the other hand, it is important to examine whether poor health behaviors account for a progress of chronic diseases in individuals with depressive symptoms.

This thesis investigated cross-sectional relations between depressive symptoms and multiple health behaviors, as well as the longitudinal effect from depressive symptoms on subsequent exercise. Links between depressive symptoms and some health behaviors are assumed to be reciprocal (e.g., Boden & Fergusson, 2011), e.g., frequent alcohol consumption may induce the development of depressive symptoms, and individuals that experience depressive symptoms are more likely to consume alcoholic drinks frequently. Further longitudinal studies might be valuable for testing to what degree depressive symptoms reduce engagement in health behaviors, and to what degree health risk behaviors induce depressive symptoms, e.g., by using cross-lag-panel analysis (Kenny, 1975).

In line with previous research, in *Chapter 2* links between depressive symptoms and multiple health behaviors were analyzed separately. To gain more insight into the interrelation of different health risk behaviors in depressive individuals, cluster analyses could be performed (Verger, Lions, & Ventelou, 2009).

To broaden the understanding of why depressive symptoms lead to a decline in different health behaviors, the psychological mechanisms responsible need to be further explored. This thesis broke the first ground by illuminating how depressive symptoms interfere with psychological mechanisms of exercise engagement (*Chapters 2* and *3*). Future

studies should test whether these patterns hold true for engagement in other health behaviors, such as dieting and alcohol consumption.

To strengthen the theoretical assumption that individuals with depressive symptoms fail to adapt health behaviors due to depleted resources, future research should aim at strictly testing whether self-regulatory resources operate as a mediator between depressive symptoms and the use of self-regulatory strategies, such as action control or action planning.

The study in *Chapter 5* did not analyze psychological pathways of the exercise intervention. In the future, mediator analyses (Preacher, & Hayes, 2008) should be conducted to test how interventions operate and why they are effective. In other words, mediation analyses can expose whether intervention effects are based on changes in particular social-cognitive determinants (e.g., increases in planning). Moderation analysis can further show whether the intervention mechanism works in both individuals with and without depressive symptoms (Preacher, Rucker, & Hayes, 2007).

To conclude, methodological improvements exist for future studies. Further, there are theoretical implications than can be derived from this dissertation.

### *Theoretical Implications*

This thesis put an emphasis on how depressive symptoms interfere with the adoption and maintenance of exercise. Links between depressive symptoms and predictors of exercise engagement might be investigated more deeply.

#### *A Closer Look at Determinants of Exercise in Individuals with Depressive Symptoms*

##### *Expectancies and Experiences*

The study in *Chapter 3* revealed that depressive individuals have less positive outcome expectancies regarding exercise. To gain a more complete picture, future studies may explore whether particular kinds of *outcome expectancies* (i.e., physical, emotional, or social) are linked to the experience of depressive symptoms. In addition to positive outcome expectancies, negative outcome expectancies might explain variance in the behavior of

individuals with depressive symptoms. Individuals reporting depressive symptoms were found to anticipate more barriers than non-depressive persons (Wagner, Kraemer, Langgut, Gawrilow, & Stadler, 2011). For example, the expectancy of pain is an issue in individuals with chronic diseases and depressive symptoms, and might further explain why individuals avoid engaging in exercise (Leonhardt et al., 2007).

The study in *Chapter 3* also showed that individuals with depressive symptoms report fewer *positive outcome experiences* regarding exercise. Positive and negative types of exercise experiences (i.e., physical, emotional, and social) should be examined more closely in individuals dealing with depressive symptoms. Moreover, investigating patterns of experiences in individuals experiencing depressive symptoms might be fruitful. Weinstein and colleagues (2010) showed that individuals with depressive symptoms reported mood improvements (i.e., a positive emotional experience) immediately after exercising, whereas they reported mood decreases (i.e., a negative emotional experience) 30 minutes after exercising. However, when evaluating experiences in individuals suffering from depressive symptoms, a recall bias regarding less positive and more negative exercise experiences may be taken into consideration. Finally, experiences should be tested as a further source of outcome expectancies (Fuchs et al., 2011).

The results presented in *Chapter 3* also revealed that more positive expectancies lead to more positive experiences. To further underpin that *outcome expectancies* affect *experiences*, experimental study designs are required that manipulate outcome expectancies.

When studying the interaction between depressive symptoms, outcome expectancies, experiences, and behavior, *self-efficacy* should be considered as a further factor (Bandura, 1997). Individuals with depressive symptoms were found to report lower levels of self-efficacy regarding exercise (Vickers, Nies, Patten, Dierkhising, & Smith, 2006). The SCT (Bandura, 1997) proposes that experiences represent one source of self-efficacy. The theory further posits that self-efficacy influences outcome expectancies, intentions and behavior.

Thus, self-efficacy may represent a valuable predictor for health behavior change in individuals with depressive symptoms.

*Considering Behavior Intentions*

Findings presented in *Chapter 4* revealed that depressive symptoms were not associated with lower levels of *behavior intentions* to engage in exercise. A study by Suija et al. (2009) revealed that the majority of individuals with depressive symptoms in a primary care setting were not motivated to engage in exercise. Thus, it might be that individuals suffering from depressive symptoms in samples other than medical rehabilitation patients, report significantly lower intentions. As the formation of an intention represents the first step towards engaging in health behavior (Schwarzer, 2008), this construct should be taken into account when studying health behavior. According to the HAPA, outcome expectancies and self-efficacy represent predictors for motivation (Schwarzer, 2008). When it comes to behavior performance, further determinants, such as self-regulatory strategies, are central.

*Self-Regulatory Strategies*

The observational findings presented in *Chapter 4* indicate that individuals reporting depressive symptoms did not use the self-regulatory strategy of *action control.* To illuminate how depressive symptoms interfere with action control, associations between depressive symptoms and the single facets of action control (i.e., awareness of standards, self-monitoring, and self-regulatory effort) might be analyzed differentially.

Aside from action control, the intervention presented in *Chapter 5* targeted *planning*. Results lead to the assumption that individuals with depressive symptoms did not benefit from the planning module. However, no direct link between depressive symptoms and the variable of planning was investigated in the study. Future observation and experimental studies should strictly test whether depressive symptoms interfere with planning. As previous research has indicated that individuals suffering from depressive symptoms have particular difficulties coping with barriers (Kraemer, Stadler, Snyder, & Bolger, 2010; Vickers et al., 2006), action

and coping planning (Schwarzer, 2008) should be considered separately. It might also be beneficial to uncover whether individuals with depressive symptoms have more difficulties with the generation of plans or adherence to plans. Finally, future studies might explore whether individuals experiencing depressive symptoms benefit from the generation of more or less plans (i.e., number of plans; Wiedemann, Lippke, Reuter, Ziegelmann, & Schüz, 2011).

In sum, further study is warranted on how depressive symptoms interfere with the social-cognitive processes of exercise engagement. In addition to considering the interplay between depressive symptoms and single determinants, implications for theoretical frameworks can be outlined.

*Frameworks of Health Behavior Change*

The following implications for theoretical frameworks of health behavior change might be suggested: First, results of this thesis indicate that the experience of depressive symptoms partly explains why some individuals fail to engage in health behaviors. Thus, negative affect represents a valuable predictor for explaining variance in health behaviors, in addition to social-cognitive factors. Theoretical frameworks might consider negative affect as a further variable in the motivational and volitional process of health behavior (Kleinert et al., 2007). As this dissertation revealed that postulated theoretical mechanisms of health behavior change (e.g., intention is translated via action control into behavior) does not hold true for individuals suffering from depressive symptoms, depressive symptoms might be regarded as a crucial moderator in theories of health behavior change. Second, theories of self-regulation (Hagger et al., 2010; Tice & Bratslavsky, 2000) postulated that some people fail to engage in behavioral tasks due to depleted self-regulatory resources (i.e., individuals experiencing a negative affective state). Hence, frameworks of health behavior change might explicitly integrate the construct of self-regulatory resources.

In conclusion, the findings of this thesis provide valuable theoretical implications for future research. Knowledge should also be accumulated for developing effective interventions.

### *Implications for Interventions*

The findings of *Chapter 5* disclosed that a common self-regulation intervention was not effective to enhance exercise in individuals with depressive symptoms. As a consequence, future research should pursue the goal of designing more effective health behavior change interventions for individuals with depressive symptoms. In the following, avenues for developing appropriate interventions for this target group are outlined. First, interventions might be more effective when adapting intervention ingredients to the particular needs of individuals experiencing depressive symptoms. As an example, suggestions for an adapted exercise intervention are presented. Second, suggestions of how to address multiple health behavior changes are given. Third, treatments that combine both the management of depressive symptoms and the management of health behaviors might be developed. Finally, different intervention modes should be taken into account.

#### *An Example of Adapted Health Behavior Change Interventions: Exercise Interventions*

Instead of providing one-size-fits-all interventions, treatments can be tailored to individuals or target groups to increase their effectiveness (Kreuter, Strecher, & Glassman, 1999). Individuals with depressive symptoms might benefit from certain strategies of health behavior change as well as from modulating common strategies of health behavior change.

A common technique to promote positive outcome expectancies is to provide information about positive consequences (Michie et al., 2011). Emotional outcome expectancies are especially predictive for engaging in behavior changes (Dunton & Vaughan, 2008; Gellert, Ziegelmann, & Schwarzer, 2011). Individuals suffering from depressive symptoms might be encouraged to focus on the positive consequence of exercise on mood. Moreover, depressive persons may benefit from receiving information on the mechanisms by

which exercise can improve mood, e.g., its reduction of stress hormones (Daley, 2008). If individuals dealing with depressive symptoms consider exercise as an explicit tool for their mood management, then they may develop more positive outcome expectancies. However, modeling realistic expectations might also be important, e.g., exercising might be exhausting in the beginning, but levels of energy will improve over time. Otherwise, people might be disappointed and therefore disengage from the behavior (Rothman, 2000).

Further, exercise recommendation for individuals with depressive symptoms might be adapted. Exercise guidelines for individuals experiencing depressive symptoms recommend a gently start (Daley, 2008). Advice refers to 10 minute bouts of exercise in the beginning, as less ambitious goals can avoid experiences of failure and frustration (Conn, 2010; Seime & Vickers, 2006). However, to meet public health guidelines and take into account the dose-response relationship between exercise and an alleviation of depressive symptoms (Dunn et al., 2005) a gradual build-up of exercise is recommended.

Setting small goals may also increase the likelihood of having positive experiences, e.g., through the experience of goal attainment. Goal attainment was found to alleviate depressive symptoms (Scholz, Knoll, Sniehotta, & Schwarzer, 2006). Interventions should focus on acknowledging mastery experiences and personal success regarding small accomplishment (Daley, 2002). The perception of positive experiences might further be enhanced by guiding a person's attention to the mood improvement experienced immediately after exercising (Weinstein et al., 2010). Finally, choosing a joyful type of exercise (Williams et al., 2008) may enhance the likelihood of positive experiences.

Instead of planning exercise alone, benefits of planning with another person (i.e., dyadic planning; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011) should be considered as an appropriate health behavior change technique for individuals suffering from depressive symptoms. Dyadic planning implies planning together with a friend, a partner, or a health professional and might take some self-regulatory effort off a depressive person's shoulders.

Further, intervention components of mobilizing social support (Carless & Douglas, 2008; Schwarzer & Knoll, 2007) or social control (Lewis, & Butterfield, 2007) may be additionally conducive for individuals with depressive symptoms. Having an exercise partner can increase the likelihood of engaging in regular activities (Stevens, Lemminnk, van Heuvelen, de Jong, & Rispens, 2003). Further, life partners or close friends can encourage or persuade individuals with depressive symptoms to perform the behavior. Such social support or social control may also counteract depletion of self-regulatory strength.

In addition to monitoring behavior with an exercise diary (Michie et al., 2011), more external behavior monitoring strategies might be favorable for individuals with depressive symptoms. The use of pedometers (Kang et al., 2009) and accelerometers (Taraldsen et al., 2012), or receiving monitoring support from other persons (e.g., health professionals, therapists, or friends; Daley, 2008) may also save self-regulatory energy.

Hence, there might be options regarding how components of exercise interventions can be modified in order to match the needs of individuals dealing with depressive symptoms. Further research need to evaluate the benefits of adapted interventions.

However, taking into account the evidence that poor exercising is not the only health risk behavior in individuals reporting depressive symptoms (*Chapter 2*), multiple health behaviors should be targeted in interventions.

*Multiple Health Behavior Interventions*

Findings of this dissertation revealed that depressive symptoms interfere with the performance of multiple health behaviors, i.e., minimal alcohol consumption, healthy dieting, and adequate exercising. This raises the question of how to change multiple health behaviors. However, there is little research on how to effectively address multiple health behaviors in general. In view of the fact that self-regulation constitutes a limited resource (Baumeister et al., 2000; Hagger et al., 2010) and the performance of every single health behavior likely requires additional self-regulatory energy, a simultaneous change of several health behaviors

might be simply overtaxing. An implication of the strength and energy model is therefore that people should not engage in too many demanding self-regulatory tasks at the same time (Hagger et al., 2010). Hence, it might be reasonable that individuals - especially those with few self-regulatory resources (i.e., individuals with depressive symptoms) - start by changing just one health behavior. Consequently, interventions might target several health behaviors consecutively. People might choose which health behavior they want to change first (Allegrante, Peterson, Boutin-Foster, Ogedegbe, & Charlson, 2008). The promotion of exercise, however, might represent an ideal starting point for multiple health behavior interventions in individuals with depressive symptoms. Regular exercise alleviates depressive feelings (Conn, 2010) and may enhance the self-regulatory capacity to adopt other health behaviors (Oaten, & Cheng, 2005). Future research should test the effect of consecutive health behavior change interventions.

Considering the assumption that a reduction of depressive symptoms may leads to more self-regulatory capacities and thereby facilitate health behavior change, interventions may also benefit from directly addressing depressive symptoms.

*Collaborative Management of Health Behavior and Depression Symptoms*

According to the results presented in *Chapter 5,* a health behavior change intervention alone did not increase exercise in individuals with depressive symptoms. Interventions might be improved by additionally focusing on the management of depressive symptoms, for example with the help of cognitive behavior therapy techniques (Hollon et al., 2006). Cognitive behavior therapy aims at changing negative schemata and the maladaptive style of information processing (Hollon et al., 2006). Through cognitive restructuring individuals can reduce the experience of negative emotions. However, when aiming to promote the management of health behavior and depression three approaches might be considered (Carroll et al., 2009): A serial, parallel, or integrated approach. A *serial approach* would address depressive symptoms and health behavior change consecutively. A *parallel approach*

addresses health behavior change and depressive symptoms simultaneously, but one treatment does not take into account the other treatment. However, if the depression treatment does not consider the need for health behavior change and vice versa, treatments might interfere (Detweiler-Bedell et al., 2008). The prioritization on either depression management or health behavior management can undermine goals related to the other condition, e.g., on the one hand, setting high exercise goals due for disease management might be overcharging for individuals with depressive symptoms and increase the likelihood of failure, an experience that might further induce depressive symptoms. On the other hand, concentrating only on activities that are joyful (as part of depression management) might decrease the likelihood of engaging in exercise, and thereby interferes with successful disease management. Therefore, an *integrated approach* provides a third option (Carroll et al., 2009). By considering depression management when promoting health behavior and vice versa, treatments might become more synergistic. However, integrated approaches have been largely unexplored with regard to increasing exercise, or even multiple health behaviors, and require more investigation. The effectiveness of integrated approaches might be compared with effects of health behavior change interventions alone, and psychological treatments alone. Further, integrated approaches should be tested against serial or parallel approaches. Thus, the advantage of integrated approaches requires further study.

*Feasible Modes of Interventions*

Finally, the mode of interventions may affect whether interventions are effective. The mode of an intervention refers, among other things, to face-to-face versus computer-based interventions, or to the number of intervention sessions.

The intervention provided in *Chapter 5* was a computer-based treatment. Internet and computer-based cognitive behavior therapy was found to reduce depressive symptoms (Sikorski, Luppa, Kersting, König, & Riedel-Heller, 2011; Spek et al., 2007). However, meta-analytic findings indicate that computer and internet based interventions that include intensive

personal contact with a therapist (e.g., via feedback, email, chat, monitoring, or live-screen) are especially effect (Sikorski et al., 2011). Most computer-delivered treatments fail to address non-specific treatment factors (e.g., empathy). Such non-specific factors contribute to the effects of face-to-face psychotherapy to a valuable degree (Burns, & Nolen-Hoeksema, 1992; Proudfoot, 2004). Thus, future studies should explore, whether persons with depressive symptoms benefit more from interventions with personal contact, e.g., face-to-face interventions, or internet and computer interventions with intensive personal contact.

Further, interventions can also vary in terms of treatment intensity (e.g., frequency of intervention contacts). The intervention in *Chapter 5* was delivered only twice. The intensity of a program might be crucial to archive changes in behavior: Interventions with frequent contacts were found to be more effective at fostering exercise maintenance in individuals than interventions with fewer contacts (Fjeldsoe et al., 2011). Particularly individuals suffering from depressive symptoms might benefit from weekly reminders and booster sessions (Hampel et al., 2009). Further study is needed to investigate the question of whether the frequency of booster sessions is important for successful health behavior change in individuals with depressive symptoms.

As a whole, due to a rising prevalence of depressive symptoms in societies and the association of unhealthy habits with depressive symptoms, the development of interventions that target health behavior change in individuals with depressive symptoms need to become a priority in research and practice.

**Conclusion**

This dissertation provides empirical evidence that depressive symptoms interfere with the adoption and maintenance of a healthy lifestyle. First, depressive symptoms are negatively related to several health behaviors. Second, depressive symptoms interfere with the psychological processes of health behavior change. Finally, individuals with depressive symptoms seem to benefit less from a common health behavior change intervention compared

to persons without depressive symptoms. From a theoretical point of view, findings of this thesis indicate that a person's (negative) affective state should be considered when predicting health behavior change. In practice, depressive symptoms should be recognized within primary and secondary care settings, and unhealthy habits need to be addressed in this target group. Health behavior interventions might benefit from considering resources, and paying attention to the particular needs of individuals dealing with depressive symptoms.

# References

Allegrante, J. P., Peterson, J. C., Boutin-Foster, C., Ogedegbe, G., & Charlson, M. E. (2008). Multiple health-risk behavior in a chronic disease population: What behaviors do people choose to change? *Preventive Medicine*, 46, 247-251.

Armitage, C. J. & Conner, M. (2000). Social cognition models and health behavior: A structured review. *Psychology & Health*, 15, 173.

Bandura, A. (1997). Self-*efficacy: The exercise of control.* New York: Freeman.

Baumeister, R. F., Gailliot, M., DeWall, C. N., & Oaten, M. (2006). Self-regulation and personality: how interventions increase regulatory success, and how depletion moderates the effects of traits on behavior. *Journal of Personality*, 74, 1773-1801.

Baumeister, R. F., Muraven, M., & Tice, D. M. (2000). Ego depletion: A resource model of volition, self-regulation, and controlled processing. *Psychological Bulletin*, 18, 130-150.

Beck, A.T. (1974). The development *of* depression. A cognitive model. In R.J. Friedman & M.M. Katz (Eds.), *The psychology of depression* (pp.3-28). New York: Wiley.

Beck, A.T., Steer, R. A., & Brown, G.K. (1996). *Manual for the Beck Depression Inventory-II.* San Antonio, TX: Psychological Corporation.

Berlin, I., Covey, L. S., & Glassman, A. H. (2009). Smoking and depression: A co-morbidity. *Journal of Dual Diagnosis*, 5, 149-158.

Bertrams, A., Unger, A. & Dickhäuser, O. (2011). Momentan verfügbare Selbstkontrollkraft - Vorstellung eines Messinstruments und erste Befunde aus pädagogisch-psychologischen Kontexten. *Zeitschrift für Pädagogische Psychologie,* 25*,* 185-196.

Boden, J.M. & Fergusson, D.M. (2011). Alcohol and depression. *Addiction*, 106, 906-914

Bönisch, R., Stemmpler, M., Bremer. F.-J., Schweidtmann, W., Ohnesorge, W., & Muthny, F.A. (2011). Motivation zur körperlichen Aktivität, Ängste und Depressivität im Rehabilitationsverlauf kardiologischer Patienten und Vorhersage des Reha-Erfolges. *Praxis klinische Verhaltensmedizin und Rehabilitation*, 88, 47-54.

Burkert, S., Scholz, U., Gralla, O., Roigas, J., & Knoll, N. (2011). Dyadic planning of health-behavior change after prostatectomy: A randomized-controlled planning intervention. *Social Science & Medicine,* 73, 783-792.

Carless, D. & K. Douglas (2008). Social support for and through exercise and sport in a sample of men with serious mental illness. *Issues In Mental Health Nursing*, 29, 1179-1199.

Carroll, S., Hides, L., Catania, L., Mathias, S., Greenwood-Smith, C., Lubman, D. (2009). Integrated cognitive behavior therapy for co-occurring substance misuse and major depression: Lessons from a youth mental health service. *Australasien Psychiatry.* 17, 365-370.

Conn, V.S. (2010). Depressive symptom outcome of physical activity interventions: Meta-analysis findings. *Annals of Behavior Medicine,* 39, 128-138

*Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revison* (*DSM-IV-TR*). 4th ed. Washington, DC: American Psychiatric Association; 2000.

Daley, A. J. (2002). Exercise therapy and mental health in clinical populations: Is exercise therapy a worthwhile intervention? *Advances in Psychiatric Treatment*, 8, 262-270.

Daley, A. J. (2008). Exercise and Depression: A Review of Reviews. *Journal of Clinical Psychology in Medical Settings,* 15, 140-147.

Detweiler-Bedell, J. B., Friedman, M. A., Leventhal, H., Miller, I. W., & Leventhal, E. A. (2008). Integrating co-morbid depression and chronic physical disease management: identifying and resolving failures in self-regulation. *Clinical Psychology Review*, 28, 1426-1446.

Dozois, D. J. A. & Beck, A.T. (2008). Cognitive Schemata, Believes and Assumptions. In K.S. Dobsen & D.J.A. Dozois (Eds.), *Risk factors in depression* (pp.121-143). Amsterdam; Boston, Elsevier/Academic.

Dunn, A.L., Trivedi, M.H., Kampert, J.B., et al. (2005). Exercise treatment for depression: efficacy and dose response. *American Journal of Preventive Medicine*, 28, 1–8.

Dunton, G. F. & Vaughan, E. (2008). Anticipated affective consequences of physical activity adoption and maintenance. *Health Psychology*, 27, 703-710.

Egger, E., Schmid, J.P., Walker Schmid, R., Saner , H.& von Känel, R. (2008). Depression and anxiety symptoms affect change in exercise capacity during cardiac rehabilitation. *European Journal of Cardiovascular Prevention & Rehabilitation*, 15, 704-708.

Fisher, E. B., Fitzgibbon, M. L., Glasgow, R.E., Haire-Joshu, D., Hayman, L. L., Kaplan, R. M., Nanney, M. S., & Ockene, J. K. (2011). Behavior matters. *American Journal of Preventive Medicine,* 40, 15-30.

Fjeldsoe, B., Neuhaus, M., Winkler, E., & Eakin, E. (2011). Systematic review of maintenance of behavior change following physical activity and dietary interventions. *Health Psychology*, 30, 99-109.

Fuchs, R., Göhner, W., & Seelig, H. (2011). Long-term effects of a psychological group intervention on physical exercise and health: The MoVo concept. *Journal of Physical Activity and Health*, 8, 794-803

Gellert, P., Ziegelmann, J. P., & Schwarzer, R. (2011). Affective and health-related outcome expectancies for physical activity in older adults. *Psychology & Health*. Advance online publication. doi: 10.1080/08870446.2011.607236

Gollwitzer, P M. & Sheeran, P (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, 38, 96-119.

Goodwin, R. D. (2003). Association between physical activity and mental disorders among adults in the United States. *Preventive Medicine*, 36, 698-703.

Hagger, M. (2010). Editoral: Self-regulation: an important construct in health psychology research and practice. *Health Psychology Review*, 4, 57-65

Hagger, M., Wood, C.W., Stiff, C., & Chatzisarantis, N.L.D. (2010). Self-regulation and self-control in exercise: The strength-energy model. *International Review of Sport and Exercise Psychology*, 3, 62-86.

Hampel, P., Graef, T., Krohn-Grimberghe, B., & Tlach, L. (2009). Effects of gender and cognitive-behavioral management of depressive symptoms on rehabilitation outcome among inpatient orthopedic patients with chronic low back pain: A 1 year longitudinal study. *European Spine Journal*, 18, 1867-1880.

Hawai'i State Department of Health. Hawai'i Health Survey, Hawai'i statistics, health insurance, 2.1: number and percent uninsured by county, gender, age, ethnicity, and poverty - population of Hawai'i (Table and Figure) 2005. Retrieved from http://hawaii.gov/health/statistics/hhs/hhs_04/hhs04t21.pdf

Hollon, S. T., Stewart, M. O. & Strunk, D. (2006). Enduring effects for cognitive behavior therapy in the treatment of depression and anxiety. *Annual Review of Psychology*, 57, 285–315.

Johnston, D. W., Johnston, M., Pollard, B., Kinmonth, A. L., & Mant, D. (2004). Motivation is not enough: Prediction of risk behavior following diagnosis of coronary heart disease from the theory of planned behavior. *Health Psychology*, *23*, 533-538.

Kanazawa, A., White, P.M., & Hampson, S.E. (2007). Ethnic variation in depressive symptoms in a community sample in Hawai'i. *Cultural Diversity and Ethnic Minority Psychology*, 13, 35-44.

Kang, M., Marshall, S.J., Barreira, T.V., & Lee, J-0. (2009). Effect of pedometer-based physical activity interventions: A meta-analysis. *Research Quarterly for Exercise and Sport*, 80, pp. 648–655

Katon, W. J. (2011). Epidemiology and treatment of depression in patients with chronic medical illness. *Dialogues In Clinical Neuroscience*, 13, 7-23.

Katon, W. J., Lin, E.H. B., Von Korff, M., Ciechanowski, P., Ludman, E., Young, B., Rutter, C., Oliver, M., & McGregor, M. (2010). Integrating depression and chronic disease care among patients with diabetes and/or coronary heart disease: the design of the TEAMcare study. *Contemporary Clinical Trials,* 31, 312-322.

Kenny, D.A. (1975). Cross-lagged panel correlation: A test for spuriousness. *Psychological Bulletin*, 82, 887-903.

Kleinert, J., Golenia, M. & Lobinger, B. (2007). Emotionale Prozesse im Bereich der Planung und Realisierung von Gesundheitshandlungen. *Zeitschrift für Sportpsychologie*, 14, 4-50.

Knittle, K., Maes, S., & de Gucht, V. (2010). Psychological interventions for rheumatoid arthritis: Examining the role of self-regulation with a systematic review and meta-analysis of randomized controlled trials. *Arthritis Care & Research*, 62, 1460-1472.

Kraemer, L., Stadler, G., Snyder, K. & Bolger, N. (2010). The influence of depression on volitional processes in physical activity: A daily diary study. *Psychology & Health*, 25 sup1, 259-260.

Kreuter, M.W., Strecher, V. J., & Glassman, B. (1999). One size does not fit all: The case for tailoring print materials. *Annals of Behavioral Medicine*, 21, 276-283.

Kroenke, K., Spitzer, R.L., Williams, J.B. (2003). The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care*, 41, 1284-1294.

Lecci, L., Karoly, P., Briggs, C., & Kuhn, K. (1994). Specificity and generality of motivational components in depression: A personal projects analysis. *Journal of Abnormal Psychology*, 103, 404-408.

Leonhardt, C., Keller, S., Becker, A., Luckmann, J., Baum, E., Donner-Banzhoff, N., Pfingsten, M., Hildebrandt, J., Chenot, J. F., Kochen, M.M., & Basler, H. (2007). Depressivität, Bewegungsangst-Kognitionen und körperliche Aktivität bei Patienten mit Rückenschmerz. *Zeitschrift für Sportpsychologie*, 14, 29-43.

Lin, E. H. B., Katon, W., Von Korff, M., Rutter, C., Simon, G. E., Oliver, M., Ciechanowski, P., Ludman, E. J., Bush, T., & Young, B. (2004). Relationship of depression and diabetes self-care, medication adherence, and preventive care. *Diabetes Care*, 27, 2154-2160.

Liu, C., Xie, B., Chou, C.-P., Koprowski, C., Zhou, D., Palmer, P., & Sun, P. (2007). Perceived stress, depression and food consumption frequency in the college students of China seven cities. *Physiology & Behavior*, 92, 748-754.

Lewis, M. A. & Butterfield, R. M. (2007). Social control in marital relationships: Effect of one's partner on health behaviors. *Journal of Applied Social Psychology*, 37, 298-319.

MacLeod, A.K., Tata, P., Kentish, J., & Jacobsen, H. (1997). Retrospective and prospective cognitions in anxiety and depression. *Cognition & Emotion*, 11, 467-479.

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychology & Health*, 26, 1479-1498.

Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V., & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: Results from the World Health Surveys. *The Lancet*, 370, 851-858.

Oaten, M., & Cheng, K. (2005). Academic examination stress impairs self-control. *Journal of Social and Clinical Psychology*, 24, 254-279.

Oswald, M.E., & Grosjean S. (2004). Confirmation Bias. In R.F. Pohl (Ed), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory* (pp. 79-96). Hove, UK: Psychology Press.

Ottowitz, W. E., Dougherty, D. D., & Savage, C. R. (2002). The neural network basis for abnormalities of attention and executive function in major depressive disorder: implications for application of the medical disease model to psychiatric disorders. *Harvard Review of Psychiatry*, 10, 86-99.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40, 879-891.

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42, 185-227.

Proudfoot, J.G. (2004). Computer-based treatment for anxiety and depression: Is it feasible? Is it effective? *Neuroscience Biobehavioral Review*, 28, 353–363

Radloff, L.S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychology Measures.* 1, 385-401.

Rothman, A. J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology*, 19, 64-69.

Ruby, M. B., Dunn, E. W., Perrino, A., Gillis, R., & Viel, S. (2011). The invisible benefits of exercise. *Health Psychology*, 30, 67-74.

Schneider, W.X. (2006). Action control and its failure in clinical depression: A neurocognitive theory. In N. Sebanz (Ed) & W. Prinz, *Disorders of volition* (pp. 275-306). Cambridge: MIT Press.

Scholz, U., Knoll, N., Sniehotta, F. F., & Schwarzer, R. (2006). Physical activity and depressive symptoms in cardiac rehabilitation: Long-term effects of a self-management intervention. *Social Science & Medicine*, 62, 3109-3120.

Schüz, B., Sniehotta, F. F., & Schwarzer, R. (2007). Stage-specific effects of an action control intervention on dental flossing. *Health Education Research*, 22, 332-341.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: An International Review*, 57, 1-29.

Schwarzer, R. (2011). Health behavior change. In H.S. Friedman (Ed.), *Oxford handbook of health psychology* (pp.591-611). New York: Oxford University Press.

Schwarzer R., & Knoll, N. (2007). Functional roles of social support within the stress and coping process: a theoretical and empirical overview. *International Journal of Psychology*, 42, 243–252. doi:10.1080/00207590701396641

Seime, R.J. &Vickers, K.S. (2006). The challenges of treating depression with exercise: from evidence to practice. *Clinical Psychology: Science and Practice*, 13,194-7

Skorski, C., Luppa, M., Kersting, A., König, H.-H., & Riedel-Heller, S.G. (2010). Effektivität computer- und internetgestützter kognitiver Verhaltenstherapie bei Depression - Ein systematischer Literaturüberblick. *Psychiatrische Praxis*, 37, 1-8.

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention-behavior-gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, *20*, 143-160.

Sniehotta, F. F., Scholz, U., Schwarzer, R., Fuhrmann, B., Kiwus, U., & Völler, H. (2005). Long-term effects of two psychological interventions on physical exercise and self-regulation following coronary rehabilitation. *International Journal of Behavioral Medicine*, 12, 244-255.

Spek, V., Cuijpers, P., Nyklicek, I., Riper, H., Keyzer, J., & Pop, V. (2007). Internet-based cognitive behaviour therapy for symptoms of depression and anxiety: A meta-analysis.

*Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences*, 37, 319-328.

Stevens, M., Lemmink, K, A., van Heuvelen, M. J., de Jong, J., & Rispens, P. (2003). Groningen Active Living Model (GALM): Stimulating physical activity in sedentary older adults; validation of the behavioral change models. *Preventive Medicine: An International Journal Devoted to Practice and Theory,* 37, 561-570.

Stordal, K. I., Lundervold, A.J., Egeland, J., Mykletun, A., Asbjornsen, A., Landro¸, N. I., Roness, A., Rund, B. R., Sundet, K., Oedegaard, K. J., &Lund, A.( 2004). Impairment across executive functions in recurrent major depression. *Nordic Journal of Psychiatry*, 58, 41-47.

Strine, T.W., Mokdad, A.H., Dube, S.R., Balluz, L.S., Gonzalez, O., Berry, J.T., Manderscheid, R., Kroenke, K. (2008). The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *General Hospital Psychiatry*, 30, 127-137.

Suija, K., Pechter, A., Kalda, R., Tähepöld, H., Maaroos, J., & Maaroos, H. (2009). Physical activity of depressed patients and their motivation to exercise: Nordic walking in family practice. *International Journal of Rehabilitation Research*, 32, 132-138.

Taraldsen, K., Chastin, S.F., Riphagen, I.I., Vereijken, B., & Helbostad, J.L. (2012). Physical activity monitoring by use of accelerometer-based body-worn sensors in older adults: a systematic literature review of current knowledge and applications. *Maturitas*, 71, 13-9.

Tice, D. M., & Bratslavsky E. (2000). Giving in to feel good: The place of emotion regulation in the context of general self-control. *Psychological Inquiry*, 11, 149-159.

Tice, D.M., Bratslavsky, E., & Baumeister, R. F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it! *Journal of Personality and Social Psychology*, 80, 53-67.

Verger, P., Lions, C., & Ventelou, B. (2009). Is depression associated with health risk-related behaviour clusters in adults? *European Journal of Public Health*, 19, 618-624.

Vickers, K. S., Nies, M. A., Patten, C. A., Dierkhising, R., & Smith, S. A. (2006). Patients with diabetes and depression may need additional support for exercise. *American Journal of Health Behavior*, 30, 353-362.

Wagner, S.C., Kraemer, L., Langgut, N., Gawrilow, C.& Stadler, G. (2011). Effects of depression on anticipated barriers to physical activity: A daily diary study. *Psychology & Health*, 26 sup2, 235-236.

Weinstein, A., Deuster, P., Francis, J., Beadling, C., & Kop, W. (2010). The role of depression in short-term mood and fatigue responses to acute exercise. *International Journal of Behavioral Medicine*, 17, 51-57.

Wells, K.B., Stewart, A., Hays, Ron D., Burnam, M. A., Rogers, W., Daniels, M., Berry, S.. Greenfield, S., & Ware, J. (1989). The functioning and well-being of depressed patients. *JAMA: The Journal of the American Medical Association*, 262, 914-919.

World Health Organization (2012). *Depression*. Retrieved from: http://www.who.int/mental_health/management/depression/definition/en/

Wiedemann, A. U., Lippke, S., Reuter, T., Ziegelmann, J. P., & Schüz, B. (2011). The more the better? The number of plans predicts health behaviour change. *Applied Psychology: Health and Well-Being*, 3, 87-106.

Williams, D. M., Lewis, B. A., Dunsiger, S., Whiteley, J. A., Papandonatos, G. D., Napolitano, M.A., Bock, B. C., Ciccolo, J. T., & Marcus, B.H. (2008). Comparing psychosocial predictors of physical activity adoption and maintenance. *Annals of Behavioral Medicine*, 36, 186-194.

Woo, J., Lynn, H., Lau, W.Y., Leung, J., Lau, E., Wong, S.Y.S., & Kwok, T. (2006). Nutrient intake and psychological health in an elderly Chinese population. *International Journal of Geriatric Psychiatry*, 21, 1036-1043.

Yang, Y. K., McEvoy, J.P., Wilson, W. H., Levin, E. D., & Rose, J. E. (2003). Reliabilities and intercorrelations of reported and objective measures of smoking in patients with schizophrenia. *Schizophrenia Research*, 60, 9-12.

Ziegelstein, R.C., Fauerbach, J. A., Stevens, S. S., Romanelli, J., Richter, D. P., & Bush, D. E. (2000). Patients with depression are less likely to follow recommendations to reduce cardiac risk during recovery from a myocardial infarction. *Archives of Internal Medicine*, 160, 1818-1823

# Curriculum Vitae

**Sarah Pomp**

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

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# List of Publications

**ARTICLES IN PEER-REVIEWED JOURNALS**

(* indicates those articles are part of the thesis)

*In press*

*Pomp, S., Fleig, L., Schwarzer, R., & S. Lippke (in press). Depressive symptoms interfere with post-rehabilitation exercise: Outcome expectancies and experience as mediators. *Psychology, Health & Medicine.*

*2010-2011*

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Exercise maintenance after rehabilitation: How experience can make a difference. *Psychology of Sport & Exercise, 12*, 293-299.

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Intervention effects of exercise selfregulation on physical exercise and eating fruits and vegetables: A longitudinal study in orthopedic and cardiac rehabilitation. *Preventive Medicine, 53*(3), 182-187.

Lippke, S., Fleig, L., Pomp, S., & Schwarzer, R. (2010). Validity of a stage algorithm for physical activity in participants recruited from orthopedic and cardiac rehabilitation clinics. *Rehabilitation Psychology, 55(*4), 398-408.

*Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Synergistic effects of intention and depression on action control: Longitudinal predictors of exercise after rehabilitation. *Mental Health and Physical Activity, 2*, 78-84.

*Under Review*

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2012). Telephone-delivered booster sessions help maintain self-regulation: A long-term follow-up in medical rehabilitation. Manuscript submitted for publication.

Fleig, L., Lippke, S., Pomp, S., Parschau, L., Koring, M., Lange, D., & Schwarzer, R. (2012). Beyond goal intentions: Processes of habit formation in the exercise domain. Manuscript submitted for publication.

*Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2012): The effect of a self-regulation intervention on physical exercise is moderated by depressive symptoms: A study in orthopedic rehabilitation. Manuscript submitted for publication.

*Pomp, S., Keller, S., & Maddock, J. (2012): Associations of depressive symptoms and health indicators in Hawai'i. A population study. Manuscript submitted for publication.

**BOOK CHAPTER**

Lippke, S., Fleig, L., Pomp, S., & Schwarzer, R. (2010). Soziale Unterstützung und die Aufrechterhaltung von Reha-Erfolgen. In Arbeitskreis Klinische Psychologie in der Rehabilitation BDP (Hrsg.). *Trends in der Medizinischen Rehabilitation* (pp. 27-39). Bonn: Deutscher Psychologen Verlag.

**MISCELLANEOUS**

Reese, C., Mittag, O., Bengel, J., Deck, R., Ehlebracht-König, I., Faller, H., Fleig, L., Geigges, W., Glombiewski, J., Grande, G., Hautzinger, M., Höder, J., Jäckel, W.H., Kortenhaus, H., Lüking, M., Mai, B., Niebling,W., Pfingsten, M., Pomp, S., Rink, M., Schmucker, D., Wörner, S. & Worringen, U. (2012a). *Praxisempfehlungen für psychologische Interventionen in der Rehabilitation: Chronische Rückenschmerzen.* [Practical guidelines for psychological interventions in rehabilitation: chronic back pain]. Retrieved from http://www.uniklinik-freiburg.de/aqms/live/Praxisempfehlungen/Orthopaedie.pdf

Reese, C., Mittag, O., Bengel, J., Deck, R., Ehlebracht-König, I., Faller, H., Fleig, L., Geigges, W., Glombiewski, J., Grande, G., Hautzinger, M., Höder, J., Jäckel, W.H., Kortenhaus, H., Lüking, M., Mai, B., Niebling,W., Pfingsten, M., Pomp, S., Rink, M., Schmucker, D., Wörner, S. & Worringen, U. (2012b). *Praxisempfehlungen für psychologische Interventionen in der Rehabilitation: Koronare Herzerkrankung.* [Practical guidelines for psychological interventions in rehabilitation: coronary heart disease]. Retrieved from http://www.uniklinik-freiburg.de/aqms/live/Praxisempfehlungen/Kardiologie.pdf

**PRESENTATIONS**

Pomp, S., Fleig, L., Schwarzer, R., Pimmer, V., & Lippke, S. (2012). Wirksamkeit einer Selbstregulationsintervention zur Förderung von körperlicher Aktivität bei orthopädischen Rehabilitanden mit und ohne depressive Symptome, Präsentation, 21. Reha-Wissenschaftlichen Kolloqium, 5.-7. März 2012, Hamburg, Deutschland.

Pomp, S. (2011). The Health Action Process Approach. Theory and Practice, eingeladener Gastvortrag, Januar 2011, University of Manoa, Department of Public Health, Honolulu, USA.

Pomp, S. (2011). Engaging in Physical Exercise when Suffering from Depressive Symptoms: Mediation- and Moderationanalyses, eingeladener Gastvortrag, März 2011, Maastricht University, Faculty of Health, Medicine and Life Sciences/ Health Promotion, Maastricht, Niederlande.

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Depressive Symptome hemmen selbstregulative Strategien zur Ausübung von körperliche Aktivität nach der Rehabilitation, Präsentation, 20. Rehabilitationswissenschaftliches Kolloquium, 14.-16. März, Bochum, Deutschland.

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Depressive Symptome und körperliche Aktivität nach einer Rehabilitation – Zusammenhänge und Mechanismen, Präsentation, 10. Fachgruppen-Kongress für Gesundheitspsychologie, Berlin, Deutschland.

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Why do depressive symptoms interfere with exercise behavior? The mediating role of positive outcome expectancies and positive exercise experiences, 32nd International Conference of the Stress and Anxiety Research Society, 18.-20. Juli, Münster, Deutschland.

Pomp, S., Fleig, L., & Lippke, S. (2010). The effect of depression on social-cognitive variables relevant for adoption and maintenance of physical activity in rehabilitation patients (2010). Präsentation, Annual Conference of the European Health Psychology Society, 1.-4. September, Cluj, Romänien.

Pomp, S., Lippke, S., Fleig, L., & Schwarzer, R. (2010). Welchen Einfluss haben depressive Symptome auf selbstregulative Prozesse zur Ausübung von körperlicher Aktivität nach der Reha? Präsentation auf der 30. Jahrestagung Klinische Psychologie in der Rehabilitation, 14.-16. Oktober, Erkner, Deutschland.

Pomp, S. & Lippke, S. (2009). Objektiver Gesundheitszustand und sozial-kognitive Prädiktoren im Prozess der Gesundheitsverhaltensänderung am Beispiel von körperlicher

Aktivität, Präsentation, 9. Fachgruppenkonferenz für Gesundheitspsychologie, 26.-28. August, Zürich, Schweiz.

Pomp, S., Lippke, S., & Wiedemann, A. (2009). Social-cognitive variables and a person‘s cardiovascular risk factors as predictors in the process of health behaviour change, Annual Conference of the European Health Psychology Society, 23.-26. September, Pisa, Italien.

# Erklärung

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

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Sarah Pomp

Berlin, April 2012