Doctoral thesis submitted to
the Faculty of Behavioural and Cultural Studies
Heidelberg University
in partial fulfillment of the requirements of the degree of
Doctor of Philosophy (Dr. phil.)
in psychology

Title of the publication-based thesis

The role of social influences and cognitive self-regulation in supporting cancer patients to engage in physical activity

presented by
Nadine Ungar

year of submission
2015

Dean: Prof. Dr. Klaus Fiedler
Advisor: Prof. Dr. Monika Sieverding

Contents

List of scientific manuscripts for the publication-based dissertation

I. Manuscript

Ungar, N., Sieverding, M., Ulrich, C. M., & Wiskemann, J. (2015). What explains the intention to be physically active in cancer patients? Different determinants for active and insufficiently active patients. *Journal of Psychosocial Oncology, 33*(1), 15-33.

II. Manuscript

Ungar, N., Sieverding, M., Weißmann, M., Knoll, A., Steindorf, K., & Wiskemann, J. (submitted). Social support, social control and reactance – exercise behavior of cancer patients and the role of their relatives. *Journal of Applied Social Psychology*.

III. Manuscript

Ungar, N., Sieverding, M., Weidner, G., Ulrich, C. M., & Wiskemann, J. (under review). A self-regulation-based intervention to increase physical activity in cancer patients. *Psychology, Health & Medicine (Special Issue „Self-regulation in the context of health and illness").*

Acknowledgements

I am grateful for all the support I received from so many people to complete this thesis. In the first place, I would like to express my gratitude to Prof. Monika Sieverding being a great supervisor. I want to thank her for her excellent guidance, for supporting me in any situation, giving me the freedom to work autonomously and providing me with an excellent atmosphere for doing research. I learned very much from her and she has been a living role model to me (after writing this thesis I know the importance of role models).

My special words of thanks go to Prof. Gerdi Weidner for sharing her knowledge and expertise, correcting my writing and her big engagement in supporting me. I am thankful for having Dr. Joachim Wiskemann as an advisor at the National Center for Tumor Diseases (NCT). He initiated the cooperation between the Psychological Institute and the NCT and thus set the foundations of this thesis. He always took his time to discuss problems, gave me valuable practical advice, helped me to get around in the “hospital jungle” and encouraged me in any situation.

I especially want to thank the Ernst Ludwig Ehrlich Studienwerk (ELES) for its financial and idealistic support. I could not have completed this thesis without a dissertation scholarship, awarded to me by ELES for four years. Additionally, I would like to take the opportunity to thank all the patients who took part in this study.

I want to thank Laura Schmidt for proofreading the thesis and sharing her ideas. During the years of my study and my dissertation (which is altogether more than 10 years now) Laura stood always by my side. I want to thank her for supporting me whenever possible – not only as a colleague but as a great friend! I also want to thank Stefan Jooß and Alexander Haussmann for proofreading my thesis. My thanks also got to Fabian Scheiter, as my dissertation was inspired through our interesting conversations.

I want to thank all interns (Stefan Jooß, Regina Sticker, Sabine Tosic, Annika Knoll, Natalie Röhm, Jennifer Zähringer, Michaeler Kammler and Annika Roth) who supported me in conducting the MOTIVACTION-Project, they were an enormous help for me. Particularly, I want to thank Mareike Weißmann and Annika Knoll, who wrote their bachelor thesis within this project, for their big engagement in conducting the second study of this thesis.

I would like to acknowledge Prof. Ralf Schwarzer and Prof. Nina Knoll for their invitation to their colloquium at the FU Berlin and their advice regarding the development of the study.

Especially, I want to thank my family for their endless support through my whole life. Thank you for showing faith in me and supporting me to choose the way that I considered right for me.

Finally yet importantly, I want to thank Florian Herbolsheimer spending countless hours listening to me talk about my research, proofreading all parts of the dissertation (several times) and taking care of everything when I needed time to write. I consider myself the luckiest person in the world to have such a supportive partner, standing behind me. I am deeply grateful to live with him and our son Finn.

Abstract

Cancer patients are recommended to engage in regular physical activity, as research has identified various beneficial effects of exercise both during and after medical treatment (Schmitz et al., 2010; Speck, Courneya, Mâsse, Duval, & Schmitz, 2010). Most cancer patients are motivated to adopt a healthy lifestyle including regular physical activity (Demark-Wahnefried, Aziz, Rowland, & Pinto, 2005). However, it has been shown that only a minority of cancer patients meet the exercise guidelines (Blanchard, Courneya, & Stein, 2008).

This thesis aims to (1) determine factors that explain the (low) level of physical activity among cancer patients and (2) help cancer patients to increase their exercise level. Thereby, the first focus of this thesis was placed on cognitive self-regulation examined within the frameworks of the Theory of Planned Behavior (Ajzen, 1991) and the Health Action Process Approach (Schwarzer, 2001, 2008). Self-regulation is assumed to be a relevant factor to adopt and maintain health-enhancing behaviors by bridging the gap between intention and behavior (De Ridder & De Wit, 2006; Schwarzer, 2008).

Besides these patient centric self-regulatory factors, social influences have consistently been found to be important predictors of physical activity among cancer patients (e.g. Barber, 2012). This thesis adds to previous research by (1) including the perspective of a family member, (2) examining the distinction between social support, social control and its relations to reactance, and (3) incorporating role model support in an intervention study.

This publication based dissertation comprises three manuscripts, which present results of three different studies. All are part of the MOTIVACTION-project (MOTivational InterVention enhancing physical ACTivity In ONcological patients) and were designed successively to build on each other's results.

The first study applied the Theory of Planned Behavior in a qualitative and a quantitative cross-sectional design. The aim of this study was to elicit a broad spectrum of attitudes – especially negative ones – and to compare already physically active and insufficiently active patients within the framework of the Theory of Planned Behavior. Attitude turned out to be a relevant predictor of the intention to exercise for insufficiently active patients, whereas social influences were especially important to maintain an active lifestyle. Additionally, self-efficacy discriminated best between active and insufficiently active patients.

The second study was a longitudinal study among patients and their family members. Through this design, the relation between perceived and relative-reported social support and

control could be determined (moderate associations occurred). Gender differences revealed that female patients perceived and received less support and control by their relatives. Furthermore, reactance might especially impede male patients to build up a physically active lifestyle. Relative-reported social support was the only significant predictor of physical activity at follow-up.

Finally, the third study was a behavior change intervention designed as a randomized controlled trial. It compared an exercise intervention focusing on self-regulation strategies from the Health Action Process Approach and role model support with stress management training. The exercise intervention was able to increase the physical activity level especially among patients who realized contact with a role model. Thus, the combination of self-regulation and social influence turned out to be most effective.

All in all, this thesis provides encouraging results that cognitive self-regulation and social influences can explain and increase the physical activity level of cancer patients.

1. Introduction

"Rest as much as possible and save your energy for the cancer treatment!" Recommendations like this one were made by many physicians up until the mid-1990s (Dimeo, 2010). Patients were advised to restrict their physical activity to a minimum. They were also told to rest six months after chemo-therapy (Baumann, 2008), due to concerns about physical activity weakening the immune system, reducing the effects of chemo-therapy, and increasing the risk for tumor growth and metastases (Baumann et al., 2012). During the last two decades, however, this picture has shifted somewhat, as research has started to focus on the benefits of lifestyle changes among cancer patients (Banzer, 2014; Cordella & Poiani, 2014; Demark-Wahnefried et al., 2005). Many interdisciplinary studies have been conducted showing the benefits of physical activity on health outcomes and quality of life during cancer treatment (e.g. Speck et al., 2010 and section 2.1). A wide range of research areas were involved including, among others, medicine, exercise science, public health, psycho-oncology and epidemiology. Based on this research, contrasting recommenddations regarding physical activity have been formulated (Banzer, 2014): cancer patients should be as active as possible, not only for cancer prevention or during rehabilitation but especially during cancer treatment. The guidelines for cancer patients of the American College of Sports Medicine recommend at least 150 minutes of moderate physical activity per week (Schmitz et al., 2010).

A cancer diagnosis has been described as a *teachable moment* for behavior change (Demark-Wahnefried et al., 2005). A teachable moment refers to the fact that naturally occurring health events can motivate individuals to spontaneously adopt risk-reducing health behaviors (McBride, Emmons, & Lipkus, 2003). It has been shown that the vast majority of cancer patients are motivated to engage in regular physical activity after cancer diagnosis (Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000). Nevertheless, only about a third of all cancer patients exercise according to the guidelines (Bellizzi, Rowland, Jeffery, & McNeel, 2005). Looking at this contrast, two important health psychological questions arise and are the leading questions of this dissertation: Why are most cancer patients not sufficiently physically active? And how can they be supported to increase their physical activity? A variety of factors – within psychology and from other fields – can be important for answering these questions. Two promising concepts were chosen as a recurrent theme of this thesis: cognitive self-regulation and social influences on behavior change.

Self-regulation can be defined as "an umbrella term used to describe the various processes by which people pursue and attain goals" (Mann, de Ridder, & Fujita, 2013, p.

488). Furthermore, “Self-regulation theorists agree upon the major distinction of self-regulation into two broad components that capture the numerous cognitive, emotional, and behavioral challenges that must be resolved in goal pursuit: goal setting and goal striving” (Mann et al., 2013, p. 488). In health psychology, self-regulation plays a crucial role as there is often a substantial discrepancy between individuals’ health goals and their frequent failure to act upon these goals, and self-regulation is needed to reduce this discrepancy (De Ridder & De Wit, 2006; Hagger, 2010; Mann et al., 2013). To study cognitive factors of self-regulation the theoretical background of the Health Action Process Approach (HAPA; Schwarzer, 2001, 2008) and the Theory of Planned Behavior (TPB; Ajzen, 1991) were chosen. The HAPA model, which especially focuses on goal pursuing being a core component of self-regulation, has not been used to study exercise behavior of cancer patients so far.

Social influences have been consistently identified as important predictors of physical activity across different populations (e.g. Anderson-Bill, Winett, & Wojcik, 2011; Bauman et al., 2012; Fraser & Rodgers, 2012; Khan, Stephens, Franks, Rook, & Salem, 2013; Van Dyck et al., 2011). In the oncological context, a meta-analysis by Barber (2012) has revealed that social support is a significant predictor of physical activity in most of the studies. Nevertheless, some important issues have not been addressed in the physical activity and cancer domain: a focus on subjective norm (being a part of the TPB), e.g. by including multiple sources like the perceived opinion of the physician (study 1), the distinction between social support and social control and its relations to reactance (study 2), the integration of family members in the study to explore their perspective on social support (also study 2) and the inclusion of exercise role model support in a behavior change intervention (study 3).

The general background of this thesis (chapter 2) will provide theoretical insights and a review of empirical findings regarding physical activity and cancer (section 2.1), self-regulation and behavior change (2.2 section), and social influences (section 2.3). Such information will result in the identification of gaps among previous studies and help to describe research questions (section 2.4). Afterwards, the design and general methods of the MOTIVACTION-study are described in chapter 3. The three manuscripts of this publication-based dissertation are presented in the following chapters (chapter 4 to 6). The thesis closes with a general discussion addressing common issues of all three publications (chapter 7). This includes the challenge of adequate assessment of physical activity, the interplay between self-regulation and social influences, and practical implementations of role model support in the hospital routine.

2. General background

A female participant of the MOTIVACTION intervention reported the following after being physically active for the first time after diagnosis:

> „*Man kriegt wieder Lust und lässt sich nicht so hängen. Dann lümmle ich nicht so auf dem Sofa rum, sondern Sport durchbricht die Schranke. Du bist einfach ein anderer Mensch wenn du läufst. Dann denke ich nicht mehr an den ganzen Mist. Man hat Ansporn und schafft wieder was.*“ [Translated: “You feel the desire to be active again instead of hanging around. As a result I don’t sit on the sofa, and it is exercise which helps to break this cycle. You are just a different person when you are running. In doing so I don’t think about that whole mess. You gain back motivation and the ability to do things.”]

Empirical results regarding the beneficial effects of engaging in regular physical activity during cancer treatment are described in the following section. Afterwards the topics of behavior change and self-regulation (section 2.2) as well as social influences (section 2.3) are addressed.

2.1 Physical activity and cancer

There have been major scientific advances in the field of physical activity and cancer during the last 15 years. A review by Courneya and Friedenreich (2007) points out that physical activity plays an important role across the entire course of the disease by presenting a Physical Activity and Cancer Control (PACG) framework. This framework was formerly called and is still known as PEACE framework (Physical Exercise Across the Cancer Experience; Courneya & Friedenreich, 2001). It illustrates that (1) pre diagnosis physical activity can help to prevent the disease, (2) diagnosed patients can prepare for the treatment using physical activity, (3) during treatment physical activity can help to cope with the disease or treatment-related side effects, (4) in rehabilitation physical activity can be used to recover from the disease or from treatment-related side effects and (5) during the survivorship-phase physical activity can help again for disease prevention and health promotion.

In some cancer control categories (e.g. prevention), physical activity is already quite established (Friedenreich, Neilson, & Lynch, 2010) whereas research and practical implementation of physical activity during actual cancer treatment is relatively new (Bauman, Zopf,

Elter, 2012). The last mentioned cancer control category is the focus of this thesis, and evidence for the benefits of physical activity during treatment is summarized in the following.

Current reviews and meta-analyses demonstrate various beneficial effects of physical activity for cancer patients during medical treatment (Courneya & Friedenreich, 2011; Fong et al., 2012; Jones & Alfano, 2012; Mishra et al., 2012; Speck et al., 2010). A systematic review and meta-analysis by Speck et al. (2010) included 82 intervention studies (90% randomized controlled trials) among cancer patients. For studies during active treatment (40%, *n* = 33), the meta-analysis found small to moderate positive effects for physical activity level, aerobic fitness, muscular strength, body weight and body fat percentage, quality of life, positive mood, anxiety and self-esteem. However, it has to be noticed that the vast majority of studies (83%) were conducted solely among breast cancer patients. This pertains to generalizability for the whole cancer spectrum.

There are further reviews and meta-analyses reporting on specific effects of physical activity. It could be shown that physical activity has a beneficial impact on health-related quality of life (Mishra et al., 2012), cancer-related fatigue (Cramp & Daniel, 2008), depression (Craft, VanIterson, Helenowski, Rademaker, & Courneya, 2012), aerobic fitness (Jones et al., 2011) and muscle strength (Stene et al., 2013; Strasser, Steindorf, Wiskemann, & Ulrich, 2013). The review and meta-analysis by Mishra et al. (2012) reported that the effects were more pronounced for exercise programs with moderate-to vigorous intensity compared to mild exercise.

Jones and Alfano (2012) applied the above described PEACE framework in a review and came to the following conclusion: “Data from published studies provides relatively strong evidence that exercise therapy is a well-tolerated and safe adjunct therapy that can mitigate several common treatment-related side effects among cancer patients across the PEACE framework” (Jones & Alfano, 2012, p. 1)

There are first insights that physical activity might be associated with a higher survival rate (Ballard-Barbash et al.; Schmid & Leitzmann, 2014). A review and random effects meta-analysis by Schmid and Leitzmann (2014) included prospective studies among breast and colorectal cancer patients. They found that pre and post diagnosis physical activity is related to a reduced mortality risk for both cancer entities. An increase of physical activity after diagnosis equivalent to the recommendation of 150 minutes/week was associated with 24%/28% (breast/colorectal cancer) reduced risk of total mortality. There were only very few studies examining this association in cancer types other than breast and colorectal cancer (e.g. among patients with prostate cancer by Kenfield, Stampfer, Giovannucci, & Chan, 2011). Furthermore, caution is advised in over interpreting these results, as the link between

physical activity and survival has been investigated in correlational and not experimental studies. A reversed causality – healthier cancer patients are able to engage more in physical activity – is also imaginable. Recently, the first two studies provided randomized data on disease-free survival (Courneya, Friedenreich, et al., 2015; Courneya et al., 2014). These exploratory follow-ups provide first evidence that physical activity may be causally related to increased survival.

To assemble research results in the field of exercise and cancer, the American College of Sports Medicine organized a "Roundtable on exercise guidelines for cancer survivors"[1] (Schmitz et al., 2010). In general aerobic exercise, resistance-training and flexibility training are evaluated as safe and advisable. Guidelines were developed recommending moderate physical activity for at least 150 minutes per week.

Looking at the actual behavior of cancer patients, only about one third meet the exercise guidelines (Bellizzi et al., 2005; Blanchard et al., 2008; Coups & Ostroff, 2005). This percentage is lower for patients during actual treatment (5-10% according to Courneya, Karvinen, & Vallance, 2007) and prevalence rates vary by age groups (Coups & Ostroff, 2005). Furthermore, research has shown that exercise levels decline after cancer diagnosis (Courneya & Friedenreich, 1998; Huy, Schmidt, Vrieling, Chang-Claude, & Steindorf, 2012). Measuring physical activity objectively via accelerometer among breast cancer patients yielded a further decline of physical activity still in the first year following cancer treatment (Sabiston, Brunet, Vallance, & Meterissian, 2014).

To summarize the state of research regarding physical activity and cancer, this section closes with a quotation from Courneya and Friedenreich (2011, p. 1):

> *"Overall, the research to date suggests that physical activity reduces the risk of developing some cancers, helps cancer survivors cope with and recover from treatments, improves the long-term health of cancer survivors, and possibly even reduces the risk of recurrence and extends survival in some cancer survivor groups."*

2.2. Behavior-change and self-regulation

Exercise recommendation and actual behavior among cancer patients often diverge considerably (see last section 2.1). Previous research has shown that most cancer patients are highly motivated to engage in regular physical activity and a cancer diagnosis has been

[1] The term *cancer survivor* refers to "from the time of diagnosis until the end of life" (National Coalition for Cancer Survivorship, 2015).

described as a *teachable moment* for behavior change (Demark-Wahnefried et al., 2005). Self-regulation processes – the first focus of this thesis – are assumed to reduce this discrepancy between intention and behavior (De Ridder & De Wit, 2006; Schwarzer, 2008).

Behavior change studies are necessary to fill this gap between motivation and actual exercie. Research has shown that they are more effective when they are theory-based (e.g. Michie & Prestwich, 2010; Noar & Zimmerman, 2005; Webb, Joseph, Yardley, & Michie, 2010). In general, all classic social cognitive theories examining health behavior change can be regarded as rudimentary self-regulation theories (De Ridder & De Wit, 2006). The TPB developed by Icek Ajzen (1991) has been chosen as the theoretical background in the first manuscript. Ajzen himself describes the theory as "a theoretical model […] in which cognitive self-regulation plays an important part" (Ajzen, 1991, p. 180). As the results of the first study highlighted the special role of self-efficacy, the HAPA (Schwarzer, 2001, 2008) was chosen as the theoretical background for the intervention study. The HAPA has a stronger focus on self-regulation than the TPB as it especially focuses on goal pursuit by assuming self-regulatory strategies to fill the gap between intention and behavior.

This section first describes the two social cognitive theories – the TPB and HAPA – used to explain and modify the exercise behavior of cancer patients. Afterwards the literature is reviewed regarding previous cross-sectional studies and behavior change interventions in the domain of exercise and oncology with a focus on the TPB and HAPA.

Description of the theories – Theory of Planned Behavior and Health Action Process Approach

The TPB is originally a social psychological theory. The theory aims to explain behavior based on different continuous factors. According to the theory, the most proximal determinant of actual behavior is behavioral intention capturing motivational factors. Intention itself is predicted by attitudes, perceived behavioral control and subjective norm. Attitudes are positive or negative evaluations of the behavior, and the literature distinguishes between an instrumental and an affective component (Crites, Fabrigar, & Petty, 1994). Perceived behavioral control is an evaluation of a person if he or she can control the behavior. It can be used interchangeably with self-efficacy (Ajzen, 2002). Subjective norm is the perceived influence whether important others believe one should perform a behavior. In most research, descriptive norm – the perception of what is typically done in a given setting (Reno, Cialdini, & Kallgren, 1993) – is included as an additional predictor of intention (Rivis & Sheeran, 2003).

Meta-analyses show that about 30% of behavior can be explained by intention in general as well as specifically in health behavior (Armitage & Conner, 2001; McEachan, Conner, Taylor, & Lawton, 2011). Downs and Hausenblas (2005) conducted a meta-analyses of studies applying the TPB and the Theory of Reasoned Action (the predecessor model of the TPB) in the field of physical activity. In line with TPB research regarding other health behaviors, intention and perceived behavioral control accounted for 21% of the variance in exercise behavior.

In contrast to the TPB, the HAPA offers a distinction between a motivation phase and a volition phase (see Schwarzer, 2008 for a description of the theory). In the first phase, preintentional motivation processes lead to a behavioral intention, whereas in the second phase, postintentional volition processes lead to the actual behavior. This distinction is typical to stage theories assuming that in different stages different variables are relevant. In the motivation phase, outcome expectancies and risk perception are important for forming an intention. In the volition phase – the focus of the HAPA – self-regulation strategies are assumed to be relevant for translating the intention into action. The two main self-regulation strategies are action planning and coping planning. Action planning refers to forming concrete implementation intention on when, where, how and with whom the behavior should be performed. Coping planning, on the other hand, means anticipating potential barriers and formulating detailed plans on how to cope with them when they emerge. A core construct in the HAPA model is self-efficacy, which is generally regarded as a key factor of self-regulation (Cervone, Mor, Orom, Shadel, & Scott, 2004; De Ridder & De Wit, 2006). The HAPA distinguishes between three types of self-efficacy as they are assumed to be phase-specific. For forming an intention task, self-efficacy is important. Maintenance self-efficacy – assumed to predict behavior and being a part of the volition phase – is the evaluation of a person regarding whether he or she can deal with barriers that could arise. Lastly, recovery self-efficacy addresses how people evaluate lapses find ways to control the violation of abstinence, and restore hope.

The HAPA self-regulation framework has been applied for a variety of health behaviors and for diverse samples from mixed cultures (Schwarzer, 2008). It has been shown that the HAPA model is a useful framework for examining the mechanisms of health behavior change (including physical activity) for persons with chronic diseases and disabilities (see the overview by Schwarzer, Lippke, & Luszczynska, 2011).

In sum, both theories provide a useful framework for investigating health behavior change. Whereas the TPB is a classical social cognitive theory which has wildly been applied

in international research in different fields (Armitage & Conner, 2001; McEachan et al., 2011), the HAPA is a more recent theory focusing explicitly on self-regulation strategies.

Cross-sectional studies explaining exercise behavior in cancer patients

Cross-sectional studies aiming to identify relevant psychosocial and behavioral factors to explain cancer patients' physical activity have applied a variety of theoretical frameworks (see Pinto & Ciccolo, 2011 for an overview). The social cognitive models range from the Transtheoretical Model (Prochaska & DiClemente, 1983), Social Cognitive Theory (Bandura, 1977, 1986) and Self-Determination Theory (Ryan & Deci, 2000). The most widely used framework is the TPB. Cross-sectional studies applying the TPB have been conducted among patients with breast cancer (Blanchard, Courneya, Rodgers, & Murnaghan, 2002; Hunt-Shanks et al., 2006), colorectal cancer (Packel, Prehn, Anderson, & Fisher, in press; Speed-Andrews et al., 2012), prostate cancer (Blanchard et al., 2002; Hunt-Shanks et al., 2006), ovarian cancer (Stevinson, Capstick, et al., 2009), brain tumor (Jones et al., 2007) and other cancer types like bladder cancer, kidney cancer, endometrial cancer or multiple myeloma (Jones et al., 2006; Karvinen et al., 2007; Karvinen et al., 2009; Keats, Culos-Reed, Courneya, & McBride, 2007; Trinh, Plotnikoff, Rhodes, North, & Courneya, 2012). One additional study is based on the TPB framework to explain palliative cancer patients' physical activity (Lowe, Watanabe, Baracos, & Courneya, 2012). Thus, there is already a big body of research applying the TPB to explaining the exercise behavior of cancer patients. The criticism that most research on physical activity is only conducted among the most common cancer types (review by Courneya, Rogers, Campbell, Vallance, & Friedenreich, 2015), does not apply to cross-sectional TPB studies.

Attitudes, self-efficacy and subjective norm could explain between 30 and 70% of the variance in behavioral intentions to exercise regularly across different cancer types (e.g. Jones et al., 2007; Karvinen et al., 2009; Keats et al., 2007; Stevinson, Tonkin, et al., 2009). The percentage of explained variance in physical activity behavior was only between 10 and 42%. Self-efficacy turned out to be the best predictor of behavioral intention in most studies (e.g. Karvinen et al., 2007; Keats et al., 2007; Speed-Andrews et al., 2012; Trinh et al., 2012) and has often even an independent effect on physical activity behavior (besides intention) (e.g. Karvinen et al., 2007; Keats et al., 2007; Trinh et al., 2012). To receive better predictions of behavior, the TPB framework was often enriched by a planning component in recent research. For example, Trinh et al. (2012) and Packel et al. (in press) could explain 42% / 30% of behavior including planning as predictor.

All in all, the TPB has proven to be a useful framework to explain cancer patients` intentions to engage in physical activity and (to a smaller extent) their actual exercise behavior

Behavior change interventions – increasing physical activity among cancer patients

Exercise trials can be classified into two main categories according to the framework by Courneya (2010): behavior change trials and health outcome trials. The main difference between both types is their primary oucome: behavior change trials aim to increase the level of physical activity, whereas health outcome trials aim to increase various mental or physical health outcomes. Furthermore, behavior change and health outcome trials differ in many ways such as appropriate theoretical models, the nature of the comparison intervention and the interpretation of results (Courneya, 2010).

According to Speck et al. (2010) 30% of randomized controlled trials during treatment were behavior change interventions. There is one general review and meta-analysis summarizing results of behavior change studies on increasing physical activity among cancer patients during and post treatment (Bourke et al., 2013). Fourteen randomized controlled trials could be identified and were included in the meta-analysis. About half (*n*= 8) included participants who were currently undergoing active treatment. The vast majority were conducted among breast cancer patients (*n* = 11), while only two studies included colorectal cancer patients and one prostate cancer patient. Notably, only about one third of the studies (*n* = 5) were explicitely based on a theoretical model. The mostly applied model (*n* = 4) was the Transtheoretical Model (Prochaska & DiClemente, 1983). The percent of cancer patients meeting the exercise recommendation of 150 minutes per week after the interventions did not exceeded 75%. Three trials (Bourke 2011, Bourke 2011, Cadmus 2009) reported an adherence of greater than 75% to a self-specified exercise goal (< 150 minutes/week) and were judged as “successful”. These three studies combined supervised exercise and home-based exercise components and used the following behavior change techniques: goal setting, prompting generalization of target behavior, prompting practise and prompting self-monitoring of behavior. Especially the last behavior change technique is a core component of self-regulation (De Ridder & De Wit, 2006).

Additionally, three specific meta-analyses and reviews exist. Two reviews and meta-analyses focus on breast cancer survivors post treatment (Bluethmann, Vernon, Gabriel, Murphy, & Bartholomew, 2015; Short, James, Stacey, & Plotnikoff, 2013). The meta-analysis by Bluethmann et al. (2015) calculated a mean effect size. The overall standardized mean

difference of the 14 studies included was 0.47 ($p < .001$) which is a moderate effect size. As the intervention of the MOTIVACTION-project only included patients during active treatment, the reviews on post-treatment survivors should not be described in detail.

One further meta-analysis (Stacey, James, Chapman, Courneya, & Lubans, 2014) is worth mentioning as it summarizes all behavior change studies using Bandura's Social Cognitive Theory (Bandura, 1977, 1986). The Social Cognitive Theory is a classical self-regulation theory. The meta-analysis included eight studies using the framework of the Social Cognitive Theory to increase physical activity or target diet change among adults with a homogenous cancer diagnosis. The meta-analysis found a significant intervention effect for physical activity (standardized mean difference = 0.33). Two trials directly assessed self-regulation via a questionnaire, but unfortunately did not report on the results (Hatchett, Hallam, & Ford, 2013; Camille E. Short, James, Girgis, Mcelduff, & Plotnikoff; Short, James, Girgis, D'Souza, & Plotnikoff, 2014). However, increasing self-efficacy was associated with a higher level of physical activity (Demark-Wahnefried et al., 2007; Ligibel et al., 2012; Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005; von Gruenigen et al., 2008).

A few studies were identified that applied the TPB as theoretical background (Cadmus et al., 2009; Keats & Culos-Reed, 2009; Trinh, Plotnikoff, Rhodes, North, & Courneya, 2014; Vallance, Courneya, Plotnikoff, & Mackey, 2008). Most of them were able to change the TPB variables through the intervention. Keats & Culos-Reed (2009) showed that all TPB variables could explain changes in behavioral intention. Intention and self-efficacy – in turn – were associated with physical activity at 1-year follow-up ($r_{intention}$ = .9 and $r_{self\text{-}efficacy}$ = .7). No behavior change intervention was built on the HAPA model.

In conclusion, behavior change studies have yielded encouraging results in increasing the exercise levels of cancer patients. However, most research is done among breast cancer patients and the theoretical foundation is often lacking (compare section 2.4 for further gaps in research).

2.3 Social influences on cancer patients' physical activity

When considering an individual's health, one has to leave the scope of a person centric view and look at the (close) social context. Therefore, the second focus of this thesis is on social influences. Before research results on social influences regarding cancer patients' physical activity are reviewed, the concepts of social support, social control, reactance and role model support are introduced.

Social support, social control reactance and role model support

Social relationships play an important role in the context of health (Newman & Roberts, 2013). Berkman et al. have proposed a conceptual model of how social networks impact health (Berkman, Glass, Brissette, & Seeman, 2000). The model points out that social influence can occur and be regarded on many different levels, from a macro-social level to psychobiological processes. Social-structural conditions of the macro level comprise culture, socioeconomic factors, politics and social change. In the mezzo level, the social network and its structure as well as characteristics of network ties are relevant factors. The level of interest in this thesis is the micro level dealing with psychosocial mechanisms. This level regards social support, social influences, social engagement, person-to-person contact and access to resources and material goods. For this thesis the first two concepts are of interest. Social support comprises four types of support: instrumental (e.g. financial aid), informational (e.g. personal advice), emotional (e.g. expression of caring) and appraisal (e.g. affirmation from statement) (Langford, Bowsher, Maloney, & Lillis, 1997; Uchino, 2004). “Social influences” means – in Berkman`s model – norms, peer pressure, social comparison processes and constraining/enabling influences on health behavior. Social norms and peer pressure are (indirectly) assessed through subjective norms as being a part of the TPB (see section 2.2).

Berkman`s model furthermore describes pathways through which social factors are affecting health outcomes. Besides physiological (e.g. reducing stress responses) and psychological effects (e.g. decreasing depression, increasing well-being), social influences are thought to influence health behavior. In this context, social support involves attempts to aid and reinforce someone’s own efforts to positively change his/her health behavior (Franks et al., 2006). However, there is also another kind of social exchange processes – not included in Berkman’s model – which can have a potential effect on health behavior: social control. Social control refers to interactions that involve influence, regulation and constrains (Helgeson, Novak, Lepore, & Eton, 2004; Lewis & Rook, 1999) and involves attempts to change someone’s health behavior who has been unable or unwilling to make such changes (Franks et al., 2006). In the context of physical activity and cancer, social support includes for example being physically active together with the cancer patient, encouraging the patient to be physically active or assisting the patient in carrying out physical activity (Khan et al., 2013; J. F. Sallis, Grossman, Pinski, Patterson, & Nader, 1987). On the other hand, examples for social control behaviors aimed at increasing physical activity levels are criticizing the patient for insufficient physical activity, prompting the patient to exercise more or observing if the recipient is really physically active (Khan et al., 2013).

Social support has been identified as a predictor of physical activity in a variety of populations (e.g. Anderson-Bill et al., 2011; Bauman et al., 2012; Fraser & Rodgers, 2012; Khan et al., 2013; Van Dyck et al., 2011). The influence of social support has been shown for different age groups across the lifespan (Dowda, Ainsworth, Addy, Saunders, & Riner, 2003; Ievers-Landis et al., 2003; Kaplan, Newsom, McFarland, & Lu, 2001).

In contrast, research results on social control are inconsistent but the evidence for a negative or non impact on physical activity behavior predominates (Franks et al., 2006; Khan et al., 2013; Knoll, Burkert, Scholz, Roigas, & Gralla, 2012; Thorpe, Lewis, & Sterba, 2008). Psychological reactance might explain the missing positive effect of social control on health behavior or even cause "boomerang effects". Reactance is described as an aversive motivational state that arises when an individual perceives its behavioral freedoms as threatened or lost (Brehm, 1966). In order to reduce reactance, individuals try to engage in behaviors that are able to reestablish the freedom that has been threatened (Brehm, 1966). Such behaviors can be contrary to the behavior that was originally desired by the person who evoked reactance.

The concepts of social support, social control and reactance are incorporated in manuscript 2. A further concept in the field of social influence – role mode support – is an important part of the intervention described in manuscript 3. Firstly, it can be regarded as classic social support. A person who already performs a certain behavior (e.g. regular physical activity) can support the target person to perform the behavior as well. For example, an already active cancer patient exercises together with the target person, gives him/her advice on how to be physically active and thus reinforces him/her to be active. Secondly, role model support has an additional (indirect) effect on behavior according to Bandura's theory (Bandura, 1977, 2000). Bandura assumes four different sources of self-efficacy: (1) mastery experience, (2) vicarious experience, (3) verbal persuasion/ symbolic experience and (4) emotional arousal. Role model support can be classified as vicarious experience assumed to increase self-efficacy and (indirectly) behavior. For instance, a cancer patient recognizes that another patient (e.g. being in a similar situation) is able to be regularly physically active. This should increase his own self-efficacy that he or she can manage it as well.

Previous studies among cancer patients examining social support and physical activity

The role of social support in increasing cancer patients' physical activity levels has been summarized in a review by Barber (2012). This review comprises 22 articles, of which seven describe interventional studies, four longitudinal studies and eleven cross-sectional

studies. More than half of the studies were conducted among female breast cancer patients. Fifty percent of the 22 studies reported a significant association between social support and physical activity. It has to be mentioned that very heterogeneous studies were included in this review. All studies that assessed physical activity as an interventional, outcome or mediator variable and that used any kind of measurement of social support were included. Thereby the research questions varied a lot. Whereas some studies examined how social support can affect physical activity (as it is the topic in this thesis), others investigated how physical activity (e.g. performed in groups) can increase the feeling of social support.

Only two studies have examined role model support. It has been shown in a cross-sectional study among breast-cancer patients that knowing a role-model is associated with an increased number of steps per day and increased energy expenditure (Rogers et al., 2005). Based on these results, Rogers et al. (2011) incorporated role model support in a randomized controlled study. They included a role model speaker in one of the group sessions of their intervention. Results showed that the intervention had neither a significant effect on reporting to have an exercise role model nor on social support. The authors concluded that patients did not consider the speaker as a role model and that more purposeful partnering might be necessary.

Social control regarding physical activity has been investigated in a study by Helgeson et al. (2004). The authors investigated the influence of social control on several health behaviors in men with prostate cancer. Results showed that social control was unrelated to health-enhancing behavior like physical activity. Health-restorative and health-comprising social control were even associated with maladaptive health behaviors and greater psychological distress.

In summary, social support has frequently been applied in previous research and has been identified as an important predictor of physical activity. Research on role model support and social control is limited.

2.4 Gaps in previous research and research questions

Through the literature review in the last sections, limitations of previous studies can be detected. A recent review concluded the following: “The beneficial effects of regular exercise for people living with or beyond cancer are becoming apparent. However, how to promote exercise behavior in sedentary cancer cohorts is not as well understood” (Bourke et al., 2013, p. 1). Shortcomings of previous research in (1) applying the TPB, (2) investigating social influ-

ences on the physical activity of cancer patients and (3) behavior change intervention, are demonstrated in this section and research questions for the manuscripts are derived.

Research gaps – TPB studies

There is already a large body of research applying the TPB to explain cancer patients' behavioral intention and physical activity level (see section 2.2). Looking at the results of previous studies using the TPB in cancer populations, it is remarkable that even insufficiently active patients stated very positive attitudes toward physical activity (e.g. Lowe et al., 2012; Speed-Andrews et al., 2012). Most TPB studies in the field of physical activity and cancer (e.g. Hunt-Shanks et al., 2006; Jones et al., 2007; Karvinen et al., 2007; Speed-Andrews et al., 2012) measured attitudes with the same five to seven point semantic differentials based on items used by Courneya and Friedenreich (1999). This type of assessment with a balanced list of positive / negative item-pairs, might lead to answers which are affected by social desirability tendencies or the tendency to give "balanced" responses. Other methods (e.g. open assessment) have to be examined to gain the full range of attitudes including negative ones.

Although there is evidence that TPB variables can explain up to 70 percent of the variance in intentions to exercise regularly in various cancer populations (see section 2.2), the studies found different variables of the TPB to be important determinants of intention. There is especially no agreement regarding the strength of impact of attitudes and subjective norms (e.g. Courneya, Blanchard, & Laing, 2001; Hunt-Shanks et al., 2006; Jones et al., 2007; Karvinen et al., 2009; Stevinson, Tonkin, et al., 2009; Trinh et al., 2012).

Research questions of manuscript 1

1. Does using an open format of assessment help to gain a broader range of attitudes? According to a prior study (Zimmermann & Sieverding, 2011), it is assumed that an open format assessment method would help patients, especially those who are insufficiently active, to also report their negative attitudes.
2. Do determinants of intention differ in their strength for active and insufficiently active patients? As assumed in stage theories (e.g. the Transtheoretical Model, Prochaska & DiClemente, 1983) there might be different determinants important for active patients who already meet the physical activity guidelines and those patients that are insufficiently active. This could explain the previous controversial results that different TPB variables were important to predict intention.

Research gaps – social influences and physical activity among cancer patients

One limitation of previous studies is given by the fact that only the cancer patients were asked to indicate the social support they perceived. According to a conceptual framework by Dunkel-Schetter describing elements of social interactions, three different perspectives of social support should be considered: the recipient, the provider and an outside observer (Dunkel-Schetter, Blasband, Feinstein, & Herbert, 1992). As relatives, friends or other persons who actually provide social support did not take part in previous studies, only one perspective could be taken into account.

So far, only one study examined social control in the field of physical activity and cancer (Helgeson et al., 2004). The difference between social support and social control in predicting cancer patients' physical activity has not been investigated. Reactance seems to be a promising concept to explain the missing or even negative effect of social control for health behaviors found in previous studies. Reactance has rarely been investigated in the health psychological context in general (e.g. Erceg-Hurn & Steed, 2011; C. H. Miller, Lane, Deatrick, Young, & Potts, 2007; Tucker, Orlando, Elliott, & Klein, 2006; Whitehead & Russell, 2004), and especially in the physical activity and cancer context, it has not yet been included. As almost two thirds of studies examining social support among cancer patients have been conducted among female breast cancer patients (Barber, 2012), gender-differences have hardly been investigated in previous research of this field.

Research questions of manuscript 2

1. How strongly are perceived social support and control related to relative-reported social support and control? The dyadic design of study 2 including patients as well as a family member allows for comparison of the two perspectives.
2. Are social control and social support associated with reactance? It is assumed according to reactance theory that social control – when perceived as a threat to personal freedom – evokes reactance, whereas social support should be unrelated to reactance.
3. Do gender differences exist regarding the amount of social support, social control and reactance? It is assumed that men and women differ in their reported social support, social control and reactance, as previous research has investigated differences between men and women regarding health behaviors (Gough, 2013; Helgeson, 2012), supporting behaviors within a marriage (Neff & Karney, 2005) and reactance (Seemann, Buboltz, Jenkins, Soper, & Woller, 2004; Woller, Buboltz, & Loveland, 2007). Typically, women take more care of their spouses' health, nutrition and

exercise and constrain health risk behavior more than men do towards their wives (Allen, Griffith, & Gaines, 2013; E. Miller & Wortman, 2002; Zhu, Nguyen, Cummins, Wong, & Wightman, 2006).

4. What is the relationship between social support, social control and reactance and exercise assessed four weeks later? The design of study 2 allows for the examination of possible differences in the influence of perceived and relative-reported social support and control with regard to physical activity behavior.

Research gaps – behavior change interventions

In a very recent review the ten most important research questions in the field of physical activity and cancer survivorship were presented and discussed (Courneya, Rogers, et al., 2015). One of these relevant research questions is "What are the most effective PA [physical activity] behavior change interventions for cancer survivors?" (Courneya, Rogers, et al., 2015, p. 5). Among others, Courneya criticized that most samples of previous behavior change studies almost exclusively consist of "healthy cancer survivors" mostly among the common cancer types. Patients with an advanced disease, for example, are mostly excluded and most behavior change studies focus on cancer survivors who have completed the treatment (often > 5 years). A further critic of Courneya (2015) is that only very few studies have validated self-reported physical activity with an objective accelerometer (Cadmus et al., 2009; Matthews et al., 2007; Pinto et al., 2005; Pinto, Papandonatos, Goldstein, Marcus, & Farrell, 2011; Rogers et al., 2009).

As described in section 2.2. there are previous behavior change studies with a focus on self-regulation. For example, trials applying self-regulation strategies from Bandura`s Social Cognitive Theory were successful in increasing exercise level. The HAPA even has a stronger focus on self-regulation (namely, emphasis on goal pursuit and distinction between different types of self-efficacy). The HAPA has not yet been applied in previous behavior change studies in the field of exercise and cancer. The strong focus on self-regulation as well as the successful application of the HAPA in other fields makes it a promising approach.

Most previous behavior change studies have solely focused on the patients themselves and not included a social support component. From the seven intervention studies included in the review addressing the association between physical activity and social support, the majority investigated how physical activity increases social support and not vice-versa. Additionally, the measurement of social support varied a lot. Most studies used a general measure of social support and not especially social support for exercising (as it is the topic of this thesis). Additionally, a match between a study participant and role model for

exercising together has not been implemented in previous studies. As research has demonstrated the impact of role model support on physical activity in a cross-sectional design (Rogers et al., 2005), a role model approach in an interventional design seems standing to reason.

Research questions of manuscript 3

1. Can an exercise intervention combining HAPA-based self-regulation strategies with role model support increase the physical activity of cancer patients? Thereby, self-reported physical activity is validated by objective accelerometer data. The study only includes patients during active cancer treatment (for acute care or palliation) to address the shortcoming that most trials only included “healthy cancer survivors”.
2. Which role does role model support play? Additional effects of role model support are assumed as research from other fields (e.g. smoking cessation) has shown that when self-regulatory strategies are combined with social support, synergistic effects emerge (i.e. high levels of self-regulation and social support was related to most successful smoking cessation; Ochsner et al., 2013).

3. General methods of the MOTIVACTION project

The MOTIVACTION project aimed to apply a mixed methods research design comprised of a qualitative study as well as quantitative cross-sectional and longitudinal studies and an intervention study (randomized controlled trial). All studies built on one another. Figure 1 provides an overview of the designs and topics of the three studies. Four (sub-) studies (1a, 1b, 2 und 3) are implemented in the three manuscripts. The remaining two sub-studies (1c und 1d) have not been incorporated in manuscripts yet and are not further described here.

All studies recruited participants from the National Center for Tumor Diseases (NCT) in Heidelberg, Germany. The NCT is a comprehensive tumor center with oncological research (e.g. the division of preventive oncology), an outpatient clinic, a day-care hospital and different counseling services. The NCT integrates a scientific as well as a practical exercise program.

3.1 Questionnaire development and application

Qualitative study 1 served as an elicitation study to develop questionnaire items (mostly for the TPB). This study applied the guidelines by Francis et al. (2004) to construct a questionnaire based on the TPB. In a semi-structured interview, patients had to state everything that came into their mind. Through this open questioning a wide range of attitudes, barriers, expectations, etc. could be gained. Items derived from the qualitative study were adopted into a questionnaire and reliability analyses were calculated. The final questionnaire was used (in parts) in the cross-sectional studies (study 1b to 1d in Figure 1) and in the randomized controlled trial (study 3). In all studies, patients had to fill out a self-administered paper-pencil version. Further, in all studies a part of the questionnaire was conducted as a structured interview, as most patients liked a personal dialog better.

3.2 Physical activity assessment

Physical activity was a core variable in all studies. It is a multidimensional construct and no single method is able to capture all its subcomponents (Warren et al., 2010). Physical activity has been defined as “any bodily movement produced by skeletal muscles that result in caloric expenditure” (Caspersen, Powell, & Christenson, 1985). Four dimensions are of major interest when describing physical activity: (1) frequency, (2), duration, (3) intensity and (4) type of activity (Caspersen et al., 1985). Ideally, day-to-day variation and seasonal

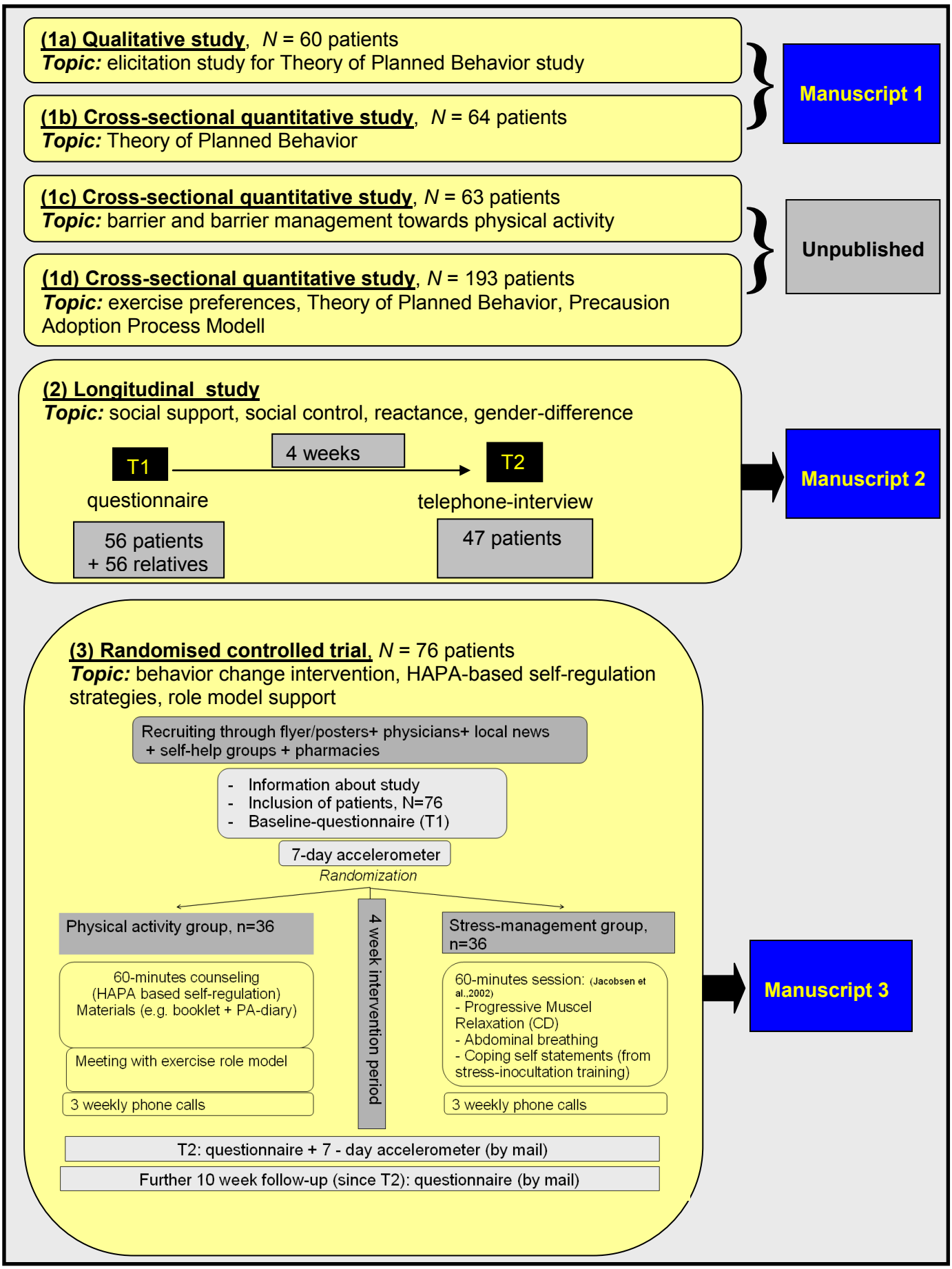

Figure 1. Overview of the different designs and topics of the three studies included in the MOTIVACTION-project.

variability should as well be considered (Warren et al., 2010). Physical activity takes place in different domains. Usually they are defined as the household or domestic domain, the occupational domain, transportation domain and leisure time domain (Warren et al., 2010). Exercise – the variable of primary interest in the MOTIVACTION project – is a subcategory of leisure time physical activity and is defined as “physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (Caspersen et al., 1985, p. 128).

Assessment methods of physical activity can be classified into two groups: self-reports versus objective measures. Self-reports comprise questionnaires, diaries, logs and recalls, whereas objective measures include motion sensors like accelerometers and pedometers, heart rate monitoring, direct observation and doubly labelled water. The different assessment methods vary in their degree of reliability, validity and responsiveness, the financial costs, the effort for application (for the participant as well as for the researcher), the measured variables, and the extent of standardization. Warren et al. (2010) state in their review that the lower the cost of an assessment method, the lower its accuracy.

Self-report is the most widely used measure and the cheapest and most feasible way to assess physical activity, especially in large-scale studies. It can be self- or interviewer-administered (Sallis & Saelens, 2000). A further advantage is that questionnaires can distinguish between the different types and domains of physical activity, which most objective measures cannot. However, several limitations are connected to self-reports. Social desirability might lead to over-reporting of activity and there can be cognitive limitations in recalling behavior being a complex cognitive task (Adams et al., 2005; Sallis & Saelens, 2000). Biased estimations are potentially encountered in terms of frequency, duration and intensity of the behavior, as the reliability and validity of questionnaires are improvable (Helmerhorst, Brage, Warren, Besson, & Ekelund, 2012). There can be problems of comprehension among researchers as well as respondents, as questionnaires often include ambiguous terms like “moderate intensity” or “leisure time” and instructions are not always easily understandable (Sallis & Saelens, 2000).

The quality of objective measures largely depends on the technique used (Warren et al., 2010). Pedometers, for example, are relatively simple and cheap devices measuring the numer of steps taken. A review has shown that pedometers are a valid measure of physical activity and that they correlate moderately with different measures of energy expenditure (Tudor-Locke, Williams, Reis, & Pluto, 2002). Nevertheless, the main disadvantage is that they do no assess physical activity that does not involve steps. Accelerometers are more cost-intensive, but offer more possibilities as they can assess acceleration mostly within three

dimensions. Thus, they can – in contrast to pedometers – also assess objectively the intensity level of activities. It is an advantage that they can assess the low intensity physical activity of every day life (e.g. being active during work, movements while sitting) which is difficult to assess in questionnaires. Nevertheless, most accelerometers do not capture water-based activities and activities of the upper body and do underestimate up-hill movement or the carrying of heavy loads (Warren et al., 2010). All objective measures of physical activity have in common that they are not affected by self-report biases but cannot distinguish well between different types of physical activity and do not assess the domains in which physical activity takes place. Furthermore, compliance is often lower compared to self-report measures, as the application is more complex.

The correlations between self-report measures and objectively assessed physical activity are mostly moderate. For example, a review reported a median correlation between pedometer and self-reported physical activity of r = .3 (Tudor-Locke et al., 2002). The associations between accelerometer and self-reported questionnaires are similar ranging mostly from r = .3 to r = .5 (e.g. Dyrstad, Hansen, Holme, & Anderssen, 2013; Prince et al., 2008; Segura-Jiménez et al., 2014). A review has shown that physical activity measured by self-report is generally higher than physical activity measured by accelerometer (Prince et al., 2008). Combining both — self-reported and objective measures — seems to be promising since it balances the different advantages and disadvantages. The review by Warren et al. summarizes the following: “The choice of method may be a compromise between accuracy level and feasibility, but the ultimate choice of tool must suit the stated aim of the research” (Warren et al., 2010, p. 127).

The different studies of the MOTIVACTION-project assessed physical activity with a mixture of methods: the assessments ranged from a single-item measure (study 1) over a physical activity recall in interview format (study 2) to a combination of a standardized questionnaire and accelerometer (study 3). In general, physical activity was assessed with increased quality during the course of the MOTIVACTION-project.

4. Manuscript 1

Ungar, N., Sieverding, M., Ulrich, C. M., & Wiskemann, J. (2015). What explains the intention to be physically active in cancer patients? Different determinants for active and insufficiently active patients. *Journal of Psychosocial Oncology, 33*(1), 15-33.

Abstract

In a qualitative elicitation study with 61 cancer patients a broad range of attitudes toward physical activity could be obtained, especially negative attitudes among insufficiently active patients. Based on these results, a second quantitative study was conducted; 64 patients patients (40 men; 42% insufficiently active (<150 minutes/week)) completed a Theory of Planned Behavior (TPB) questionnaire. Regression analyses revealed that different variables of the TPB are relevant for explaining the intention to exercise for physically active (subjective norm) and insufficiently active (attitudes) cancer patients. Health professionals should adapt their support to the special needs of insufficiently active and active cancer patients.

Keywords: Theory of Planned Behavior, physical activity, oncology, attitude, stage theory

Introduction

Based on recent findings (see e.g. the review by Speck, Courneya, Mâsse, Duval, & Schmitz, 2010), it is recommended for cancer patients to be regularly physically active. The official recommendation is to exercise 150 minutes a week with at least moderate intensity (Schmitz et al., 2010). This recommendation is based on studies showing that an active lifestyle helps, for example, to improve the quality of life, to increase physical functioning, to reduce fatigue, anxiety, depression and stress, and furthermore, to mitigate several side-effects of cancer treatment (compare for example Courneya & Friedenreich, 2011; Fitzpatrick & Farone, 2011; Jones & Alfano, 2012).

Nevertheless, most cancer survivors are not sufficiently physically active (Bellizzi, Rowland, Jeffery, & McNeel, 2005; Blanchard, Courneya, & Stein, 2008; Coups & Ostroff, 2005) and face different kind of barriers (Brawley, Culos-Reed, Angove, & Hoffman-Goetz, 2002). To explain and predict the reasons, why the majority of patients are physically inactive while others manage to be active the Theory of Planned Behavior (TPB) (Ajzen, 1991) has been widely applied (see Pinto & Ciccolo, 2011). The TPB states that attitude (positive or negative evaluation of performing a behavior; consisting of an instrumental and an affective component (Crites, Fabrigar, & Petty, 1994)), subjective norm (perceived influence whether important others believe one should perform a behavior), and perceived behavioral control (evaluation if they can control the behavior, similar to self-efficacy) predict behavioral intention. Intention captures the motivational factors and is seen as the most proximal determinant of actual behavior. Meta-analyses show that about 30 percent of behavior can be explained by intention (Armitage & Conner, 2001; Downs & Hausenblas, 2005b; Godin & Kok, 1996).

Looking at the results of previous studies using the TPB in cancer populations, it is remarkable that even insufficiently active patients stated very positive attitudes toward physical activity. Lowe, Watanabe, Baracos and Courneya (2012), Speed-Andrews et al. (2012) and Bélanger, Plotnikoff, Clark and Courneya (2012) observed average scores for instrumental attitudes of M = 6.2 (SD = 0.6), M = 5.9 (SD = 1.0) and M = 6.1 (SD = 0.9) on a scale from 1 to 7 among insufficiently active patients (less than 60 or 150 minutes physical activity per week). Similarly, Peddle et al. (2009) reported high instrumental (M = 6.5, SD = 0.4) and affective (M = 5.7, SD = 0.8) attitudes for cancer patients with a low adherence to an exercise intervention.

Most TPB studies in the field of physical activity and cancer (e.g. Hunt-Shanks et al., 2006; Jones et al., 2007; Karvinen et al., 2007; Speed-Andrews et al., 2012) measured attitudes with the same five to seven point semantic differentials based on items used by

Courneya and Friedenreich (1999)[2]. These items cover relevant potential positive and negative attitudes toward physical activity. Nevertheless, this type of assessment with a balanced list of positive / negative item-pairs, might lead to answers which are affected by social desirability tendencies or the tendency to give "balanced" responses. Zimmermann and Sieverding (2011) showed for another health-related behavior (alcohol consumption) that a semantic differential, which included a balanced list of positive and negative items, produced a tendency to the mean in the responses of young adults. In contrast, free associations regarding the same behavior appeared to be less prone to mean tendencies and therefore, might be more appropriate to reflect the full spectrum of attitudes, including negative ones.

Although there is evidence that TPB variables can explain around 25 to 70 percent of the variance in intentions to exercise regularly in different cancer populations (e.g. Jones et al., 2007; Karvinen et al., 2009; Keats, Culos-Reed, Courneya, & McBride, 2007; Stevinson et al., 2009), the different studies found different variables of the TPB to be important determinants of intention. Results regarding the role of attitudes toward physical activity were heterogeneous (Courneya, Blanchard, & Laing, 2001; Jones et al., 2007; Karvinen et al., 2009; Trinh, Plotnikoff, Rhodes, North, & Courneya, 2012). Similarly, the TPB construct of subjective norm emerged in some studies as a significant determinant of intention (e.g. Hunt-Shanks et al., 2006; Peddle et al., 2009), whereas in other studies, it did not have any importance (e.g. Karvinen et al., 2007; Stevinson et al., 2009).

One factor explaining these heterogeneous results may be that there are different determinants important for active patients who already meet the physical activity guidelines than for those who do not. This approach is based on stage theories (e.g. the Transtheoretical Model, Prochaska & DiClemente, 1983), which assume that for each stage, a different set of predictors is influential. Lippke, Nigg and Maddock (2007) tested this assumption empirically regarding the physical activity of healthy adults. They showed that different variables of the TPB are relevant in predicting intention at different stages of the Transtheoretical Model. Other studies in the field of physical activity and cancer have – to our knowledge - only examined the determinants of intention, independently of the level of physical activity. The distinction of subgroups (meeting the physical activity guidelines or not) is also relevant in practice as these two groups may require different kinds of support, either to maintain or to enhance a physically active lifestyle.

Our study compares physically active and insufficiently active cancer patients within the framework of the TPB first qualitatively (study 1) and second quantitatively (study 2).

---

[2] The items were: useless–useful, harmful–beneficial, wise–foolish, bad–good (instrumental) and unenjoyable–enjoyable, boring-interesting, unpleasant–pleasant (affective).

Study 1

The goal of study 1 was to examine cancer patients' attitudes toward the recommendation to be physically active using a qualitative approach. Concretely, we wanted to investigate what participants associate with the physical activity recommendation to exercise 150 minutes per week, when they express their thoughts freely. This study aimed to elicit the full range of modally salient beliefs (the antecedents of attitudes in the TPB framework) toward physical activity in cancer patients by using free associations. According to a prior study (Zimmermann & Sieverding, 2011), we assumed that this kind of open format assessment method would help, especially with insufficiently active patients, to also report their negative attitudes.

Method

The qualitative study 1 was conducted with 61 patients described in Table 1. Patients of any cancer entity and any out-patient therapy regime, who were above 18 years and where able to follow the study instructions were eligible to participate in the study. Any patients with inpatient treatment, mental retardation or severe physical restrictions that completely impeded physical activity (i.e. no ability to walk or stand) were excluded from the study.

This study followed the guidelines by Francis et al. (2004) to construct a questionnaire based on the TPB. Francis argues that a qualitative elicitation study is necessary before constructing a TPB questionnaire to assess the underlying modally salient beliefs. Study 1 followed the recommendations for the qualitative elicitation study with regard to wording of the questions, collecting and analyzing the data (see Francis page 25ff.).

The primary author of this manuscript administered a semi-structured 15-20 minute interview with each participant which consisted of five questions (assessing attitudes, barriers, barrier management, perceived benefits and perceived costs). In this paper, only the first question regarding attitudes is examined. At the start of the interview, the recommenddation regarding physical activity for cancer patients (150 minutes of at least moderate physical activity per week, see Schmitz et al., 2010) was described to the patients, and they were then asked if they had fulfilled this recommendation during the past week. Then, patients were asked to imagine exercising 150 minutes per week and to give free associations how this is/would be for them. As the aim was to elicit the full spectrum of attitudes, especially negative ones, we wanted to examine if we reached our aim and established the following categories: "positive" (e.g. beneficial, enjoyable), "neutral" (e.g. normal, realistic) and "negative" (e.g. painful, time-consuming). Two raters classified the responses independently and the consensus-rate was high (87%). The 13%, which were rated inconsistently, were classified by a third rater and a consensus was achieved.

Table 1

Demographic and medical characteristics of participants in study 1 and study 2.

Demographic or medical variable	*M*	(*SD*)	or	*N*	(%)
		Study 1, (N = 61)			
Sex					
Male				30	(49.2%)
Female				31	(50.8%)
Age in years	62.19	(10.30)			
Chemotherapy at present				24	(39.3%)
Radiotherapy at present				1	(1.6%)
Radiotherapy completed				24	(39.3%)
Cancer entity					
Breast				14	(23.0%)
Colorectal				11	(18.0%)
Skin				11	(18.0%)
Others				25	(41.0%)
		Study 2, (N = 64)			
Sex					
Male				40	(62.5%)
Female				24	(37.5%)
Age in years	59.77	(10.79)			
Chemotherapy at present				31	(48.4%)
Radiotherapy at present				3	(4.7%)
Radiotherapy completed				24	(37.5%)
Cancer entity					
Breast				12	(18.8%)
Colorectal				9	(14.1%)
Lung				6	(9.5%)
Others				37	(57.8%)

Note. All data is from self-report.

Results

About half of the patients *(N* = 34, 56%) responded that they fulfilled the exercise recommendation during the last week. Patients spontaneously named between 1 and 7 associations (on average: 3.3 associations); overall, the patients named a total of 203 associations. Generally, the interviewed patients had positive attitudes toward physical activity. 51% of the 203 associations were classified as positive, 23% as neutral and the remaining 26% as negative. Comparing active patients who already met the guidelines with insufficiently active patients using Chi-squared tests revealed significant differences: Active people mentioned 68% positive associations and only 10% negative ones, whereas insufficiently active patients came up with only 33% positive and 43% negative attitudes ($\chi^2(2) = 32.76$, $p < .001$), see Figure 1.

Evaluating the positive responses of the whole sample, 34% of the patients stated that exercising 150 minutes per week would be beneficial for them, 21% said it would be useful, and 15% said they would really enjoy it. Further positive associations were “you can achieve an aim, feeling competent”, “it is just necessary, I could not live without it”, “it is distractive”. For example, a woman said “When I exercise I always feel unburdened and free. My mind gets fresh and clear and I don´t think of my disease all the time”.

Regarding the negative associations, 23% reported exercising makes them tired and is exhausting, 16% said it would not be feasible, for 12% it is too much, 8% stated it would be painful and for 5%, it would be very time-consuming. For example, one woman said “150 minutes a week? That is way too much. That is not feasible for me, I am happy when I can get out of my bed” (all translated from German language).

As study 1 also served as an elicitation study for the TPB questionnaire in study 2, the 17 most frequently mentioned (at least 3 times) associations were collected. Of these, 6 were negative (exhausting, not feasible, too much, painful, time-consuming, laborious), 2 were neutral (normal, realistic), and 9 were positive (good, beneficial, enjoyable, useful, great, desirable, healthy, helpful, pleasant).

Discussion

The main goal of study 1 was to elicit the full range of attitudes toward physical activity in cancer patients by using free associations. Using the open format in study 1 did indeed elicit negative attitudes toward physical activity in addition to the positive ones; this was true especially for insufficiently active cancer patients.

In most other studies (e.g. Hunt-Shanks et al., 2006; Jones et al., 2007; Karvinen et al., 2007; Speed-Andrews et al., 2012), attitudes were measured with the same five to seven semantic differentials based on items used by Courneya & Friedenreich (1999). Our elicitation study elaborated 17 behavioral beliefs. Five of these 17 behavioral beliefs replicate

the five to seven “standard” items by Courneya and Friedenreich (1999): good, beneficial, enjoyable, useful, and pleasant. Beyond that, more negative modally salient beliefs were collected and were included in study 2. Thus, through this elicitation study, 17 attitude items were obtained for study 2, of which almost two thirds are non-standard behavioral beliefs which enrich the spectrum of attitudes.

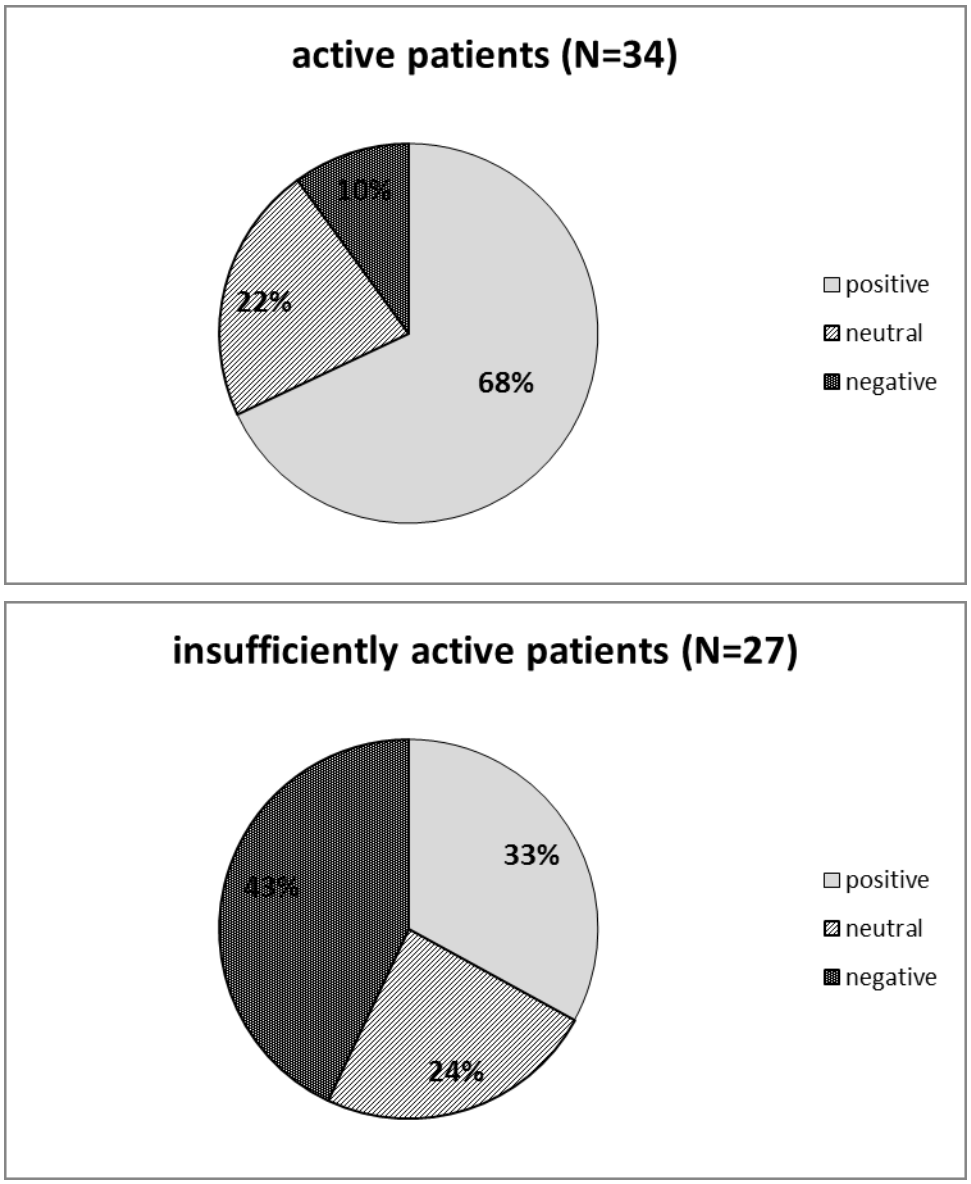

Figure 1. Free associations regarding the recommendation to exercise 150 minutes per week among active (≥ 150 minutes physical activity per week) and insufficiently active cancer patients.

Study 2

Study 2 compared active and insufficiently active cancer patients regarding the variables of the TPB toward the recommendation to exercise 150 minutes per week. So far, three studies have categorized cancer patients regarding their physical activity level (e.g. meeting the guidelines or not) and found higher mean levels in TPB variables for active patients (Bélanger et al., 2012; Lowe et al., 2012; Speed-Andrews et al., 2012). To our knowledge, to date, no study has investigated if the determinants of intention differ in their strength for reportedly active and insufficiently active patients. It was hypothesized that physically active patients would score higher on all variables of the TPB than insufficiently active cancer patients when comparing the means. Beyond that it was expected that different variables of the TPB would be relevant to explain the intention to exercise in the two groups, as assumed in stage theories.

Method

The cross-sectional survey was conducted at the National Center for Tumor Diseases in Heidelberg, Germany. Cancer patients of different entities and different outpatient therapy regimes were recruited. Inclusion and exclusion criteria were the same as in study 1. Sixty-four persons participated in this study and are described in Table 1. The primary author of this manuscript systematically approached patients in the waiting areas or while receiving treatment (e.g. chemotherapy). The participation was voluntary, but about 90% of the patients who were contacted took part. Participants were informed about the study, gave their informed consent and were asked to complete a two-page questionnaire assessing the variables of the TPB relating to the recommendation to exercise 150 minutes per week. The study personnel gave oral instructions about the questionnaire at the beginning and were available for questions throughout.

Measures. The two-page questionnaire was prepared in German. Variables of the TPB were assessed in accordance with guidelines by Ajzen (2002) and Francis et al. (2004).

Behavioral intention was measured by two items (see Sieverding, Matterne, & Ciccarello, 2010): “Think of the next 4 weeks, please. Do you intend to exercise regularly for 150 minutes a week?” (7-point-Likert scale with the endpoints “no, under no circumstances and “yes, at any rate”) and “How likely is it (in percent from 0 to 100%) that you will exercise regularly for 150 minutes per week within the next 4 weeks?”. We calculated a composite score (possible values from1 to 7) by using the following formula: [(item 1-1)+(item 2*6/100) /2]+1. The internal consistency for these items was good (Cronbach’s α = .81).

Attitude was assessed by responses to the stem, “To be regularly physically active for 150 minutes a week would be…” on 17 semantic differentials (7-point scales) (e.g. *beneficial – not beneficial, unrealistic – realistic)* which were elicited in study 1. In line with the approach

by Francis et al. (2004) the modally salient behavioral beliefs revealed in the elicitation study are included in the TPB questionnaire of study 2. Five of these 17 items are similar to the "standard" items used in most other studies applying the TPB in the field of physical activity and cancer (Courneya & Friedenreich, 1999), the other 12 associations are "new" attitudes derived through our elicitation study (see results section of study 1). As a factor analysis (extraction method: principal component, rotation: varimax) did not result in the theoretically assumed distinction between affective and instrumental attitudes, this distinction could not be used in further analyses. Instead, this factor analysis revealed two factors explaining a total of 69.40% of the variance, in which the first factor describes positive attitudes and the second, negative attitudes (similar to the rating of attitudes in study 1). We built two sum scores of all attitude items which were consistently categorized through the factor analysis and the rating of study 1 (as the factor analysis revealed only two factors – the third factor had an eigenvalue below 1 - all items rated as neutral in study 1 were not included). The positive attitude score included the 9 items good, beneficial, enjoyable, useful, great, desirable, healthy, helpful, pleasant (Cronbachs's α = .93) and all items were recoded so that '7' was the positive end-point; the negative attitude score included the 5 items exhausting, not feasible, too much, time-consuming, laborious (Cronbachs's α = .84) and all items were recoded so that 7 was the negative end-point.

Subjective norm was measured by 5 items (Cronbach's α = .89): "My … (1) partner / (2) family / (3) friends and acquaintances / (4) attending physician / (5) most people I consider important … think(s), I should be regularly physically active for 150 minutes per week.". A 7-point Likert-scale was used (complete disagreement to complete agreement).

Self-efficacy was assessed with two items (e.g. "It is difficult for me, to be regularly 150 minutes per week physically active" - negatively converted). The items were assessed on 7-point Likert-scales with the endpoints 'completely disagree' and 'completely agree' (Cronbach's α = .62).

To measure *physical activity,* patients were first given a detailed description of the recommendation to exercise 150 minutes per week with at least moderate intensity. Examples were provided (e.g. Nordic Walking for 30 minutes/day on five days a week so that they feel at least "a little bit exhausted"). Afterwards, patients were asked to estimate how many minutes per week they are currently physically active.

The following *sociodemographic and illness-related variables* were assessed: Age in years, sex, cancer entity, surgery (yes/no, when "yes" when was your last surgery), chemotherapy [chemotherapy completed (when completed); currently undergoing chemo-therapy (when did it start); never had any chemotherapy], radiotherapy [radiotherapy completed (when completed); currently undergoing radiotherapy (when did it start); never had any radiotherapy].

Statistical Analyses. First descriptive analyses where conducted. T-tests for continuous variables and chi-squared tests for discrete variables were used to detect differences between physically active and insufficiently physically active patients in sociodemographic or illness-related factors.

To test the hypotheses, first a one-way multivariate analysis of variance (MANOVA) with five variables of the TPB (intention, self-efficacy, positive attitudes, negative attitudes and subjective norm) as dependent variables, and the factor "physical activity status" (active versus insufficiently active) as the independent variable was used. Given a significant overall effect, five one-way analyses of variance (ANOVAs) were conducted to examine univariate main effects. Partial eta squared was used as effect size measure.

Afterwards, regression analyses were conducted separately for active and insufficiently active cancer patients with intention as dependent variable and all variables of the TPB (positive and negative attitude, self-efficacy and subjective norm) as determinants.

As only 2.9% of data was missing for variables of the TPB, we did not use any imputation technique, but calculated the scale means of TPB variables with all existing data. In all analyses, *p*-values < .05 were considered statistically significant. IBM SPSS Statistics 20 was used to conduct all analyses.

Results

Twenty-seven patients (42%) of the sample were classified as insufficiently physically active (<150 minutes/week, M = 78.59 minutes/week; range: 0-130 minutes/week; SD = 36.78), 36 as physically active (M = 287.22 minutes/week; range: 150-990 minutes/week; SD = 198.25) and one could not be classified because of missing data. Physically active and insufficiently physically active patients did not significantly differ in any of the sociodemographic or illness-related factors (sex, age, cancer entity, time since surgery, chemotherapy-status, radiotherapy-status).

Mean comparisons for TPB variables. A significant multivariate main effect for physical activity status (active versus insufficiently active), Pillais' Trace = .492, F (5, 55) = 10.64, p <. 001, μ^2 = .492 was found. Subsequently, all one-way ANOVAS showed a significant main effect for physical activity status, meaning that active cancer patients scored higher on all variables of the TPB: intention to exercise 150 minutes per week in the next four weeks ($M_{\text{insufficiently active}}$ = 4.70 (SD = 1.82), M_{active} = 6.56 (SD = 0.73), F(1,59) = 29.33, p < .001, μ^2 = .332), self-efficacy ($M_{\text{insufficiently active}}$ = 3.94 (SD = 1.53), M_{active} = 5.88 (SD = 1.14), F(1,59) = 32.00, p < .001, μ^2 = .352), positive attitudes toward the exercise recommendation ($M_{\text{insufficiently active}}$ = 5.50 (SD = 1.28) , M_{active} =6.15 (SD = 1.01) , F(1,59) =4.93 , p = .030, μ^2 = .077), negative attitudes toward the exercise recommendation ($M_{\text{insufficiently active}}$ =3.96 (SD = 1.53) ,

M_{active} =2.39 (*SD* = 1.25), $F(1,59)$ =19.65 , $p < .001$, $\mu^2 = .250$) and subjective norm ($M_{insufficiently\ active}$ = 4.48 (*SD* = 1.82) , M_{active} = 5.93 (*SD* = 1.50), $F(1,59) = 11.65$, $p = .001$, $\mu^2 = .165$).

Table 2

Regression analyses explaining intention to exercise for active and insufficiently active cancer patients with variables of the Theory of Planned Behavior

Active cancer patients, N = 34		
Determinant	β	*p*
Self-efficacy	.042	.869
Positive attitude	–.347	.097
Negative Attitude	–.329	.205
Subjective norm	.406	.018
R^2 for Model	.322	
Adjusted R^2	.228	
Insufficiently active[a] *cancer patients, N = 27*		
Determinant	β	*p*
Self-efficacy	–.200	.322
Positive attitude	.399	.048
Negative attitude	–.482	.026
Subjective norm	.199	.201
R^2 for Model	.582	
Adjusted R^2	.506	

Note. [a] insufficiently active means “less than 150 minutes of moderate physical activity a week”; all variables of the Theory of Planned Behavior scored from 1 to 7.

Determinants of the intention to be physically active in the next four weeks. Results of the regression analyses are presented in Table 2. As none of the sociodemographic (age, sex) and illness-related variables (chemotherapy, time since surgery) significantly correlated with the dependent variable, and as those variables could only explain little variance of intention (R^2_{active} = .01 and $R^2_{insufficiently\ active}$ = .09), they were not included in the regression analyses. For active patients, TPB variables explained 32% of the variance of intention, while the explained variance for insufficiently active patients was 58%.

Although the variables of the TPB were important determinants in the analyses for active and insufficiently active cancer patients, the influence of the single constructs of the TPB was very different in the two groups. Regarding physically active patients, their intention to exercise 150 minutes a week regularly could only be significantly explained by their subjective norm (p = .018); positive and negative attitudes and self-efficacy were not significant determinants. In contrast, for insufficiently active patients, the only significant determinant for their intention were their positive (p =.048) and negative attitudes (p = .026), whereas subjective norm and self-efficacy had no significant influence.

Additional Analysis. We wanted to investigate whether the attitudes we obtained in our qualitative study 1 and which were used for the semantic differential in study 2 really mirror a broader spectrum of attitudes. Therefore we compared the attitudes elicited in our study 1 to the standard attitudes in the semantic differential used in most studies (e.g. Courneya & Friedenreich, 1999). All items by Courneya and Friedenreich (1999) that were replicated in our study 1 (good, beneficial, enjoyable, useful, pleasant) were summed into one score ("standard attitudes") and compared to the other attitudes ("new attitudes": exhausting, not feasible, too much, painful, time-consuming, laborious, normal, realistic, great, desirable, healthy, helpful). As expected, the new attitudes scored more negatively (had a lower mean) especially among insufficiently active patients (M_{new} = 4.79, SD = 1.22, $M_{standard}$ = 5.49, SD = 1.39, $t(26) = 4.47$, $p < .001$, d = .535). Therefore, while the standard items had a ceiling effect toward the positive end point (M = 5.49 on a scale from 1-7), the new attitude items were more equally distributed in the middle of the scale. This result of study 2 together with the results of study 1 support our assumption that the open format in study 1 enabled the detection of additional negative attitudes toward physical activity among insufficiently active cancer patients and thus broadened the spectrum.

General discussion

The main goal of this study was to identify the full range of attitudes toward physical activity among cancer patients including negative ones, and to discover if different determinants explain the intention to be physically active in active and insufficiently active cancer patients. A qualitative study was conducted first (study 1), then physically active and insufficiently active cancer patients were compared quantitatively, regarding variables of the TPB in study 2.

In study 1, patients expressed their free associations toward the recommendation to exercise 150 minutes/week. Through this open format of assessment, a broader spectrum of patients' attitudes toward physical activity could be gained. As hypothesized, insufficiently active patients mentioned more negative (43%) than positive (33%) associations toward the exercise recommendation, while active patients reported more positive associations (68%

positive and 10% negative). This is in contrast to other studies reporting very positive attitudes (mostly with a mean above $M = 5$ or $M = 6$ on a scale from 1 to 7) even for insufficiently active cancer patients (e.g. Lowe et al., 2012; Peddle et al., 2009; Trinh et al., 2012). A study by Zimmermann & Sieverding (2011) compared qualitative and quantitative assessment methods regarding prototypes of alcohol consumption. They reported that open answers have fewer tendencies to the mean than the semantic differential with a balanced list of positive and negative items. Open format answers might be more appropriate to reflect the full range of attitudes, including negative ones, than a semantic differential.

To date, only a few other studies in the field of physical activity and cancer have used elicitation studies to assess the behavioral beliefs which predict attitudes in the TPB framework (Bélanger et al., 2012; Courneya & Friedenreich, 1999; Karvinen et al., 2007; Keats et al., 2007; Peddle et al., 2009; Trinh et al., 2012; Vallance, Lavallee, Culos-Reed, & Trudeau, 2012) . This is a good approach, but one needs to be careful that the behavioral beliefs are not biased in a positive direction. For example, Karvinen et al. (2007), Trinh et al. (2012), Bélanger et al. (2012) and Keats et al. (2007) only asked for benefits and advantages (not for disadvantages) of physical activity to assess behavioral beliefs.

Results of study 2 revealed that variables of the TPB differentiated very well between active and insufficiently active cancer patients: active patients scored higher on all variables of the TPB. Analyses revealed a very high overall effects size of $\mu^2 = .49$, with self-efficacy having the largest univariate effect ($\mu^2 = .35$). This result is in accordance with the study of Speed-Andrews et al. (2012), which also found differences in all TPB variables for colorectal cancer patients of four activity levels. The fact that self-efficacy reaches the highest effect size confirms the results of other studies showing the importance of this TPB construct (e.g. Karvinen et al., 2007; Keats et al., 2007; Trinh et al., 2012). It is also worth mentioning that negative attitudes had a much higher effect size ($\mu^2 = .25$) than positive attitudes ($\mu^2 = .08$). Thus, negative attitudes discriminate much better between active and insufficiently active cancer patients than do positive ones. This strengthens the aim of study 1 to elicit the full range of attitudes and to especially include the negative ones.

Furthermore, study 2 compared active and insufficiently active patients in regards to the strength of TPB determinants in explaining intention. As hypothesized, there were different determinants relevant for active and insufficiently active patients in explaining their intention to be physically active. For insufficiently active patients, attitudes might be very important to develop an intention to exercise regularly, with negative attitudes having a stronger effect ($\beta = -.482$, $p = .026$) than positive ones ($\beta = .399$, $p = .048$). On the other hand, only subjective norm played a statistically significant role for active patients to explain their intention ($\beta = .41$). This result is consistent with the theoretical framework of stage theories assuming that different sets of determinants are relevant for different stages.

The different determinants of intention for active and insufficiently active patients have important practical implications. Health professionals can have the possibility to advise their patients regarding physical activity. According to the results of our study, it is the best to screen patients regarding their physical activity: do they already meet the 150 minutes/week guidelines or not? Depending on the results of this screening, different advice is necessary.

Differences between our results and those of other studies must be addressed. Former TPB studies in the field of physical activity among cancer survivors showed heterogeneous results regarding the role of attitudes. Reasons why some studies showed no or weaker associations between attitudes and intention (e.g. Courneya et al., 2001; Peddle et al., 2009) might be that they did not regard insufficiently active patients separately or did not assess the full spectrum of attitudes. Most other studies (e.g. Hunt-Shanks et al., 2006; Jones et al., 2007; Karvinen et al., 2007; Speed-Andrews et al., 2012) consistently used the same standard semantic-differential items to assess attitudes (Courneya & Friedenreich, 1999). Results of study 2 confirmed that these standard items were rated more positively than the additional ones elicited in study 1. It might be that the negative adjectives of the standard items are too strongly worded. For example, participants might hesitate to evaluate physical activity as “bad”, “harmful” or “useless”. Weaker adjectives that were detected in study 1 like “laborious”, “too much” or “exhausting” might be more acceptable and might thus reduce ceiling effects. Nevertheless, cultural differences might also explain the discrepancy between the results of our study and other literature. This was the first study about the TPB in the field of physical activity in a German cancer population. There might be differences in the promotion of physical activity in different countries which might be reflected in different attitudes.

To our knowledge, only two studies among cancer survivors have used more than the standard items and assessed attitudes with 14 adjectives for the semantic differential (Culos-Reed, Shields, & Brawley, 2005; Keats et al., 2007). Unfortunately, the adjectives are not mentioned in these articles and there is no information provided regarding how these items were derived. Notably, both of these other studies confirmed our result that attitude was the only significant predictor of intention.

The result that subjective norm is the most important determinant of intention for active patients is not in line with the results of Lippke et al. (2007). In a sample of healthy adults, they found that subjective norm is only important in the precontemplation and contemplation (thus inactive) stages of the Transtheoretical Model. For cancer patients this pattern might be different. As there is usually a decline in physical activity during cancer therapy (Huy, Schmidt, Vrieling, Chang-Claude, & Steindorf, 2012), the social environment might be especially important in maintaining the level of physical activity. Aside from the many other factors in the social environment, positive social relationships were found to be

important for cancer patients to be physically active: in a recent systematic review, Barber (2012) revealed a positive relationship between social support and cancer patients' physical activity in about 50% of the included 22 studies.

Our study has some limitations. First, all data is based on self-reports which can lead to response biases. Whereas self-reports are the standard for assessing the variables of the TPB, the assessment of physical activity used in this study needs improvement. Physical activity was measured by one item accompanied by a detailed description and examples of the exercise guidelines. A validated and reliable questionnaire or even an objective measure to assess physical activity should be used in future research. Furthermore there might be a social desirability effect in the responses, because the exercise guidelines were presented prior to the questions. Nevertheless, we think it was necessary to define physical activity first and make everybody have the same background information about the exercise recommendation before answering the questions. Second, this study only tested if variables of the TPB explain the intention to exercise, but not the actual behavior. Third, there are some limitations about the sampling and recruitment strategy. Both studies are based on relatively small and non-representative samples, as we used convenience samples. The low number of participants might have led to a low power of the statistical tests. Thus, there might be some "true" relations which we did not detect. Furthermore, the sample of study 2 is unbalanced regarding the sexes (24 women, 40 men). Lastly, all disadvantages of a cross-sectional survey should be regarded when interpreting the results of this study.

In spite of these limitations, our study has broadened the existing TPB literature in the field of physical activity and cancer in two directions: First, in study 1, a new qualitative assessment method for attitudes (free associations) was used to achieve the full range of attitudes including negative ones. Second, in study 2, active and insufficiently active patients were compared regarding variables of the TPB. According to the assumptions by stage theories, we found that different TPB variables are important for these two subgroups in explaining physical activity intention – subjective norm for active and attitudes for insufficiently active patients.

Conclusions can be drawn for research and practice. Future research should be aware that negative aspects of attitudes are also assessed, for example, by using an open format of assessment. Longitudinal and experimental studies are necessary to detect if the influences of TPB variables – especially attitudes and subjective norm - on intention, change over time. Thereby it would be interesting to include the assumptions of stage models and see if the progression in stages moderates the relationship between the TPB variables and intention. Furthermore, the results of this study can be translated into practice. Health professionals should adapt the advice they give cancer patients regarding their physical activity according to the physical activity status of the patient. Insufficiently active patients

would benefit the most if health professionals try to modify their negative attitudes toward physical activity. Additionally, it would help already active patients most to maintain an appropriate level of physical activity if health professionals address their social environment.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Constructing a TpB-questionnaire: Conceptual and methodological considerations. http://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471-499. doi: 10.1348/014466601164939

Barber, F. D. (2012). Social support and physical activity engagement by cancer survivors. *Clinical Journal of Oncology Nursing, 16*(3), E84-E98. doi: 10.1188/12.CJON.E84-E98

Bélanger, L. J., Plotnikoff, R. C., Clark, A. M., & Courneya, K. S. (2012). Determinants of physical activity in young adult cancer survivors. *American Journal of Health Behavior, 36*(4), 483-494. doi: 10.5993/ajhb.36.4.5

Bellizzi, K. M., Rowland, J. H., Jeffery, D. D., & McNeel, T. (2005). Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *Journal of Clinical Oncology, 23*(34), 8884-8893. doi: 10.1200/jco.2005.02.2343

Blanchard, C. M., Courneya, K. S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: Results from the American Cancer Society's SCS-II. *Journal of Clinical Oncology, 26*(13), 2198-2204. doi: 10.1200/jco.2007.14.6217

Brawley, L. R., Culos-Reed, S. N., Angove, J., & Hoffman-Goetz, L. (2002). Understanding the barriers to physical activity for cancer patients: Review and recommendations. *Journal of Psychosocial Oncology, 20*(4), 1-21. doi: 10.1300/J077v20n04_01

Coups, E. J., & Ostroff, J. S. (2005). A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Preventive Medicine, 40*(6), 702-711. doi: 10.1016/j.ypmed.2004.09.011

Courneya, K. S., Blanchard, C. M., & Laing, D. M. (2001). Exercise adherence in breast cancer survivors training for a dragon boat race competition: A preliminary investigation. *Psycho-Oncology, 10*(5), 444-452. doi: 10.1002/pon.524

Courneya, K. S., & Friedenreich, C. M. (1999). Utility of the theory of planned behavior for understanding exercise during breast cancer treatment. *Psycho-Oncology, 8*(2), 112-122. doi: 10.1002/(sici)1099-1611(199903/04)8:2<112::aid-pon341>3.0.co;2-l

Courneya, K. S., & Friedenreich, C. M. (Eds.). (2011). *Physical activity and cancer*: Springer Berlin Heidelberg.

Courneya, K. S., Jones, L. W., Mackey, J. R., & Fairey, A. S. (2006). Exercise Beliefs of Breast Cancer Survivors Before and After Participation in a Randomized Controlled

Trial. *International Journal of Behavioral Medicine, 13*(3), 259-264. doi: 10.1207/s15327558ijbm1303_10

Courneya, K. S., Karvinen, K. H., & Vallance, J. K. (2007). Exercise motivation and behavior change *Handbook of cancer survivorship* (pp. 113-132): Springer.

Crites, S. L., Fabrigar, L. R., & Petty, R. E. (1994). Measuring the affective and cognitive properties of attitudes: Conceptual and methodological issues. *Personality and Social Psychology Bulletin, 20*(6), 619-634. doi: 10.1177/0146167294206001

Culos-Reed, S. N., Shields, C., & Brawley, L. R. (2005). Breast cancer survivors involved in vigorous team physical activity: Psychosocial correlates of maintenance participation. *Psycho-Oncology, 14*(7), 594-605. doi: 10.1002/pon.881

Downs, D. S., & Hausenblas, H. A. (2005a). Elicitation studies and the theory of planned behavior: a systematic review of exercise beliefs. *Psychology of Sport and Exercise, 6*(1), 1-31. doi: 10.1016/j.psychsport.2003.08.001

Downs, D. S., & Hausenblas, H. A. (2005b). The theories of reasoned action and planned behavior applied to exercise: A meta-analytic update. *Journal of Physical Activity & Health, 2*(1), 76-97.

Fitzpatrick, T. R., & Farone, D. W. (2011). Leisure, Household Activities, and Health Among Mexican American Elders with Cancer. *Journal of Psychosocial Oncology, 29*(2), 199-214. doi: 10.1080/07347332.2010.548441

Francis, J. J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., . . . Bonetti, D. (2004). Constructing questionnaires based on the theory of planned behaviour. A manual for health services researchers. Retrieved 11.12.2013, from http://pages.bangor.ac.uk/~pes004/exercise_psych/downloads/tpb_manual.pdf

Godin, G., & Kok, G. (1996). The theory of planned behavior: a review of its applications to health-related behaviors. *American Journal of Health Promotion, 11*(2), 87-98. doi: 10.4278/0890-1171-11.2.87

Hunt-Shanks, T. T., Blanchard, C. M., Baker, F., Hann, D., Roberts, C. S., McDonald, J., . . . Kaw, O. C. K. (2006). Exercise use as complementary therapy among breast and prostate cancer survivors receiving active treatment: Examination of exercise intention. *Integrative Cancer Therapies, 5*(2), 109-116. doi: 10.1177/1534735406288742

Huy, C., Schmidt, M. E., Vrieling, A., Chang-Claude, J., & Steindorf, K. (2012). Physical activity in a German breast cancer patient cohort: one-year trends and characteristics associated with change in activity level. *European Journal of Cancer, 48*(3), 297-304. doi: 10.1016/j.ejca.2011.08.005

Jones, L. W., & Alfano, C. M. (2012). Exercise-oncology research: Past, present, and future. *Acta Oncologica, 52*(2), 195-215. doi: 10.3109/0284186x.2012.742564

Jones, L. W., Guill, B., Keir, S. T., Carter, K., Friedman, H. S., Bigner, D. D., & Reardon, D. A. (2007). Using the theory of planned behavior to understand the determinants of exercise intention in patients diagnosed with primary brain cancer. *Psycho-Oncology, 16*(3), 232-240. doi: 10.1002/pon.1077

Karvinen, K. H., Courneya, K. S., Campbell, K. L., Pearcey, R. G., Dundas, G., Capstick, V., & Tonkin, K. S. (2007). Correlates of exercise motivation and behavior in a population-based sample of endometrial cancer survivors: an application of the Theory of Planned Behavior. *International Journal of Behavioral Nutrition and Physical Activity, 4*(21). doi: 10.1186/1479-5868-4-21

Karvinen, K. H., Courneya, K. S., Plotnikoff, R. C., Spence, J. C., Venner, P. M., & North, S. (2009). A prospective study of the determinants of exercise in bladder cancer survivors using the Theory of Planned Behavior. *Supportive Care in Cancer, 17*(2), 171-179. doi: 10.1007/s00520-008-0471-8

Keats, M. R., Culos-Reed, S. N., Courneya, K. S., & McBride, M. (2007). Understanding physical activity in adolescent cancer survivors: An application of the theory of planned behavior. *Psycho-Oncology, 16*(5), 448-457. doi: 10.1002/pon.1075

Lippke, S., Nigg, C. R., & Maddock, J. E. (2007). The theory of planned behavior within the stages of the transtheoretical model: Latent structural modeling of stage-specific prediction patterns in physical activity. *Structural Equation Modeling, 14*(4), 649-670. doi: 10.1080/10705510701575586

Lowe, S. S., Watanabe, S. M., Baracos, V. E., & Courneya, K. S. (2012). Determinants of physical activity in palliative cancer patients: An application of the theory of planned behavior. *The Journal of Supportive Oncology, 10*(1), 30-36. doi: 10.1016/j.suponc.2011.07.005

Peddle, C. J., Jones, L. W., Eves, N. D., Reiman, T., Sellar, C. M., Winton, T., & Courneya, K. S. (2009). Correlates of adherence to supervised exercise in patients awaiting surgical removal of malignant lung lesions: Results of a pilot study. *Oncology Nursing Forum, 36*(3), 287-295. doi: 10.1188/09.onf.287-295

Pinto, B. M., & Ciccolo, J. T. (2011). Physical activity motivation and cancer survivorship. In K. Courneya & C. M. Friedenreich (Eds.), Physical Activity and Cancer (pp. 367-387): Springer. doi: 10.1007/978-3-642-04231-7_16

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395. doi: 10.1037//0022-006X.51.3.390

Schmitz, K. H., Courneya, K. S., Matthews, C., Demark-Wahnefried, W., Galvao, D. A., Pinto, B. M., . . . Schwartz, A. L. (2010). American College of Sports Medicine Roundtable

on Exercise Guidelines for Cancer Survivors. *Medicine and Science in Sports and Exercise, 42*(7), 1409-1426. doi: 10.1249/MSS.0b013e3181e0c112

Sieverding, M., Matterne, U., & Ciccarello, L. (2010). What role do social norms play in the context of men's cancer screening intention and behavior? Application of an extended theory of planned behavior. *Health Psychology, 29*(1), 72-81. doi: 10.1037/a0016941

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 4*(2), 87-100. doi: 10.1007/s11764-009-0110-5

Speed-Andrews, A. E., Rhodes, R. E., Blanchard, C. M., Culos-Reed, S. N., Friedenreich, C. M., Belanger, L. J., & Courneya, K. S. (2012). Medical, demographic and social cognitive correlates of physical activity in a population-based sample of colorectal cancer survivors. *European Journal of Cancer Care, 21*(2), 187-196. doi: 10.1111/j.1365-2354.2011.01290.x

Stevinson, C., Tonkin, K., Capstick, V., Schepansky, A., Ladha, A. B., Vallance, J. K., . . . Courneya, K. S. (2009). A Population-based study of the determinants of physical activity in ovarian cancer survivors. *Journal of Physical Activity & Health, 6*(3), 339-346.

Trinh, L., Plotnikoff, R. C., Rhodes, R. E., North, S., & Courneya, K. S. (2012). Correlates of physical activity in a population-based sample of kidney cancer survivors: An application of the theory of planned behavior. *The International Journal of Behavioral Nutrition and Physical Activity, 9*. doi: 10.1186/1479-5868-9-96

Vallance, J. K., Lavallee, C., Culos-Reed, N. S., & Trudeau, M. G. (2012). Predictors of physical activity among rural and small town breast cancer survivors: An application of the theory of planned behaviour. *Psychology, Health & Medicine, 17*(6), 685-697. doi: 10.1080/13548506.2012.659745

Weinstein, N. D., & Sandman, P. M. (1992). A model of the precaution adoption process: Evidence from home radon testing. *Health Psychology, 11*(3), 170-180. doi: 10.1037/0278-6133.11.3.170

Zimmermann, F., & Sieverding, M. (2011). Young adults' images of abstaining and drinking: Prototype dimensions, correlates and assessment methods. *Journal of Health Psychology, 16*(3), 410-420. doi: 10.1177/1359105310373412

5. Manuscript 2

Ungar, N., Sieverding, M., Weißmann, M., Knoll, A., Steindorf, K., & Wiskemann, J. (submitted). Social support, social control and reactance – exercise behavior of cancer patients and the role of their relatives. *Journal of Applied Social Psychology*.

Abstract

Social support is an important factor for exercise among cancer patients, but too much control could elicit reactance and lead to detrimental effects. The present study investigates social support and social control from a patient's and a relative's perspective and examines the role of reactance as well as gender-differences. 56 dyads (cancer patient and relative) filled out a questionnaire assessing social support, social control and reactance. After four weeks (T2), patients' exercise was assessed with a 7-day-recall. As hypothesized, perceived control (r = .4, p < .01) but not perceived support was correlated with reactance. Male patients received more support, but were also more prone to reactance. Relative-reported support was the only predictor of exercise at T2. Practical implications on supporting patients without evoking reactance are discussed.

Keywords: social support, social control, reactance, physical activity, cancer, gender differences

Introduction

Physical activity has been identified to reduce side-effects and improve quality of life in cancer patients both during and post medical treatment (e.g. Mishra, Scherer, Geigle, et al., 2012; Mishra, Scherer, Snyder, et al., 2012; Speck, Courneya, Mâsse, Duval, & Schmitz, 2010). The „Roundtable on Exercise Guidelines for Cancer Patients" recommends a weekly activity of 150 minutes of moderate-intensity exercise (Schmitz et al., 2010). However, it has been shown that only about one third of adult cancer patients meet these recommended exercise guidelines (Bellizzi, Rowland, Jeffery, & McNeel, 2005; Blanchard, Courneya, & Stein, 2008). Furthermore, exercise levels decline after cancer diagnosis (Courneya & Friedenreich, 1998; Huy, Schmidt, Vrieling, Chang-Claude, & Steindorf, 2012). Therefore, the question arises how cancer patients can be supported in setting up or maintaining a physically active lifestyle.

Social support is an important factor influencing health outcomes (e.g. Berkman, Glass, Brissette, & Seeman, 2000; Holt-Lunstad, Smith, & Layton, 2010). According to the theory by Uchino (2006) – describing the links between social support and physical health – one pathway for this relation is that supportive others help to increase health behaviors. Social support involves attempts to aid and reinforce someone's own efforts to positively change his or her health behavior (Franks et al., 2006). In contrast, social control refers to interactions that involve influence, regulation and constraints (Helgeson, Novak, Lepore, & Eton, 2004; Lewis & Rook, 1999) and comprises attempts to change someone's health behavior who has been unable or unwilling to make such changes (Franks et al., 2006). Thus, both social support and social control behaviors are conducted with the intention to protect the recipient's health (Khan, Stephens, Franks, Rook, & Salem, 2013), but represent two distinct constructs (Helgeson et al., 2004).

In the context of exercise and cancer, social support includes for example being physically active together with the cancer patient, encouraging the patient to exercise or assisting the patient in carrying out exercise (Khan et al., 2013; Sallis, Grossman, Pinski, Patterson, & Nader, 1987). On the other hand, examples for social control behaviors aimed at increasing exercise levels are criticizing the patient for his or her insufficient physical activity, prompting the patient to exercise more or observing if the recipient really is exercising (Khan et al., 2013).

Social support has already been identified as a positive determinant of exercise in various populations (e.g. Anderson-Bill, Winett, & Wojcik, 2011; Bauman et al., 2012; Franks et al., 2006; Khan et al., 2013; Van Dyck et al., 2011). A review by Barber (2012) revealed a positive relationship between social support and cancer patients' physical activity in about

50% of the included 22 studies. However, the samples consisted mostly (59%) of breast cancer patients.

In contrast, the findings regarding the direction of the relationship between social control and exercise are inconsistent (see Knoll, Burkert, Scholz, Roigas, & Gralla, 2012): The use of pressure (e.g. criticizing, nagging), which can be classified as a social control strategy, was associated with better health behavior (including physical activity) in patients suffering from osteoarthritis (Stephens et al., 2009). Other research findings, however, suggest that social control has a negative impact on exercise in adults suffering from diabetes (Khan et al., 2013; Thorpe, Lewis, & Sterba, 2008). Franks et al. (2006) also found reduced health behavior, including physical activity, as a result of social control in patients participating in cardiac rehabilitation.

To the authors' knowledge, no study in the exercise and cancer domain has distinguished between social support and social control and there is only one study that has analyzed the impact of social control on cancer patients' physical activity levels so far (Helgeson et al., 2004). Helgeson and colleagues investigated the influence of social control on several health behaviors in men with prostate cancer. Results showed that social control was unrelated to health-enhancing behavior like physical activity. Health-restorative and health-comprising social control were even associated with poor health behaviors and greater psychological distress (Helgeson et al., 2004).

Overall, the evidence for a negative or no impact of social control on exercise behavior predominates. A construct that could explain the missing positive effect of social control on health behavior or even "boomerang effects" is psychological reactance. Reactance is described as an aversive motivational state that arises when an individual perceives its behavioral freedoms as threatened or lost (Brehm, 1966). In order to reduce reactance, individuals try to engage in behaviors that are able to reestablish the freedom that has been threatened. Such behaviors can be contrary to the behavior that was originally desired by the person who evoked reactance. According to reactance theory, social control should – when perceived as a threat to the personal freedom – evoke reactance, whereas social support should be unrelated to reactance. To our knowledge, no studies have examined the role of reactance in the field of exercise among cancer patients so far.

When examining the associations between social support, social control, reactance and exercise, it is important to consider gender differences. Previous research has investigated differences between men and women regarding health behaviors (Gough, 2013; Helgeson, 2012) and supporting behaviors within a marriage (Neff & Karney, 2005). There are gender differences in how much women and men facilitate their spouses' health behavior: typically, women take more care of their spouses' health, nutrition and exercise and constrain health risk behavior more than men do towards their wives (Allen, Griffith, & Gaines, 2013;

Miller & Wortman, 2002; Zhu, Nguyen, Cummins, Wong, & Wightman, 2006). In line with these findings, women are often regarded as “health promotion agents” (Marcell, Howard, Plowden, & Watson, 2010) for their partners. Furthermore, large cross-sectional surveys among (culturally diverse) undergraduates have shown that men had a significantly higher level of trait reactance than women (Seemann, Buboltz, Jenkins, Soper, & Woller, 2004; Woller, Buboltz, & Loveland, 2007). Previous studies did not investigate whether female and male cancer patients differ in the amount of received social support and control by their relatives to engage in exercise and if they react with a varying extent of reactance.

Another limitation of previous research on social influences on physical activity among cancer patients – e.g. included in the review by Barber (2012) – is that social support was only assessed by self-reports of cancer patients. According to the conceptual framework by Dunkel-Schetter describing elements of social interactions, three different perspectives of social support should be considered: the recipient’s, the provider’s and an outside observer’s perspective (Dunkel-Schetter, Blasband, Feinstein, & Herbert, 1992). As relatives, friends or other persons who actually provide social support did not take part in previous studies, only one perspective could be gained. An exception is a study by Gilliam et al. (2012) which questioned both child and adolescent patients and their caregivers about predictors of physical activity, including family support. They found that strength of predictors varied dependent on caregiver and patient reports. To our knowledge, in adult cancer patients the perspective of relatives has not been included so far.

The first aim of this study was to examine associations between social support and control as perceived by the patient and relative-reported social support and control (research question 1). Additionally, we wanted to test our hypothesis that social control but not social support is associated with reactance (hypothesis 2). A further focus was on possible gender-differences within these social factors (research question 3). Finally, we investigated whether social support, social control and reactance are predictors of exercise behavior which was assessed 4 weeks later (research question 4).

Methods

The study consisted of two assessment points and was conducted at the National Center for Tumor Diseases Heidelberg (NCT) in Heidelberg, Germany. At the first measurement point (T1) cancer patients and their relatives took part. Four weeks later (T2), cancer patients were recontacted. Inclusion criteria for the patients were an age of at least 18 years, currently receiving out-patient treatment or follow-up care and being accompanied by a relative or a partner who also agreed to participate in the study. Exclusion criteria were inability to follow the study instructions, in-patient treatment and severe physical constraints which made exercise impossible (i.e. inability to walk or stand). The study was approved by

the ethics committee of the medical faculty Heidelberg (ethics registration number: S-026/2013).

Ninety cancer patients accompanied by a person were personally approached by the study personal (Mareike Weissmann and Annika Knoll) of which 56 patients (62.2%) met the inclusion criteria and agreed to participate. Reasons for not participating were: lack of interest, anticipation of in-patient treatment in the near future, not speaking sufficiently German and being accompanied by a friend but not a relative.

Four weeks after T1, cancer patients were contacted by phone and interviewed (T2). Forty-seven patients (83.9%) completed the study. Of the nine persons who dropped out at T2, seven persons could not be contacted, one person could not be interviewed because of a hospital stay and one person did not want to take part in the survey anymore. One further patient could not be included in the analyses on exercise behavior due to missing values for this variable.

Procedures

At T1, cancer patients who were accompanied by a relative were approached in the waiting areas at the outpatient care unit of the NCT. If they were interested in participating in the study, they provided informed consent prior to receiving instructions for study procedures. Cancer patients at first indicated their exercise behavior within an interview. Thereafter, cancer patients completed a self-administered paper questionnaire that assessed perceived social support and perceived social control for exercise received from the accompanying relative, reactance as well as sociodemographic and medical information. At the same time, relatives completed a paper questionnaire independently from the patient (relatives were told not be in contact with the patient while filling out the questionnaire) regarding social support and social control for cancer patients' exercise and sociodemographic information.

Approximately four weeks after T1 (M = 25.9 days, SD = 4.6 days), cancer patients were recontacted by phone. In the second interview, only exercise and some medical information were assessed.

Measures

Exercise behavior. At both assessment time points, cancer patient's current physical activity behavior was measured with the Seven-Day Physical Activity Recall (Sallis et al., 1985; Sallis et al., 1997). It was asked for the frequency and duration of light, moderate and vigorous physical activity as well as type of physical activity that cancer patients had carried out on each of the last seven days. Behavioral descriptors and examples were provided for all three intensities. Unlike the original, it was only asked for physical activity behavior during the whole day and not for physical activity at specific times of the day (morning, afternoon, evening). The Seven-Day Physical Activity Recall has demonstrated good reliability and validity in multiple studies [see Sallis et al. (1997) for an overview].

Exercise (in minutes per week) was calculated by adding up exclusively moderate and vigorous exercise behavior. This variable was of major interest as it mirrors the exercise guidelines of at least 150 minutes moderate-to-vigorous exercise per week (Schmitz et al., 2010).

In additional analyses *leisure time physical activity* was used comprising a wider range of activities. Beside moderate-to-vigorous exercise it additionally includes *light* leisure time activities (e.g. walking) during the last week. As this variable comprises activities with a wide range of different intensities (from light to vigorous) all activities were weighted with its energy expenditure. Therefore, the time spent in an activity was multiplied with the metabolic equivalents (METs) of the activity according to the compendium by Ainsworth et al. (2011) before summing up all activities per week. The final unit of this "leisure time activity" variable was MET-hours per week.

Social Support and Social Control. At T1, social support and social control for exercise were measured with the Spousal Involvement in Patient Exercise Scale developed by Khan et al. (2013) based on research on spousal involvement in illness management (Franks et al., 2006; Trief et al., 2003). The items were translated into German by native speakers through forward-backward translation. One additional item ("Exercised with me"), which was taken from the Family Support for Exercise Habits Scale (Sallis et al., 1987), was added to the social support scale. The social support scale thus consisted of eight items (in the questionnaire for patients for example: "He/she listened to my concerns about maintaining an exercise routine") and the social control scale of seven items (in the questionnaire for relatives for example: "I tried to influence him/her to do more physical exercise"). All items were rated on a scale from 1 (not at all) to 4 (very much). Khan et al. (2013) reported good reliabilities for both the social support scale (α = .90, daily test-retest α = .72) and the social control scale (α = .90, daily test-retest α = .67). These questionnaires were completed both by cancer patients (perceived social support and control from the accompanying relative) and relatives (relative-reported social support and control) so that reports on social support and social control were independently obtained from two perspectives. In the current sample, Cronbach's alpha for perceived (patient-reported) social support was α = .91 and for relative-reported social support it was α = .77. Cronbach's alpha for perceived and relative-reported social control scale were α = .90 and α = .87 respectively.

State Reactance. State reactance was measured with a modified short scale with six items that had been developed for an intervention-study on fruit and vegetable intake, with a good internal consistency (Cronbach's α = .92) (Ungar, Sieverding, Schweizer, & Stadnitska, under review; Ungar, Sieverding, & Stadnitski, 2013). The items asked for cognitions that have been described as typical indicators of reactance (e.g. Quick & Stephenson, 2007; Traut-Mattausch, Jonas, Förg, Frey, & Heinemann, 2008): Examples are: "Through my

relative's behavior concerning my exercise during the last month, I felt very restricted in my personal freedom" or "Through my relative's behavior concerning my exercise during the last month, I was able to freely decide when I wanted to be physically active and which amount of exercise I wanted to do.". Each statement was rated on a scale from 1 (does not apply at all) to 7 (applies completely). Two items were with reversed polarity. As the internal consistency with all six items was very low (α = .34), participants probably did not comprehend the recoding. The two recoded items were excluded (for all analyses) and Cronbach's alpha of the final scale (4 items) was α = .71.

Statistical Analyses

Descriptive statistics were used to examine demographic, medical and psychological variables as well as exercise for all participants (n = 56 patients and n = 56 relatives). Participants and non-participants at T2 were compared using t-tests (for metric variables) and chi-squared tests (for non-metric variables) including any demographic, medical or psychological variables.

To test the research questions and the hypothesis, bivariate correlations and t-tests were calculated. Pearson correlations were used to test associations between perceived and relative-reported social support /social control (research question 1) and between social support / social control and reactance (hypothesis 2). Gender differences regarding perceived and relative-reported social support and social control as well as reactance were tested based on t-tests (research question 3). To analyze the associations between exercise behavior at T2 and psychological variables at T1 (research question 4) Spearman correlations were used, as the exercise variable strongly deviated from a normal distribution. For an additional analysis of research question 4 a linear regression was conducted with leisure-time physical activity as dependent variable. All socio-demographic and medical variables which correlated significantly with the dependent variable were included as covariates in a first step. Perceived and relative-reported social support and social control as well as reactance were included as predictors in the second step and the adjusted R^2 were compared. Analyses were carried out with IBM SPSS Statistics 21 and employed a significance level of $p < .05$.

Results

Participants

The sample consisted of N = 56 cancer patients (53.6% female) with a mean age of 53.6 years (SD = 12.7; range: 27-75 years) and N = 56 relatives (51.8% female, M_{age} = 52.8, SD = 13.4). In 89% of the dyads the relative was the life partner of the patient. The

Table 1
Sample characteristics (n = 56 cancer patients; n = 56 relatives)

Variable	*Mean*	*(SD)*	or	*%*
Patient report				
Demographic variables				
Female				53.6
Age in years	53.58	(12.72)		
BMI in kilogram/meters^2	25.56	(4.65)		
Marital status				
Married				94.6
Single				3.6
Divorced/widowed				1.8
Currently not working				76.8
Degree of relationship				
Couples				89.3
Parent-child				7.1
Siblings				3.6
Living in one household				89.3
Medical variables				
Type of cancer				
Breast				39.3
Skin				14.3
Colorectal				12.5
Gastric				5.4
Hepatic				5.4
Other				23.2
Time since diagnosis in months	26.31	(33.78)		
Current chemotherapy				57.4
Current radiation therapy				0.0
Previous chemotherapy				20.4
Previous radiation therapy				35.2
Physical activity				
Moderat-to-vigorous exercise at T1[a]	85.98	(181.84)		
Moderate-to-vigorous exercise at T2[a]	90.65	(154.66)		
Leisure time physical activity at T1[b]	16.73	(15.94)		
Leisure time physical activity at T2[b]	18.70	(15.80)		
Psychological Variables				
Social support[c]	2.91	(0.83)		
Social control[c]	2.06	(0.84)		
Reactance[d]	1.61	(0.98)		
Relative report				
Demographic variables				
Female				51.8
Age in years	52.75	(13.42)		
BMI in kilogram/meters^2	25.58	(3.96)		
Psychological Variables				
Social support[c]	3.07	(0.54)		
Social control[c]	2.23	(0.73)		

Note. [a] in minutes per week [b]in MET-hours per week; including light, moderate and vigorous leisure time activities [c] on a scale from 1-4 [d] on a scale from 1-7.

sociodemographic and medical variables are listed in Table 1. All sociodemographic and medical variables were unrelated to exercise behavior and the psychological variables investigated in this study (all *p's* > .05), thus sociodemographic and medical variables were not included in further correlational analyses.

The only significant difference between participants and non-participants at T2 emerged for relative-reported social support, $t(54) = 2.34$, $p < .05$. At T1, relatives of non-participants indicated more social support ($M = 3.44$, $SD = 0.37$) than relatives of participants ($M = 3.00$, $SD = 0.54$). For all other demographic, medical or psychological variable, no differences were found (all *p's* < .05).

Research question 1: Associations between perceived and relative-reported social support and control

Overall, there were significant positive correlations between perceived and relative-reported social support ($r = .431$, $p = .001$) as well as social control ($r = .490$, $p < .001$). Analyzing female and male participants separately, for women we found moderate and significant correlations, whereas for men the correlations between perceived and relative reported measures were lower and not significant (see Table 2).

Hypothesis 2: Associations between social support, social control and reactance

As hypothesized, analyses revealed significant positive correlations between social control and reactance. This was true for perceived social control ($r = .375$, p = .004) as well as for relative reported social control ($r = .407$, $p = .002$). As expected perceived social support was not significantly correlated with reactance, but – unexpectedly – we found a significant association between relative-reported social support and reactance ($r = .303$, $p = .023$).

Research question 3: Gender differences

Gender differences are shown in Figure 1. Male cancer patients perceived significantly more social support and control compared to female patients. Their (mostly female) relatives reported to support and control them more as well. But men also reported a higher amount of reactance.

Comparisons of relative-reported and perceived support and control for male and female relatives separately revealed, that male relatives reported significant higher amounts of social support and social control than the related (mostly female) patients perceived [social support: $M_{\text{relativ-reported}} = 2.98$ ($SD = 0.48$) versus $M_{\text{perceived}} = 2.65$ ($SD = .85$), $t(26) = –2.083$, $p = .047$; social control: $M_{\text{relativ-reported}} = 1.93$ ($SD = 0.56$) versus $M_{\text{perceived}} = 1.62$ ($SD = .65$), $t(26) = –2.166$, $p = .040$]. For female relatives, there were no such differences between relative-reported and perceived social support or social control.

Table 2

Intercorrelations of study variables for the whole sample (above the diagonal) and separated by sex (below diagonal: men-bold, women-italic)

Variable	1.	2.	3.	4.	5.	6.	7.
1. Exercise at T2[a]	_	.32 *	.06	.32 *	.05	.04	-.13
2. Exercise at T1[a]	**.34** *.30*	_	-.03	.09	–.18	–.23 °	–.10
3. Perceived social support[b]	**.04** *.24*	**–.27** *.30*	_	.43 **	.65 **	.40 **	.20
4. Relative reported social support[b]	**.05** *.53* **	**.30** *.07*	**.19** *.43* *	_	.25 °	.60 **	.30 *
5. Perceived social control[b]	**–.11** *.36* °	**–.53** ** *.29*	**.44** * *.65* **	**<.01** *.20*	_	.49 **	.38 **
6. Relative-reported social control[b]	**–.12** *.23*	**–.06** *–.29*	**.11** *.35*	**.68** ** *.44* *	**.24** *.39* *	_	.41 **
7. Reactance[c]	**–.39** ° *.10*	**.05** * *–.08*	**.15** *–.08*	**.36** ° *.02*	**.37** ° *–.02*	**.37** ° *<.01*	_

Note. Pearson correlations were conducted for all variables except exercise at T1 and exercise at T2. For the exercise variables Spearman correlations were used because of strong deviation from normal assumption [a] in minutes per week derived from the 7-day recall [b] on a scale from 1-4, [c] on a scale from 1-7, ° p < .10, * *p* < *.05, ** p* < *.01*

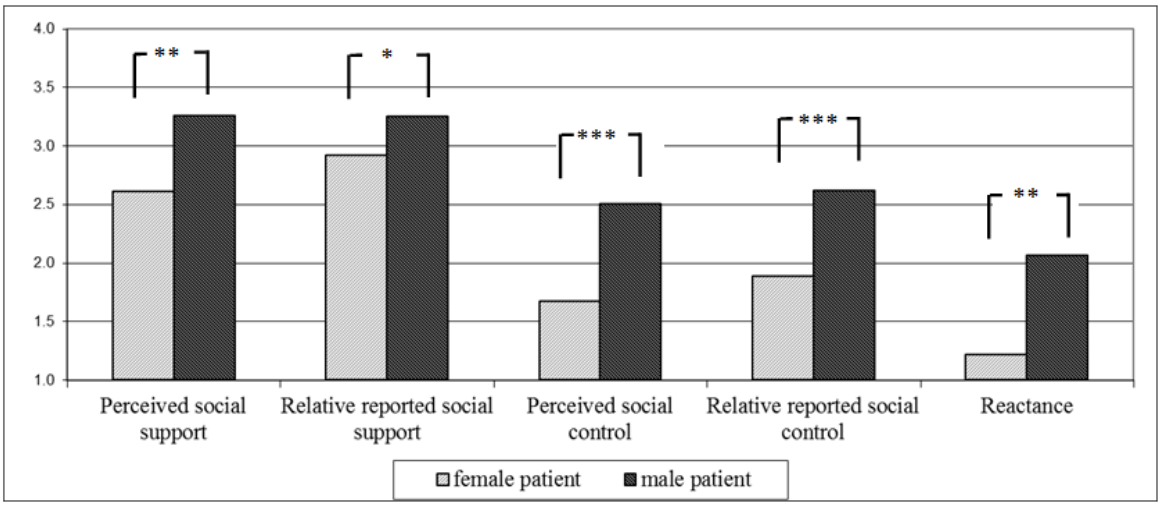

Figure 1. Gender-differences in psychological variables (assessed at T1). Social support and social control were assessed on a scale from 1-4, reactance was assessed on a scale from 1-7; *t*-tests were calculated; ** p < .05, ** p < .01, *** p < .001.*

Research question 4: Predictors of exercise at T2

Exercise at T2 turned out to have a highly zero-inflated distribution, as 63% of participants did not engage in any moderate-to-vigorous exercise at T2. Because of this highly skewed distribution, the clumbing of zeros and the resulting missing normality assumption, no linear regression analyses could be performed. Spearman correlations show that exercise at T2 was positively associated with relative-reported social support at T1 (r = .324, p = .028). There were no associations with all other psychological variables (see Table 2). Analyzing male and female patients separately, yielded different patterns. Among women, relative-reported social support at T1 was highly (r = .533, p = .004) and social control marginally (r = .359, p = .066) related to exercise at T2. For men, on the other hand, reactance at T1 was the only marginally significant determinant (r = –.392, p = .097): the more men felt restricted in their freedom the less they exercised at T2.

Additional analyses for research question 4

The associations between psychological variables at T1 and physical activity at T2 were additionally examined using *leisure time physical activity* (instead of at least moderate *exercise*) as a broader indicator of physical activity. As most of the participants engaged in (some amount of) *leisure time physical activity* (only 11% did not engage in any leisure time physical activity) this variable could be used as dependent variable in a hierarchical linear regression analyses. The Spearman correlation between *exercise* and *leisure time physical activity* was r = .532 (p < .001). Leisure time physical activity at T1 and body mass index were included as covariates in a first step (as they significantly correlated with the dependent

variable), were both significant determinants (physical activity at T1: β = .702, p < .001; BMI: β = .315, p = .003) and explained 56% of the variance. In a second step, all psychological variables (assessed at T1) were included. The regression analysis revealed that relative-reported social support was the only psychological variable being a significant predictor (β = .312, p = .012) over and above physical activity at T1 and BMI confirming the above described correlational analyses. Additional 9% of the variance could be explained in the second step.

Discussion

Social support can help cancer patients to increase their exercise level (see review by Barber, 2012), but social control can have detrimental effects (Helgeson et al., 2004; Khan et al., 2013; Knoll et al., 2012). This study adds to the previous literature in the exercise and cancer domain by distinguishing between social support and social control and examining the role of reactance. By including not only the patients but also a relative (to our knowledge for the first time), two different perspectives could be gained and compared: perceived versus relative-reported support and control. Furthermore, gender-differences were regarded.

Results yielded that perceived social support and social control were moderately associated with relative reported support and control. But, interestingly, this association was only found for female patients. One reason for the missing associations between perceived and relative-reported social support and control among male patients might be that they are not aware of the support they receive by their wives or other relatives. Recently, the new research topic of invisible social support and invisible social control has emerged as research has shown that support and control attempts of a provider are sometimes not recognized by the receiver (e.g. Lüscher, Ochsner, Berli, et al., 2014; Stephens, Rook, Franks, Khan, & Iida, 2010).

We also investigated how psychological variables at T1 were related to exercise behavior at T2 controlling for exercise at T1 and BMI. Relative-reported social support was the only variable that was significantly related to exercise across two different measurements of physical activity. This is in line with previous studies from other domains, showing that social support has positive effects on exercise (e.g. Barber, 2012; Bauman et al., 2012; Franks et al., 2006; Fraser & Rodgers, 2012; Khan et al., 2013; Van Dyck et al., 2011), whereas the results regarding social control were inconsistent (e.g. Helgeson et al., 2004; Khan et al., 2013; Stephens et al., 2009; Tucker & Anders, 2001).

Surprisingly, in our study only relative-reported and not perceived social support revealed to be a significant predictor of exercise at T2. According to the conceptual frame-work of Dunkel-Schetter et al. (1992) different perspectives of social support should be considered (the recipient, the provider and an outside observer) but the highest priority has

perceived social support of the recipient (Dunkel-Schetter & Bennett, 1990). Nevertheless, our results are congruent to evidence from prior research that found that spouses' perceptions of their influence, and not patients' reports, explained patients' dietary adherence (Stephens et al., 2010). Furthermore, Franks et al. (2006) and Khan et al. (2013) have shown that relative-reported social support had a positive effect on health behavior. This gap between the theoretical assumption that the perception of the recipient is most influential and empirical findings highlighting the effects providers' reports has to be further investigated.

Results of this study revealed that male cancer patients were more supported by their partners than female patients. This was true for the patients' and the relatives' perspectives of social support. This result is in line with findings of a study examining the course of spousal support in the context of mainly gastrointestinal cancer surgery (Luszczynska, Boehmer, Knoll, Schulz, & Schwarzer, 2007). Another recent study has not only focused on the help by a relative but differentiated between support received by a significant other and support received by friends (Coleman, Berg, & Thompson, 2014). It came out that walking for exercise was only associated with greater friend support. The support by friends might be especially important for women and this might compensate for the lower support of their partners. Previous research has shown that women have a wider range of sources of their support (Fuhrer & Stansfeld, 2002) and that they do not nominate their spouse as closest person as much as men do (women: 79.6%; men: 92.4%) (Fuhrer, Stansfeld, Chemali, & Shipley, 1999).

For male patients, reactance seems to play a more important role than for female patients. Our data show that male patients reported a higher amount of reactance than females did which is in line with previous research (Seemann et al., 2004; Woller et al., 2007). Additionally, we found that especially male patients felt their behavioral freedoms as threatened when they felt controlled by their relatives (mostly wives) regarding their exercise behavior. Contrary, for female cancer, there was no association between social control and reactance. Furthermore, only among men there was a (marginally significant) relation between reactance at T1 and exercise at T2 (r = –.39). Men who felt reactant at the first measurement point were (marginally) less physically active later on.

Interestingly, only male relatives reported significant higher amounts of social support and social control than the related (mostly female) patients perceived. For female relatives, there were no such differences between relative-reported and perceived social support or social control. It might be that male relatives exaggerated in rating their support and control, whereas female relatives estimated their supporting behavior more realistic.

Several limitations of the study have to be mentioned. The study consisted of a small and heterogeneous sample. Especially the analyses separately for men and women were based on very small sample sizes. Due to the small sample size possible analysis options

were restricted. The study can be regarded as pilot study and the found associations have to be investigated in bigger and representative samples. One further limitation of this study is that the analyses of research question 1 and 3 and hypothesis 2 are based on cross-sectional data and do not allow any causal assumption. Changes in psychological variables across time could not be regarded.

Additionally, more than half of participants did not engage in any moderate-to-vigorous exercise. This made the analysis of the exercise variable difficult. As the sample size was too small for appropriate regression models accounting for this zero-inflated distribution [e.g. by calculating a Poisson-Gamma regression (Brown & Dunn, 2011)] only Spearman correlations were conducted. Nevertheless, the finding of this high proportion of sedentary cancer patients is in line with previous research: For example, in a study by Speed-Andrews et al. (2012) 46% of colorectal cancer patients were classified as completely sedentary (i.e. 0 min/week physical activity). Coups and Ostroff (2005) reported that between 68% and 80% of cancer patients were physically inactive (i.e. not meeting the exercise recommendation). In our study 86% / 74% did not meet the exercise recommendation at T1 / T2.

Finally, the measure of reactance could be improved. In the present study reactance was measured retrospectively. However, it is possible that cancer patients did not remember accurately how they had felt after social control behaviors of their relatives. Some of the studies investigating state reactance use experimental designs, thus being able to measure state reactance directly when it occurs in the individual (e.g. Erceg-Hurn & Steed, 2011; Quick & Stephenson, 2007).

A major strength of the study was the dyadic design. In contrast to previous research regarding exercise behavior among cancer patients, not only the patients but also a close relative (mostly the husband or wife) who accompanied the patient to treatment in the NCT was included in the study. Thereby two different perspectives of social support and control could be gained and compared. Social exchange processes were regarded more differentiated than in previous research in the exercise and cancer domain, as the study distinguished between social support and social control. Additionally, this study was a first attempt to examine the role of reactance regarding exercise behavior in cancer patients.

Future research should broaden its view and not only look at the patients but also at their family, friends, physicians and further parts of their network. Different sources of social support and social control should be compared. Thereby, it would be necessary to include relationship satisfaction in future studies as it has been shown to be a relevant moderator between social control and health behavior (Knoll et al., 2012). Furthermore, research should test the relations found in this correlational study within experimental designs.

Our study has direct practical implications. Results support the need to integrate relatives in the promotion of exercise among cancer patients. It was shown that especially

relative-reported “actual” support – not perceived social support – was a predictor of engaging in exercise behavior. Consequently, relatives should be reinforced to support their partners. For example, an information event addressing relatives of cancer patients could inform about basic rules regarding exercise during cancer treatment like exercise guidelines, contraindications, etc. Furthermore, information on psychological mechanisms should be provided (e.g. support versus control) and relatives should be made aware of the danger to evoke reactance. A study by Aymanns, Filipp, & Winkeler (2013) has shown that higher self-ascribed competence to help was associated with an increased provision of social support.

As results revealed that female patients were less supported by their relatives than male patients, a coaching for male partners on how to support their female cancer patient seems promising. Neff and Karney (2005) have shown that husbands and wives did not differ in their skill at providing support but in their responsiveness to their partners´ changing needs. Thus, male caregivers might profit from being advised how to respond to their partners’ needs. This seems especially necessary during the unstable time of a cancer treatment.

In conclusion, this study highlighted that social exchange processes are relevant for exercise behavior among cancer patients by integrating two perspectives: the view of the patients as well as relatives. The distinction between social support and social control seems promising as only support was positively related to exercise. Reactance might play a role especially for male cancer patients.

References

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Tudor-Locke, C., . . . Leon, A. S. (2011). 2011 compendium of physical activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise, 43*(8), 1575-1581. doi: 10.1249/MSS.0b013e31821ece12

Allen, J. O., Griffith, D. M., & Gaines, H. C. (2013). “She looks out for the meals, period”: African American men's perceptions of how their wives influence their eating behavior and dietary health. *Health Psychology, 32*(4), 447-455. doi: 10.1037/a0028361

Anderson-Bill, E. S., Winett, R. A., & Wojcik, J. R. (2011). Social cognitive determinants of nutrition and physical activity among web-health users enrolling in an online intervention: the influence of social support, self-efficacy, outcome expectations, and self-regulation. *Journal of Medical Internet Research, 13*(1), e28. doi: 10.2196/jmir.1551

Anton, P. M., Partridge, J. A., & Morrissy, M. J. (2013). Cancer caregivers’ perceptions of an exercise and nutrition program. *Supportive Care in Cancer, 21*(3), 803-810. doi: 10.1007/s00520-012-1583-8

Barber, F. D. (2012). Social support and physical activity engagement by cancer survivors. *Clinical Journal of Oncology Nursing, 16*(3), E84-E98. doi: 10.1188/12.CJON.E84-E98

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet, 380*(9838), 258-271. doi: 10.1016/S0140-6736(12)60735-1

Bellizzi, K. M., Rowland, J. H., Jeffery, D. D., & McNeel, T. (2005). Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *Journal of Clinical Oncology, 23*(34), 8884-8893. doi: 10.1200/jco.2005.02.2343

Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine, 51*(6), 843-857. doi: 10.1016/S0277-9536(00)00065-4

Blanchard, C. M., Courneya, K. S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: Results from the American Cancer Society's SCS-II. *Journal of Clinical Oncology, 26*(13), 2198-2204. doi: 10.1200/jco.2007.14.6217

Brehm, J. W. (1966). *A theory of psychological reactance*. New York [u.a.]: Academic Press.

Brown, J. E., & Dunn, P. K. (2011). Comparisons of tobit, linear, and poisson-gamma regression models: An application of time use data. *Sociological Methods & Research, 40*(3), 511-535. doi: 10.1177/0049124111415370

Coleman, S., Berg, C. J., & Thompson, N. J. (2014). Social support, nutrition intake, and physical activity in cancer survivors. *American Journal of Health Behavior, 38*(3), 414-419. doi: 10.5993/AJHB.38.3.10

Coups, E. J., & Ostroff, J. S. (2005). A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Preventive Medicine, 40*(6), 702-711. doi: 10.1016/j.ypmed.2004.09.011

Courneya, K. S., & Friedenreich, C. M. (1998). Relationship between exercise during treatment and current quality of life among survivors of breast cancer. *Journal of Psychosocial Oncology, 15*(3-4), 35-57. doi: 10.1300/J077v15n03_02

Dunkel-Schetter, C., & Bennett, T. L. (1990). Differentiating the cognitive and behavioral aspects of social support. In B. R. Sarason, I. G. Sarason & G. R. Pierce (Eds.), *Social support: An interactional view* (Vol. xvi, pp. 267-296). Oxford, England: John Wiley & Sons.

Dunkel-Schetter, C., Blasband, D. E., Feinstein, L. G., & Herbert, T. B. (1992). Elements of supportive interactions: When are attempts to help effective? In S. Spacapan & S. Oskamp (Eds.), *Helping and being helped: Naturalistic studies. The Claremont Symposium of Applied Psychology* (pp. 83-114). Thousand Oaks, CA: Sage Publications.

Erceg-Hurn, D. M., & Steed, L. G. (2011). Does exposure to cigarette health warnings elicit psychological reactance in smokers? *Journal of Applied Social Psychology, 41*(1), 219-237. doi: 10.1111/j.1559-1816.2010.00710.x

Franks, M. M., Stephens, M. A. P., Rook, K. S., Franklin, B. A., Keteyian, S. J., & Artinian, N. T. (2006). Spouses' provision of health-related support and control to patients participating in cardiac rehabilitation. *Journal of Family Psychology, 20*(2), 311-318. doi: 10.1037/0893-3200.20.2.311

Fraser, S. N., & Rodgers, W. M. (2012). The influence of general and exercise specific social support on self-sfficacy for overcoming barriers to cardiac rehabilitation. *Journal of Applied Social Psychology, 42*(8), 1811-1829. doi: 10.1111/j.1559-1816.2012.00919.x

Fuhrer, R., & Stansfeld, S. A. (2002). How gender affects patterns of social relations and their impact on health: a comparison of one or multiple sources of support from “close persons”. *Social Science & Medicine, 54*(5), 811-825. doi: 10.1016/S0277-9536(01)00111-3

Fuhrer, R., Stansfeld, S. A., Chemali, J., & Shipley, M. J. (1999). Gender, social relations and mental health: prospective findings from an occupational cohort (Whitehall II study). *Social Science & Medicine, 48*(1), 77-87. doi: 10.1016/S0277-9536(98)00290-1

Gilliam, M. B., Madan-Swain, A., Whelan, K., Tucker, D. C., Demark-Wahnefried, W., & Schwebel, D. C. (2012). Social, demographic, and medical influences on physical

activity in child and adolescent cancer survivors. *Journal of Pediatric Psychology*, jsr085. doi: 10.1093/jpepsy/jsr085

Gough, B. (2013). The psychology of men's health: Maximizing masculine capital. *Health Psychology, 32*(1), 1-4. doi: 10.1037/a0030424

Helgeson, V. S. (2012). Gender and health - A social psychological perspective. In A. Baum, T. A. Revenson & J. Singer (Eds.), *Handbook of health psychology (2nd ed.).* (pp. 519-537). New York, NY US: Psychology Press.

Helgeson, V. S., Novak, S. A., Lepore, S. J., & Eton, D. T. (2004). Spouse social control efforts: Relations to health behavior and well-being among men with prostate cancer. *Journal of Social and Personal Relationships, 21*(1), 53-68. doi: 10.1177/0265407504039840

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: a meta-analytic review. *PLoS Medicine,* 7(7), e1000316. doi: 10.1371/journal.pmed.1000316

Huy, C., Schmidt, M. E., Vrieling, A., Chang-Claude, J., & Steindorf, K. (2012). Physical activity in a German breast cancer patient cohort: one-year trends and characteristics associated with change in activity level. *European Journal of Cancer, 48*(3), 297-304. doi: 10.1016/j.ejca.2011.08.005

Khan, C. M., Stephens, M. A. P., Franks, M. M., Rook, K. S., & Salem, J. K. (2013). Influences of spousal support and control on diabetes management through physical activity. *Health Psychology, 32*(7), 739-747. doi: 10.1037/a0028609

Knoll, N., Burkert, S., Scholz, U., Roigas, J., & Gralla, O. (2012). The dual-effects model of social control revisited: Relationship satisfaction as a moderator. *Anxiety, Stress & Coping, 25*(3), 291-307. doi: 10.1080/10615806.2011.584188

Lewis, M. A., & Rook, K. S. (1999). Social control in personal relationships: impact on health behaviors and psychological distress. *Health Psychology, 18*(1), 63-71. doi: 10.1037/0278-6133.18.1.63

Lüscher, J., Ochsner, S., Berli, C., Knoll, N., Stadler, G., Hornung, R., & Scholz, U. (2014). Invisible social control as predictor of daily negative affect and smoking after a self-set quit date. *Zeitschrift für Gesundheitspsychologie, 22*(4), 165-174. doi: 10.1026/0943-8149/a000126

Lüscher, J., Ochsner, S., Knoll, N., Stadler, G., Hornung, R., & Scholz, U. (2014). Examining gender differences in received, provided, and invisible social control: an application of the dual-effects model. *Anxiety, Stress & Coping*, 27(6), 678-94. doi: 10.1080/10615806.2014.892585

Luszczynska, A., Boehmer, S., Knoll, N., Schulz, U., & Schwarzer, R. (2007). Emotional support for men and women with cancer: Do patients receive what their partners

provide? *International Journal of Behavioral Medicine, 14*(3), 156-163. doi: 10.1007/BF03000187

Marcell, A. V., Howard, T. L., Plowden, K., & Watson, C. (2010). Exploring women's perceptions about their role in supporting partners' and sons' reproductive health care. *American Journal of Mens Health, 4*(4), 297-304. doi: 10.1177/1557988309335822

Miller, E., & Wortman, C. (2002). Gender differences in mortality and morbidity following a major stressor: The case of conjugal bereavement. In G. Weidner, M. S. Kopp & M. Kristenson (Eds.), *Heart disease: Environment, stress, and gender* (Vol. 327, pp. 251-266). Amsterdam, Netherlands: IOS Press.

Mishra, S. I., Scherer, R. W., Geigle, P. M., Berlanstein, D. R., Topaloglu, O., Gotay, C. C., & Snyder, C. (2012). Exercise interventions on health-related quality of life for cancer survivors. *The Cochrane Library, Issue 8. Art. No.: CD007566*. doi: 10.1002/14651858.CD007566.pub2

Mishra, S. I., Scherer, R. W., Snyder, C., Geigle, P. M., Berlanstein, D. R., & Topaloglu, O. (2012). Exercise interventions on health-related quality of life for people with cancer during active treatment. *The Cochrane Library, Issue 8. Art. No.: CD008465*. doi: 10.1002/14651858.CD008465.pub2

Neff, L. A., & Karney, B. R. (2005). Gender differences in social support: a question of skill or responsiveness? *Journal of Personality and Social Psychology, 88*(1), 79-90. doi: 10.1037/0022-3514.88.1.79

Quick, B. L., & Stephenson, M. T. (2007). Further evidence that psychological reactance can be modeled as a combination of anger and negative cognitions. *Communication Research, 34*(3), 255-276. doi: 10.1177/0093650207300427

Sallis, J. F., Grossman, R. M., Pinski, R. B., Patterson, T. L., & Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*(6), 825-836. doi: 10.1016/0091-7435(87)90022-3

Sallis, J. F., Haskell, W. L., Wood, P. D., Fortmann, S. P., Rogers, T., Blair, S. N., & Paffenbarger, R. S. (1985). Physical activity assessment methodology in the Five-City Project. *American Journal of Epidemiology, 121*(1), 91-106.

Sallis, J. F., Sarkin, J., Campbell, J., Gross, L., Roby, J., Bazzo, S., & Calfas, K. (1997). Seven-day physical activity recall. *Medicine & Science in Sports & Exercise, 29*(6 Supplement), 89-103. doi: 10.1097/00005768-199706001-00018

Schmitz, K. H., Courneya, K. S., Matthews, C., Demark-Wahnefried, W., Galvao, D. A., Pinto, B. M., . . . Schwartz, A. L. (2010). American college of sports medicine roundtable on exercise guidelines for cancer survivors. *Medicine and Science in Sports and Exercise, 42*(7), 1409-1426. doi: 10.1249/MSS.0b013e3181e0c112

Seemann, E. A., Buboltz, W. C., Jenkins, S. M., Soper, B., & Woller, K. (2004). Ethnic and gender differences in psychological reactance: the importance of reactance in multicultural counselling. *Counselling Psychology Quarterly, 17*(2), 167-176. doi: 10.1080/09515070410001728316

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 4*(2), 87-100. doi: 10.1007/s11764-009-0110-5

Speed-Andrews, A. E., Rhodes, R. E., Blanchard, C. M., Culos-Reed, S. N., Friedenreich, C. M., Belanger, L. J., & Courneya, K. S. (2012). Medical, demographic and social cognitive correlates of physical activity in a population-based sample of colorectal cancer survivors. *European Journal of Cancer Care, 21*(2), 187-196. doi: 10.1111/j.1365-2354.2011.01290.x

Stephens, M. A. P., Fekete, E. M., Franks, M. M., Rook, K. S., Druley, J. A., & Greene, K. (2009). Spouses' use of pressure and persuasion to promote osteoarthritis patients' medical adherence after orthopedic surgery. *Health Psychology, 28*(1), 48-55. doi: 10.1037/a0012385

Stephens, M. A. P., Rook, K. S., Franks, M. M., Khan, C., & Iida, M. (2010). Spouses use of social control to improve diabetic patients' dietary adherence. *Families, Systems, & Health, 28*(3), 199-208. doi: 10.1037/a0020513

Thorpe, C. T., Lewis, M. A., & Sterba, K. R. (2008). Reactions to health-related social control in young adults with type 1 diabetes. *Journal of Behavioral Medicine, 31*(2), 93-103. doi: 10.1007/s10865-007-9125-4

Traut-Mattausch, E., Jonas, E., Förg, M., Frey, D., & Heinemann, F. (2008). How should politicians justify reforms to avoid psychological reactance, negative attitudes, and financial dishonesty? *Zeitschrift für Psychologie/Journal of Psychology, 216*(4), 218-225. doi: 10.1027/0044-3409.216.4.218

Trief, P. M., Sandberg, J., Greenberg, R. P., Graff, K., Castronova, N., Yoon, M., & Weinstock, R. S. (2003). Describing support: a qualitative study of couples living with diabetes. *Families, Systems, & Health, 21*(1), 57-67. doi: 10.1037/h0089502

Tucker, J. S., & Anders, S. L. (2001). Social control of health behaviors in marriage. *Journal of Applied Social Psychology, 31*(3), 467-485. doi: 10.1111/j.1559-1816.2001.tb02051.x

Uchino, B. N. (2006). Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine, 29*(4), 377-387. doi: 10.1007/s10865-006-9056-5

Ungar, N., Sieverding, M., Schweizer, F., & Stadnitska, T. (under review). Let me eat what I want: Intervention-Elicited Reactance and Its Implications. *Zeitschrift für Psychologie [Journal of Psychology]*.

Ungar, N., Sieverding, M., & Stadnitski, T. (2013). Increasing fruit and vegetable intake. "Five a day" versus "just one more". *Appetite, 65*, 200-204. doi: 10.1016/j.appet.2013.02.007

Van Dyck, D., Cardon, G., Deforche, B., Giles-Corti, B., Sallis, J. F., Owen, N., & De Bourdeaudhuij, I. (2011). Environmental and psychosocial correlates of accelerometer-assessed and self-reported physical activity in Belgian adults. *International Journal of Behavioral Medicine, 18*(3), 235-245. doi: 10.1007/s12529-010-9127-4

Woller, K. M., Buboltz, W. C., & Loveland, J. M. (2007). Psychological reactance: examination across age, ethnicity, and gender. *The American Journal of Psychology*, 15-24. doi: 10.2307/20445379

Zhu, S.-H., Nguyen, Q. B., Cummins, S., Wong, S., & Wightman, V. (2006). Non-smokers seeking help for smokers: a preliminary study. *Tobacco Control, 15*(2), 107-113. doi: 10.1136/tc.2005.012401

6. Manuscript 3

Ungar, N., Sieverding, M., Weidner, G., Ulrich, C. M., & Wiskemann, J. (under review). A self-regulation-based intervention to increase physical activity in cancer patients. *Psychology, Health & Medicine (Special Issue „Self-regulation in the context of health and illness").*

Abstract

The study examined if a behavior-change intervention focusing on self-regulatory strategies and emphasizing role model support increases physical activity (PA) among insufficiently active (not meeting PA guidelines of 150min/week) cancer patients. Ambulatory cancer patients [*N*=72; 54% female; *M*=56 years, *SD*=12.34; most with breast or colon cancer (34%, 15%)] were enrolled in the MOTIVACTION study, a 4-week intervention (1hr counseling followed by weekly phone calls), with pre-test (T1), post-test (T2), and a 10-week follow-up (T3). Participants were randomized to either an exercise or to a stress management intervention (active control). The exercise intervention emphasized self-regulatory strategies (e.g. action- and coping planning and self-monitoring); patients were also encouraged to contact a physically active same sex role model as a potential exercise partner. The active control condition consisted of coping and relaxation techniques. Sixty-seven patients remained in the study and completed the SQUASH assessment of PA and a measure of perceived stress. PA was validated by Actigraph accelerometry. At T2, 46% of the patients in the exercise group, and 19% of stress management patients increased their activity levels to meet PA guidelines (>150min/week; $\chi^2(1)=5.51$, $p=.019$). At T3, participants in the exercise intervention maintained their exercise level (46%), but also 31% of the stress management patients met the guidelines. All patients reported reductions in perceived stress. Additional analyses comparing patients in the exercise group by role model contact (63% realized contact), revealed that those who had contact with their role model were significantly more likely to adhere to the recommended guidelines (T2:50%; T3:64%) compared to those who did not have contact with a role model (T2:39%; T3:15%) suggesting the potential of mobilizing role model support to facilitate PA. In sum, cancer patients may not only benefit from an exercise intervention emphasizing self-regulation, but also from stress management, regarding both reducing stress and increasing PA.

Keywords: self-regulation; behavior change; physical activity; role model; perceived stress

Introduction

Physical activity has beneficial effects for cancer patients during medical treatment, such as improved quality of life, increased physical functioning, reduced fatigue, and fewer side-effects of cancer treatment (Courneya & Friedenreich, 2011; Speck, Courneya, Mâsse, Duval, & Schmitz, 2010). Exercise guidelines for cancer patients recommend 150 minutes of moderate-intensity aerobic exercise per week (Schmitz et al., 2010). While patients generally express motivation to be physically active (e.g. Demark-Wahnefried, Peterson, McBride, Lipkus, & Clipp, 2000), only 20-40% of cancer patients meet the recommended guidelines (Bellizzi, Rowland, Jeffery, & McNeel, 2005; Blanchard, Courneya, & Stein, 2008; Coups & Ostroff, 2005).

To ameliorate this situation, several behavior change interventions have been conducted that found increases in (mostly self-reported) physical activity among cancer patients (see e.g. Bennett, Lyons, Winters-Stone, Nail, & Scherer, 2007; Demark-Wahnefried et al., 2007; Short, James, Stacey, & Plotnikoff, 2013; von Gruenigen et al., 2008). The interventions in these studies were typically based on the Transtheoretical Model (Prochaska & DiClemente, 1983), the Social Cognitive Theory (Bandura, 1977, 1986) or the Theory of Planned Behavior (Ajzen, 1991), which all attempt to increase the patient's motivation to act. A more recent behavior change model is the Health Action Process Approach (Schwarzer, 2001, 2008), which focuses on self-regulatory processes, such as planning and action control, to help motivated persons to turn their intention into practice.

Our study employs a HAPA-based intervention, emphasizing self-regulation strategies, and adds a social support component to the intervention for the following reasons: Previous research, albeit in a different context (smoking cessation), has shown that when self-regulatory strategies are combined with social support, synergistic effects emerge (i.e. high levels of the self-regulation and social support was related to most successful smoking cessation; Ochsner et al., 2013). Additionally, a cross-sectional study of breast-cancer patients showed that simply knowing an exercise role-model (a cancer survivor who is already physically active) was associated with increased physical activity (Laura Q. Rogers et al., 2011; L. Q. Rogers et al., 2005). To our knowledge, individual contact with an exercise role model has not been implemented within an intervention study yet.

Thus, in the current study we combined a HAPA based counseling focusing on self-regulatory strategies with encouraging the patient to contact a role model to exercise together. The active control condition consisted of a stress management intervention. Furthermore, we validated self-reported physical activity using an accelerometer. The main aim of the study was to investigate whether patients assigned to an exercise intervention will

be more likely to meet the recommended exercise guidelines for cancer patients than patients receiving stress management.

Methods

Design

Patients were stratified by sex, age (i.e. < or ≥60 years), metastases (i.e. yes/no), and current chemo-therapy (i.e. yes/no) and randomized to either an exercise intervention group or to an active control group, consisting of stress management training. Baseline measurement (T1) took place before the start of the intervention. A post-test (T2) was conducted directly after 4-weeks of intervention, a follow-up (T3), 10 weeks after the post-test. The study protocol for the MOTIVACTION (MOTivational InterVention enhancing physical ACTivity In ONcology patients) study was approved by the institutional review board of the University of Heidelberg.

Participants

Patients of any cancer entity receiving out-patient therapy (acute or maintenance therapy) or finished this therapy not longer than six months ago, who were above 18 years, did not meet the current guidelines of 150 min/week of physical activity, and were able to follow the study instructions were eligible to participate in the study. Exclusion criteria were: planned rehabilitation or inpatient treatment during the next eight weeks, bone metastases, wound healing / scarring not completed, serious diseases or disease-related limitations.

Procedure

From 3/2012 until 12/2012, participants were recruited from the National Center for Tumor Diseases (NCT) in Germany, by newspaper articles, talks, posters in pharmacies, and private oncological practices. Patients were recruited with the slogan “Do something good for yourself – through exercise or stress management”. Both activities were advertised as equally beneficial for the patient (e.g. stress reduction). Interested patients were informed about the study and screened by telephone or personal interview. Eligible patients were scheduled for a baseline assessment session, in which they were interviewed about socio-demographic and medical variables and provided informed consent. They received two packages of questionnaires and an accelerometer. They were instructed to wear the accelerometer for 7 days and to complete the second package of questionnaires containing all items regarding physical activity after the accelerometer period to avoid priming effects. They were told that the accelerometer measures their “activity pattern and stress level” to avoid a sole focus on exercise.

Both interventions consisted of an individual 1hr-counseling session, followed by three weekly telephone calls. After the 4-week intervention (T2), patients were mailed the two packages of questionnaires and the accelerometer again, including written instructions (same

procedure as T1). Approximately 10 weeks after T2, patients completed the final questionnaire and had a telephone-call consisting of a brief interview (5 minutes) and were debriefed (T3). Patients were also offered a summary of their accelerometer data (no feedback during the study).

Treatment groups

The exercise intervention and the stress management intervention (active control group) were of equal length, intensity and duration of contact with the study personnel. The stress management intervention was adapted from stress management training for cancer patients undergoing chemo-therapy (Jacobsen & Meade, 2006; Jacobsen et al., 2002; Jacobsen et al., 2013). The exercise intervention included matching with a same-sex exercise role model as a potential exercise partner, who was recruited from exercise programs at the NCT (if the participant lived more than 50km from the study-center no matching could be done). The role models were informed about the MOTIVACTION-study and agreed to share their contact details. Study participants and role models were encouraged to talk about physical activity (e.g. personal barriers, barrier management strategies), and to meet at least once for walking or cycling together, and/or discuss the above topics via phone. Both conditions are described in Table 1.

Measures

Two physical activity measures were used: the self-reported Short QUestionnaire to ASsess Health-enhancing physical activity (SQUASH) (Wendel-Vos, Schuit, Saris, & Kromhout, 2003) at T1, T2 and T3 and an accelerometer at T1 and T2.

The SQUASH has acceptable psychometric properties (Wagenmakers et al., 2008; Wendel-Vos et al., 2003). The slightly modified questionnaire contained questions about physical activities related to commuting, household, leisure-time, and work. Every activity referred to the last 7 days and included three questions: days per week, average time per day and intensity (light, moderate or vigorous). As the intervention focused on exercise behavior and not physical activity in general, we generated the variable “exercise in minutes/week” according to Caspersen, Powell and Christenson (1985) as “physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (p.128). Accordingly, the exercise variable included all items of the domain leisure-time activities that were rated as at least moderately intense. These six items were: brisk (Nordic-) walking, bicycling, gymnastic or resistance training and three open-ended items called “sport activities”. The open-ended responses were excluded from analysis if the indicated activity was below a metabolic equivalent of 4 according to the Ainsworth compendium (Ainsworth et al., 2011).

Table 1. Description of the two interventions – exercise and stress management

	exercise intervention	**stress management intervention (active control group)**
Duration of intervention	• 1h hour individual counseling session • 3 weekly telephone calls (*M* = 14 min/call) • 4 weeks practicing at home	• 1h hour individual counseling session • 3 weekly telephone calls (*M* = 13 min/call) • 4 weeks practicing at home
Materials used during counseling and to take home	• booklet with behavior change techniques • stretch band • diary to record exercises	• booklet with stress management techniques • CD with relaxation techniques • diary to record stress management techniques
Content of counseling session	Increasing self-regulatory skills for behavior change based on the Health Action Process Approach (HAPA) 1. information about exercise during cancer treatment (past experiences of the patient?) 2. goal setting, goal pursuit (what is realistic during treatment?) 3. action planning (separate plans for days with and without side-effects) 4. coping planning (identifying barriers using a screening questionnaire; how to deal with barriers during treatment) 5. self-monitoring (with diary) 6. trying out exercises	Increasing general self-regulation for coping with the disease 1. information about stress management (past experiences of the patient?) 2. abdominal breathing 3. progressive muscle relaxation 4. cognitive coping technique (coping self-statements based on stress inoculation training (Meichenbaum, 1985)) 5. self-monitoring (with diary) 6. trying out techniques
Content of booster calls	• reviewing the past week • adapting goals and plans • addressing barriers	• reviewing the past week • implementation of techniques in everyday life • addressing barriers
Practicing at home	• exercising according to the individual plan was encouraged	• regular relaxation techniques (if possible daily) were encouraged
Role model	• meeting with an exercise role model (physically active cancer patient) for walking/cycling together was encouraged	• experiences of other cancer patients who practice already relaxation techniques were reported in the booklet

The variable of primary interest was “meeting physical activity guidelines”. If participants exercised equal to or more than 150 minutes/week, this variable was coded as “meeting guidelines”, below 150 minutes/week as “not meeting guidelines”. In addition, a continuous variable “moderate-to-vigorous physical activity” was calculated, including all items of the questionnaire that were rated as at least moderately intense.

Accelerometer

The ActiGraph GT3X+ (ActiGraph, LLC, Pensacola, FL) is a light (19g) and small tri-axial accelerometer recording time-varying accelerations ranging ±6g (http://www.theactigraph.com/products/gt3x-plus/). They were initialized to sample acceleration at a rate of 30 Hz and ActiLife6 LITE analysis software was used. The accelerometer was worn for seven continuous days (during waking hours) before and after the intervention only removed during water-based activities. Data were analyzed if the accelerometer was worn for at least ten hours per day, for at least four days. Analyses were run on moderate-to-vigorous activity (average minutes of moderate, vigorous and very vigorous activity per valid days) and moderate-to-vigorous activity bouts (average time spent in moderate-to-vigorous activity for at least 10 minutes in a row; see Freedson, Melanson, & Sirard (1998)

Perceived stress

The Distress-Thermometer was developed by the National Comprehensive Cancer Network (National Comprehensive Cancer Network, 2003) and the German version has been tested by Mehnert, Müller, Lehmann and Koch (2006). The single-item tool screens psychological distress in cancer patients referring to the last week. The thermometer-like Likert scale ranges from 0 (no distress) to 10 (extreme distress).

Statistical analysis

To detect between-group differences at baseline, Chi-squared tests, t-tests and analyses of variances (ANOVAs) were used. We validated the self-reported exercise measure conducting Pearson´s correlations with the accelerometer values. Chi-squared tests compared groups regarding meeting or not meeting the exercise guidelines at T1, T2 and T3. 2x3 mixed-model ANOVAS used exercise (minutes/week) and perceived stress as a continuous dependent variables, condition (exercise vs. stress management) as between subject factor and time (T1, T2 and T3) as within-subject factor. Additional analyses stratified the exercise group by role model contact, and compared three groups: exercise group with role model contact, exercise group without role model contact, stress management. Analyses were carried out with IBM SPSS Statistics 21 and employed a significance level of $p < .05$.

Results

Study Flow and sample

Study flow can be seen in Figure 1. The final sample consisted of 72 cancer patients who were randomized to receive the exercise (*n* = 36) or stress management (*n* = 36) intervention. The drop-out rate between T1 and T3 was very low, (n = 5, 3 due to death). Thus, 67 participants completed assessments for all time points. Participants' characteristics are shown in Table 2. No significant group differences were noted for any of the variables.

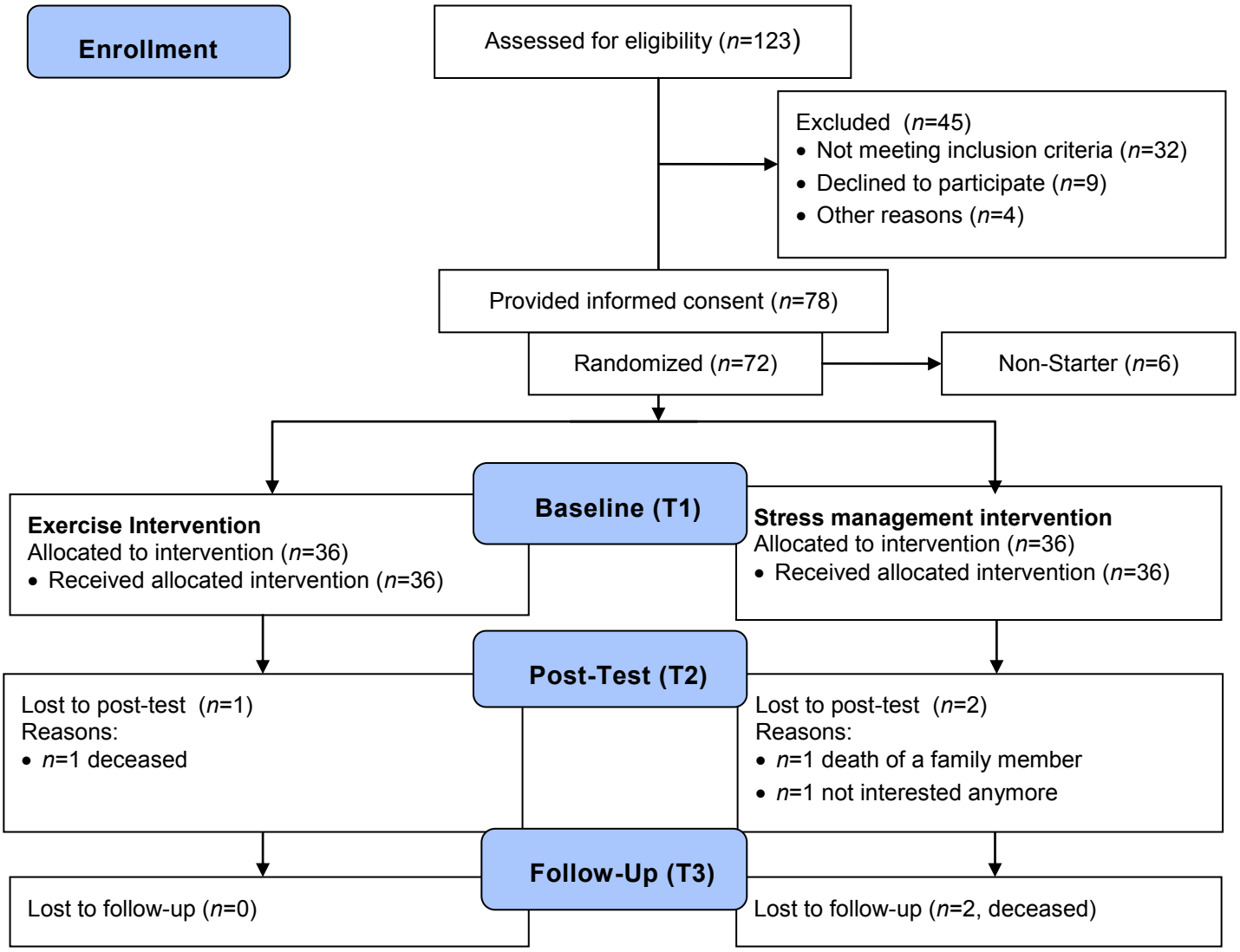

Figure 1. Flow chart of patient participating in the MOTIVACTION study.

Table 2. Baseline characteristics of the sample (N = 67) by group allocation

	exercise				stress management						
	M	(*SD*)	*N*	(%)	*M*	(*SD*)	*N*	(%)	*t*	X^2	*p*-value
age in years	56.69	13.43			54.09	11.72			0.838		.405
female			19	54.3			16	50.0		0.123	.726
family-status										0.552	.759
relationship			28	80.0			27	84.4			
single			3	8.6			3	9.4			
separated			4	11.4			2	6.3			
education level[a]										0.645	.878
low			8	22.9			5	15.6			
middle			9	25.7			8	25.0			
high			18	51.4			19	59.4			
occupation										0.531	.767
full-time			6	17.1			7	21.9			
part-time			5	14.3			3	9.4			
no occupation			24	68.6			22	68.8			
cancer entity										2.206	.531
breast			14	40.0			8	25.0			
colorectal			3	8.6			5	15.6			
prostate			2	5.7			3	9.4			
others			16	45.7			16	50.0			
existance of metastases			13	37.1			9	28.1		0.616	.432
chemotherapy										0.522	.770
currently			12	34.3			13	40.6			
completed			8	22.9			8	25.0			
radiotherapy										1.034	.596
currently			5	14.3			5	15.6			
completed			9	25.7			5	15.6			
treatment at NCT			22	62.9			20	62.5		0.001	.976
exercise[b]	52.14	101.95			41.84	92.47			0.432		.667
PMR[c]			13	39.4			12	41.4		0.025	.874
perceived stress	6.42	2.08			5.75	2.16			1.248		.204

Note: [a] low: ≤ 9 years; middle: 10 years; high: 12 years or more; [b] in minutes per week (practiced during the last week); [c] having ever tried out progressive muscle relaxation according to Jacobsen.

Validation of self-reported physical activity with accelerometer data

Forty-one (61.2%) participants fulfilled the criteria of wearing the accelerometer for at least 10hrs/day on at least 4 days/week on both measurement points. The correlation between questionnaire and accelerometer for moderate-to-vigorous physical activity at T1 was: r = .707 (p<.01). The SQUASH-variable of interest, self-reported exercise (in minutes) at T2 minus T1 correlated with the respective change score obtained from the accelerometer with time spent in moderate-to-vigorous activity bouts (T2 minus T1): r = .346 (p = .027).

Meeting exercise guidelines

Recall that participants were recruited into the MOTIVACTION-study if they did not meet the physical activity guideline of 150 minutes during a regular week at the time of screening. However, at T1, after the accelerometer phase and before randomization, n = 9 (13.4%) (of these n = 5 were in the exercise-group) already met the guidelines (see Figure 2). At T2, 45.7% of the patients of the exercise-group and only 18.8% of the stress management-group exercised 150 minutes/week [$X^2(1) = 5.511$, p = .019]. At T3, still 45.7% of the exercise group exercised 150 minutes/week, but 31.2% of the stress management participants also met the guidelines, rendering the group difference at T3 insignificant [X^2 (1) = 1.473, p = .225].

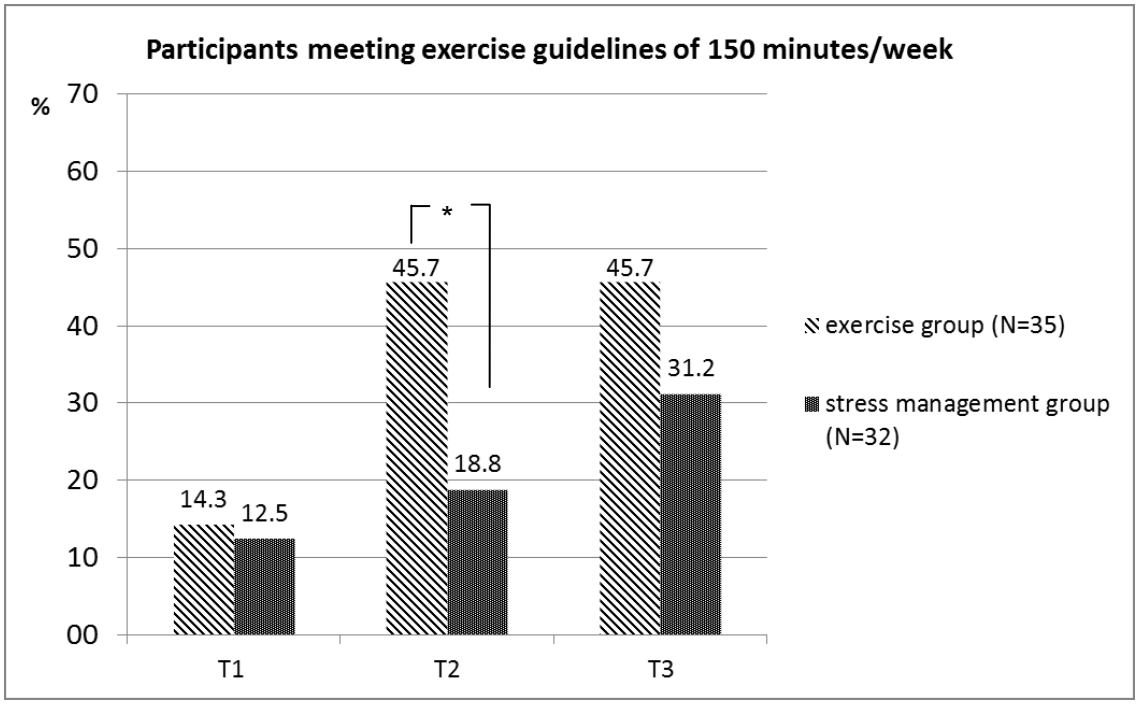

Figure 2. Percentage of patients in the two conditions meeting exercise guidelines of 150 minutes/week. Note: Chi-squared tests were calculated; T1: baseline, T2: post-test (after 4 week intervention), T3: 10-week follow up; * p < .05

In analyses of physical activity as a continuous variable, the interaction did not yield the expected time by condition interaction (p =.318). Instead, there was a significant main effect of time [$F(2,130) = 9.35$, $p < .001$, $\eta_p^2 = .126$], indicating that both the exercise and the stress management group increased their exercise level.

Perceived stress

Regarding perceived stress a significant main effect for time [$F(2,118) = 3.04$, $p = .05$, $\eta_p^2 = .049$] , no significant main effect for condition ($p = .128$) and no significant interaction effect ($p = .584$) were yielded. Thus, both groups were able to reduce their level of perceived stress (exercise group: $M_{T1} = 6.52$ (SD=2.05); $M_{T2} = 5.45$ (SD=2.68); M_{T3}=5.58 (SD=2.51); stress management group: M_{T1}=5.53 (SD=2.03); M_{T2}=5.20 (SD=2.61); M_{T3}=4.77 (SD=2.40).

Role model contact- results from exploratory analyses

Of the 35 patients in the exercise group 22 (=63%) reported contact with the role model (13 met in person, 9 via phone). To explore whether having contact with a role model was associated with physical activity, we compared three groups of patients: exercise intervention with role model contact (n=22), exercise intervention without role model (n=13), and stress management. There were no significant group differences in demographic and medical characteristics. However, a significant finding for meeting the guidelines by T2 and T3 emerged [$X_{T2}^2(2) = 6.004$, $p = .050$; $X_{T3}^2(2) = 9.484$, $p = .009$]. Among those in the exercise group who had contact with a role model 50.0% (T2)/ 63.6% (T3) met the guidelines, compared to only 38.5% (T2)/ 15.4% (T3) of those without contact. The corresponding values for the stress management group were 18.8% (T2) and 31.2% (T3).

Analyses of physical activity as a continuous variable (3x3 mixed ANOVA) yielded the expected time x condition interaction [$F(4,128) = 2.87$; $p = .026$] and a significant main effect for time [$F(2,128) = 8.02$; $p = .001$] and condition [$F(2,64) = 3.76$; $p = .028$]: among those who had contact with a role model, exercise levels significantly increased from a mean of M_{T1} = 51.82 (SD = 112.70) to M_{T3} = 260.45 (SD = 272.74) minutes/week, compared to those without any contact, who fell almost back to baseline at T3 (Figure 3).

Discussion

The study investigated if an exercise intervention incorporating self-regulatory strategies derived from the HAPA model and encouraging role model support can increase the exercise level of cancer patients compared to an active control group receiving stress management training. Results showed that after 4-weeks of the intervention, 46% of the exercise group exercised at least the recommended 150 minutes/week, significantly more than the active

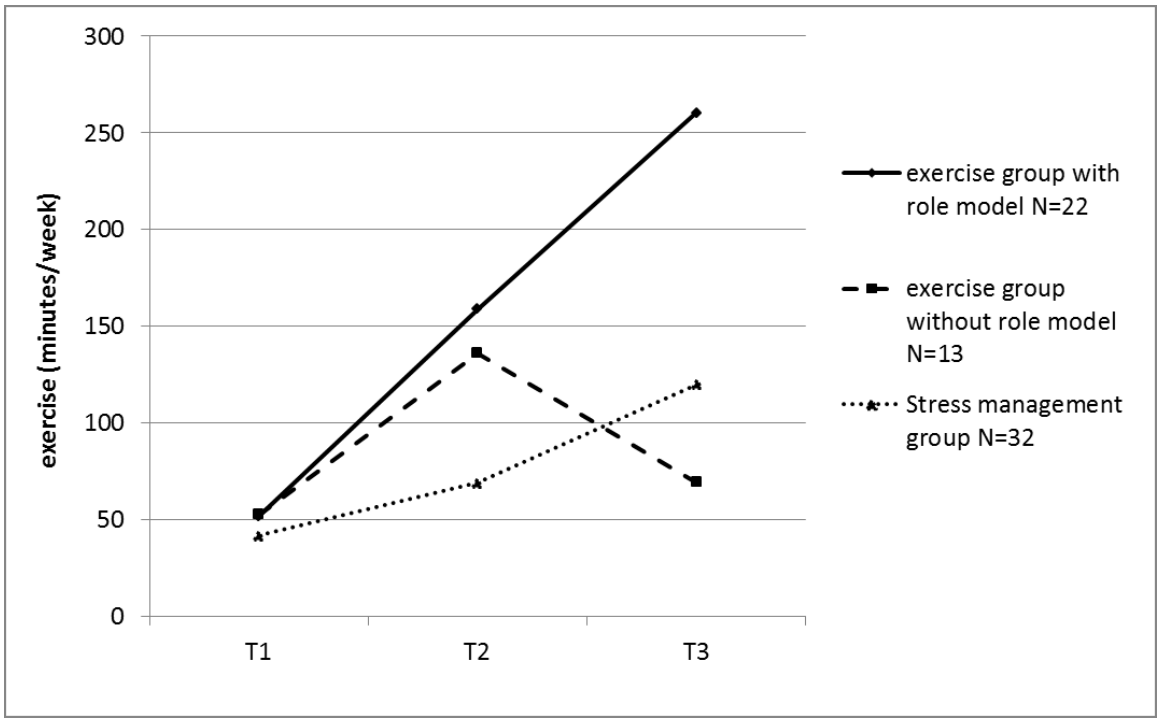

Figure 3. Exercise level of the three groups during the course of the study.
Note: exercise groups with role model and exercise group without role model are non-randomized subgroups of the exercise group; T1: baseline, T2: post-test (after 4 week intervention), T3: 10-week follow up.

control group. At 10-week follow-up, participants of the exercise group maintained their exercise level, but 31% of participants of the stress management group also reached the guidelines. Comparing patients who had contact with a role model to patients without role model contact in the exercise group showed a more differentiated picture. At T2 both groups increased their physical activity and exercised, on average, 150 minutes/week. At T3 however, only patients with role model contact could further increase their exercise to 260 minutes/week, whereas patients without any role model contact fell back to below the recommended level.

The HAPA self-regulation framework has been applied to rehabilitation settings and health promotion (including physical activity) for people with chronic diseases and disabilities [Schwarzer, Lippke and Luszczynska (2011)]. To our knowledge, this study is the first HAPA based intervention targeting physical activity in a population of cancer patients. Our results suggest that an exercise intervention based on this model is not only related to significant increases in exercise at the conclusion of the intervention, but can also be maintained 10 weeks after the intervention. Our exploratory comparison of exercise levels among patients with and without role model support illustrate the potential benefits of incorporating role model support in future studies aiming to increase exercise levels in this patient population.

The importance of role model support is in line with a literature review by Barber (2012) who concluded that social support is an important predictor of cancer patients' physical activity. Specifically role model support has rarely been investigated (Laura Q. Rogers et al., 2011; L. Q. Rogers et al., 2005) and individual contact with an exercise role model has not been implemented within an intervention study yet. A survey among 456 cancer survivor provides some hints that implementing role model support in practice would meet the preferences of cancer patients. The majority of respondents stated that they would prefer to exercise with another cancer survivor (Blaney, Lowe-Strong, Rankin-Watt, Campbell, & Gracey, 2013).

It was unexpected that not only the exercise group increased exercise levels but also the active control group practicing stress management. It could be argued that learning to manage one's stress is also a form of self-regulation that may facilitate a healthier life style. Physical activity may have also been prompted by wearing the accelerometer and by being asked to report on physical activities. Recall that in this population preselected for not meeting physical activity guidelines, 13% of the patients met the guidelines right after the accelerometer phase (before randomization). There is also some evidence suggesting that targeting one health behavior may initiate changes in other health behaviors (Fleig, Lippke, Pomp, & Schwarzer, 2011; Lippke, Nigg, & Maddock, 2012).

Several limitations are to be mentioned. Only 63% of patients in the exercise group reported role model contact. The main reasons for not having role model contact were organizational problems (e.g. long distance). Most importantly, the two role model groups were not randomized, and, therefore, preexisting differences between the groups in characteristics not assessed in our study might explain the differences. Second, only a subgroup of participants (61.2%) fulfilled the criteria of wearing the accelerometer for at least 10h/day on at least 4 days/week on both measurement points and could be included in the validation. Nevertheless, the correlation between self-reported and objectively measured exercise were similar to that reported by others (e.g. r=.35, Arends et al., 2013). Finally, our choice of an active control group rather than a usual care group may have diminished group differences.

Strengths of the study were the low drop-out rate of 6.9%, the long follow-up, validation of physical activity by accelerometer, the theoretically driven intervention emphasizing self-regulatory strategies, and incorporating a role model support. Results from our exploratory analyses of social support indicate that in future research, the role of role model support should be evaluated by randomizing participants to receive or not receive role model support. In conclusion, the current study has shown that an exercise intervention incorporating self-regulatory strategies based on the HAPA-model and role model support was associated with sustained high exercise levels among formerly insufficiently active cancer patients. The study provides first indications that role model support may be a promising approach to increase physical activity during cancer treatment.

References

Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Tudor-Locke, C., . . . Leon, A. S. (2011). 2011 compendium of physical activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise, 43*(8), 1575-1581. doi: 10.1249/MSS.0b013e31821ece12

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T

Arends, S., Hofman, M., Kamsma, Y., der Veer, E. v., Houtman, P., Kallenberg, C., . . . Brouwer, E. (2013). Daily physical activity in ankylosing spondylitis: validity and reliability of the IPAQ and SQUASH and the relation with clinical assessments. *Arthritis Research & Therapy, 15*(4), R99. doi: 10.1186/ar4279

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*, 191 - 215. doi: 10.1037/0033-295X.84.2.191

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ US: Prentice-Hall, Inc.

Barber, F. D. (2012). Social support and physical activity engagement by cancer survivors. *Clinical Journal of Oncology Nursing, 16*(3), E84-E98. doi: 10.1188/12.CJON.E84-E98

Bellizzi, K. M., Rowland, J. H., Jeffery, D. D., & McNeel, T. (2005). Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *Journal of Clinical Oncology, 23*(34), 8884-8893. doi: 10.1200/jco.2005.02.2343

Bennett, J. A., Lyons, K. S., Winters-Stone, K., Nail, L. M., & Scherer, J. (2007). Motivational interviewing to increase physical activity in long-term cancer survivors: a randomized controlled trial. *Nursing Research, 56*(1), 18-27. doi: 10.1097/00006199-200701000-00003

Blanchard, C. M., Courneya, K. S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: Results from the American Cancer Society's SCS-II. *Journal of Clinical Oncology, 26*(13), 2198-2204. doi: 10.1200/jco.2007.14.6217

Blaney, J. M., Lowe-Strong, A., Rankin-Watt, J., Campbell, A., & Gracey, J. H. (2013). Cancer survivors' exercise barriers, facilitators and preferences in the context of fatigue, quality of life and physical activity participation: a questionnaire–survey. *Psycho-oncology, 22*(1), 186-194. doi: 10.1002/pon.2072

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports, 100*(2), 126.

Coups, E. J., & Ostroff, J. S. (2005). A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Preventive Medicine, 40*(6), 702-711. doi: 10.1016/j.ypmed.2004.09.011

Courneya, K. S., & Friedenreich, C. M. (Eds.). (2011). *Physical activity and cancer*: Springer Berlin Heidelberg.

Demark-Wahnefried, W., Clipp, E. C., Lipkus, I. M., Lobach, D., Snyder, D. C., Sloane, R., . . . McBride, C. M. (2007). Main outcomes of the FRESH START trial: a sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *Journal of Clinical Oncology, 25*(19), 2709-2718. doi: 10.1200/JCO.2007.10.7094

Demark-Wahnefried, W., Peterson, B., McBride, C., Lipkus, I., & Clipp, E. (2000). Current health behaviors and readiness to pursue life-style changes among men and women diagnosed with early stage prostate and breast carcinomas. *Cancer, 88*(3), 674-684. doi: 10.1002/(SICI)1097-0142(20000201)88:3%3C674::AID-CNCR26%3E3.0.CO;2-R

Fleig, L., Lippke, S., Pomp, S., & Schwarzer, R. (2011). Intervention effects of exercise self-regulation on physical exercise and eating fruits and vegetables: a longitudinal study in orthopedic and cardiac rehabilitation. *Preventive Medicine, 53*(3), 182-187. doi: 10.1016/j.ypmed.2011.06.019

Freedson, P. S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and Science in Sports and Exercise, 30*(5), 777-781. doi: 10.1097/00005768-199805000-00021

Jacobsen, P. B., & Meade, C. D. (2006). *Coping with chemotherapy*: H. Lee Moffitt Cancer Center & Research Institute at the University of South Florida, Tampa, Florida.

Jacobsen, P. B., Meade, C. D., Stein, K. D., Chirikos, T. N., Small, B. J., & Ruckdeschel, J. C. (2002). Efficacy and costs of two forms of stress management training for cancer patients undergoing chemotherapy. *Journal of Clinical Oncology, 20*(12), 2851-2862. doi: 10.1200/jco.2002.08.301

Jacobsen, P. B., Phillips, K. M., Jim, H. S., Small, B. J., Faul, L. A., Meade, C. D., . . . Fishman, M. (2013). Effects of self-directed stress management training and home-based exercise on quality of life in cancer patients receiving chemotherapy: a randomized controlled trial. *Psycho-Oncology, 22*(6), 1229-1235. doi: 10.1002/pon.3122

Lippke, S., Nigg, C. R., & Maddock, J. E. (2012). Health-promoting and health-risk behaviors: Theory-driven analyses of multiple health behavior change in three international samples. *International Journal of Behavioral Medicine, 19*(1), 1-13. doi: 10.1007/s12529-010-9135-4

Mehnert, A., Müller, D., Lehmann, C., & Koch, U. (2006). Die deutsche Version des NCCN Distress-Thermometers: Empirische Prüfung eines Screening-Instruments zur Erfassung psychosozialer Belastung bei Krebspatienten [The German version of the NCCN Distress Thermometer: Validation of a screening instrument for assessment of psychosocial distress in cancer patients]. *Zeitschrift für Psychiatrie, Psychologie und Psychotherapie, 54*(3), 213-223. doi: 10.1024/1661-4747.54.3.213

National Comprehensive Cancer Network. (2003). Distress management. Clinical practice guidelines. *Journal of the National Comprehensive Cancer Network: JNCCN, 1*(3), 344.

Ochsner, S., Luszczynska, A., Stadler, G., Knoll, N., Hornung, R., & Scholz, U. (2013). The interplay of received social support and self-regulatory factors in smoking cessation. *Psychology & Health, 29*(1), 16-31. doi: 10.1080/08870446.2013.818674

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395. doi: 10.1037//0022-006X.51.3.390

Rogers, L. Q., Markwell, S., Hopkins-Price, P., Vicari, S., Courneya, K. S., Hoelzer, K., & Verhulst, S. (2011). Reduced barriers mediated physical activity maintenance among breast cancer survivors. *Journal of Sport & Exercise Psychology, 33*(2), 235-254.

Rogers, L. Q., Shah, P., Dunnington, G., Greive, A., Shanmugham, A., Dawson, B., & Courneya, K. S. (2005). Social cognitive theory and physical activity during breast cancer treatment. *Oncology Nursing Forum, 32*(4), 807-815. doi: 10.1188/05.onf.807-815

Schmitz, K. H., Courneya, K. S., Matthews, C., Demark-Wahnefried, W., Galvao, D. A., Pinto, B. M., . . . Schwartz, A. L. (2010). American College of Sports Medicine Roundtable on Exercise Guidelines for Cancer Survivors. *Medicine and Science in Sports and Exercise, 42*(7), 1409-1426. doi: 10.1249/MSS.0b013e3181e0c112

Schwarzer, R. (2001). Social-cognitive factors in changing health-related behaviors. *Current Directions in Psychological Science, 10*(2), 47-51. doi: 10.1111/1467-8721.00112

Schwarzer, R. (2008). Modeling Health Behavior Change: How to Predict and Modify the Adoption and Maintenance of Health Behaviors. *Applied Psychology, 57*(1), 1-29. doi: 10.1111/j.1464-0597.2007.00325.x

Schwarzer, R., Lippke, S., & Luszczynska, A. (2011). Mechanisms of health behavior change in persons with chronic illness or disability: The Health Action Process Approach (HAPA). *Rehabilitation Psychology, 56*(3), 161-170. doi: 10.1037/a0024509

Short, C. E., James, E. L., Stacey, F., & Plotnikoff, R. C. (2013). A qualitative synthesis of trials promoting physical activity behaviour change among post-treatment breast

cancer survivors. *Journal of Cancer Survivorship, 7*(4), 570-581. doi: 10.1007/s11764-013-0296-4

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 4*(2), 87-100. doi: 10.1007/s11764-009-0110-5

von Gruenigen, V. E., Courneya, K. S., Gibbons, H. E., Kavanagh, M. B., Waggoner, S. E., & Lerner, E. (2008). Feasibility and effectiveness of a lifestyle intervention program in obese endometrial cancer patients: a randomized trial. *Gynecologic oncology, 109*(1), 19-26. doi: 10.1016/j.ygyno.2007.12.026

Wagenmakers, R., van den Akker-Scheek, I., Groothoff, J. W., Zijlstra, W., Bulstra, S. K., Kootstra, J. W. J., . . . Stevens, M. (2008). Reliability and validity of the short questionnaire to assess health-enhancing physical activity (SQUASH) in patients after total hip arthroplasty. *Bmc Musculoskeletal Disorders, 9*, 141. doi: 10.1186/1471-2474-9-141

Wendel-Vos, G. C. W., Schuit, A. J., Saris, W. H. M., & Kromhout, D. (2003). Reproducibility and relative validity of the Short Questionnaire to Assess Health-enhancing physical activity. *Journal of Clinical Epidemiology, 56*(12), 1163-1169. doi: 10.1016/s0895-4356(03)00220-8

7. General discussion

Briefly, this thesis comprises three studies. Studies 1 and 2 examine factors associated with the low level of physical activity among cancer patients. Study 3 is an intervention study that incorporates the knowledge gained from studies 1 and 2 into an intervention aimed at increasing exercise levels. The specific focus of the intervention is cognitive self-regulation and social influences. This general discussion addresses broad issues comprising all three manuscripts of this dissertation, such as the interplay between self-regulation and social influences, and adequate assessment of physical activity. After giving a summary of the studies (section 7.1), study results are integrated into the broader context of research on behavior change, self-regulation and social influences (section 7.2). General strengths and limitations of the MOTIVACTION project are described (section 7.3), and an outlook on future research directions (section 7.4) – like examining dyadic self-regulation and the effects of giving support to others – is given. The thesis closes with a discussion of practical implications for the hospital routine (section 7.5) before finishing with closing remarks (section 7.6).

7.1 Summary of studies

Two thirds of all cancer patients do not follow the exercise guidelines developed by the “Roundtable of exercise guidelines for cancer survivors” (Bellizzi et al., 2005; Blanchard et al., 2008; Coups & Ostroff, 2005; Schmitz et al., 2010). Psychological research has the important role to (1) determine factors that explain the (low) level of physical activity and (2) to help cancer patients to change their behavior. This dissertation aims to add knowledge to both research topics. To address these topics initially, qualitative, cross-sectional and longitudinal surveys were conducted elaborating on factors that were thereupon incorporated in an intervention aiming to increase the activity level of cancer patients. All studies focused on self-regulation and social aspects of behavior change. The theoretical background was provided by the TPB and especially the HAPA in order to examine the cognitive self-regulatory skills necessary to increase the level of physical activity and bridge the gap between intention and behavior. Social factors of interest included subjective norm (study 1), social support and social control (study 2), and role model support (study 3).

All studies were part of the MOTIVACTION-project and build on one another. In manuscript 1, a qualitative study was conducted to gain first insights and develop items for a cross-sectional quantitative survey (also part of manuscript 1). The aim was to elicit the full

range of attitudes – especially negative ones – and compare already physically active and insufficiently active patients within the framework of the TPB (Ajzen, 1991). Attitude turned out to be a relevant predictor of the intention to exercise for insufficiently active patients. For maintaining an active lifestyle – conversely – social influence was especially important (subjective norm was the only significant predictor of behavioral intention for active patients). Additionally, self-efficacy discriminated best between active and insufficiently active patients.

In manuscript 2, a longitudinal study was conducted incorporating a cancer patient's family member by interrogating him/her separately. Through this design, the relation between perceived and relative-reported social support and control could be determined (moderate associations occurred). Gender differences revealed that female patients perceived and received less support and control from their relatives. Furthermore, reactance – which was related to the social control carried out by the relative – might especially impede male patients to build up a physically active lifestyle. Relative-reported social support was the only significant predictor of physical activity at follow-up.

In manuscript 3, factors that were found to be important in study 1 (self-efficacy) and study 2 (social support) were implemented in a HAPA-based intervention study (randomized controlled trial) aiming to increase the exercise level of cancer patients. A one hour exercise counseling session addressing self-regulation strategies specified in the HAPA was combined with role model support (walking or cycling together with an already active same-sex cancer patient). The exercise intervention was compared to an active control group receiving stress management training. The exercise counseling helped cancer patients to reach the guidelines: after the 4-week intervention almost half (46%) of the formerly insufficiently active patients exercised according to the guidelines, whereas only a minority (19%) of participants of the stress management group reached this aim. Further analyses revealed that only participants of the exercise group who realized contact with a role model further increased their exercise at the 10-week follow-up, whereas participants without role model contact fell back to baseline level. In accordance with study 1 and 2, this positive result of study 3 highlights the joint impact of self-regulation (HAPA-based counseling) and social influences (role model support) for cancer patients to change their behavior and engage in regular physical activity.

7.2 Integration of study results into the broader context

Receiving a cancer diagnosis is a threatening life event. Three strategies can be useful to cope with the disease according to a conceptual framework by Shelley Taylor (1983) called "cognitive adaptation to threatening events": (1) regaining mastery, (2)

searching for meaning and (3) restoring self-esteem. Physical activity might facilitate coping with the disease by addressing these mechanisms. The primary focus of the MOTIVACTION-study was on behavior change (i.e. increasing the exercise level) and not on health outcomes (i.e. beneficial effects of physical activity) according to the classification of exercise trials by Courneya (2010) (see section 2.2). Nevertheless, one subsidiary result was that participants of the exercise group (as well as the stress-management group) decreased their perceived stress during the course of the intervention. Thus, this study corroborates previous literature that both – exercise and stress-management – seem to be successful ways to cope with the disease (e.g. Jacobsen et al., 2013).

Nevertheless, changing one's behavior (e.g. for building up a physically active lifestyle) is very difficult as people tend to adhere to behavior they are used to (Neal, Wood, Labrecque, & Lally, 2012). The concept of habit strength has gained attention in health psychology. For example, De Bruijn and Rhodes (2011) demonstrated the usefulness of integrating measures of habit strength to the TPB framework for explaining exercise behavior. Compared to primary prevention, the oncological context might be very fruitful for promoting physical activity. A threatening life event like receiving a cancer diagnosis has been described as a *teachable moment* for changing health behavior (Demark-Wahnefried et al., 2005). For example, a survey among 1,667 patients diagnosed with breast or prostate cancer revealed a strong interest in health promotion programs across behaviors (Demark-Wahnefried et al., 2000). The studies included in this thesis also showed encouraging results. The HAPA-based exercise intervention was able to support more than half of formerly insufficiently active participants to exercise according to the recommendation. Nevertheless, if participants of the intervention group were able to maintain the increased exercise level for the longer term (e.g. after completion of the medical treatment in everyday working life) cannot be concluded from this study and needs further research and longer follow ups.

The field of exercise oncology is relatively new. Numerous research has been conducted within the last 15 years, and exercise has also been established within oncological practice (see section 2.1). Only since it has been shown that exercise is safe and beneficial for cancer patients (as for example stated in the "Roundtable on exercise guidelines for cancer survivors" (Schmitz et al., 2010) has psychology come into play and research on behavior change necessary. Thus, (psychological) research addressing behavior change in the domain of exercise and cancer is still in its early stages.

A big challenge will be to gain knowledge from research studying people with other (chronic) diseases like, for example, diabetes or cardiovascular diseases. Compared to other

populations, exercise was recommended very late for cancer patients (Schmitz et al., 2010; Warburton, Nicol, & Bredin, 2006). For people with other (chronic) diseases as well as for the healthy population, there is already a big body of research on psychological factors of exercise and behavior change (Greaves et al., 2011; O'Halloran et al., 2014). Thus it has to be investigated what can be transferred and what is distinct to the field of oncology.

Compared to many other diseases, a neoplastic disease is often life threatening and the treatment of cancer is mostly very intensive: it covers a very long period of time, is accompanied by many side effects and often patients do not work during the treatment period (Baumann, 2008). Research has shown that the great majority of cancer patients face exercise barriers that are specifically related to the disease and its treatment (Blaney et al., 2010; Blaney, Lowe-Strong, Rankin-Watt, Campbell, & Gracey, 2013; Courneya et al., 2008). For example, one of the most reported exercise barriers is cancer-related fatigue (Blaney et al., 2013; Clark et al., 2007; Rogers et al., 2008).

By means of the lifestyle program "Active" you can see how important it is to design interventions in accordance with the special needs of the addressed group. This program consisted of small group meetings for six months, was based on the Transtheoretical Model (Prochaska & DiClemente, 1983) and the Social Cognitive Theory (Bandura, 1977, 1986), and aimed to build up self-efficacy and cognitive-behavioral skills to integrate regular physical activity into the daily routine (A. L. Dunn et al., 1997). The program was able to increase the physical activity level of inactive healthy adults (A. L. Dunn et al., 1998). Afterwards, a similar program was used for patients with prostate cancer. In this sample, the intervention did not influence the physical activity of the participants (effects were [only] found for cognitive variables) (C. L. C. Taylor et al., 2006). Thus, the "active" program probably did not sufficiently address the special needs of patients with prostate cancer.

In contrast, many psychological mechanisms might be comparable for cancer patients, the general population or other chronic diseases. For example, a systematic review of reviews on intervention components of physical activity (and dietary) intervention showed that the type of study population did not affect the outcome (Greaves et al., 2011). A result of this synthesis of many intervention studies aiming to increase the physical activity level of adults at risk of developing type 2 diabetes was that social support as well as a cluster of self-regulatory techniques (goal-setting, prompting self-monitoring, providing feedback on performance and goal reviews) increased intervention effectiveness. This mirrors the two foci of this thesis.

The first focus of the project was on social influences. Uchino (2006) has proposed a model linking social support to increased health. One pathway is that other supporting people

can help to increase health behaviors. Social factors can be important for initiation as well as maintenance of health behavior (Conner & Norman, 2005). To initiate behavior, social support may need to focus on encouragement from others. To support maintenance it may instead be more useful to know others with whom to perform the behavior (Conner & Norman, 2005). Results of this dissertation suggest that social factors might be especially helpful for cancer patients to *maintain* an active lifestyle. Study 1 showed that subjective norm is only relevant for patients who are already physically active (and maintain this level). In contrast, for insufficiently active patients, who might try to initiate an active lifestyle a more self-oriented construct – attitude – is important. In study 3, role model support was especially useful in the follow-up period. Right after the intervention (posttest), both groups – with and without role model support – increased their exercise level. Thus, physical activity initiation was successful independent of role model support. At the 10-week-follow-up only patients with role model support maintained and even further increased their exercise level, while patients without role model support fell back below the recommended 150 minutes per week. The importance of social support for the maintenance phase is in line with results of a three-round Delphi study. In this study key-experts had to determine the most relevant determinants of awareness, initiation and maintenance of physical activity among over-fifties (van Stralen, Lechner, Mudde, de Vries, & Bolman, 2010). All social determinants (among them social support) were only considered relevant for the maintenance phase. A review of 59 studies about predictors of physical activity regarded social support more differentiated. It revealed that different aspects of social support are important for initiation (e.g. family and friends) and for maintenance (e.g. exercise group members) (van Stralen, De Vries, Mudde, Bolman, & Lechner, 2009).

The second focus of the project – self-regulation – was developed during the course of the project. Study 1 revealed that self-efficacy discriminated best between physically active and insufficiently active cancer patients. A further result of the second quantitative MOTIVACTION survey among 193 insufficiently active patients (study 1d in Figure 1) was that 59% of the patients were interested in physical activity, but only a minority took concrete steps to get active: at the end of the survey patients were offered options to get physically active as a ‘thank you’ for participating in the study (indirect behavior measure). It came out that only 11% gave their contact details for participating in a sport program and only 1% actually attended the program afterwards (unpublished data). This huge gap between intention and behavior as well as the effect of self-efficacy pointed out the pivotal role of self-regulation. That is why the HAPA model was chosen for the intervention. The HAPA model focuses on goal pursuing, a central component of self-regulation, as self-regulation strategies (e.g. action control, self-monitoring) are supposed to bridge the gap between intention and

behavior. The HAPA self-regulation framework has been applied to rehabilitation settings and health promotion (including physical activity) for people with chronic diseases and disabilities (Schwarzer, Lippke and Luszczynska (2011). Interventions focusing on HAPA self-regulation strategies have been shown to be successful in increasing physical activity in healthy adults (Koring et al., 2012). To my knowledge, the current study is the first HAPA based intervention targeting physical activity in a population of cancer patients.

De Ridder and Wit (2006) state that "Social-cognitive models of health behavior can be regarded as rudimentary self-regulation models, as they are somewhat concerned with the way people engage in future action." (p. 13). Ajzen himself highlights the role of cognitive self-regulation in the TPB. However, research on self-regulation in the health domain has developed a lot (see De Ridder & De Wit, 2006 for a historic view on the emergence of self-regulation) and the TPB cannot be regarded as sufficient to describe self-regulatory strategies as it does not consider the gap between intention and behavior (De Ridder & De Wit, 2006; Mann et al., 2013). There are various modern trends in research on self-regulation and health behavior (Hagger, Wood, Stiff, & Chatzisarantis, 2009; Hall & Fong, 2007; Van Damme, Crombez, Goubert, & Eccleston, 2009). For example, a recent review article "self-regulation of health behavior" (Mann et al., 2013) stated that the following factors of goal setting and goal striving are considered relevant: when and why people adopt and abandon goals, goal characteristics (e.g. performance vs. mastery goals), prospection and planning, automatic behavior, construal and effortful inhibition.

The two focuses of this thesis – social influences and self-regulation – do not have to be regarded separately from each other. Self-regulation does not occur detached from the social context. In Bandura's Social Cognitive Theory, self-regulation is viewed as an interaction of personal, behavioral and environmental triadic processes (Bandura, 1986; Zimmerman, 2000). Bandura states the following: "In the interactionist perspective of social cognitive theory, social factors affect the operation of the self-regulative system." (Bandura, 1991, p. 248). Thus, social factors are integrated in self-regulation. A good example is exercise role model support, which is the core component of the MOTIVACTION intervention. On the one hand, it can be regarded as classic social support for exercising together. On the other hand, a role model is, according to Bandura (1977, 2000), a source of self-efficacy. By seeing a person similar to oneself able to do something (vicarious experience), one's self-efficacy increases. Self-efficacy in turn plays a pivotal role in self-regulation (De Ridder & De Wit, 2006). The results of the MOTIVACTION intervention confirm this interactionistic perspective: only a combined intervention with self-regulation and role model support (not self-regulation alone) was able to increase the physical activity level at follow-up (social support alone was not tested).

However, major behavior change theories focus mostly on cognitions; social aspects like social support are only tangentially included in these studies (Conner & Norman, 2005). Studies have shown that the predictive power of the TPB can been increased when social support is integrated (e.g. Courneya, Plotnikoff, Hotz, & Birkett, 2000; Hamilton & White, 2008; Rhodes, Jones, & Courneya, 2002). Conner and Norman (2005, p. 351) state that "An integrated model of the initiation and maintenance of health behavior would include motivation and self-efficacy as key constructs but also address how social influences impact on initiation and maintenance […]". For example, Bauman (2012) introduced an ecological framework to explain physical activity including determinants of all levels — individual, social, environmental, and policy. A challenge will be to implement this theoretically complex framework into concrete empirical research.

7.3 Limitations and strengths

Each publication included in this dissertation has its own limitations and strengths, which are addressed in the respective discussions of the manuscripts. In this general discussion, broad issues which all three studies have in common are discussed.

All three studies are conducted among a very heterogeneous sample. The samples consisted of participants with different cancer entities, different types of treatment and different age groups. This heterogeneity might have biased the results and diminished effects. Nevertheless, results from the (second) cross-sectional survey of the MOTIVACTION project (study 1d in Figure 1; results are not published yet) have shown that participants with diverse cancer entities did not differ in psychological variables (mainly of the TPB) regarding exercise behavior.

One further limitation is that the samples of all three studies consisted of a relatively small number of participants due to feasibility reasons. To address this disadvantage, effect-sizes were reported in the manuscripts. Nevertheless, the small sample size has led to some restrictions in statistical analyses. For example, more differentiated analyses – like e.g. moderation or mediation analyses – were often difficult to perform and the sample size mostly did not allow for adjusting of many covariates.

All studies were conducted at the NCT. At the NCT a well-known exercise program has already been implemented (in research and practice). This special environment might have biased the results. As patients, relatives and physicians are probably more informed about and "pushed" towards physical activity than people in a standard hospital, social

desirability might have affected results. This pertains to the generalizability of the findings to cancer patients in rural areas and standard hospitals.

A major challenge within all studies was to adequately assess physical activity. A review by Warren et al.(2010) summarizes: “Physical activity is multidimensional, and a complex behavior to measure; its various domains are often misunderstood. Inappropriate or crude measures of physical activity have serious implications, and are likely to lead to misleading results and underestimate effect size” (p. 127). Similarly, Shephard (2003) concluded the following: “Despite extensive use over 40 years, physical activity questionnaires still show limited reliability and validity” (p. 197). A more recent review revealed that reliability is mostly acceptable, but especially low validity needs to be improved (Helmerhorst et al., 2012). Physical activity questionnaires are prone to measurement bias mainly because of social desirability, cognitive limitations in recalling behavior, comprehension or biased estimations of duration and intensity of the behavior (Adams et al., 2005; Helmerhorst et al., 2012; Warren et al., 2010).

Another difficulty in measuring physical activity is its different subcategories, e.g. occupational activities, commuting activities, exercise, leisure-time physical activity, and household activities. In the studies of the MOTIVACTION project, very high (unrealistic?) amounts of physical activity emerged when all types of activity (including household activities, occupational activity, etc.) were regarded. The amount of physical activity sometimes varied drastically depending on which activities were included in the measure. Unfortunately, both issues seem to be general problems among studies assessing self-reported physical activity. For example, a study among patients with fibromyalgia reported the high amount of 317 minutes of physical activity per day (i.e. 2219 minutes of total physical activity per week) as significantly higher than the physical activity level measured by an accelerometer (Segura-Jiménez et al., 2014). As especially activities with low intensity are difficult to assess (Shephard, 2003), the three studies presented here mostly focused on exercise behavior as defined as “physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (Caspersen et al., 1985, p. 128). Nevertheless, different subcategories are not always easily separable. Additionally, other categories than exercise and leisure-time physical activity (e.g. occupational or household activity) might also have beneficial effects for cancer patients and are not examined within the three studies, within the exercise guidelines (Schmitz et al., 2010) and within most other studies of the physical and cancer domain.

One further problem is the clumping at zero which is typical for the assessment of physical activity and time-use-data in general (J. E. Brown & Dunn, 2011; Slymen, Ayala, Arredondo, & Elder, 2006). For example, in study 2 almost 60% of participants did not engage in any at least moderate exercise behavior. Special statistical methods like Poisson-Gamma Regression models can analyze these kind of data appropriately (J. E. Brown & Dunn, 2011). This method could not be applied because the sample size was too small. Unfortunately, in most studies the proportion of zeros is not mentioned and thus it cannot be judged if an appropriate method was used.

Beside these limitations, the MOTIVACTION project has a high relevance, novelty and applicability of the research topic. As described in section 2.1, the domain of physical activity during cancer treatment is an emerging field. As (mainly) epidemiological research has shown the beneficial effects of physical activity, it is now the important role of health psychology to investigate topics like physical activity promotion, health education and behavior change.

The project differs from most previous research on physical activity promotion among cancer patients, as it overcomes a patient centrist view and encloses the close social context. To my knowledge, study 2 was the first survey in the exercise and cancer domain which further adds the perspective of cancer patients' relatives by including them in the survey. The intervention was the first of its kind that included individual (exercise-) meetings between participant and other cancer patients who had already adopted a physically active lifestyle (role model support).

A further strength is that all studies of this dissertation build upon one another in regard to the content as well as the design. Different types of studies were included step-by-step so that each study could be informed by the previous. First a qualitative study was conducted. This study gave first insights about patients´ attitudes on physical activity and helped to afterwards develop and conduct quantitative surveys (studies 1b-d and 2). Finally, factors which were found in the cross-sectional study 1 and the longitudinal study 2 to be relevant (e.g. self-efficacy, social support) were implemented in a randomized controlled trial with three measurement-points. Through the variety of research designs, different but interrelated findings could be gained.

It is furthermore noteworthy that the three studies had very good participation and low drop-out rates. Especially the participation rate of study 1 (about 90% of participants who were addressed took part in the study) and the very low drop-out rate of the intervention study (6.9% between baseline and follow-up; only 2.7% dropped out for other reasons than death) are worth mentioning.

Despite the mentioned difficulty in adequately assessing physical activity, it is a strength of the MOTIVACTION project that a mixture of methods was used to assess physical activity. Through shortcomings and challenges in the first studies, improvement could be made in the assessment of physical activity in the following studies. In study 3 a combination of a standardized questionnaire and accelerometer was used, as this provided the opportunity to compare subjectively and objectively measured physical activity. For moderate to vigorous physical activity, a high correlation of $r = .7$ could be gained.

7.4 Future directions in research

Many research questions remain open in the attempt to determine factors that predict (low) level of physical activity and help cancer patients to change their behavior. In general, future research should (1) use longer follow-up periods for investigating exercise maintenance, (2) examine different social cognitive theories (besides the TPB and HAPA used within this thesis), (3) differentiate between different types of cancer and stages of the disease, (4) analyze the change of influential psychological and social factors across the course of the disease, (5) explore gender differences and (6) examine the interplay between psychological variables, medical issues and socio-demographic factors.

Self-regulation – a dyadic perspective

Research – including the MOTIVACTION-project – has usually focused on individual self-regulatory processes for health-behaviour change. How can the two domains found to be relevant in this thesis – self-regulation and social influences – be further combined? Recent research has investigated the role of the close social environment for applying self-regulation strategies by investigating partner's involvement in behavior change through dyadic planning (Burkert, Knoll, Luszczynska, & Gralla, 2012; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011). Dyadic planning means planning health-behavior change together with a partner (Burkert et al., 2011). For example, a dyadic planning intervention was conducted to increase pelvic-floor exercise among prostatectomy-patients, and social support/control and self-regulation strategy (action control) were examined as mediators (Burkert et al., 2011). Future research should further investigate dyadic planning in the exercise and cancer domain as many questions of this new research field are still unanswered (e.g. gender differences, impact of dyad composition, the partners' perspective).

Lewis et al. (2006) proposed a framework called "interpendence model of communal coping and behavior change" which even goes one step further. It does not focus on how the partner might be able to support self-regulation but explicitly considers dyadic processes as determinants of health behavior change. Core elements of this model are couple efficacy

(“the couple’s confidence that together they can engage in communal coping effort” (Lewis et al., 2006, p. 1374) and communal coping (“utilization of strategies which are characterized as communal in nature such as couple communication about behavior change, joint decision making and planning regarding the behavior, or working together to engage in the behavior” (Lewis et al., 2006, p. 1374). Thus, classical self-regulation processes – self-efficacy and coping – are no longer connected to the “self” but are directly applied to dyadic processes. As these concepts inherently combine social influences and self-regulation it would be a logical continuation of the results of the MOTIVACTION-study to apply them in the context of physical activity and cancer to further extend knowledge in this domain.

Who matters?

This thesis has addressed the social support of family members and exercise role models (other cancer patients). According to the results, both might play a role in supporting the patient to increase physical activity behavior. Partners are the most important source of practical and emotional support to cope with an oncological disease in general (Badr, Carmack, Milbury, & Temech, 2013). Regarding specific social support for increasing exercise, future research has to examine which sources of social support exist and compare their influences. Are partners especially supportive, or can other family members (e.g. children, distant relatives) or friends have a similar influence on the patient’s physical activity? Is it important that the support provider lives in the same household as the recipient or is relationship quality the determining factor? Thereby, moderating factors like gender, age, type of cancer, stage of the disease, etc. have to be considered. Study 2 has shown that women receive less social support from their relatives compared to men. Based on previous research outside oncology (Fuhrer & Stansfeld, 2002; Fuhrer, Stansfeld, Chemali, & Shipley, 1999), one might for example hypothesize that men rely more on the support of their partners whereas women have more sources of social support apart from their partner. Gender-specific investigations are needed to gain further knowledge concerning this research question.

The role of physicians and allied health personnel as a source of social support in the promotion of health behavior is not clear yet. Previous research in primary care has shown inconsistent results regarding simply advising patients to exercise regularly without concrete assistance (e.g. review by Eden, Orleans, Mulrow, Pender, & Teutsch, 2002). Therefore, Estabrooks provides a framework on what physicians can do to promote physical activity in primary care (Estabrooks, Glasgow, & Dzewaltowski, 2003): (1) assess (e.g. the activity level, physical abilities and beliefs/knowledge), (2) advise (e.g. on appropriate amount, health risks, benefits of change), (3) agree (e.g. collaboratively develop a personalized action plan,

set specific goals), (4) assist to adhere (e.g. identify personal barriers and coping techniques, arrange social support by finding community opportunities) and (5) arrange (e.g. specific plan for follow-up visits, mailed reminders). It will remain a challenge to apply all strategies within a busy practice schedule, but maybe the physician could delegate parts to other health professionals (e.g. in a rehabilitation clinic). Additionally, a review by Lobelo and de Quevedo (2014) has found that physicians and other health care providers serve as role models. This review furthermore revealed that physically active physicians provide physical activity counseling more frequently to their patients.

In the exercise and cancer domain the role of the physician has rarely been investigated. Oncologists and nurses were identified as preferred individuals from whom cancer patients would like to receive information regarding physical activity (McGowan et al., 2013). Additionally, an intervention among new breast cancer patients showed that simply receiving a recommendation by the oncologist resulted in increased activity levels (Jones, Courneya, Fairey, & Mackey, 2004). These encouraging results lead to the assumption that a physician's recommendation might be especially fruitful in cancer patients as it uses the "teachable moment" (Demark-Wahnefried et al., 2005). Interestingly, there is a big gap between patients' and physicians' perception: about 20-40% of patients reported that they received a recommendation from their physician regarding physical activity (Demark-Wahnefried et al., 2000; Jones & Courneya, 2002). In contrast, in a representative sample of US oncologists, physicians state that they provide guidance regarding physical activity to about 65% of patients (Karvinen, DuBose, Carney, & Allison, 2010). Future research should examine how oncologists' support regarding physical activity can reach the patient. Maybe short simple advice is not enough and is easily lost. More concrete assistance might be needed as described in the framework of Estabrooks (2003).

The effects of giving support to others

Research from other fields has shown that people cannot only benefit from receiving social support but also from providing it (see for an overview Konrath & Brown, 2013). For example, correlational and longitudinal studies found that providing social support is related to positive psychological factors like increased well-being, better mental health and less loneliness (De Jong Gierveld & Dykstra, 2008; E. W. Dunn, Aknin, & Norton, 2008; Schwartz, Meisenhelder, Ma, & Reed, 2003). In the study by Schwartz et al. (2003), the effect of giving help was even a more important predictor of mental health than receiving help. Giving social support is also associated with beneficial physical health outcomes (e.g. S. L. Brown, Nesse, Vinokur, & Smith, 2003; Piferi & Lawler, 2006; Schwartz, Keyl, Marcum, & Bode, 2009). It would be a very important question for future research as to whether role models benefit

themselves when meeting with (and providing help to) an insufficiently active patient. The role models are cancer patients themselves and therefore face different challenges like adverse treatment-related (long term) effects, and dealing with an increased likelihood for disease progression and comorbidities (Demark-Wahnefried et al., 2005). Similarly, relatives of cancer patients who support the patient also tend to suffer very much from the disease (Kim & Given, 2008; Pitceathly & Maguire, 2003). A hypothesis (for future research) would be that supporting the patients in being physically active gives the relative a feeling of control and reduces helplessness.

However, it is not clear yet who benefits from giving under which circumstances (Konrath & Brown, 2013). Therefore, Konrath and Brown (2013) have proposed a framework which predicts when giving is likely to result in health benefits versus costs. According to this model, only when helping behavior is motivated through caregiving motivation (e.g. compassion) does it leads to stress regulation. Other motivations (e.g. obligation or self-enhancement) would not yield this beneficial effect. By applying this framework, future research could test the effects on role models and relatives who provide support.

Including self-identity

All three manuscripts confirm social factors as influences on physical activity of cancer patients. Self-identity, originating from Identity Theory (Stryker, 1968, 1986), might moderate this relationship between social influences and physical activity. It can be defined as “salient part of an actor’s self which relates to a particular behavior” (Conner & Armitage, 1998, p. 1444). It is assumed that social influences on performing a behavior are stronger when there is less self-identification with that behavior (Biddle, Bank, & Slavings, 1987; Callero, 1985; Hamilton & White, 2008). For example, Hamilton and White (2008) have empirically shown that people exercise more and have a higher behavioral intention when they identify themselves as exercisers even when controlling for the effects of past behavior, TPB variables and social support.

Besides identification with the role of an exerciser, how much the person identifies with a “typical cancer patient” might be important. For example, a survey among adults who had previously experienced cancer identified themselves to a varying extent with being a patient, a person who has had cancer, a victim or a survivor (Park, Zlateva, & Blank, 2009). A strong self-identity of being a cancer patient might negatively influence physical activity, as having a serious disease might mostly be associated with inactivity and sedentary behavior. Prototypes of the typical exerciser and the typical cancer patient have to be investigated in future research and the matching between self-identity and prototype has to be regarded. To

my knowledge, so far no studies have investigated self-identity concepts in the field of physical activity and cancer.

The amount of physical activity promotion

In general, results of the MOTIVACTION project encourage promoting physical activity for cancer patients. Nonetheless, it is important not to exaggerate this attempt. Results of study 2 have given first hints that – especially male – cancer patients tend to be reactant when they are pushed too much. It has to be investigated if reactance only occurs through relatives´ social control (especially by a partner) (as investigated in study 2) or through external pressure within the promotion of physical activity in general. Feeling too much pressure to engage in physical activity – e.g. though media, physicians, other cancer patient – might lead to adverse effects. The sources of reactance as well as the threshold of pressure from which on reactance is aroused for most patients should be investigated in future research.

Furthermore, during realization of the MOTIVACTION project, I was confronted with the negative effects of (too intensive or misunderstood) promotion of physical activity. For example, patients felt that it is their own fault that they had cancer, that the disease progressed or that they experienced strong side-effects of cancer treatment because they were not physically active. Occasionally I made the observation that patients were disappointed that they felt miserable during cancer treatment and did not feel the promoted beneficial effects of physical activity. In consequence, they gave up their attempt to exercise regularly. Further potential negative aspects of physical activity promotion should be investigated empirically.

7.5 Practical implications

As the MOTIVACTION project consists of very applied research it has direct practical implications. While conducting the project, many cancer patients were very interested in physical activity. This is reflected by the high participation rates and low drop-out rates of the studies. Additionally, results of study 1 show that even insufficiently active patients had the high intention to exercise. As most of them are – despite this big interest – still insufficiently active, practical support is essential. Results of the studies point out some possible ways for providing such support.

Manuscript 3 provided the first hints that role model support might be an effective way to maintain a physically active lifestyle. Meeting another cancer patient – who had already

managed to be regularly physically active – for walking or cycling together and discussing e.g. shared barriers, possible ways of coping, and benefits of regular exercise, seemed to help to further increase physical activity at follow-up. If further research is to strengthen this result, concepts have to be developed on how to integrate role model support in hospital routines. For example, an online platform could help to arrange meetings, and match cancer patients from similar regions, age levels and exercise preferences. Similarly, a bulletin board within a clinic could help patients to find exercise partners. As one-on-one meetings between patient and role model might be difficult to organize, one could alternatively think of group sessions. For example, a cancer patient who is experienced in Nordic-walking (exercise role model) could lead a Nordic walking group consisting of inexperienced walkers. This could be implemented within ambulatory clinics, rehabilitation centers or self-help groups. The study by Blaney et al. (2013) provides some hints that implementing role model support in practice would meet the preferences of cancer patients. Four hundred and fifty-six cancer patients were asked “Who would you prefer to exercise with?”. The majority (40.8%) answered that they would prefer to exercise with another cancer patient. Only 15.8% would like to exercise alone, 11.1% with family, 20.8% with friends and 7.6% within the general public.

Furthermore the relevant role of relatives was highlighted especially in study 2. Medical treatment usually focuses on the patient itself and pays only limited attention to the personal context of the patient (Wühr, 2011). Results of study 2 support the need to integrate family members in health issues: It was shown that especially relative-reported “actual” support – not perceived social support – was important for engaging in physical activity. Consequently, relatives should be supported in supporting. For example, an information event addressing relatives of cancer patients could provide basic rules regarding physical activity during cancer treatment like exercise guidelines, contraindications, etc. A study by Aymanns, Filipp, & Winkeler (2013) has shown that higher self-ascribed competence to help was associated with an increased provision of social support. Conversely study 2 has shown that too much social control could lead to reactance, especially among male cancer patients. This in turn could have adverse effects and even decrease exercise behavior. It is very difficult for relatives to keep the golden mean between supporting but not over controlling. Thus, the above mentioned information event should also address psychological mechanisms (e.g. support versus control) and make relatives aware of the dangers of evoking reactance.

Study 1 has found subjective norm to be a determinant for the intention to stay physically active. A prerequisite for this is that significant others – like the partner – are convinced of the beneficial effects of exercise and thereupon regard physical activity as necessary for their sick partners. How can this be reached? One way might be to let a

relative accompany the patient to a physical activity program so that relatives can exercise themselves. A program called “Strong Survivors Nutrition and Exercise Program for Cancer Survivors and Caregivers” is one of the first projects exploring relatives’ perceptions of participating in an exercise program alongside the cancer patient (Anton et al., 2013). Next to other beneficial effects for both patient and relative, relatives reported that the exercise program led to feeling increased social support in their caregiving duties (Anton et al., 2013). If relatives can be convinced of the beneficial effects of exercise through participating in the program themselves this might indirectly increase the perceived norm of the patients. This idea of encouraging a relative to participate in the sport program alongside the patient should further be implemented in practice.

7.6 Conclusion

“Be active! Strengthen your body, to make it through the medical treatment!” Nowadays, cancer patients are advised to be physically active, in contrast to the past when physicians recommended rest (Banzer, 2014; Schmitz et al., 2010). But why are most cancer patients not sufficiently physically active? And how can patients be supported to increase their physical activity? These were the key issues of the current dissertation. To answer these questions focus was placed on self-regulation and social influences. The MOTIVACTION project yielded encouraging results. More than half of the formerly insufficiently active participants exercised according to the recommendation after the exercise intervention. Thereby, the combination of strengthening self-regulation and social influences (role model) seems promising. It will remain a challenge for future research and practice to support cancer patients to maintain a high level of exercise during the course of cancer treatment and beyond. As the length of survival is expanding (American Cancer Society, 2015; Robert Koch-Institut & Gesellschaft der epidemiologischen Krebsregister in Deutschland e.V. (Eds.), 2013) an increase in health enhancing behavior after diagnosis might result in a continuing healthy lifestyle for many years (Demark-Wahnefried et al., 2005). A healthy lifestyle can in turn be preventive for cancer recurrence and other diseases (e.g. Vrieling & Kampman, 2010; Warburton et al., 2006).

Research on self-regulation – focusing on pursuing and attaining goals – might help getting closer to reaching the aim of supporting patients in maintaining a healthy lifestyle. Interest in self-regulation has burgeoned during the last years and there is growing popularity in applying this concept within health psychology (De Ridder & De Wit, 2006). Applying new concepts and trends regarding self-regulation as, e.g. described by Mann et al. (2013), might bring forward research on long term behavior change in the exercise and cancer domain.

This thesis should further encourage researchers, physicians, health professionals and relatives of cancer patients not to focus their attention solely on the patient; the social context is also important for coping with the disease and for a healthy lifestyle (Dukes Holland & Holahan, 2003; Newman & Roberts, 2013). Despite the important role of social influences, I want to give the last words in this thesis to a cancer patient keeping in mind that she or he is the one who has to get physically active. A male patient who participated in the MOTIVACTION-intervention wrote me a letter after the completion of the study:

> *„Es war eine gute Sache, den Anstoß und Hilfestellungen zu bekommen und ich bin heute froh und dankbar, dieses Angebot bekommen und angenommen zu haben. […].Die Kombination Entspannungsübungen mit regelmäßiger Bewegung erscheint mir optimal zu sein. Bei der Bewegung bin ich soweit, dass mir etwas fehlt, wenn ich es mal an einem Tag nicht machen kann.“* [Translated: “Getting and accepting this impulse and support was a good thing that I am happy and grateful for today. The combination of relaxation exercise and regular physical activity seems optimal to me. When it comes to physical activity, I am now missing something if I am not able to do it for a day“].

References

Adams, S. A., Matthews, C. E., Ebbeling, C. B., Moore, C. G., Cunningham, J. E., Fulton, J., & Hebert, J. R. (2005). The effect of social desirability and social approval on self-reports of physical activity. *American Journal of Epidemiology, 161*(4), 389-398. doi: 10.1093/aje/kwi054

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *Journal of Applied Social Psychology, 32*(4), 665-683. doi: 10.1111/j.1559-1816.2002.tb00236.x

Allen, J. O., Griffith, D. M., & Gaines, H. C. (2013). “She looks out for the meals, period”: African American men's perceptions of how their wives influence their eating behavior and dietary health. *Health Psychology, 32*(4), 447-455. doi: 10.1037/a0028361

American Cancer Society. (2015). *Cancer facts & figures 2015*. Atlanta: American Cancer Society.

Anderson-Bill, E. S., Winett, R. A., & Wojcik, J. R. (2011). Social cognitive determinants of nutrition and physical activity among web-health users enrolling in an online intervention: the influence of social support, self-efficacy, outcome expectations, and self-regulation. *Journal of Medical Internet Research, 13*(1), e28. doi: 10.2196/jmir.1551

Anton, P. M., Partridge, J. A., & Morrissy, M. J. (2013). Cancer caregivers’ perceptions of an exercise and nutrition program. *Supportive Care in Cancer, 21*(3), 803-810. doi: 10.1007/s00520-012-1583-8

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*(4), 471-499. doi: 10.1348/014466601164939

Badr, H., Carmack, C., Milbury, K., & Temech, M. (2013). Psychosocial interventions for couples coping with cancer: A systematic review. In B. I. Carr & J. Steel (Eds.), *Psychological Aspects of Cancer* (pp. 177-198): Springer US.

Ballard-Barbash, R., Friedenreich, C. M., Courneya, K. S., Siddiqi, S. M., McTiernan, A., & Alfano, C. M. Physical activity, biomarkers, and disease outcomes in cancer survivors: a systematic review. *Journal of the National Cancer Institute, 104*(11), 815-840. doi: 10.1093/jnci/djs207

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. doi: 10.1037/0033-295X.84.2.191

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ US: Prentice-Hall, Inc.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational behavior and human decision processes, 50*(2), 248-287. doi: 10.1016/0749-5978(91)90022-L

Bandura, A. (2000). Self-efficacy, *Encyclopedia of Psychology* (Vol. 7, pp. 537-538). Washington, DC: American Psychological Association.

Banzer, W. E. (2014). Onkologie und Bewegung [Oncology and physical activity]. *Deutsche Zeitschrift für Sportmedizin, 65*(1), 3-4. doi: 10.5960/dzsm.2014.112

Barber, F. D. (2012). Social support and physical activity engagement by cancer survivors. *Clinical Journal of Oncology Nursing, 16*(3), E84-E98. doi: 10.1188/12.CJON.E84-E98

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., & Martin, B. W. (2012). Correlates of physical activity: why are some people physically active and others not? *The Lancet, 380*(9838), 258-271. doi: 10.1016/S0140-6736(12)60735-1

Baumann, F. T. (2008). *Bewegungstherapie und Sport bei Krebs: Leitfaden für die Praxis [physical-exercise therapy and exercise in cancer]*: Deutscher Ärzteverlag.

Baumann, F. T., Zopf, E., Elter, T., Zimmer, P., Beulertz, J., & Bloch, W. (2012). Körperliche Aktivität und Sport bei Krebs [Physical activity and exercise among cancer patients]. In F. T. Baumann, W. Bloch & E. Jäger (Eds.), *Sport und körperliche Aktivität in der Onkologie [Exercise and physical activity in oncology]* (pp. 31-40): Springer.

Bellizzi, K. M., Rowland, J. H., Jeffery, D. D., & McNeel, T. (2005). Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *Journal of Clinical Oncology, 23*(34), 8884-8893. doi: 10.1200/jco.2005.02.2343

Berkman, L. F., Glass, T., Brissette, I., & Seeman, T. E. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine, 51*(6), 843-857. doi: 10.1016/S0277-9536(00)00065-4

Biddle, B. J., Bank, B. J., & Slavings, R. L. (1987). Norms, preferences, identities and retention decisions. *Social Psychology Quarterly, 50*(4), 322-337. doi: 10.2307/2786817

Blanchard, C. M., Courneya, K. S., Rodgers, W. M., & Murnaghan, D. M. (2002). Determinants of exercise intention and behavior in survivors of breast and prostate cancer: an application of the theory of planned behavior. *Cancer Nursing, 25*, 88-95. doi: 10.1097/00002820-200204000-00002

Blanchard, C. M., Courneya, K. S., & Stein, K. (2008). Cancer survivors' adherence to lifestyle behavior recommendations and associations with health-related quality of life: Results from the American Cancer Society's SCS-II. *Journal of Clinical Oncology, 26*(13), 2198-2204. doi: 10.1200/jco.2007.14.6217

Blaney, J., Lowe-Strong, A., Rankin, J., Campbell, A., Allen, J., & Gracey, J. (2010). The cancer rehabilitation journey: Barriers to and facilitators of exercise among patients with cancer-related fatigue. *Physical Therapy, 90*(8), 1135-1147. doi: 10.2522/ptj.20090278

Blaney, J. M., Lowe-Strong, A., Rankin-Watt, J., Campbell, A., & Gracey, J. H. (2013). Cancer survivors' exercise barriers, facilitators and preferences in the context of fatigue, quality of life and physical activity participation: a questionnaire–survey. *Psycho-Oncology, 22*(1), 186-194. doi: 10.1002/pon.2072

Bluethmann, S., Vernon, S., Gabriel, K., Murphy, C., & Bartholomew, L. K. (2015). Taking the next step: a systematic review and meta-analysis of physical activity and behavior change interventions in recent post-treatment breast cancer survivors. *Breast Cancer Research and Treatment, 149*(2), 331-342. doi: 10.1007/s10549-014-3255-5

Bourke, L., Homer, K. E., Thaha, M. A., Steed, L., Rosario, D. J., Robb, K. A., . . . Taylor, S. J. (2013). Interventions for promoting habitual exercise in people living with and beyond cancer. *Cochrane Database of Systematic Reviews, Issue 9. Art. No.: CD010192*. doi: 10.1002/14651858.CD010192.pub2

Brehm, J. W. (1966). *A theory of psychological reactance*. New York [u.a.]: Academic Press.

Brown, J. E., & Dunn, P. K. (2011). Comparisons of tobit, linear, and poisson-gamma regression models: An application of time use data. *Sociological Methods & Research, 40*(3), 511-535. doi: 10.1177/0049124111415370

Brown, S. L., Nesse, R. M., Vinokur, A. D., & Smith, D. M. (2003). Providing social support may be more beneficial than receiving it: Results from a prospective study of mortality. *Psychological Science, 14*(4), 320-327. doi: 10.1111/1467-9280.14461

Burkert, S., Knoll, N., Luszczynska, A., & Gralla, O. (2012). The interplay of dyadic and individual planning of pelvic-floor exercise in prostate-cancer patients following radical prostatectomy. *Journal of Behavioral Medicine, 35*(3), 305-317. doi: 10.1007/s10865-012-9416-2

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*(5), 783-792. doi: 10.1016/j.socscimed.2011.06.016

Cadmus, L. A., Salovey, P., Yu, H., Chung, G., Kasl, S., & Irwin, M. L. (2009). Exercise and quality of life during and after treatment for breast cancer: Results of two randomized controlled trials. *Psycho-Oncology, 18*(4), 343-352. doi: 10.1002/pon.1525

Callero, P. L. (1985). Role-Identity Salience. *Social Psychology Quarterly, 48*(3), 203-215. doi: 10.2307/3033681

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Cervone, D., Mor, N., Orom, H., Shadel, W. G., & Scott, W. D. (2004). Self-efficacy beliefs and the architecture of personality. In D. K. Vohs & R. F. Baumeister (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 188-210). New York: The Guilford Press.

Clark, M. M., Vickers, K. S., Hathaway, J. C., Smith, M., Looker, S., Petersen, L., . . . Loprinzi, C. L. (2007). Physical activity in patients with advanced-stage cancer actively receiving chemotherapy. *Journal of Supportiv Oncology, 5*(10), 487-493.

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: A review and avenues for further research. *Journal of Applied Social Psychology, 28*(15), 1429-1464. doi: 10.1111/j.1559-1816.1998.tb01685.x

Conner, M., & Norman, P. (2005). *Predicting health behaviour: Research and practice with social cognition models* (2 ed.). Maidenhead, BRK England: Open University Press.

Cordella, M., & Poiani, A. (2014). *Behavioural oncology: psychological, communicative, and social dimensions*. New York, Heidelberg: Springer.

Coups, E. J., & Ostroff, J. S. (2005). A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Preventive Medicine, 40*(6), 702-711. doi: 10.1016/j.ypmed.2004.09.011

Courneya, K. S. (2010). Efficacy, effectiveness, and behavior change trials in exercise research. *The International Journal of Behavioral Nutrition and Physical Activity, 7*. doi: 10.1186/1479-5868-7-81

Courneya, K. S., Blanchard, C. M., & Laing, D. M. (2001). Exercise adherence in breast cancer survivors training for a dragon boat race competition: A preliminary investigation. *Psycho-Oncology, 10*(5), 444-452. doi: 10.1002/pon.524

Courneya, K. S., Friedenreich, C., Franco-Villalobos, C., Crawford, J., Chua, N., Basi, S., . . . Reiman, T. (2015). Effects of supervised exercise on progression-free survival in lymphoma patients: an exploratory follow-up of the HELP Trial. *Cancer Causes & Control, 26*(2), 269-276. doi: 10.1007/s10552-014-0508-x

Courneya, K. S., & Friedenreich, C. M. (1998). Relationship between exercise during treatment and current quality of life among survivors of breast cancer. *Journal of Psychosocial Oncology, 15*(3-4), 35-57. doi: 10.1300/J077v15n03_02

Courneya, K. S., & Friedenreich, C. M. (1999). Utility of the theory of planned behavior for understanding exercise during breast cancer treatment. *Psycho-Oncology, 8*(2), 112-122. doi: 10.1002/(sici)1099-1611(199903/04)8:2<112::aid-pon341>3.0.co;2-l

Courneya, K. S., & Friedenreich, C. M. (2001). Framework PEACE: an organizational model for examining physical exercise across the cancer experience. *Annals of Behavioral Medicine, 23*(4), 263-272. doi: 10.1207/S15324796ABM2304_5

Courneya, K. S., & Friedenreich, C. M. (2007). Physical activity and cancer control. *Seminars in Oncology Nursing, 23*(4), 242-252. doi: 10.1016/j.soncn.2007.08.002

Courneya, K. S., & Friedenreich, C. M. (Eds.). (2011). *Physical activity and cancer*. Berlin, Heidelberg: Springer

Courneya, K. S., Karvinen, K. H., & Vallance, J. K. (2007). Exercise motivation and behavior change. In M. Feuerstein (Ed.), *Handbook of cancer survivorship* (pp. 113-132): Springer US.

Courneya, K. S., McKenzie, D. C., Reid, R. D., Mackey, J. R., Gelmon, K., Friedenreich, C. M., . . . Segal, R. J. (2008). Barriers to supervised exercise training in a randomized controlled trial of breast cancer patients receiving chemotherapy. *Annals of Behavioral Medicine, 35*(1), 116-122. doi: 10.1007/s12160-007-9009-4

Courneya, K. S., Plotnikoff, R. C., Hotz, S. B., & Birkett, N. J. (2000). Social support and the theory of planned behavior in the exercise domain. *American Journal of Health Behavior, 24*(4), 300-308. doi: 10.5993/AJHB.24.4.6

Courneya, K. S., Rogers, L. Q., Campbell, K. L., Vallance, J. K., & Friedenreich, C. M. (2015). Top 10 research questions related to physical activity and cancer survivorship. *Research Quarterly for Exercise and Sport*, 1-10. doi: 10.1080/02701367.2015.991265

Courneya, K. S., Segal, R. J., McKenzie, D. C., Dong, H., Gelmon, K., Friedenreich, C. M., . . . Mackey, J. R. (2014). Effects of exercise during adjuvant chemotherapy on breast cancer outcomes. *Medicine and Science in Sports and Exercise, 46*(9), 1744-1751. doi: 10.1249/MSS.0000000000000297

Craft, L. L., VanIterson, E. H., Helenowski, I. B., Rademaker, A. W., & Courneya, K. S. (2012). Exercise effects on depressive symptoms in cancer survivors: A systematic review and meta-analysis. *Cancer Epidemiology Biomarkers & Prevention, 21*(1), 3-19. doi: 10.1158/1055-9965.epi-11-0634

Cramp, F., & Daniel, J. (2008). Exercise for the management of cancer-related fatigue in adults. *Cochrane Database of Systematic Reviews, Issue 2. Art. No.: Cd006145*. doi: 10.1002/14651858.CD006145.pub2

Crites, S. L., Fabrigar, L. R., & Petty, R. E. (1994). Measuring the affective and cognitive properties of attitudes: Conceptual and methodological issues. *Personality and Social Psychology Bulletin, 20*(6), 619-634. doi: 10.1177/0146167294206001

De Bruijn, G., & Rhodes, R. (2011). Exploring exercise behavior, intention and habit strength relationships. *Scandinavian Journal of Medicine & Science in Sports, 21*(3), 482-491. doi: 10.1111/j.1600-0838.2009.01064.x

De Jong Gierveld, J., & Dykstra, P. A. (2008). Virtue is its own reward? Support-giving in the family and loneliness in middle and old age. *Ageing and Society, 28*(2), 271-287. doi: 10.1017/S0144686X07006629

De Ridder, D. T., & De Wit, J. B. (Eds.). (2006). *Self-regulation in health behavior: Concepts, theories, and central issues*. West Sussex, England: John Wiley & sons.

Demark-Wahnefried, W., Aziz, N. M., Rowland, J. H., & Pinto, B. M. (2005). Riding the crest of the teachable moment: Promoting long-term health after the diagnosis of cancer. *Journal of Clinical Oncology, 23*(24), 5814-5830. doi: 10.1200/jco.2005.01.230

Demark-Wahnefried, W., Clipp, E. C., Lipkus, I. M., Lobach, D., Snyder, D. C., Sloane, R., . . . McBride, C. M. (2007). Main outcomes of the FRESH START trial: a sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *Journal of Clinical Oncology, 25*(19), 2709-2718. doi: 10.1200/JCO.2007.10.7094

Demark-Wahnefried, W., Peterson, B., McBride, C., Lipkus, I., & Clipp, E. (2000). Current health behaviors and readiness to pursue life-style changes among men and women diagnosed with early stage prostate and breast carcinomas. *Cancer, 88*(3), 674-684. doi: 10.1002/(SICI)1097-0142(20000201)88:3%3C674::AID-CNCR26%3E3.0.CO;2-R

Dimeo, F. C. (2010). Körperliche Aktivität und Sport bei Tumorerkrankungen - Bewegung im eigenen Takt [Physical activity and exercise in tumor diseases - movement in the own rythm]. *Im Focus Onkologie 5*, 60-66.

Dowda, M., Ainsworth, B. E., Addy, C. L., Saunders, R., & Riner, W. (2003). Correlates of physical activity among US young adults, 18 to 30 years of age, from NHANES III. *Annals of Behavioral Medicine, 26*(1), 15-23. doi: 10.1207/S15324796ABM2601_03

Downs, D. S., & Hausenblas, H. A. (2005). The theories of reasoned action and planned behavior applied to exercise: A meta-analytic update. *Journal of Physical Activity & Health, 2*(1), 76-97.

Dukes Holland, K., & Holahan, C. K. (2003). The relation of social support and coping to positive adaptation to breast cancer. *Psychology & Health, 18*(1), 15-29. doi: 10.1080/0887044031000080656

Dunkel-Schetter, C., Blasband, D. E., Feinstein, L. G., & Herbert, T. B. (1992). Elements of supportive interactions: When are attempts to help effective? In S. Spacapan & S. Oskamp (Eds.), *Helping and being helped: Naturalistic studies. The Claremont Symposium of Applied Psychology* (pp. 83-114). Thousand Oaks, CA: Sage Publications.

Dunn, A. L., Garcia, M. E., Marcus, B. H., Kampert, J. B., Kohl, H., & Blair, S. N. (1998). Six-month physical activity and fitness changes in ProjectActive, a randomized trial. *Medicine and Science in Sports and Exercise, 30*(7), 1076-1083. doi: 10.1097/00005768-199807000-00009

Dunn, A. L., Marcus, B. H., Kampert, J. B., Garcia, M. E., Kohl Iii, H. W., & Blair, S. N. (1997). Reduction in cardiovascular disease risk factors: 6-month results from ProjectActive. *Preventive Medicine, 26*(6), 883-892. doi: 10.1006/pmed.1997.0218

Dunn, E. W., Aknin, L. B., & Norton, M. I. (2008). Spending money on others promotes happiness. *Science, 319*(5870), 1687-1688. doi: 10.1126/science.1150952

Dyrstad, S. M., Hansen, B. H., Holme, I. M., & Anderssen, S. A. (2014). Comparison of self-reported versus accelerometer-measured physical activity. *Medicine and Science in Sports and Exercise, 46*(1), 99-106. doi: 10.1249/MSS.0b013e3182a0595f

Eden, K. B., Orleans, C. T., Mulrow, C. D., Pender, N. J., & Teutsch, S. M. (2002). Does counseling by clinicians improve physical activity? A summary of the evidence for the US Preventive Services Task Force. *Annals of Internal Medicine, 137*(3), 208-215. doi: 10.7326/0003-4819-137-3-200208060-00015

Erceg-Hurn, D. M., & Steed, L. G. (2011). Does exposure to cigarette health warnings elicit psychological reactance in smokers? *Journal of Applied Social Psychology, 41*(1), 219-237. doi: 10.1111/j.1559-1816.2010.00710.x

Estabrooks, P. A., Glasgow, R. E., & Dzewaltowski, D. A. (2003). Physical activity promotion through primary care. *Journal of the American Medical Association, 289*(22), 2913-2916. doi: 10.1001/jama.289.22.2913

Fong, D. Y. T., Ho, J. W. C., Hui, B. P. H., Lee, A. M., Macfarlane, D. J., Leung, S. S. K., . . . Cheng, K.-k. (2012). Physical activity for cancer survivors: meta-analysis of randomised controlled trials. *British Medical Journal, 344*, e70. doi: 10.1136/bmj.e70

Francis, J. J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., . . . Bonetti, D. (2004). Constructing questionnaires based on the theory of planned behaviour. A manual for health services researchers. Retrieved 29.03.2015, from http://openaccess.city.ac.uk/1735

Franks, M. M., Stephens, M. A. P., Rook, K. S., Franklin, B. A., Keteyian, S. J., & Artinian, N. T. (2006). Spouses' provision of health-related support and control to patients participating in cardiac rehabilitation. *Journal of Family Psychology, 20*(2), 311. doi: 10.1037/0893-3200.20.2.311

Fraser, S. N., & Rodgers, W. M. (2012). The influence of general and exercise specific social support on self-sfficacy for overcoming barriers to cardiac rehabilitation. *Journal of Applied Social Psychology, 42*(8), 1811-1829. doi: 10.1111/j.1559-1816.2012.00919.x

Friedenreich, C. M., Neilson, H. K., & Lynch, B. M. (2010). State of the epidemiological evidence on physical activity and cancer prevention. *European Journal of Cancer, 46*(14), 2593-2604. doi: 10.1016/j.ejca.2010.07.028

Fuhrer, R., & Stansfeld, S. A. (2002). How gender affects patterns of social relations and their impact on health: a comparison of one or multiple sources of support from “close persons”. *Social Science & Medicine, 54*(5), 811-825. doi: 10.1016/S0277-9536(01)00111-3

Fuhrer, R., Stansfeld, S. A., Chemali, J., & Shipley, M. J. (1999). Gender, social relations and mental health: prospective findings from an occupational cohort (Whitehall II study). *Social Science & Medicine, 48*(1), 77-87. doi: 10.1016/S0277-9536(98)00290-1

Gough, B. (2013). The psychology of men's health: Maximizing masculine capital. *Health Psychology, 32*(1), 1-4. doi: 10.1037/a0030424

Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BioMed Central Public Health, 11*(1), 119. doi: 10.1186/1471-2458-11-119

Hagger, M. S. (2010). Self-regulation: An important construct in health psychology research and practice. *Health Psychology Review, 4*(2), 57-65. doi: 10.1080/17437199.2010.503594

Hagger, M. S., Wood, C., Stiff, C., & Chatzisarantis, N. L. D. (2009). The strength model of self-regulation failure and health-related behaviour. *Health Psychology Review, 3*(2), 208-238. doi: 10.1080/17437190903414387

Hall, P. A., & Fong, G. T. (2007). Temporal self-regulation theory: A model for individual health behavior. *Health Psychology Review, 1*(1), 6-52. doi: 10.1080/17437190701492437

Hamilton, K., & White, K. M. (2008). Extending the theory of planned behavior: the role of self and social influences in predicting adolescent regular moderate-to-vigorous physical activity. *Journal of Sport & Exercise Psychology, 30*(1), 56-74.

Hatchett, A., Hallam, J. S., & Ford, M. A. (2013). Evaluation of a social cognitive theory-based email intervention designed to influence the physical activity of survivors of breast cancer. *Psycho-Oncology, 22*(4), 829-836. doi: 10.1002/pon.3082

Helgeson, V. S. (2012). Gender and health - A social psychological perspective. In A. Baum, T. A. Revenson & J. Singer (Eds.), *Handbook of health psychology (2nd ed.).* (pp. 519-537). New York, NY US: Psychology Press.

Helgeson, V. S., Novak, S. A., Lepore, S. J., & Eton, D. T. (2004). Spouse social control efforts: Relations to health behavior and well-being among men with prostate cancer.

Journal of Social and Personal Relationships, 21(1), 53-68. doi: 10.1177/0265407504039840

Helmerhorst, H. J., Brage, S., Warren, J., Besson, H., & Ekelund, U. (2012). A systematic review of reliability and objective criterion-related validity of physical activity questionnaires. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 103-157. doi: 1186/1479-5868-9-103

Hunt-Shanks, T. T., Blanchard, C. M., Baker, F., Hann, D., Roberts, C. S., McDonald, J., . . . Kaw, O. C. K. (2006). Exercise use as complementary therapy among breast and prostate cancer survivors receiving active treatment: Examination of exercise intention. *Integrative Cancer Therapies, 5*(2), 109-116. doi: 10.1177/1534735406288742

Huy, C., Schmidt, M. E., Vrieling, A., Chang-Claude, J., & Steindorf, K. (2012). Physical activity in a German breast cancer patient cohort: one-year trends and characteristics associated with change in activity level. *European Journal of Cancer, 48*(3), 297-304. doi: 10.1016/j.ejca.2011.08.005

Ievers-Landis, C. E., Burant, C., Drotar, D., Morgan, L., Trapl, E. S., & Kwoh, C. K. (2003). Social support, knowledge, and self-efficacy as correlates of osteoporosis preventive behaviors among preadolescent females. *Journal of Pediatric Psychology, 28*(5), 335-345. doi: 10.1093/jpepsy/jsg023

Jacobsen, P. B., Phillips, K. M., Jim, H. S., Small, B. J., Faul, L. A., Meade, C. D., . . . Fishman, M. (2013). Effects of self-directed stress management training and home-based exercise on quality of life in cancer patients receiving chemotherapy: a randomized controlled trial. *Psycho-Oncology, 22*(6), 1229-1235. doi: 10.1002/pon.3122

Jones, L. W., & Alfano, C. M. (2012). Exercise-oncology research: Past, present, and future. *Acta Oncologica, 52*(2), 195-215. doi: 10.3109/0284186x.2012.742564

Jones, L. W., & Courneya, K. S. (2002). Exercise discussions during cancer treatment consultations. *Cancer practice, 10*(2), 66-74. doi: 10.1046/j.1523-5394.2002.102004.x

Jones, L. W., Courneya, K. S., Fairey, A. S., & Mackey, J. R. (2004). Effects of an oncologist's recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: A single-blind, randomized controlled trial. *Annals of Behavioral Medicine, 28*(2), 105-113. doi: 10.1207/s15324796abm2802_5

Jones, L. W., Courneya, K. S., Vallance, J. K. H., Ladha, A. B., Mant, M. J., Belch, A. R., & Reiman, T. (2006). Understanding the determinants of exercise intentions in multiple myeloma cancer survivors: An application of the theory of planned behavior. *Cancer Nursing, 29*(3), 167-175. doi: 10.1097/00002820-200605000-00001

Jones, L. W., Guill, B., Keir, S. T., Carter, K., Friedman, H. S., Bigner, D. D., & Reardon, D. A. (2007). Using the theory of planned behavior to understand the determinants of exercise intention in patients diagnosed with primary brain cancer. *Psycho-Oncology, 16*(3), 232-240. doi: 10.1002/pon.1077

Jones, L. W., Liang, Y., Pituskin, E. N., Battaglini, C. L., Scott, J. M., Hornsby, W. E., & Haykowsky, M. (2011). Effect of exercise training on peak oxygen consumption in patients with cancer: a meta-analysis. *The oncologist, 16*(1), 112-120. doi: 10.1634/theoncologist.2010-0197

Kaplan, M. S., Newsom, J. T., McFarland, B. H., & Lu, L. (2001). Demographic and psychosocial correlates of physical activity in late life. *American Journal of Preventive Medicine, 21*(4), 306-312. doi: 10.1016/S0749-3797(01)00364-6

Karvinen, K. H., Courneya, K. S., Campbell, K. L., Pearcey, R. G., Dundas, G., Capstick, V., & Tonkin, K. S. (2007). Correlates of exercise motivation and behavior in a population-based sample of endometrial cancer survivors: an application of the theory of planned behavior. *International Journal of Behavioral Nutrition and Physical Activity, 4*(21). doi: 10.1186/1479-5868-4-21

Karvinen, K. H., Courneya, K. S., Plotnikoff, R. C., Spence, J. C., Venner, P. M., & North, S. (2009). A prospective study of the determinants of exercise in bladder cancer survivors using the theory of planned behavior. *Supportive Care in Cancer, 17*(2), 171-179. doi: 10.1007/s00520-008-0471-8

Karvinen, K. H., DuBose, K. D., Carney, B., & Allison, R. R. (2010). Promotion of physical activity among oncologists in the United States. *The Journal of Supportive Oncology, 8*(1), 35-41.

Keats, M. R., & Culos-Reed, S. (2009). A theory-driven approach to encourage physical activity in pediatric cancer survivors: A pilot study. *Journal of Sport and Exercise Psychology, 31*(2), 267-283.

Keats, M. R., Culos-Reed, S. N., Courneya, K. S., & McBride, M. (2007). Understanding physical activity in adolescent cancer survivors: An application of the theory of planned behavior. *Psycho-Oncology, 16*(5), 448-457. doi: 10.1002/pon.1075

Kenfield, S. A., Stampfer, M. J., Giovannucci, E., & Chan, J. M. (2011). Physical activity and survival after prostate cancer diagnosis in the health professionals follow-up study. *Journal of Clinical Oncology, 29*(6), 726-732. doi: 10.1200/JCO.2010.31.5226

Khan, C. M., Stephens, M. A. P., Franks, M. M., Rook, K. S., & Salem, J. K. (2013). Influences of spousal support and control on diabetes management through physical activity. *Health Psychology, 32*(7), 739-747. doi: 10.1037/a0028609

Kim, Y., & Given, B. A. (2008). Quality of life of family caregivers of cancer survivors. *Cancer, 112*(S11), 2556-2568. doi: 10.1002/cncr.23449

Knoll, N., Burkert, S., Scholz, U., Roigas, J., & Gralla, O. (2012). The dual-effects model of social control revisited: Relationship satisfaction as a moderator. *Anxiety, Stress & Coping, 25*(3), 291-307. doi: 10.1080/10615806.2011.584188

Konrath, S., & Brown, S. (2013). The effects of giving on givers. In M. L. Newman & N. A. Roberts (Eds.), *Health and social relationships: The good, the bad, and the complicated*: American psychological association.

Koring, M., Richert, J., Parschau, L., Ernsting, A., Lippke, S., & Schwarzer, R. (2012). A combined planning and self-efficacy intervention to promote physical activity: A multiple mediation analysis. *Psychology, Health & Medicine, 17*(4), 488-498. doi: 10.1080/13548506.2011.608809

Langford, C. P. H., Bowsher, J., Maloney, J. P., & Lillis, P. P. (1997). Social support: a conceptual analysis. *Journal of Advanced Nursing, 25*(1), 95-100. doi: 10.1046/j.1365-2648.1997.1997025095.x

Lewis, M. A., McBride, C. M., Pollak, K. I., Puleo, E., Butterfield, R. M., & Emmons, K. M. (2006). Understanding health behavior change among couples: An interdependence and communal coping approach. *Social Science & Medicine, 62*(6), 1369-1380. doi: 10.1016/j.socscimed.2005.08.006

Lewis, M. A., & Rook, K. S. (1999). Social control in personal relationships: impact on health behaviors and psychological distress. *Health Psychology, 18*(1), 63-71. doi: 10.1037/0278-6133.18.1.63

Ligibel, J. A., Meyerhardt, J., Pierce, J. P., Najita, J., Shockro, L., Campbell, N., . . . Wood, M. (2012). Impact of a telephone-based physical activity intervention upon exercise behaviors and fitness in cancer survivors enrolled in a cooperative group setting. *Breast Cancer Research and Treatment, 132*(1), 205-213. doi: 10.1007/s10549-011-1882-7

Lobelo, F., & de Quevedo, I. G. (2014). The evidence in support of physicians and health care providers as physical activity role models. *American Journal of Lifestyle Medicine*, 1559827613520120. doi: 10.1177/1559827613520120

Lowe, S. S., Watanabe, S. M., Baracos, V. E., & Courneya, K. S. (2012). Determinants of physical activity in palliative cancer patients: An application of the theory of planned behavior. *The Journal of Supportive Oncology, 10*(1), 30-36. doi: 10.1016/j.suponc.2011.07.005

Mann, T., de Ridder, D., & Fujita, K. (2013). Self-regulation of health behavior: Social psychological approaches to goal setting and goal striving. *Health Psychology, 32*(5), 487-498. doi: 10.1037/a0028533

Matthews, C. E., Wilcox, S., Hanby, C. L., Ananian, C. D., Heiney, S. P., Gebretsadik, T., & Shintani, A. (2007). Evaluation of a 12-week home-based walking intervention for

breast cancer survivors. *Supportive Care in Cancer, 15*(2), 203-211. doi: 10.1007/s00520-006-0122-x

McBride, C. M., Emmons, K. M., & Lipkus, I. M. (2003). Understanding the potential of teachable moments: the case of smoking cessation. *Health Education Research, 18*(2), 156-170. doi: 10.1093/her/18.2.156

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the heory of planned behaviour: A meta-analysis. *Health Psychology Review, 5*(2), 97-144. doi: 10.1080/17437199.2010.521684

McGowan, E. L., Speed-Andrews, A. E., Blanchard, C. M., Rhodes, R. E., Friedenreich, C. M., Cubs-Reed, S. N., & Courneya, K. S. (2013). Physical activity preferences among a population-based sample of colorectal cancer survivors. *Oncology Nursing Forum, 40*(1), 44-52. doi: 10.1188/13.onf.44-52

Michie, S., & Prestwich, A. (2010). Are interventions theory-based? Development of a theory coding scheme. *Health Psychology, 29*(1), 1-8. doi: 10.1037/a0016939

Miller, C. H., Lane, L. T., Deatrick, L. M., Young, A. M., & Potts, K. A. (2007). Psychological reactance and promotional health messages: The effects of controlling language, lexical concreteness, and the restoration of freedom. *Human Communication Research, 33*(2), 219-240. doi: 10.1111/j.1468-2958.2007.00297.x

Miller, E., & Wortman, C. (2002). Gender differences in mortality and morbidity following a major stressor: The case of conjugal bereavement. In G. Weidner, M. S. Kopp & M. Kristenson (Eds.), *Heart disease: Environment, stress, and gender* (Vol. 327, pp. 251-266). Amsterdam, Netherlands: IOS Press.

Mishra, S. I., Scherer, R. W., Snyder, C., Geigle, P. M., Berlanstein, D. R., & Topaloglu, O. (2012). Exercise interventions on health-related quality of life for people with cancer during active treatment. *The Cochrane Library, Issue 8. Art. No.: CD008465*. doi: 10.1002/14651858.CD008465.pub2

National Coalition for Cancer Survivorship. (2015). Retrieved January, 29th, 2015, from http://www.canceradvocacy.org/about/org

Neal, D. T., Wood, W., Labrecque, J. S., & Lally, P. (2012). How do habits guide behavior? Perceived and actual triggers of habits in daily life. *Journal of Experimental Social Psychology, 48*(2), 492-498. doi: 10.1016/j.jesp.2011.10.011

Neff, L. A., & Karney, B. R. (2005). Gender differences in social support: a question of skill or responsiveness? *Journal of Personality and Social Psychology, 88*(1), 79-90. doi: 10.1037/0022-3514.88.1.79

Newman, M. L., & Roberts, N. A. (2013). *Health and social relationships: The good, the bad, and the complicated*: American Psychological Association.

Noar, S. M., & Zimmerman, R. S. (2005). Health behavior Tbheory and cumulative knowledge regarding health behaviors: are we moving in the right direction? *Health Education Research, 20*(3), 275-290. doi: 10.1093/her/cyg113

O'Halloran, P. D., Blackstock, F., Shields, N., Holland, A., Iles, R., Kingsley, M., . . . Taylor, N. F. (2014). Motivational interviewing to increase physical activity in people with chronic health conditions: a systematic review and meta-analysis. *Clinical Rehabilitation, 28*(12), 1159-1171. doi: 10.1177/0269215514536210

Ochsner, S., Luszczynska, A., Stadler, G., Knoll, N., Hornung, R., & Scholz, U. (2013). The interplay of received social support and self-regulatory factors in smoking cessation. *Psychology & Health, 29*(1), 16-31. doi: 10.1080/08870446.2013.818674

Packel, L. B., Prehn, A. W., Anderson, C. L., & Fisher, P. L. (in press). Factors influencing physical activity behaviors in colorectal cancer survivors. *American Journal of Health Promotion*. doi: 10.4278/ajhp.140103-QUAN-7

Park, C., Zlateva, I., & Blank, T. (2009). Self-identity after cancer: "Survivor","Victim", "Patient", and "Person with Cancer". *Journal of General Internal Medicine, 24*(2), 430-435. doi: 10.1007/s11606-009-0993-x

Piferi, R. L., & Lawler, K. A. (2006). Social support and ambulatory blood pressure: An examination of both receiving and giving. *International Journal of Psychophysiology, 62*(2), 328-336. doi: 10.1016/j.ijpsycho.2006.06.002

Pinto, B. M., & Ciccolo, J. T. (2011). Physical activity motivation and cancer survivorship. In K. Courneya & C. M. Friedenreich (Eds.), *Physical Activity and Cancer* (pp. 367-387): Springer.

Pinto, B. M., Frierson, G. M., Rabin, C., Trunzo, J. J., & Marcus, B. H. (2005). Home-based physical activity intervention for breast cancer patients. *Journal of Clinical Oncology, 23*(15), 3577-3587. doi: 10.1200/JCO.2005.03.080

Pinto, B. M., Papandonatos, G. D., Goldstein, M. G., Marcus, B. H., & Farrell, N. (2011). Home-based physical activity intervention for colorectal cancer survivors. *Psycho-Oncology, 22*(1), 54-64. doi: 10.1002/pon.2047

Pitceathly, C., & Maguire, P. (2003). The psychological impact of cancer on patients' partners and other key relatives: a review. *European Journal of cancer, 39*(11), 1517-1524. doi: 10.1016/S0959-8049(03)00309-5

Prince, S., Adamo, K., Hamel, M., Hardt, J., Gorber, S., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 5*(56), 1-24. doi: doi:10.1186/1479-5868-5-56

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395. doi: 10.1037//0022-006X.51.3.390

Reno, R. R., Cialdini, R. B., & Kallgren, C. A. (1993). The transsituational influence of social norms. *Journal of Personality and Social Psychology, 64*(1), 104-112.

Rhodes, R. E., Jones, L. W., & Courneya, K. S. (2002). Extending the theory of planned behavior in the exercise domain: a comparison of social support and subjective norm. *Research Quarterly for Exercise & Sport, 73*(2), 193-199. doi: 10.1080/02701367.2002.10609008

Rivis, A., & Sheeran, P. (2003). Descriptive norms as an additional predictor in the theory of planned behaviour: A meta-analysis. *Current Psychology, 22*(3), 218-233. doi: 10.1007/s12144-003-1018-2

Robert Koch-Institut , & Gesellschaft der epidemiologischen Krebsregister in Deutschland e.V. (Eds.). (2013). Krebs in Deutschland 2009/2010. Retrieved January 16th, 2015, from www.rki.de/krebs

Rogers, L. Q., Courneya, K., Robbins, K. T., Malone, J., Seiz, A., Koch, L., & Rao, K. (2008). Physical activity correlates and barriers in head and neck cancer patients. *Supportive Care in Cancer, 16*(1), 19-27. doi: 10.1007/s00520-007-0293-0

Rogers, L. Q., Hopkins-Price, P., Vicari, S., Pamenter, R., Courneya, K. S., Markwell, S., . . . Lowy, M. (2009). A randomized trial to increase physical activity in breast cancer survivors. *Medicine and Science in Sports and Exercise, 41*(4), 935-946. doi: 10.1249/MSS.0b013e31818e0e1b

Rogers, L. Q., Markwell, S., Hopkins-Price, P., Vicari, S., Courneya, K. S., Hoelzer, K., & Verhulst, S. (2011). Reduced barriers mediated physical activity maintenance among breast cancer survivors. *Journal of Sport & Exercise Psychology, 33*(2), 235-254.

Rogers, L. Q., Shah, P., Dunnington, G., Greive, A., Shanmugham, A., Dawson, B., & Courneya, K. S. (2005). Social cognitive theory and physical activity during breast cancer treatment. *Oncology Nursing Forum, 32*(4), 807-815. doi: 10.1188/05.onf.807-815

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. doi: 10.1037/0003-066X.55.1.68

Sabiston, C. M., Brunet, J., Vallance, J. K., & Meterissian, S. (2014). Prospective examination of objectively assessed physical activity and sedentary time after breast cancer treatment: Sitting on the crest of the teachable moment. *Cancer Epidemiology Biomarkers & Prevention, 23*(7), 1324-1330. doi: 10.1158/1055-9965.epi-13-1179

Sallis, J. F., Grossman, R. M., Pinski, R. B., Patterson, T. L., & Nader, P. R. (1987). The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine, 16*(6), 825-836. doi: 10.1016/0091-7435(87)90022-3

Sallis, J. F., & Saelens, B. E. (2000). Assessment of physical activity by self-report: status, limitations, and future directions. *Research quarterly for exercise and sport, 71*(2 Suppl), S1.

Schmid, D., & Leitzmann, M. (2014). Association between physical activity and mortality among breast cancer and colorectal cancer survivors: a systematic review and meta-analysis. *Annals of Oncology, 25*(7), 1293-1311. doi: 10.1093/annonc/mdu012

Schmitz, K. H., Courneya, K. S., Matthews, C., Demark-Wahnefried, W., Galvao, D. A., Pinto, B. M., . . . Schwartz, A. L. (2010). American college of sports medicine roundtable on exercise guidelines for cancer survivors. *Medicine and Science in Sports and Exercise, 42*(7), 1409-1426. doi: 10.1249/MSS.0b013e3181e0c112

Schwartz, C. E., Keyl, P., Marcum, J., & Bode, R. (2009). Helping others shows differential benefits on health and well-being for male and female teens. *Journal of Happiness Studies, 10*(4), 431-448. doi: 10.1007/s10902-008-9098-1

Schwartz, C. E., Meisenhelder, J. B., Ma, Y., & Reed, G. (2003). Altruistic social interest behaviors are associated with better mental health. *Psychosomatic Medicine, 65*(5), 778-785. doi: 10.1097/01.PSY.0000079378.39062.D4

Schwarzer, R. (2001). Social-cognitive factors in changing health-related behaviors. *Current Directions in Psychological Science, 10*(2), 47-51. doi: 10.1111/1467-8721.00112

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology, 57*(1), 1-29. doi: 10.1111/j.1464-0597.2007.00325.x

Schwarzer, R., Lippke, S., & Luszczynska, A. (2011). Mechanisms of health behavior change in persons with chronic illness or disability: The Health Action Process Approach (HAPA). *Rehabilitation Psychology, 56*(3), 161-170. doi: 10.1037/a0024509

Seemann, E. A., Buboltz, W. C., Jenkins, S. M., Soper, B., & Woller, K. (2004). Ethnic and gender differences in psychological reactance: the importance of reactance in multicultural counselling. *Counselling Psychology Quarterly, 17*(2), 167-176. doi: 10.1080/09515070410001728316

Segura-Jiménez, V., Álvarez-Gallardo, I. C., Romero-Zurita, A., Camiletti-Moirón, D., Munguía-Izquierdo, D., Carbonell-Baeza, A., & Ruiz, J. R. (2014). Comparison of physical activity using questionnaires (leisure time physical activity instrument and physical activity at home and work instrument) and accelerometry in fibromyalgia patients: The Al-Ándalus Project. *Archives of Physical Medicine and Rehabilitation, 95*(10), 1903-1911. e1902. doi: 10.1016/j.apmr.2014.05.015

Shephard, R. J. (2003). Limits to the measurement of habitual physical activity by questionnaires. *British Journal of Sports Medicine, 37*(3), 197-206. doi: 10.1136/bjsm.37.3.197

Short, C. E., James, E., Girgis, A., Mcelduff, P., & Plotnikoff, R. (2012). Move more for life: The protocol for a randomised efficacy trial of a tailored-print physical activity intervention for post-treatment breast cancer survivors. *BioMed Central Cancer, 12*(1), 172. doi: 10.1186/1471-2407-12-172

Short, C. E., James, E. L., Girgis, A., D'Souza, M. I., & Plotnikoff, R. C. (2014). Main outcomes of the Move More for Life Trial: a randomised controlled trial examining the effects of tailored-print and targeted-print materials for promoting physical activity among post-treatment breast cancer survivors. *Psycho-Oncology*, first published online. doi: 10.1002/pon.3639

Short, C. E., James, E. L., Stacey, F., & Plotnikoff, R. C. (2013). A qualitative synthesis of trials promoting physical activity behaviour change among post-treatment breast cancer survivors. *Journal of Cancer Survivorship, 7*(4), 570-581. doi: 10.1007/s11764-013-0296-4

Slymen, D. J., Ayala, G. X., Arredondo, E. M., & Elder, J. P. (2006). A demonstration of modeling count data with an application to physical activity. *Epidemiologic Perspectives & Innovations, 3*, 3-9. doi: 10.1186/1742-5573-3-3

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis. *Journal of Cancer Survivorship, 4*(2), 87-100. doi: 10.1007/s11764-009-0110-5

Speed-Andrews, A. E., Rhodes, R. E., Blanchard, C. M., Culos-Reed, S. N., Friedenreich, C. M., Belanger, L. J., & Courneya, K. S. (2012). Medical, demographic and social cognitive correlates of physical activity in a population-based sample of colorectal cancer survivors. *European Journal of Cancer Care, 21*(2), 187-196. doi: 10.1111/j.1365-2354.2011.01290.x

Stacey, F. G., James, E. L., Chapman, K., Courneya, K. S., & Lubans, D. R. (2014). A systematic review and meta-analysis of social cognitive theory-based physical activity and/or nutrition behavior change interventions for cancer survivors. *Journal of Cancer Survivorship*, 1-34. doi: 10.1007/s11764-014-0413-z

Stene, G. B., Helbostad, J. L., Balstad, T. R., Riphagen, I. I., Kaasa, S., & Oldervoll, L. M. (2013). Effect of physical exercise on muscle mass and strength in cancer patients during treatment—A systematic review. *Critical Reviews in Oncology/Hematology, 88*(3), 573-593. doi: 10.1016/j.critrevonc.2013.07.001

Stevinson, C., Capstick, V., Schepansky, A., Tonkin, K., Vallance, J. K., Ladha, A. B., . . . Courneya, K. S. (2009). Physical activity preferences of ovarian cancer survivors. *Psycho-Oncology, 18*(4), 422-428. doi: 10.1002/pon.1396

Stevinson, C., Tonkin, K., Capstick, V., Schepansky, A., Ladha, A. B., Vallance, J. K., . . . Courneya, K. S. (2009). A Population-based study of the determinants of physical activity in ovarian cancer survivors. *Journal of Physical Activity & Health, 6*(3), 339-346.

Strasser, B., Steindorf, K., Wiskemann, J., & Ulrich, C. M. (2013). Impact of resistance training in cancer survivors: a meta-analysis. *Medicine and Science in Sports and Exercise, 45*(11), 2080-2090. doi: 10.1249/MSS.0b013e31829a3b63

Stryker, S. (1968). Identity salience and role performance: The relevance of symbolic Iinteraction theory for family research. *Journal of Marriage and Family, 30*(4), 558-564. doi: 10.2307/349494

Stryker, S. (1986). Identity theory: developments and extensions. In K. Yardley, Honess T. (Ed.), *Self and identity: Psychosocial perspectives* (pp. 89-104). New York: Wiley.

Taylor, C. L. C., Demoor, C., Smith, M. A., Dunn, A. L., Basen-Engquist, K., Nielsen, I., . . . Gritz, E. R. (2006). Active for life after cancer: A randomized trial examining a lifestyle physical activity program for prostate cancer patients. *Psycho-Oncology, 15*(10), 847-862. doi: 10.1002/pon.1023

Taylor, S. E. (1983). Adjustment to threatening events: A theory of cognitive adaptation. *American Psychologist, 38*(11), 1161-1173. doi: 10.1037/0003-066X.38.11.1161

Thorpe, C. T., Lewis, M. A., & Sterba, K. R. (2008). Reactions to health-related social control in young adults with type 1 diabetes. *Journal of Behavioral Medicine, 31*(2), 93-103. doi: 10.1007/s10865-007-9125-4

Trinh, L., Plotnikoff, R. C., Rhodes, R. E., North, S., & Courneya, K. S. (2012). Correlates of physical activity in a population-based sample of kidney cancer survivors: An application of the theory of planned behavior. *The International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 96-107. doi: 10.1186/1479-5868-9-96

Trinh, L., Plotnikoff, R. C., Rhodes, R. E., North, S., & Courneya, K. S. (2014). Feasibility and preliminary efficacy of adding behavioral counseling to supervised physical activity in kidney cancer survivors: A randomized controlled trial. *Cancer Nursing, 37*(5), E8-E22. doi: 10.1097/NCC.0b013e3182a40fb6

Tucker, J. S., Orlando, M., Elliott, M. N., & Klein, D. J. (2006). Affective and behavioral responses to health-related social control. *Health Psychology, 25*(6), 715-722. doi: 10.1037/0278-6133.25.6.715

Tudor-Locke, C., Williams, J. E., Reis, J. P., & Pluto, D. (2002). Utility of pedometers for assessing physical activity. *Sports Medicine, 32*(12), 795-808. doi: 10.2165/00007256-200232120-00004

Uchino, B. N. (2004). *Social support and physical health: Understanding the health consequences of relationships*: Yale University Press.

Uchino, B. N. (2006). Social support and health: A review of physiological processes potentially underlying links to disease outcomes. *Journal of Behavioral Medicine, 29*(4), 377-387. doi: 10.1007/s10865-006-9056-5

Vallance, J., Courneya, K. S., Plotnikoff, R. C., & Mackey, J. R. (2008). Analyzing theoretical mechanisms of physical activity behavior change in breast cancer survivors: results from the activity promotion (ACTION) trial. *Annals of Behavioral Medicine, 35*(2), 150-158. doi: 10.1007/s12160-008-9019-x

Van Damme, S., Crombez, G., Goubert, L., & Eccleston, C. (2009). Current issues and new directions in Psychology and Health: The costs and benefits of self-regulation – a call for experimental research. *Psychology & Health, 24*(4), 367-371. doi: 10.1080/08870440902866902

Van Dyck, D., Cardon, G., Deforche, B., Giles-Corti, B., Sallis, J. F., Owen, N., & De Bourdeaudhuij, I. (2011). Environmental and psychosocial correlates of accelerometer-assessed and self-reported physical activity in Belgian adults. *International Journal of Behavioral Medicine, 18*(3), 235-245. doi: 10.1007/s12529-010-9127-4

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*(2), 147-207. doi: 10.1080/17437190903229462

van Stralen, M. M., Lechner, L., Mudde, A. N., de Vries, H., & Bolman, C. (2010). Determinants of awareness, initiation and maintenance of physical activity among the over-fifties: a Delphi study. *Health Education Research, 25*(2), 233-247. doi: 10.1093/her/cyn045

von Gruenigen, V. E., Courneya, K. S., Gibbons, H. E., Kavanagh, M. B., Waggoner, S. E., & Lerner, E. (2008). Feasibility and effectiveness of a lifestyle intervention program in obese endometrial cancer patients: a randomized trial. *Gynecologic Oncology, 109*(1), 19-26. doi: 10.1016/j.ygyno.2007.12.026

Vrieling, A., & Kampman, E. (2010). The role of body mass index, physical activity, and diet in colorectal cancer recurrence and survival: a review of the literature. *The American Journal of Clinical Nutrition, 92*(3), 471-490. doi: 10.3945/ajcn.2009.29005

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal, 174*(6), 801-809. doi: 10.1503/cmaj.051351

Warren, J. M., Ekelund, U., Besson, H., Mezzani, A., Geladas, N., & Vanhees, L. (2010). Assessment of physical activity – a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. *European Journal of Cardiovascular Prevention & Rehabilitation, 17*(2), 127-139. doi: 10.1097/HJR.0b013e32832ed875

Webb, T., Joseph, J., Yardley, L., & Michie, S. (2010). Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *Journal of Medical Internet Research, 12*(1), e4. doi: 10.2196/jmir.1376

Whitehead, D., & Russell, G. (2004). How effective are health education programmes — resistance, reactance, rationality and risk? Recommendations for effective practice. *International Journal of Nursing Studies, 41*(2), 163-172. doi: 10.1016/S0020-7489(03)00117-2

Woller, K. M., Buboltz, W. C., & Loveland, J. M. (2007). Psychological reactance: examination across age, ethnicity, and gender. *The American Journal of Psychology*, 15-24. doi: 10.2307/20445379

Wühr, E. (2011). *Systemische Medizin: auf der Suche nach einer besseren Medizin [Systemic medicine: searching for a better medicine]*: Systemische Medizin.

Zhu, S. H., Nguyen, Q. B., Cummins, S., Wong, S., & Wightman, V. (2006). Non-smokers seeking help for smokers: a preliminary study. *Tobacco Control, 15*(2), 107-113. doi: 10.1136/tc.2005.012401

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaeterts, P. R. Pintrich & M. Zeidner (Eds.), Handbook of self-regulation. San Diego, California [u.a.]: Acadademic Press.

Zimmermann, F., & Sieverding, M. (2011). Young adults' images of abstaining and drinking: Prototype dimensions, correlates and assessment methods. *Journal of Health Psychology, 16*(3), 410-420. doi: 10.1177/1359105310373412

List of abbreviations

e.g.	for example
HAPA	Health Action Process Approach
i.e.	id est (Latin), that is to say
MOTIVACTION	motivational intervention enhancing physical activity in cancer patients
NCT	National Center for Tumor Diseases
PA	physical activity
PACG	physical activity and cancer control
PEACE	physical exercise across the cancer experience
TPB	Theory of Planned Behavior

Erklärung gemäß § 8 Abs. 1 Buchst. b) und c) der Promotionsordnung der Fakultät für Verhaltens- und Empirische Kulturwissenschaften
Declaration in accordance to § 8 (1) b) and § 8 (1) c) of the doctoral degree regulation of Heidelberg University, Faculty of Behavioural and Cultural Studies

---

Promotionsausschuss der Fakultät für Verhaltens- und Empirische Kulturwissenschaften der Ruprecht-Karls-Universität Heidelberg
Doctoral Committee of the Faculty of Behavioural and Cultural Studies of Heidelberg University

Erklärung gemäß § 8 Abs. 1 Buchst. b) der Promotionsordnung der Universität Heidelberg für die Fakultät für Verhaltens- und Empirische Kulturwissenschaften
Declaration in accordance to § 8 (1) b) and § 8 (1) c) of the doctoral degree regulation of Heidelberg University, Faculty of Behavioural and Cultural Studies

Ich erkläre, dass ich die vorgelegte Dissertation selbstständig angefertigt, nur die angegebenen Hilfsmittel benutzt und die Zitate gekennzeichnet habe.
I declare that I have made the submitted dissertation independently, using only the specified tools and have correctly marked all quotations.

Erklärung gemäß § 8 Abs. 1 Buchst. c) der Promotionsordnung der Universität Heidelberg für die Fakultät für Verhaltens- und Empirische Kulturwissenschaften

Ich erkläre, dass ich die vorgelegte Dissertation in dieser oder einer anderen Form nicht anderweitig als Prüfungsarbeit verwendet oder einer anderen Fakultät als Dissertation vorgelegt habe.
I declare that I did not use the submitted dissertation in this or any other form as an examination paper until now and that I did not submit it in another faculty.

Vorname Nachname
First name Family name _____

Datum, Unterschrift
Date, Signature _____