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Planning with a partner? Individual and dyadic planning in three health behaviour contexts

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Abstract

Health behaviours such as fruit and vegetable intake as well as physical activity are related to reduced risk for specific diseases (e.g., cardiovascular diseases, cancer) and all-cause mortality. Despite the importance to engage in these health behaviours regularly, the majority of German adults do not adhere to such public guidelines. Empirical evidence shows that many individuals fail to translate their health-behaviour-related intentions into action. In health behaviour change theories, *individual planning* is suggested as an important self-regulatory strategy to bridge this *intention-behaviour gap*. That is, individuals form plans on when, where, and how to perform a behaviour. An example plan for the enhancement of physical activity would read "When I come home from work, then I will go jogging for 30 minutes" (When: after work; Where: home as the starting point; Behaviour: Jogging; How: for 30 minutes). Moreover, as health regulation is strongly affected by our social environment, the conceptualisation *dyadic planning* was introduced, that is, planning one's health behaviour together with a partner.

This thesis starts with introducing the literature on individual planning, followed by reviewing empirical evidence on individual planning and dyadic forms of planning. To further contribute to research on health behaviour-related individual and dyadic planning, the following research questions will be investigated (summarised).

1) How frequently are individual and dyadic planning used at baseline and over time? (Chapters 2 to 5)
2) How are psychosocial predictors linked to dyadic planning? (Chapter 2)
3) Which behavioural links show individual and dyadic planning and how do these links change over time? (Chapter 3)
4) Which mechanisms of an individual planning intervention explain health behaviour changes? (Chapter 4)

5) Which plan characteristics of individual and dyadic plans are associated with plan enactment? Which enactment rates show individual and dyadic plans? (Chapter 5)

The data to answer these questions come from three study projects investigating three health contexts and samples: prostate cancer patients' post-surgery rehabilitation and their partners (Chapters 2 and 3), adult individuals' fruit and vegetable consumption (Chapter 4), and adult couples' physical activity (Chapter 5). The results of the empirical chapters lead to the following answers to the research questions (1) to (5).

1) Participants used individual planning more often than dyadic planning (Chapters 2 to 5). Regarding planning use over time, individual and dyadic planning of rehabilitative exercises were used more frequently in the beginning, but less frequently at later stages of prostate cancer patients' rehabilitation.
2) Relevant unique predictors of prostate cancer patients' dyadic planning of rehabilitative exercises were patients' positive affect and self-efficacy, patients' and their partners' relationship quality, as well as partners' reports on patients' urinary incontinence severity (Chapter 2).
3) Individual planning was a constant and positive correlate of prostate cancer patients' rehabilitative exercise. Dyadic planning became more important for PFE at later stages of rehabilitation (Chapter 3).
4) Improved levels of persons' intentions following an individual planning intervention was the most important predictor of fruit and vegetable consumption (Chapter 4).
5) For both individual and dyadic plans, plan enactment was more likely in earlier plans, when plans included a routine, and when the time-cue was less specific. Dyadic plans were more likely enacted as compared to individual plans (Chapter 5).

In the general discussion, these results are integrated into the literature on health behaviour-related planning and implications for research and practice are discussed. In conclusion, this thesis fills important gaps in the literature by comprehensively

investigating dyadic planning as a predictor of health behaviour, as an outcome of psychosocial constructs, and as an active ingredient of interventions.

Zusammenfassung

Gesundheitsverhaltensweisen wie regelmäßiger Obst- und Gemüsekonsum oder körperliche Aktivität gehen mit einem reduziertem Risiko für Erkrankungen (z.B. kardiovaskuläre Erkrankungen, Krebserkrankungen) und allgemeiner Mortalität einher. Trotz der Wichtigkeit, diese Gesundheitsverhaltensweisen regelmäßig auszuführen, erfüllt die Mehrheit der Erwachsenen in Deutschland nicht die Empfehlungen der Weltgesundheitsorganisation. Bisherige Forschung zeigte, dass viele Personen die Absicht haben, entsprechende Gesundheitsverhaltensweisen auszuüben, diese aber oftmals nicht in Handlungen umsetzen (*Intentions-Verhaltens-Lücke*). In Theorien zu Prozessen der Gesundheitsverhaltensänderung wird angenommen, dass die *individuelle Planung* von Gesundheitsverhalten eine wichtige Strategie sein kann, um die Intentions-Verhaltens-Lücke zu schließen. Individuelle Planung beinhaltet das konkrete Aufstellen von wann-wo-wie Plänen, um ein Gesundheitsverhalten zu steigern. Ein Beispielplan zur Steigerung der körperlichen Aktivität wäre: „Wenn ich von der Arbeit nach Hause komme, dann gehe ich für 30 Minuten joggen“ (Wann: nach der Arbeit; Wo: von zu Hause aus; Verhalten: Joggen; Wie: für 30 Minuten). Es sollte außerdem berücksichtigt werden, dass unsere Gesundheitsregulation stark von unserem sozialen Umfeld beeinflusst wird und gesundheitsverhaltensbezogene Pläne auch zusammen mit einer weiteren Person aufgestellt werden. Dies wird durch das Konzept der *dyadischen Planung* adressiert, bei der eine Person das Gesundheitsverhalten gemeinsam mit einer weiteren Person plant.

Diese Dissertation beginnt mit einer Einführung in die Literatur zur individuellen Planung. Anschließend wird die empirische Evidenz von Studien zur individuellen Planung sowie dem Planen in der Dyade zusammengetragen. Um einen Beitrag zur weiteren Erforschung der individuellen und dyadischen Planung von Gesundheitsverhalten

zu leisten, widmet sich diese Dissertation den folgenden zusammengefassten Forschungsfragen:

1. Wie häufig werden individuelle und dyadische Pläne von Personen zum Studienbeginn und über den Studienverlauf angewendet? (Kapitel 2 bis 5)
2. Welche psychosozialen Prädiktoren sind mit dyadischer Planung assoziiert? (Kapitel 2)
3. Welche Assoziationen zeigen individuelle Planung und dyadische Planung mit Gesundheitsverhalten? Wie ändern sich diese Assoziationen über die Zeit? (Kapitel 3)
4. Welche Mechanismen einer individuellen Planungsintervention erklären die Veränderung von Gesundheitsverhalten? (Kapitel 4)
5. Welche Eigenschaften von individuellen und dyadischen Plänen sind mit Planumsetzung assoziiert? Wie häufig werden individuelle und dyadische Pläne umgesetzt? (Kapitel 5)

Diese Fragestellungen werden mithilfe von Daten aus drei Studienprojekten beantwortet, welche die folgenden drei Gesundheitsbereiche und Stichproben untersuchten: den Rehabilitationsprozess von Prostatakrebspatienten und ihren Partnerinnen (Kapitel 2 und 3), den Obst- und Gemüsekonsum von erwachsenen Personen (Kapitel 4), sowie die körperliche Aktivität von erwachsenen, gesunden Paaren (Kapitel 5). Anhand der Ergebnisse der empirischen Kapitel können die Forschungsfragen (1) bis (5) wie folgt beantwortet werden:

1. Das individuelle Planen von Gesundheitsverhalten wurde häufiger angewendet als das dyadische Planen (Kapitel 2 bis 5). Bezogen auf die Nutzung beider Planungsformen über die Zeit wurde gefunden, dass sowohl individuelle als auch dyadische Planung häufiger in früheren Phasen der Rehabilitation von Prostatakrebspatienten genutzt wurden. In späteren Phasen der Rehabilitation wurden beide Planungsformen seltener angewendet.

2. Als wichtige Prädiktoren der dyadischen Planung von Prostatakrebspatienten und ihren Partnerinnen zeigten sich: der positive Affekt und die Selbstwirksamkeitserwartung des Patienten, die Beziehungsqualität beider Personen sowie der von der Partnerin eingeschätzte Schweregrad der Inkontinenz des Patienten (Kapitel 2).
3. Individuelle Planung war ein kontinuierlich positiver Prädiktor für die Ausübung von Beckenbodentraining. Dahingegen war die dyadische Planung in ihrer Wichtigkeit für die Ausübung von Beckenbodentraining anfangs weniger bedeutsam, wurde aber in späteren Phasen der Rehabilitation umso wichtiger (Kapitel 3).
4. Es zeigte sich, dass die gesteigerte Intention nach der individuellen Planungsintervention der wichtigste Prädiktor für den Obst- und Gemüsekonsum von Personen war (Kapitel 4).
5. Sowohl für individuelle als auch für dyadische Pläne zeigte sich, dass die Wahrscheinlichkeit der Planumsetzung höher für zuerst aufgestellte Pläne war. Außerdem wurde die Planumsetzung begünstigt, wenn Pläne eine Routine enthielten und der geplante Zeitpunkt/Zeitraum weniger spezifisch formuliert war. Im Allgemeinen wurden dyadische Pläne häufiger umgesetzt als individuelle Pläne (Kapitel 5).

In der allgemeinen Diskussion werden diese Ergebnisse den Ergebnissen der Literatur gegenübergestellt und Implikationen für Forschung und Praxis abgeleitet. Zusammenfassend lässt sich festhalten, dass diese Dissertation einen substanziellen Beitrag für die Literatur zur dyadischen Planung leistet und mehrere Facetten der dyadischen Planung beleuchtet. Dies beinhaltet die Facetten der dyadischen Planung als Prädiktor für Gesundheitsverhaltensänderung, als Korrelat verschiedener psychosozialer Faktoren sowie als Baustein von gesundheitspsychologischen Interventionen.

1

Introduction

Introduction

Health-protective behaviours such as regular fruit and vegetable consumption or physical activity are associated with reduced risk for specific diseases (e.g., cardiovascular disease, cancer) as well as for all-cause mortality (Aune et al., 2017; Rhodes, Janssen, Bredin, Warburton, & Bauman, 2017). The World Health Organization (WHO) recommends eating at least 5 portions of fruit and vegetables per day (Guilbert, 2003), however, only 15% of adult women and 7% of adult men meet these recommendations in Germany (Mensink et al., 2013). Regarding physical activity, the WHO recommends engaging in moderate activity (at least 150 min per week) or vigorous activity (at least 75 min per week), or an equivalent combination of the two (WHO, 2016). These guidelines are met by only 35% of adult women and 44% of adult men in Germany (Robert Koch Institut, 2012). Not adhering to health behaviour-related guidelines could be based on motivational (e.g., a person does not have the intention to change the behaviour) or volitional (e.g., a person fails to act upon good intentions) problems (Schwarzer, 2008). The latter was illustrated by results from 6 prospective studies with a collective $N = 3006$ participants, most of whom (62%) intended to perform regular physical activities, but only 33% of participants actually followed through with their intentions to perform physical activities (Godin & Conner, 2008). In contrast to other health behaviour change models (e.g., Theory of Planned Behavior; Ajzen, 1991; Social Cognitive Theory of Self-Regulation; Bandura, 1991), the Health Action Process Approach (HAPA; Schwarzer, 1992, 2008) explicitly addresses this "*intention-behaviour-gap"* (Sheeran & Orbell, 1999). In the HAPA, planning is suggested to bridge the intention-behaviour-gap, that is, a person forms plans on her or his health behaviour (Sniehotta, 2009), which has been shown to be an effective self-regulatory strategy in several health behaviour contexts (Gollwitzer & Sheeran, 2006). Due to its importance for health regulation and the need to further examine the role of planning in the health behaviour change process (Hagger & Luszczynska,

2014), one focus of this thesis is on individual planning. Furthermore, as health regulation is strongly influenced by those around us (Jackson, Steptoe, & Wardle, 2015), a second focus of this thesis concerns dyadic planning, that is, a person plans her or his health behaviour together with a partner (Burkert, Scholz, Gralla, Roigas, & Knoll, 2011).

This thesis is aimed at examining the occurrence of individual and dyadic planning, predictors of dyadic planning, behavioural links of individual and dyadic planning, as well as mechanisms of an individual and dyadic planning intervention. The research questions of the empirical chapters start with a focus on spontaneous individual and dyadic planning using data from a longitudinal study (Chapters 2 and 3), whereas data from two randomised controlled trials were used to examine effects and mechanisms of individual and dyadic planning interventions (Chapters 4 and 5). In the general discussion (Chapter 6), findings of the empirical chapters will be integrated into the planning literature. Recommendations on how research and practice can continue with individual planning and, particularly, dyadic forms of planning will be provided.

Individual Planning of Behaviour Change and Where it Came From

Planning has been intensively examined in the field of health psychology for many decades (Hagger & Luszczynska, 2014). It might have started with Kurt Lewin (1947) who investigated family food habits and stated that an overall plan as well as specific plans can be used as helpful means to reach an objective. Approximately two decades later, Leventhal, Singer, and Jones (1965) introduced the term ‘action planning’ and conducted an action planning intervention on students’ vaccination behaviour. In the planning intervention material, the authors provided information on *where* to go and *what* to do to receive the tetanus shot. Students were then asked to check their weekly schedule and select *when* they will get the tetanus shot. Leventhal et al.’s (1965) findings indicate that the action planning intervention resulted in a higher vaccination frequency compared to other group conditions.

In the 1990's, implementation intents (Heckhausen & Beckmann, 1990) and implementation intentions (Gollwitzer, 1993, 1999) were described as simple planning strategies to transfer an intention into action. Both planning concepts show a large theoretical overlap which led to implementation intentions being particularly examined in subsequent research. Implementation intentions can be defined as persons' mental simulation of anticipated cues of future situations (i.e. *when* and *where*) which are linked to a behavioural response (i.e. *what*) to achieve a goal behaviour (Gollwitzer, 1993, 1999). These cue-behaviour links are formulated in an if/when-then format such as "When situation x arises, then I will perform behaviour y".

Several decades after Leventhal et al.'s (1965) study, action planning was included in health behaviour change theories such as the Health Action Process Approach (HAPA; Schwarzer, 1992), the Integrated-Change Model (de Vries, Mesters, van de Steeg, & Honing, 2005), the MoVo concept (Fuchs, Goehner, & Seelig, 2011), and the Integrated Behavior Change Model (Hagger & Chatzisarantis, 2014). The action planning concept in these theories additionally includes information about *how* the behaviour will be executed (Hagger & Luszczynska, 2014), for instance, "going for a walk for 30 minutes on 3 times a week". As an extension of action planning, *coping planning* (Sniehotta, Schwarzer, Scholz, & Schüz, 2005; Kwasnicka, Presseau, White, & Sniehotta, 2013) was included in health behaviour change models (e.g., HAPA; Schwarzer, 2008) to address persons' experiences that something could hinder them from enacting their plans. While coping planning, persons anticipate future barriers or obstacles and plan how they would execute their intended behaviour in these situations.

In their publication about state of the planning research, Hagger and Luszczynska (2014) summarize that action planning and implementation intentions show a lot of similarities. Both represent the preparation of plans for intended future behaviours and entail "when-where-what" components. However, Gollwitzer (1993, 1999) emphasized

that the when and where components of implementation intentions reflect information about the situation which should trigger the behavioural response. In case the time and/or location of the behaviour-triggering situation would differ from the time and/or location of the behavioural enactment, action plans and implementation intentions would be distinct. For Leventhal et al.'s (1965) tetanus shot context, an example of an action plan would be: "When: Monday at 4 pm; Where: University Health Service building; What: Get a tetanus shot". An analogous implementation intention (Gollwitzer, 1993, 1999), in which the behaviour-triggering situation occurs earlier, would be: "When I am at home on Monday at 3:45 pm, then I will leave and get a tetanus shot". In these examples, the action plan entails information about the time and location of behavioural enactment, whereas the if/when-part of the implementation intention reflects when and where the behaviour change starts. However, time and/or location of the behaviour-triggering situation and behavioural enactment could also be the same which would result in an equivalent action plan and implementation intention (e.g., "When: Morning; Where: Station; What: Take the stairs" vs. "When I arrive at the station in the morning, then I will take the stairs"). Due to a high conceptual overlap between planning concepts, meta-analyses and reviews summarized studies on these concepts to one planning category (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011; Belanger-Gravel, Godin, & Amireault, 2013). Similarly, action planning and implementation intentions will henceforth be summarized as *individual planning* in this thesis. The notion of individual planning also contrasts the concept *dyadic planning* which will be introduced further below.

Individual Planning in Other Contexts

Individual planning or conceptually similar forms have been used and investigated in other areas of psychology. One form of planning, the *SMART* concept, is particularly applied in the organizational context as a technique for coaching, human resource development, or project management (Doran, 1981) and investigated in organizational

psychology (e.g., Rubin, 2002). While SMART planning, persons set plans towards an intended outcome (e.g., achievement of a project-related goal) which should be specific, measurable, achievable, realistic, and time-bound. Comparable to planning in health psychology, SMART plans are more detailed compared to broader goals or intentions. In a SMART worksheet suggested by Morrison (2011), persons are instructed to form when-what-how plans which is similar to when-where-what/how planning instructions in health psychology interventions.

Within the field of clinical psychology, forms of planning are applied in cognitive behavioural therapy such as the widely used psychoeducational intervention program "Coping with Depression Course" (CWD; Lewinsohn, Antonuccio, Steinmetz, & Teri, 1984; Cuijpers, Muñoz, Clarke, & Lewinsohn, 2009). In the *activity scheduling* CWD module, participants collect information about negative or unpleasant events, decide which issues they want to change in the future, and formulate desired changes as plans for the increase of pleasant and/or social activities. Subsequently, participants test their plans in daily life and improve these plans over time (Steinmetz, Zeiss, & Thompson, 1987). Results from a meta-analysis with 16 randomised controlled trials yielded that activity scheduling conditions were superior to control conditions (evidenced by a larger effect size) and as effective as other cognitive therapy conditions in reducing depressive symptoms (Cuijpers, van Straten, & Warmerdam, 2007).

Health Behaviour-Related Individual Planning Interventions

Coming back to health psychology, one could ask whether health behaviour-related individual planning interventions might be effective for increases in health enhancing behaviour. Empirical evidence from meta-analyses shows that individual planning interventions effectively increase fruit and vegetable consumption (Adriaanse et al., 2011), physical activity (Belanger-Gravel et al., 2013; Carraro & Gaudreau, 2013), and overall goal achievement (Gollwitzer & Sheeran, 2006). Thereby, the design and provision of

individual planning material can vary. Planning material were provided as weekly calendars (Ahern et al., 2017) in which participants were asked to assign time-related information of a calendar (e.g. Tuesday morning) to a health behaviour (e.g. eat an apple). Also, intervention material can instruct participants to enter information in "when-where-what/how" or "if/when-then" blank fields (Chapman, Armitage, & Norman, 2009). As a strength of planning interventions, each way of providing planning material is leading to brief, parsimonious, and straightforward interventions (Lhakhang, Godinho, Knoll, & Schwarzer, 2014; Luszczynska, Tryburcy, & Schwarzer, 2007).

Dyadic Forms of Planning

Previous research has investigated planning mostly from the perspective of the individual (Hagger & Luszczynska, 2014), however, less is known about how planning with other persons influences health behaviour change. There is evidence from a randomised controlled trial that researcher-assisted planning in the lab was superior to a standard individual planning intervention in increasing physical activity (Ziegelmann, Lippke, & Schwarzer, 2006). Trained study personnel used motivational interviewing techniques such as empathetic listening, creating self-motivating statements, and responding to resistance (Miller & Rollnick, 2002). However, health behaviour-related planning together with another person could also occur in persons' natural environment such as planning with the romantic partner for one's nutrition or physical activity. In general, romantic partners have been shown to be highly involved in each other's health behaviours (Jackson et al., 2015) and overall health regulation (Martire, Schulz, Helgeson, Small, & Saghafi, 2010). Together with the fact that the majority of adults are living in stable relationships (in Germany: 20.6 million couples; Statistisches Bundesamt 2016), the couple context appears suitable and important for investigating dyadic forms of planning.

Next to researcher-assisted planning, two further forms of planning in a dyad have been suggested: *collaborative implementation intentions* (henceforth described as

collaborative planning; Prestwich et al., 2005, 2012, 2014) and *dyadic planning* (Benyamini, Ashery, & Shiloh, 2011; Burkert, Knoll, Luszczynska, & Gralla, 2012; Burkert et al., 2011; Knoll et al., 2017). Whereas collaborative planning refers to jointly planning the joint performance of a health behaviour ("we for us"), dyadic planning addresses the joint planning of a health behaviour for one person ("we for me"). Dyadic planning distinguishes between a *target person* for whom the behaviour is planned and the *planning partner* who provides planning assistance. It is assumed that the planning partner provides plan-related ideas, critically asks questions, or supports and encourages the target person in forming a realistic and feasible plan (Burkert et al., 2011). In comparison with collaborative planning, dyadic planning should lead to higher plan flexibility as the planned time, location, and behaviour does not need to be the same for both persons (Burkert et al., 2011). To overview whether collaborative and dyadic planning are important co-regulatory strategies for health behaviour promotion, the following sections include empirical evidence for both planning concepts.

Empirical evidence on collaborative planning. Collaborative planning was examined by three randomized controlled trials in three different health behaviour contexts: women's breast self-examination (Prestwich et al., 2005), physical activity (Prestwich et al., 2012), and reduced fat consumption (Prestwich et al., 2014).

In the study by Prestwich et al. (2005), female students were randomized into a planning vs. no planning condition. Subsequently, women who were randomly assigned to the planning condition could choose to jointly plan and perform breast self-examination with their partner (i.e. collaborative planning condition) or not (i.e. individual planning condition). It needs to be noted that the assignment to the collaborative planning condition or individual planning condition was not based on randomization. Women in the collaborative planning condition were instructed to take the planning material with them, consult their planning partner, and jointly enter the collaborative plan in blank fields: "We

will perform a breast-exam on ___ (day) at ___ (time) in ___ (location)". The planning partner did not actively participate in the study. Prestwich et al.'s (2005) results indicated that students in the collaborative planning condition showed the highest likelihood for breast self-examination at a 1-month follow-up. Regarding mechanisms of the collaborative planning condition, the authors found that collaborative planning reduced the likelihood to forget BSE which, in turn, resulted in higher BSE. In contrast, the anticipated enjoyment to involve a partner in women's BSE was no mediator of the collaborative planning condition-BSE relationship.

The studies by Prestwich et al. (2012, 2014) respectively compared a collaborative planning condition with a partner-only-, an individual planning-, and a control condition in the context of employees' physical activity (Prestwich et al., 2012) and fat consumption (Prestwich et al., 2014). In both studies, employees in the two partner conditions could freely choose their partner (e.g., housemate, romantic partner) – note, that the partners were not actively participating in the study. In the collaborative planning conditions, employees were asked to recruit a partner and form a plan together (i.e., "If we're in situation X, then we will do y"), whereas in the partner condition, employees were instructed to only recruit a partner for joint behaviour change. Findings in the study by Prestwich et al. (2012) showed that physical activity in the collaborative planning condition was higher compared to the other conditions at several follow-ups. None of the hypothesized mediators (i.e. enjoyment, intention, self-efficacy, and social influence) did mediate between partner-based conditions and physical activity due to non-significant links to physical activity. In the study by Prestwich et al. (2014), results indicated that the three intervention conditions showed greater reductions in fat intake compared to the control condition at a 3-months follow-up. However, the collaborative planning group did not differ from the other intervention groups regarding fat intake reduction. Probes into the mechanisms of partner-based conditions showed that social influence, partner-related

support and enjoyment were partial mediators between partner-based conditions and fat intake outcomes, whereas intention and self-efficacy did not mediate these relationships.

Empirical evidence on dyadic planning. Apart from the studies included in Chapters 3 and 5 of this thesis, empirical evidence on dyadic planning-health behaviour relationships comes from three randomized controlled trials and one observational study. These studies investigated three different health contexts: women's breast self-examination (Benyamini et al., 2011), prostate cancer patients' pelvic floor exercise (PFE; Burkert et al., 2011; 2012), and couples' physical activity (Knoll et al., 2017).

The randomised controlled trial by Benyamini et al. (2011) examined women who were assigned to either a planning intervention condition with spouse involvement (i.e. the husband also participated in the study) or a planning intervention condition without spouse involvement. Both conditions showed an increase in women's breast self-examination at a 3-months follow-up. As a moderator effect of the planning intervention condition with spouse involvement, husband's lower involvement in women's health issues was associated with higher breast self-examination of women. It needs to be noted that the planning intervention condition with spouse involvement did not instruct women and their husbands to formulate plans on provided planning material. The manipulation in this condition included husbands' additional participation and the instruction to support their wives in executing BSE.

The randomised controlled trial by Burkert et al. (2011) investigated a sample of prostate cancer patients who underwent radical prostatectomy and their partners. Following the removal of patients' post-surgery catheter, regular PFE is recommended to reduce problems with post-surgery urinary incontinence. PFE is a new physical exercise for many prostate cancer patients, thus, the adoption and maintenance of PFE might be challenging and volitional strategies such as planning might be helpful to perform regular PFE (Burkert et al., 2011). The study design included a dyadic PFE-planning-, a dyadic nutrition-

planning- (i.e. to control for dyadic planning of a health behaviour), an individual PFE-planning- (i.e. to control for planning of PFE), and an individual nutrition-planning condition (i.e. to control for planning of a health behaviour). In the dyadic planning conditions, both partners planned patient's health behaviour. In the individual planning conditions, patients planned their health behaviour alone and partners worked on a questionnaire in a separate room. Burkert et al.'s (2011) results indicated that the dyadic PFE-planning intervention condition was not superior to the other conditions in increasing PFE at follow-ups up to 6 months. However, a positive mediator effect of action control was found which mediated between spontaneous dyadic planning following the dyadic planning intervention and short-term PFE at the 2-weeks follow-up.

In the longitudinal observational study with prostate cancer patients and their partners (Burkert et al., 2012), mediators for the relationships of PFE-related individual and dyadic planning with actual PFE were investigated. The authors' findings yielded that partner-provided social support and social control mediated between dyadic planning and long-term PFE, whereas action control did not. Dyadic planning was positively associated with both partner-provided social support and control, however, PFE associations were positive for social support and negative for social control.

Examining the physical activity context, the randomised controlled trial by Knoll et al. (2017) randomized healthy, adult couples' to either a dyadic planning intervention condition (DPC), an individual planning intervention condition (IPC), or an active no-planning control condition (CC). As a further randomization procedure, both partners were assigned to a study role (i.e. target person or partner). In the DPC, the couple jointly planned on the target person's physical activity increases. To control for physical activity-related planning, target persons in the IPC planned alone on their physical activity, whereas the IPC partners worked on a distractor task. To control for the partner interaction, CC couples jointly worked on a distractor task. Findings indicated that changes in target

persons' moderate and vigorous physical activity did not differ across DPC IPC, and CC for the follow-up at 6-weeks. Partners of the DPC showed higher vigorous physical activity increases at the 1-week follow-up, however, this effect wore off at the 6-weeks follow-up. The hypothesized mediators action control, social support, and social control did not mediate between the DPC and target persons' and partners' moderate or vigorous physical activity. Exploratory analyses indicated that DPC target persons with lower relationship quality decreased their moderate physical activity, whereas DPC target persons with higher relationship quality maintained their moderate physical activity. As a note, results of Knoll et al. (2017) refer to primary analyses of the randomized controlled trial which was also analysed in Chapter 5.

Continuing Research on (Dyadic) Planning and Aims of This Thesis

To summarize, previous dyadic planning research provides little insight into how and for whom dyadic planning is related to health behaviours. Although effects of randomised controlled trials seem rather modest, continuing research on dyadic planning in elaborated study designs and diverse health behaviour contexts is encouraged (Hagger & Luszczynska, 2014; Hagger et al., 2016). As several research questions have not yet been comprehensively answered by previous research, this thesis aimed to further investigate individual and dyadic planning in naturalistic settings as well as in interventions. The aims of this thesis are based on the following four rationales.

First, as an informative basis for the overall discussion of the empirical chapters, it is aimed to collect information about the occurrence of individual and dyadic planning in different health behaviour context. Knowing more about the frequency of individual and dyadic planning use would inform about the degree to which persons are used to apply both planning strategies for the regulation of respective health behaviours. Therefore, descriptive statistics on individual and dyadic planning from all empirical chapters will be collected. Second, previous studies have not yet comprehensively examined predictors of

dyadic planning which might be linked to the likelihood of persons' use of dyadic planning. This is an important issue because one needs to know under which conditions dyadic planning is actually applied (vs. rather not applied) before intervening on it. In Chapter 2 of this thesis, predictors of dyadic planning should be identified and tested by transferring a taxonomy of social support predictor domains (Dunkel-Schetter & Skokan, 1990) to the dyadic planning context. Third, studies often examine persons' use of dyadic planning at baseline (Burkert et al., 2012) or, as part of manipulation checks, at pre- and post-intervention assessments (Burkert et al., 2011; Knoll et al., 2017). However, not much is known about the trajectory of spontaneous dyadic planning over longer time intervals and whether spontaneous individual and dyadic planning show similar trajectories over time. Again, it appears important to learn more about the use of dyadic planning as well as its association with behavioural outcomes in naturalistic settings before intervening on it. In Chapter 3, the aim is to investigate longer term trajectories of individual and dyadic planning and link these trajectories to a health behaviour by using Bodenmann's (2000) cascade model as a theoretical backdrop. Fourth, it is of high importance to gain further knowledge of mechanisms of planning which explain how and/or for whom planning interventions lead to a successful translation of a plan into behaviour. Most studies focus on ex-situ mechanisms that are assessed outside of the planning situation (e.g., a person's habits, action control, or self-efficacy; Knoll et al., 2017; Lippke, Wiedemann, Ziegelmann, Reuter, & Schwarzer, 2009; Webb, Sheeran, & Luszczynska, 2009). However, there is an increasing number of studies recently in which participants' self-set plans are content-analysed to identify plan characteristics (e.g., specificity of a plan) as in-situ mechanisms of planning interventions (e.g. Fleig et al., 2017). Associations between the occurrence of plan characteristics and successful enactment of the plan would provide important insights into the question about how a plan should be formulated. To learn more about the role of ex-situ (Chapter 4) as well as in-situ (Chapter 5) planning mechanisms,

this thesis also aimed to test established and newly developed mechanisms of planning interventions. With particular potential to contribute to recent plan content literature, the study design presented in Chapter 5 allows content-analysis and comparison of both individual and dyadic plans. The conceptual model of this thesis (Figure 1) integrates individual and dyadic planning in an overall behaviour change framework. Each empirical chapter focusses on specific relationships of individual and/or dyadic planning with other psychosocial, contextual, or behavioural factors.

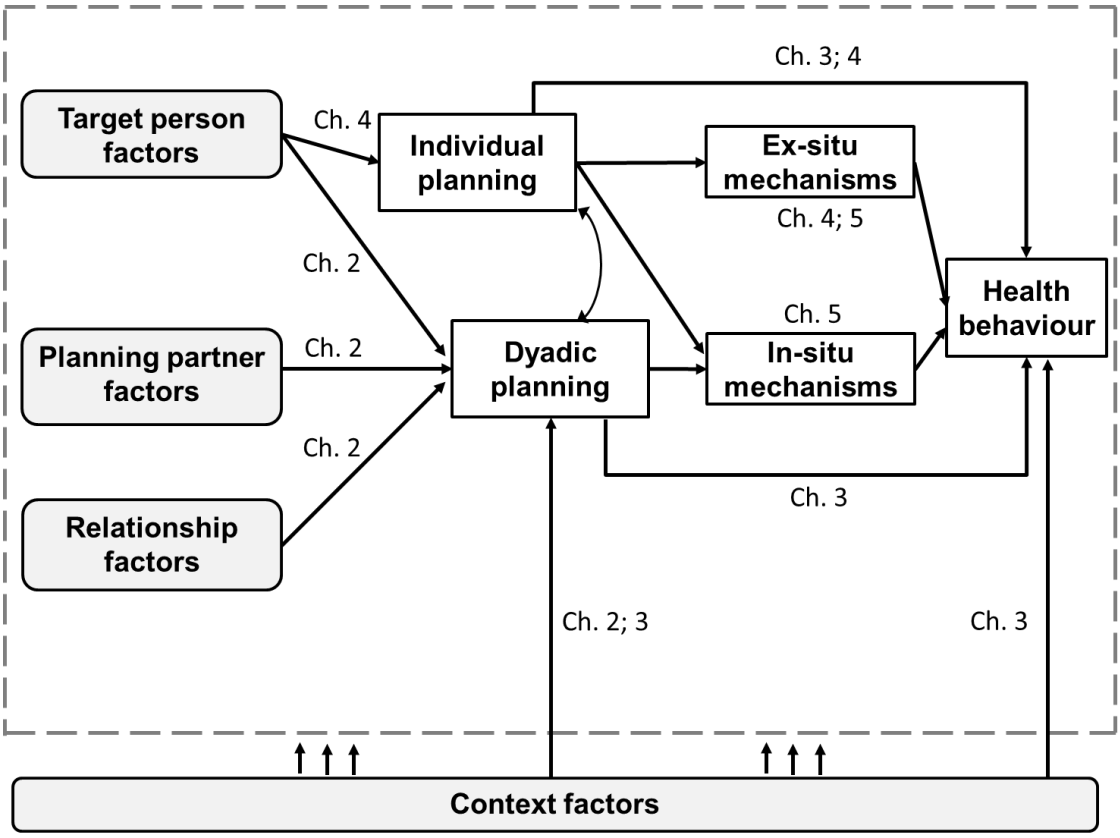

Figure 1. Conceptual model of this thesis.

Note. Ch.: Chapter(s)

Research Questions of This Thesis

This thesis aimed to further contribute to research on health behaviour-related individual and dyadic planning. The following research questions were investigated:

1) How frequently are individual and dyadic planning used at baseline and over time? (Chapters 2 to 5)

2) Developing a framework of dyadic planning predictors: How are psychosocial and contextual factors linked to dyadic planning? (Chapter 2)
3) Which behavioural links show individual and dyadic planning and how do these links change over time? (Chapter 3)
4) Which ex-situ mechanisms of an individual planning intervention explain health behaviour changes? (Chapter 4)
5) Developing a framework of plan characteristics as in-situ mechanisms of participant-generated plans: How can the content of individual and dyadic plans be characterized? Which plan characteristics are associated with plan enactment? Which enactment rates show individual and dyadic plans? Are there differences between plan characteristic-plan enactment links across individual and dyadic plans? (Chapter 5)

In Chapter 6, an overall discussion of the empirical chapters of this thesis will integrate empirical findings into the planning literature and put them into a broader perspective. As an outcome of the overall discussion, implications for research and practice are provided on how to continue with individual planning and, particularly, dyadic forms of planning.

Study Projects Used in This Thesis

As an overall strength of this thesis, three health behaviour change contexts were examined by three study projects. These health behaviour contexts are pelvic floor exercise of prostate cancer patients (PFE; study project: *Lines of Defense*; *LoD*; Chapters 2 and 3), fruit and vegetable consumption of adult individuals (study project: *Happy 5,* Chapter 4), and general physical activity of adult couples (study project: *Days in motion*; *DiM*; Chapter 5). The following paragraphs will summarise the study designs of LoD, Happy 5, and DiM.

Lines of Defense (LoD). Following radical prostatectomy and removal of the post-surgery catheter, many prostate cancer patients suffer from urinary incontinence (Resnick et al., 2013). To control urinary incontinence, the performance of regular PFE is recommended, especially within 6 months following surgery (MacDonald, Fink, Huckabay, Monga, & Wilt, 2007). PFE is a new health-related behaviour for many patients and the performance of PFE on several times a day is challenging (Burkert et al., 2011). As patients are highly motivated to perform regular PFE (Burkert et al., 2011) and their partners are an important source of social support (Knoll, Burkert, Luszczynska, Roigas, & Gralla, 2011), volitional PFE-related strategies (e.g., individual and dyadic planning) might be especially important in this health context. In Chapters 2 and 3, secondary data analyses of a longitudinal couple study project (LoD) with *N*=209 prostate cancer patients and their partners were conducted (for more information on primary analyses of LoD, please see Knoll et al. (2015)). Data from patients and partners at 1 month (T1), 3 months (T2), 5 months (T3), and 7 months (T4) following catheter removal were analysed (see Figure 2).

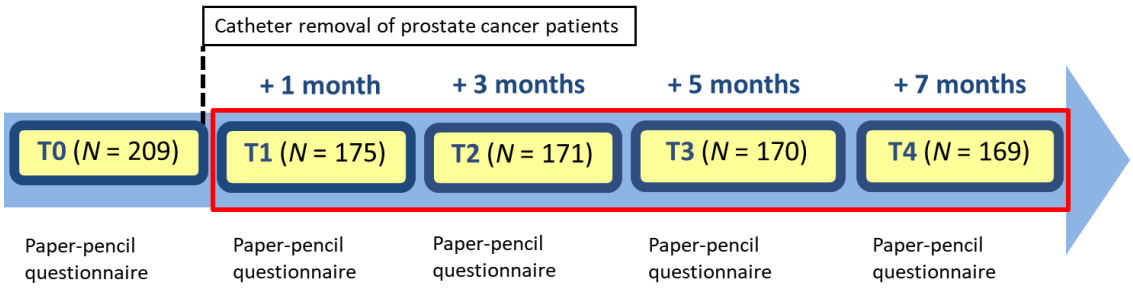

Figure 2. Timeline of study project LoD (Chapters 2 and 3).

Note. Data which were analysed in Chapters 2 and 3 are marked by the box.

Happy 5. The promotion of fruit and vegetable by interventions targeting the general population reflects an intervention of primary prevention. Consuming fruits and vegetables is a specific behaviour of healthy nutrition with which persons are familiar with, however,

the number of consumed daily portions is often lower than recommended (Aune et al., 2017). As nutrition is a behaviour which is executed on several occasions a day, including more fruits and vegetables can be facilitated by, e.g., restructuring persons' eating- and drinking routines through a planning intervention (e.g., eating a salad instead of a burger; Adriaanse et al., 2011). In Chapter 4, the online-based randomized controlled trial Happy 5 examined the effectiveness and mechanisms of an individual planning intervention and an individual planning plus self-efficacy intervention in a sample of *N*=279 adult individuals. Participants responded to a baseline questionnaire which was followed by the intervention. Follow-up assessments took place at 2 weeks and at 4 weeks following baseline (see Figure 3).

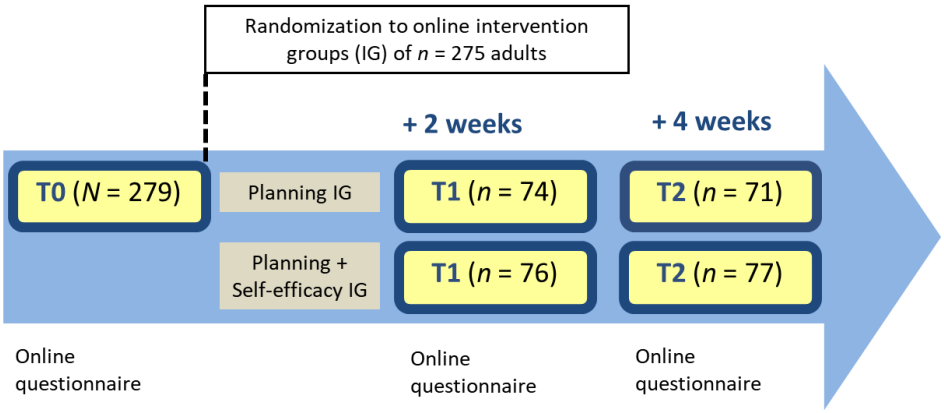

Figure 3. Timeline of study project Happy 5 (Chapter 4).

Note: From the baseline assessment onwards, the notions T0, T1, and T2 were used to use consistent notions in Figure 2, 3, and 4. However, this varies from the notions (T1, T2, T3) described in Chapter 4.

Days in motion (DiM). Similar to fruit and vegetable consumption, the promotion of moderate-to-vigorous physical activity (MVPA) in the general population reflects an intervention of primary prevention. MVPA is a specific form of activity-related behaviours (other forms: sedentary behaviour and light physical activity). As a difference to fruit and vegetable consumption which is assessed in portions, MVPA is measured in time units (e.g., minutes). MVPA can occur in a variety of different activities (e.g. transport-,

household- or sports-related activities) on several occasions a day. This characteristic can be used when intervening on it by, e.g., a planning intervention. That is, persons can select their preferred and feasible activity as well as appropriate occasions from a variety of choices. In Chapter 5, secondary data analyses of a randomized controlled trial (DiM) with *N*=346 healthy, adult, heterosexual, and cohabiting couples were conducted (for more information on primary analyses of DiM, please see Knoll et al. (2017)). Couples participated in the baseline assessment (T0) and were randomised to a dyadic planning-, an individual planning-, or a control condition. The main intervention was conducted at one week following baseline. Follow-up assessments took place at 1 (T2), 6 (T3), 19 (T4), 26 (T6), and 52 (T7) weeks following the main intervention.

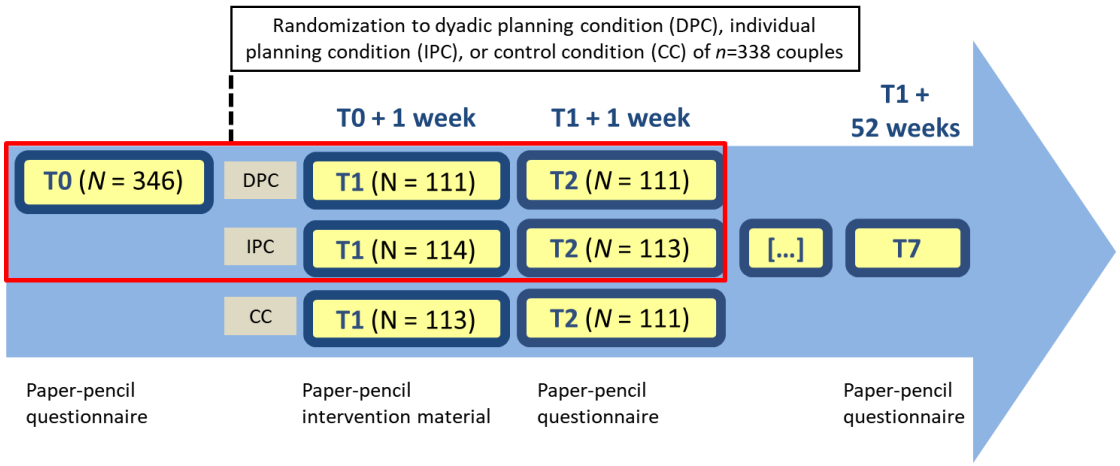

Figure 4. Timeline of measurement points used for secondary analyses of the DiM study project (Chapter 5)

Note. Data which were analysed in Chapter 5 are marked by the box.

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2

Predictors of Dyadic Planning: Perspectives of Prostate Cancer Survivors and Their Partners

Keller, J., Wiedemann, A. U., Hohl, D. H., Scholz, U., Burkert, S., Schrader, M., & Knoll, N. (2017). Predictors of dyadic planning: Perspectives of prostate cancer survivors and their partners. *British Journal of Health Psychology*, *22*(1), 42-59. doi:10.1111/bjhp.12216

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Abstract

Objectives: Extending individual planning of health behaviour change to the level of the dyad, dyadic planning refers to a target-person and a planning partner jointly planning the target person's health behaviour change. To date, predictors of dyadic planning have not been systematically investigated. Integrating cognitive predictors of individual planning with four established predictor domains of social support provision, we propose a framework of predictors of dyadic planning. Including target-persons' and partners' perspectives, we examine these predictor domains in the context of prostate cancer patients' rehabilitative pelvic floor exercise (PFE) following radical prostatectomy.

Design: Longitudinal data from 175 patients and their partners were analysed in a study with four post-surgery assessments across six months.

Methods: PFE-related dyadic planning was assessed from both partners together with indicators from four predictor domains: context -, target person -, partner -, and relationship factors. Individual planning and social support served as covariates.

Results: Findings from two-level models nesting repeated assessments in individuals showed that context - (patients' incontinence), target person - (i.e., positive affect and self-efficacy), and relationship factors (i.e., relationship satisfaction) were uniquely associated with dyadic planning, whereas partner factors (i.e., positive and negative affect) were not. Factors predicting patients' and partners' accounts of dyadic planning differed.

Conclusions: Resembling prior findings on antecedents of support provision in this context, partner factors did not prevail as unique predictors of dyadic planning, whereas indicators from all other predictor domains did. To establish predictive direction, future work should use lagged predictions with shorter inter-measurement intervals.

Keywords: dyadic planning, individual planning, predictors, prostate cancer

Introduction

Planning health behaviour change was shown to be an effective self-regulatory strategy for the translation of intentions into actual behaviour (e.g., Hagger & Luszczynska, 2014). Within the planning process, individuals anticipate the implementation of a behavioural goal (e.g. increasing physical activity) by mentally linking future situational cues (time and/or place; e.g., coming home from work) to future behavioural responses (e.g. going for a walk; Gollwitzer, 1999). Individual planning is assumed to be predicted by the intention to change behaviour (Gollwitzer, Heckhausen, & Steller, 1990; Schwarzer, 2008). Recently, individual planning has been extended to the level of the dyad (e.g., Prestwich et al., 2005; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011). Dyadic planning, one of these extensions, refers to joint planning of a target person's new behaviour by the target person and a planning partner (Burkert, Knoll, Luszczynska, & Gralla, 2012; Burkert et al., 2011). Although a number of studies have investigated effects of dyadic forms of planning on behaviour change (e.g. Prestwich et al., 2014), to date not much is known about potential predictors of dyadic planning. This study derives and investigates a framework of dyadic planning predictors by combining cognitive predictors of health behaviour change with established predictor domains of social support provision.

Dyadic Forms of Planning

Extending individual planning to the level of the dyad, two conceptualizations for planning together with a partner have been proposed: *collaborative implementation intentions* (e.g., Prestwich et al., 2005) and *dyadic planning* (e.g., Burkert et al., 2011). As in individual planning, both strategies are assumed to link anticipated situations to future behaviour and thereby aid the implementation of intentions. In developing collaborative implementation intentions, two individuals are planning a future behaviour which they will *jointly* perform (Prestwich et al., 2005, 2014). In contrast, dyadic planning addresses future

behaviour being performed by only one person (Benyamini, Ashery, & Shiloh, 2011; Burkert et al., 2011; 2012). Accordingly, dyadic planning distinguishes between two roles within the dyad: a target person whose behavioural outcome is addressed by planning and a partner who provides planning assistance, but is not included in the planned activities. With that, dyadic planning circumvents barriers inherent in collaborative implementation intentions, such as identifying a joint opportunity to act. Furthermore, in several settings the targeted behaviour change may be central for only one person of a dyad, e.g., gender-specific disease prevention among heterosexual couples. Here, dyadic planning appears to be a suitable strategy due to defined roles within the dyad: one person is targeting health issues and the other person is motivated to provide support (Knoll, Burkert, Luszczynska, Roigas, & Gralla, 2011).

Three randomized controlled trials examined effects of a dyadic planning intervention in the contexts of women's breast self-examination (Benyamini et al., 2011), prostate cancer patients' rehabilitative training (Burkert et al., 2011), and healthy couples' physical activity increase (Knoll et al., 2017). Findings by Benyamini et al. (2011) revealed that breast self-examination increased at a 3-month follow-up for both the intervention and control groups, with lower involvement in health issues of husbands being related with higher breast self-examination of women. Comparing a dyadic planning intervention to increase regular pelvic floor exercise (PFE) with three control groups, Burkert et al. (2011) did not find direct, but only indirect effects of a dyadic planning intervention on PFE via spontaneous dyadic planning and action control. In a RCT comparing effects of a dyadic planning intervention with an individual planning - and a no-planning control condition, Knoll et al. (2017) found direct short-term effects of a dyadic planning intervention to increase physical activity only in planning partners, whereas target persons' effects were moderated by relationship quality. Regarding correlational results of individual and dyadic planning's links to health behaviour, a longitudinal study found

sequential effects with individual planning being a continuous correlate of PFE and dyadic planning showing increased associations with PFE over time (Keller et al., 2015). In sum, although the few available intervention findings on effects of dyadic planning are rather modest, correlational findings point to some promising areas of future research. Correlational analyses of factors which might be predictive for dyadic planning may thus contribute to a comprehensive picture of the dyadic planning process.

Potential Predictor Domains of Dyadic Planning

Predictors of dyadic planning have received rather little attention to date. Results from randomization checks of a dyadic planning intervention by Burkert et al. (2011) included cognitive predictors (e.g.,, intentions) which were not significantly associated with dyadic planning change. The present study combines theories and findings from *two* areas of the health psychological literature to derive potential predictor domains of dyadic planning: (1) *cognitive models of behaviour change* and (2) *predictors of social support provision*.

(1) Cognitive models of behaviour change (e.g., Ajzen, 1991; Bandura, 1991; Schwarzer, 2008) specify variables that regulate an individual's behaviour change process. For instance, the Health Action Process Approach splits the process of behaviour change into two stages: the *motivational stage* that culminates in the formation of an intention to change health-relevant behaviour and the *volitional stage* in which individuals translate intentions into action (cf. Heckhausen & Gollwitzer, 1987). Intention formation directly precedes individual planning, a key volitional factor. In addition to intention as a direct predecessor of planning, self-efficacy is also proposed to predict individual planning (Schwarzer, 2008). Self-efficacy refers to individuals' confidence in their own competence to perform challenging tasks such as changing health behaviour (Bandura, 1997). So far, much empirical evidence has demonstrated that intention and self-efficacy predict individual planning (e.g. Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008; van

Genugten, van Empelen, & Oenema, 2012). Given the conceptual similarities, we propose that these cognitive predictors of individual planning will also predict dyadic planning.

(2) Predictors of social support provision. To derive further predictors of dyadic planning, we used a taxonomy of predictors of social support provision. Building on a large theory - and evidence base of the prediction of prosocial behaviour, Dunkel-Schetter and Skokan (1990) proposed a taxonomy of characteristics of a target person, a support-providing partner, their relationship, and their shared context that are assumed to predict support provision under conditions of stress. *Context factors* include objective characteristics of the shared context and target persons' and support providing partners' appraisals thereof (Dunkel-Schetter & Skokan, 1990). *Target-person - or recipient factors* that trigger the provision of support comprise emotional (e.g., negative affect), cognitive, and behavioural reactions to the situation at hand (e.g., active coping) as well as personal resources (e.g., high self-efficacy). Support providing *partner factors* focus on affective states as the most proximal predictors of support provision. These include affect toward the target person that is preceded by attributions of the target person's degree of control over and responsibility for the onset of the stressful situation. Attributions may result in affect states that may prevent support provision (e.g., anger) or facilitate it (e.g., pity; Weiner, Perry, & Magnusson, 1988). Moreover, providers' maintenance of pleasant affect states was shown to predict support provision (Carlson, Charlin, & Miller, 1988). Finally, *relationship factors* entail relationship quality as an important correlate of support exchange in couples (Dunkel-Schetter, Blasband, Feinstein, & Herbert, 1992).

Since the publication of Dunkel-Schetter and Skokan's initial taxonomy, several studies successfully applied variations of variables within these domains to the prediction of support provision in couples (e.g., Bolger, Foster, Vinokur, & Ng, 1996; Iida, Seidman, Shrout, Fujita, & Bolger, 2008; Knoll et al., 2011). Although the taxonomy was conceptualized to predict support provision within stress contexts, we propose that it may

also be a good starting point for the exploration of dyadic planning predictors. First, dyadic planning is a social exchange strategy that involves the assistance of another person in the target person's planning process and is thus conceptually related to support provision. Second, Dunkel-Schetter and Skokan's taxonomy is comprehensive in that it accounts for cognitive and affective characteristics of both persons involved in the interaction and appraisals of their relationship and shared context. Accounting for both partners' perspectives, we investigate a framework (see Figure 1) of predictors of dyadic planning that integrates proximal cognitive predictors of individual planning with a taxonomy of established predictors of support provision.

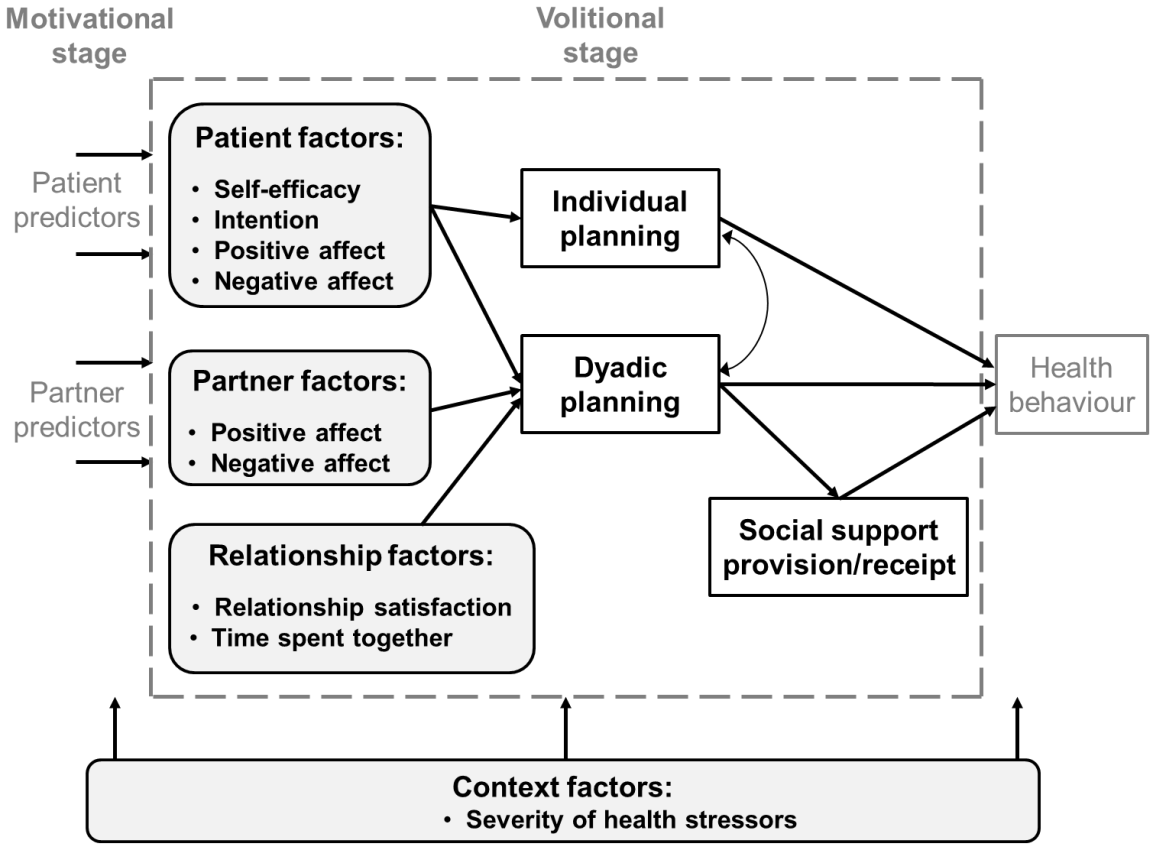

Figure 1. Conceptual Model of Dyadic planning's role in a behaviour regulation framework

A Framework of Predictors of Dyadic Planning

As illustrated by Figure 1, the framework of dyadic planning predictors integrates assumptions from both areas of health psychological literature reviewed above.

In sum, *context predictors of dyadic planning* include both partners' appraisals of health-related need to change a target person's health behaviour (e.g. perceived severity of health-stressors). *Target-person factors* include cognitive predictors of individual planning, specifically the target person's intention and self-efficacy. Following Dunkel-Schetter and Skokan's framework, the target person's affect is also considered. Whereas target persons' negative affect may trigger partners' need to provide assistance (Weiner et al., 1988), higher positive affect may be indicative of a more successful handling of a stressful situation and inspire partners' willingness to assist in planning a behaviour that promises further remedy (Knoll et al., 2011). Concerning *partner factors*, the framework includes planning partners' affect states as predictors of dyadic planning (Dunkel-Schetter & Skokan, 1990). In terms of *relationship factors*, we propose relationship quality and the couple's waking time spent together (Knoll et al., 2011).

As *additional factors*, the framework entails individual planning as well as behaviour-specific support receipt and - provision. The former could be conceptualized as a target-person factor and an indicator of active coping with the situation (Dunkel-Schetter & Skokan, 1990). Recent findings, however, suggest that both individual and dyadic planning may be parallel instead of sequential processes (Keller et al., 2015), thus, we refrain from adding individual planning to the taxonomy of predictors and implement it as a covariate in this study. Behaviour-specific support as provided by planning partners and received by target persons has originally been proposed as a mediator of effects of dyadic planning on behaviour change (Burkert et al., 2012). However, because of social support's conceptual closeness to dyadic planning -- dyadic planning could be seen as an instrumental supportive action towards a behavioural outcome -- we will also define support indicators as covariates in the present study. In sum, we focus on the left part of the framework (Figure 1) as predictors of dyadic planning and consider individual planning and social support as covariates.

Prostate Cancer and Sequelae of Radical Prostatectomy

Prostate cancer is the second most common cancer in men worldwide (Ferlay et al., 2015). One standard treatment for localized prostate cancer is radical prostatectomy where the prostate gland including the tumour is surgically removed (Hegarty et al., 2010). Whereas radical prostatectomy is associated with reduced prostate cancer mortality (e.g. Bill-Axelson et al., 2011), it often causes functional limitations including urinary incontinence (Resnick et al., 2013). Particularly during the first 6 months following the removal of the post-surgery indwelling catheter, incontinence can negatively impact patients' daily functioning and affective well-being (Knoll, Burkert, Scholz, Roigas, & Gralla, 2012). To control urinary incontinence, patients are advised to perform regular PFE (MacDonald, Fink, Huckabay, Monga, & Wilt, 2007). Because the vast majority of patients lack prior experience with these exercises, self- and co-regulatory effort from close others, mostly partners (Burkert et al., 2012), should be important in patients' rehabilitation from surgery.

Aim and Hypotheses

This study examines potential predictors of dyadic planning as reported by target persons (henceforth referred to as "patients") taking up a new health behaviour (i.e., rehabilitation exercises) and their planning partners (henceforth referred to as "partners"). Based on the framework described above, we hypothesized bivariate relations of patients' and partners' accounts of dyadic planning with the following variables: Context factors: patients' burden by urinary incontinence. Patient factors: intentions regarding PFE, PFE-specific self-efficacy, positive and negative affect. Partner factors: positive and negative affect. Relationship factors: relationship quality, couple's daily wake time spent together. In addition to bivariate relations, we explored each proposed predictors' unique relation with dyadic planning, controlling for social support and individual planning.

Methods

Sample and Procedure

Data from 209 prostate cancer patients recovering from sequelae of prostatectomy and their partners were collected in a longitudinal study with a correlational design between 2009 and 2011. We recruited study participants in two departments of urology at a large university hospital in Berlin, Germany. Patients undergoing prostatectomy and their partners were included if they were living in a committed relationship. Exclusion criteria were: patients not having a partner, partner's refusing to participate in the study, patient's and/or partner's not giving informed consent, and patient's or partner's insufficient knowledge of the German language. For full study participation, couples received a compensation of 110 EUR. Parts of these data were previously analysed by Hohl et al. (2016), Keller et al. (2015), Knoll et al. (2015), Knoll, Wiedemann, Schultze, Schrader, & Heckhausen (2014).

Upon admission to the hospital, one day prior to surgery, patients and their partners were approached and informed about the study. After couples gave informed consent, they were asked to respond to a paper-pencil questionnaire on the same day (Time0; T0). Further assessments were at 1 month (T1), 3 months (T2), 5 months (T3), and 7 months (T4) following removal of the post-surgery catheter, i.e., the onset of incontinence. Via mail to their homes, couples received questionnaires along with return envelopes. The study was approved by the hospital's Institutional Review Board.

At T0, 209 couples were enrolled. Of those, 175 provided data up to T1 and 169 provided data at all measurement points (see Figure 2). Attrition analyses yielded no differences between patients and partners in the longitudinal sample and those who dropped out regarding key study variables. However, attrition was related to patient-reported difficulty with performing activities of daily living (lower in continuers) and

partner-reported vocational training (school degree with higher vocational education; less often in continuers). For details on attrition analyses, see Knoll et al. (2014).

Of the 175 couples who participated at T1, patients' mean age was 63.53 years (*SD* = 6.74, range 46 to 77), partners' mean age was 60.07 years (*SD* = 7.90, range 39 to 75). Most of the participating couples were married (87.30%). Patients reported a mean relationship duration of 32.45 years (*SD* = 14.08) and a majority (89%) reported to have children. About half (51.50%) of the patients and 41.60% of the partners reported more than ten years of schooling, the remainder reported nine or ten years of schooling. Over one half (57.60%) of the patients and 48.60% of the partners were retired. Patients' tumours differed in their progressions. Using the TNM staging system, 1.10% of patients were given diagnosis of T1 (small tumour); 66.70% were diagnosed with T2 (larger, but still confined to the prostate gland); and 32.20% of patients were given a diagnosis of T3 (larger, grown beyond the prostate gland); in 17 cases, tumours had spread to lymph nodes (N for nodes; N1: 10.06%), and one tumour had spread to more distant parts of the body (M for metastasis; M1: 0.60%).

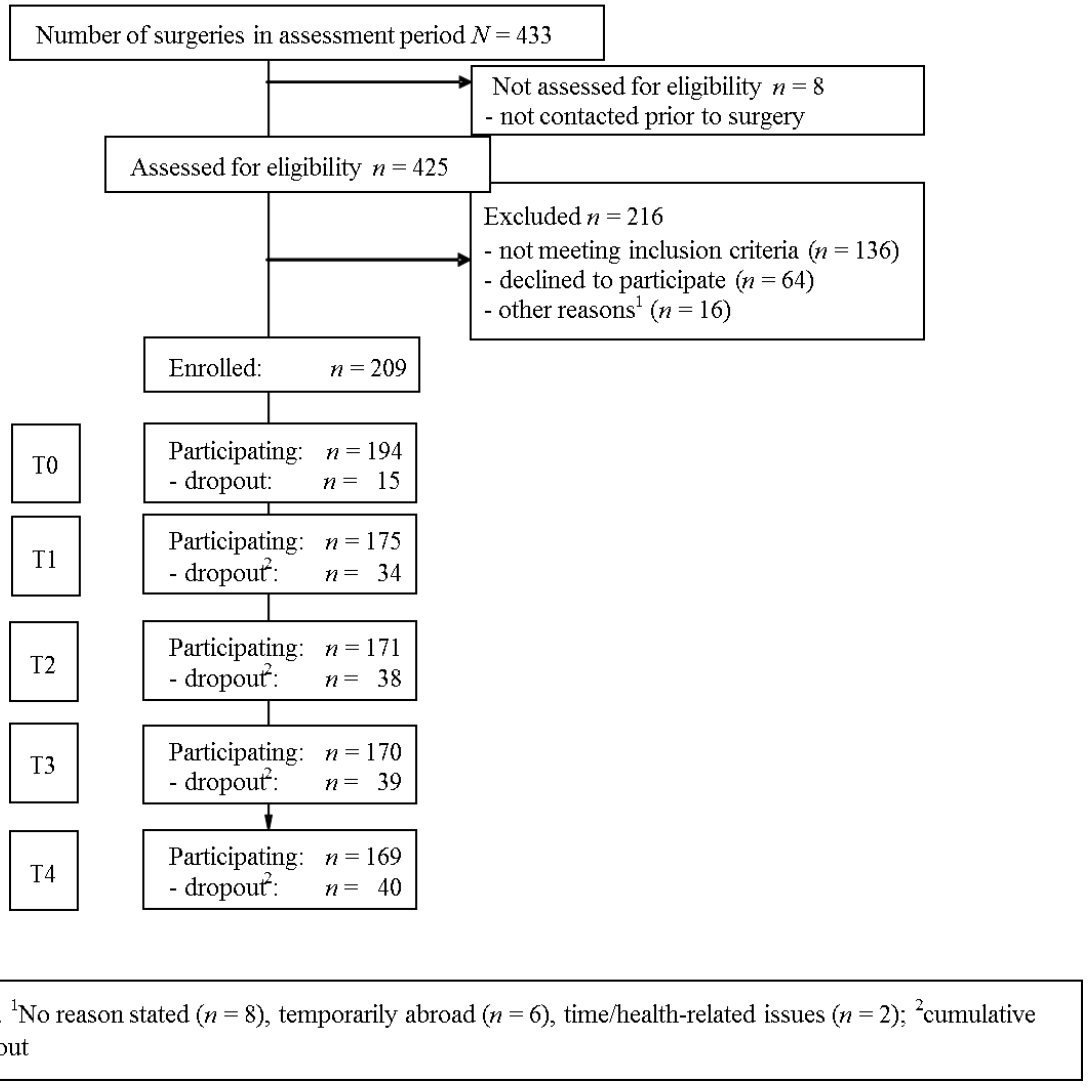

Figure 2. Participant flow (T = Time).

Measures

All variables were assessed at all post-surgery measurement points (T1-T4).

Dyadic planning. Patients' and partners' reports of dyadic planning of patients' rehabilitative training were measured by 2 items on a 6-point Likert scale (1 "totally disagree" - 6 "totally agree"; Burkert et al., 2012). Patients' items read "Together with my partner, I have made a detailed plan regarding when, where, and how I will perform pelvic floor exercise" and "Together with my partner, I have made a detailed plan regarding good opportunities for action". For patient and partner reports, item inter-correlations ranged between r = .87 and .98.

Context factor: Burden of urinary incontinence. Patients' burden by incontinence was assessed by 1 item from the short form of the International Consultation of Incontinence Questionnaire (ICIQ-SF; Karantanis, Fynes, Moore, & Stanton, 2004) asking patients (via self-report) and partners (via other-report) about how severely the patient's life was burdened by incontinence within the past 7 days. Patients and partners responded to this item on 11-point scales (0 "not at all" - 10 "severe"). Test-retest correlations of subsequent measurement points ranged between r = .64 and .84.

Patient factor: Self-efficacy. Behaviour-specific self-efficacy was assessed by 2 items with a 6-point Likert scale (1 "totally disagree" - 6 "totally agree") adapted from Wiedemann et al. (2009). A sample item was: "I am confident that I can perform pelvic floor exercise three times a day". Item inter-correlations ranged between r = .77 and .85.

Patient factor: Intention. To assess behaviour-specific intentions, patients responded to the item "I intend to perform pelvic floor exercise three times a day" on a 6-point Likert scale from 1 "totally disagree" to 6 "totally agree" (Burkert et al., 2011). Test-retest-correlations were r = .44 (T1-T2), r = .67 (T2-T3), and r = .77 (T3-T4).

Patient/Partner factor: Affect. Positive and negative affect were measured using the Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clark, & Tellegen, 1988). Patients and partners responded to 20 items on 4-point scales (0 "not at all" - 3 "very much"). Internal consistencies ranged between Cronbach's α = .81 and .92. Within same measurement points, positive and negative affect yielded low to moderate negative correlations in patients and partners (range: r = -.25 to r = -.50). Between patient and partner reports, affect variables showed low positive correlations (range: r = .19 to r = .36).

Relationship factor: Relationship satisfaction. Relationship satisfaction was measured with the Relationship Assessment Scale (RAS; Sander & Böcker, 1993) that consists of 7 items with 5-point-Likert scales. Cronbach's α for patient and partner reports

ranged from α = .84 to .91. Patient-reported average wake time spent together was assessed as hours per day.

Covariate: Individual planning. Patients' behaviour-specific individual planning was measured by 2 items e.g., "I have made a detailed plan regarding when, where, and how I will perform pelvic floor exercise" (Burkert et al., 2012). Responses on 6-point Likert scales (1 "totally disagree" - 6 "totally agree") yielded high item inter-correlations, ranging from *r* = .80 to .94. Dyadic planning items only differed from individual planning items by the wording "together with my partner" in the item stem. To test whether individual planning and dyadic planning items can be disentangled as two distinct factors, we ran a principal component analysis with varimax rotation. Similar to findings by Burkert et al. (2012), we found evidence for separate factors with item loadings of more than .90 on the theoretically matching and less than .30 on the non-matching factor at each measurement point.

Covariate: Social support. Behaviour-specific patient-reported received support and partner-reported provided support (mirrored versions) were assessed with 3 items each using a 6-point Likert scale from 1 "totally disagree" to 6 "totally agree" (adapted from Burkert et al., 2011; Schulz & Schwarzer, 2003). A sample item for patient received support was "My partner reminded me of strategies, which help me to do my exercises regularly". Internal consistencies ranged between Cronbach's α = .74 and .85.

Data Analysis

Using IBM SPSS Statistics Version 23, we computed means and standard deviations of each study variable, as well as bivariate correlations among variables assessed by patient and partner reports. Applying Mplus 7 (Muthén & Muthén, 1998-2012), we conducted paired *t*-tests to examine mean differences between patients' and partners' reports of dyadic planning and patients' incontinence burden. To account for missingness, Mplus models used Full Information Maximum Likelihood (Arbuckle, 1996).

Two-level models with repeated assessments nested in individuals were fit using a maximum-likelihood estimation with robust standard errors in Mplus. First, we computed separate models of bivariate associations of each predictor with patients' and partners' dyadic planning with a linear TIME trend as the respective covariate (henceforth referred to as "bivariate models"). In a second step, we fitted main models for patients' - ("Full Model 1") and partners' dyadic planning ("Full Model 2") by including all proposed predictors simultaneously to gain more insight into each predictor's unique association with dyadic planning. We used individual planning, social support receipt (Full Model 1) or social support provision (Full Model 2), and a linear TIME-trend as covariates. Except for the linear TIME-trend (coded in months, centred at T1 = 0) and couple's time spent together (hours), each predictor was grand-mean centred. All level-1 predictors were time-varying. Level-2 models were tested for random effects. Initially, all random effects parameters were estimated, but retained only if models converged and random effect variances were significant.

Results

Descriptive Statistics and *T*-Test Results

Table 1 displays descriptive statistics among study variables. Through T1 to T4, medium to large correlations between patients' and partners' reports on incontinence burden (range between r = .56 and r = .76) and dyadic planning (range between r = .48 and r = .54) were found. Squared correlations indicated shared within-couple variance of ca. 45% for incontinence burden and ca. 25% for dyadic planning. *T*-tests revealed that partner-reported dyadic planning was higher than patient-reported dyadic planning at T1, whereas there were no mean differences at T2, T3, and T4. Regarding patients' incontinence burden, partner-reports were consistently higher than self-reports by patients at all measurement points.

Table 1

Descriptive Statistics of Study Variables and T-Test Results for Dyadic Planning and Incontinence Burden

Measures	Range	Time 1 (1 month post-surgery)			Time 2 (3 months post-surgery)			Time 3 (5 months post-surgery)			Time 4 (7 months post-surgery)		
		M	*SD*	*r* *within-couple*	*M*	*SD*	*r* *within-couple*	*M*	*SD*	*r* *within-couple*	*M*	*SD*	*r* *within-couple*
Patient dyadic planning	1-6	2.74[a]	1.98	.49*	2.83[b]	2.12	.53*	2.66[c]	2.14	.48*	2.44[d]	2.09	.54*
Partner dyadic planning	1-6	3.13[a]	1.98		2.95[b]	1.93		2.69[c]	1.88		2.66[d]	1.97	
Patient individual planning	1-6	4.53	1.71	--	4.56	1.76	--	4.26	1.92	--	4.10	2.00	--
Patient received social support	1-6	2.75	1.66	.59*	2.88	1.67	.46*	2.73	1.72	.58*	2.70	1.78	.71*
Partner provided social support	1-6	2.93	1.55		2.99	1.48		2.67	1.51		2.61	1.62	
Patient incontinence burden (patient-report)	0-10	4.80[e]	3.19	.69*	3.44[f]	3.31	.66*	2.77[g]	3.17	.56*	2.53[h]	3.06	.76*

Patient incontinence burden (partner-report)	0-10	6.49[e]	3.48		5.24[f]	3.50		4.31[g]	3.63		3.81[h]	3.43	
Patient self-efficacy	1-6	4.97	1.30	--	4.35	1.62	--	4.29	1.76	--	4.01	1.75	--
Patient intention	1-6	4.54	1.73	--	3.57	2.01	--	3.41	2.06	--	3.04	2.04	--
Patient positive affect	0-3	1.45	0.62	--	1.43	0.61	--	1.53	0.61	--	1.59	0.62	--
Patient negative affect	0-3	0.24	0.34	--	0.24	0.36	--	0.19	0.30	--	0.22	0.36	--
Partner positive affect	0-3	1.43	0.58	--	1.46	0.60	--	1.45	0.65	--	1.46	0.62	--
Partner negative affect	0-3	0.28	0.32	--	0.25	0.31	--	0.25	0.33	--	0.29	0.34	--
Patient relationship satisfaction	1-5	4.53	0.50	.55*	4.46	0.57	.59*	4.43	0.60	.59*	4.43	0.59	.60*
Partner relationship satisfaction	1-5	4.28	0.64		4.30	0.65		4.26	0.68		4.22	0.66	
Time spent together (hours/day)	0-18	8.50	4.91	--	8.96	4.38	--	9.24	4.72	--	9.45	4.57	--

Note. $N = 175$. * $p < .05$. [a] t-test for paired samples, $t(174) = -2.54$, $p = .011$; [b] t-test for paired samples, $t(169) = -0.58$, $p = .560$; [c] t-test for paired samples, $t(167) = -0.15$, $p = .881$; [d] t-test for paired samples, $t(167) = -1.13$, $p = .261$; [e] t-test for paired samples, $t(172) = -7.61$, $p < .001$; [f] t-test for paired samples, $t(164) = -8.12$, $p < .001$; [g] t-test for paired samples, $t(162) = -6.47$, $p < .001$; [h] t-test for paired samples, $t(156) = -7.66$, $p < .001$.

Proposed Predictors of Dyadic Planning

To test our framework of dyadic planning predictors, we first analyzed bivariate dyadic planning associations with each proposed predictor (bivariate models; see Table 2) followed by simultaneous predictions of dyadic planning by all predictors at once (Patient: Full Model 1; Partner: Full Model 2; see Table 3).

Patient-Reports of Dyadic Planning as Outcomes

Regarding *covariates*, the linear TIME-trend suggested that dyadic planning remained steady over time. In line with our assumptions, patients' individual planning and their received social support yielded strong positive associations with patient-reported dyadic planning.

Concerning *context factors*, patient-reported incontinence burden was not linked to patients' dyadic planning in either the bivariate model or the Full Model 1. However, incontinence burden turned out to be a random effects predictor, that is, patients differed from each other in how much their incontinence burden was associated with dyadic planning.

As for *patient factors*, bivariate models yielded a negative relationship of patients' negative affect with patients' dyadic planning, whereas patients' positive affect, intention, and self-efficacy yielded positive relationships. In the Full Model 1, we again found positive relationships of patients' self-efficacy and patients' positive affect with their own reports of dyadic planning. In contrast, patients' intention and negative affect were no longer significant predictors. Post-hoc analyses (not reported in Table 2) showed that associations between patients' intention and dyadic planning were significant when excluding individual planning as a covariate.

For *partner factors*, partners' negative affect was negatively, and positive affect positively associated with patients' dyadic planning in bivariate models. In Full Model 1, both predictors were not uniquely related to patients' dyadic planning any longer.

Concerning *relationship factors,* relationship satisfaction was positively linked to patients' dyadic planning in the bivariate model and in Full Model 1. Couples' wake time spent together was only positively associated with patients' dyadic planning in the bivariate model.

Partners' Reports of Dyadic Planning as Outcomes

Regarding *covariates,* the linear TIME-trend showed a marginal decrease of partners' reports of dyadic planning over time. Patients' individual planning and partners' provided social support showed positive links to partners' dyadic planning.

As for *context factors,* partner-ratings of patients' incontinence burden were positively related to partner-reported dyadic planning in both the bivariate model and Full Model 2.

Concerning *patient factors*, bivariate models revealed that only patients' positive affect was positively related to partners' dyadic planning, whereas the remaining predictors showed non-significant relations. In Full Model 2, none of the patient factors were uniquely related to partner-reported dyadic planning.

With regard to *partner factors*, we found negative bivariate links of partners' negative affect with partners' dyadic planning, whereas partners' positive affect was not related. In Full Model 2, neither of the partner factors were uniquely associated with partner-reported dyadic planning.

As for *relationship factors,* relationship satisfaction was positively associated with partners' dyadic planning in bivariate models and Full Model 2. Only in the bivariate model couples' time spent together yielded a significant random effect indicating that couples differed in how much their daily time spent together was associated with partners' dyadic planning.

Table 2

Bivariate Models of Predictors of Patient-reported and Partner-reported Dyadic Planning of Pelvic Floor Exercise

Patient-reported dyadic planning			Partner-reported dyadic planning		
Predictors	Fixed Estimate *(SE)*	*p*	Predictors	Fixed Estimate *(SE)*	*p*
Patient incontinence burden (patient-report)[1]	0.04 (0.03)	.221	Patient incontinence burden (partner-report)	0.05 (0.02)	.030
Patient self-efficacy	0.21 (0.05)	<.001	Patient self-efficacy	-0.01 (0.05)	.831
Patient intention	0.19 (0.05)	<.001	Patient intention	0.02 (0.04)	.608
Patient positive affect	0.45 (0.15)	.002	Patient positive affect	0.21 (0.07)	.001
Patient negative affect	-0.50 (0.22)	.026	Patient negative affect	-0.01 (0.20)	.997
Partner positive affect	0.34 (0.15)	.018	Partner positive affect	0.16 (0.12)	.205
Partner negative affect	-0.69 (0.21)	.001	Partner negative affect	-0.50 (0.17)	.004
Patient relationship satisfaction	0.54 (0.17)	.002	Partner relationship satisfaction	0.25 (0.06)	<.001
Time spent together	0.05 (0.02)	.011	Time spent together[2]	0.05 (0.02)	.013

Note. N = 175. Each predictor was analysed in a separate model, controlling for a linear TIME trend. Random effect variances: [1]incontinence burden σ^2*(SE)* = 0.04 (0.02), *p* = .007. [2]time spent together σ^2*(SE)* = 0.01 (0.01), *p* = .037. Coefficients < -0.01 rounded to -0.01.

Table 3

Main Models of Predictors of Patient-reported (Full Model 1) and Partner-reported (Full Model 2) Dyadic Planning of Pelvic Floor Exercise

Full Model 1: Patient-reported dyadic planning			Full Model 2: Partner-reported dyadic planning		
Predictors	Fixed Estimate *(SE)*	*p*	Predictors	Fixed Estimate *(SE)*	*p*
Intercept	2.67 (0.10)	<.001	Intercept	2.75 (0.17)	<.001
TIME	0.01 (0.02)	.842	TIME	-0.04 (0.02)	.068
Patient individual planning	0.21 (0.04)	<.001	Patient individual planning	0.10 (0.04)	.013
Patient received social support	0.62 (0.05)	<.001	Partner provided social support	0.70 (0.05)	<.001
Patient incontinence burden (patient-report)[1]	0.02 (0.03)	.382	Patient incontinence burden (partner-report)	0.05 (0.02)	.029
Patient self-efficacy	0.07 (0.04)	.077	Patient self-efficacy	-0.06 (0.04)	.139
Patient intention	0.04 (0.04)	.320	Patient intention	-0.02 (0.04)	.637
Patient positive affect	0.30 (0.11)	.006	Patient positive affect	0.12 (0.13)	.327
Patient negative affect	0.11 (0.19)	.547	Patient negative affect	0.10 (0.18)	.584
Partner positive affect	0.12 (0.12)	.313	Partner positive affect	-0.15 (0.11)	.180
Partner negative affect	-0.14 (0.16)	.401	Partner negative affect	-0.24 (0.18)	.182
Patient relationship satisfaction	0.23 (0.11)	.047	Partner relationship satisfaction	0.29 (0.11)	.006
Time spent together	-0.01 (0.01)	.746	Time spent together	0.02 (0.02)	.122

Note. N = 175. Full Model 1: Random effect variances: intercept σ^2_0*(SE)* = 0.43 (0.14), p = .001; [1]incontinence burden σ^2_5*(SE)* = 0.03 (0.01), p = .008. Level-1 residual variance σ^2 *(SE)* = 1.24 (0.13), p < .001. Full Model 2: Random effect variances: intercept σ^2_0*(SE)* = 0.59 (0.11), p < .001. Level-1 residual variance σ^2 *(SE)* = 1.23 (0.11), p < .001. Coefficients < -0.01 rounded to -0.01.

Discussion

The present study investigated potential predictors of prostate cancer patients' and their partners' dyadic planning of patients' rehabilitative exercises. We built a framework of dyadic planning predictors by combining cognitive predictors of individual planning with four established predictor domains of social support provision.

Context Factors as Potential Predictors of Dyadic Planning

Patients' self-reported incontinence burden as a *context factor* was not significantly associated with patients' dyadic planning in bivariate analyses. This is contrary to the literature on predictors of social support provision (e.g. Bolger et al., 1996; Knoll et al., 2011). Because patients' incontinence was shown to be a proximal predictor of increases in patients' rehabilitative exercises (Keller et al., 2015), patients' burden by incontinence might be an effective cue to act without a need for preparation by regulatory strategies. In contrast to previous studies which included only self-reports of stressor - or context factors among support exchanging partners (e.g. Iida et al., 2008), we also examined partners' reports on patients' incontinence. Interestingly, partner-reports of patients' incontinence burden were positively related to partner-reported dyadic planning both bivariately and uniquely. Also, partners' accounts of incontinence burden were higher than patients' self-rated scores, pointing to a well-documented overestimation of patient-symptoms by partners (Martire et al., 2006), which could have motivated partners to engage in dyadic planning of patients' rehabilitative exercises.

Patient Factors and Dyadic Planning

Regarding bivariate relations between *patient factors* and patient-reported dyadic planning, patients' intention and self-efficacy turned out to be significant correlates. This finding supported our assumption that cognitive predictors of individual planning (Scholz et al., 2008; van Genugten et al., 2012) may also act as predictors of dyadic planning. However, after including individual planning as a covariate in Full Model 1, patients'

intentions were no longer uniquely associated with patients' dyadic planning and patients' self-efficacy's association was reduced to a trend. Likely, the empirical overlap between individual and dyadic planning and the fact that intention formation, self-efficacy, and individual planning are all individual processes accounted for the failure to confirm intention or self-efficacy as unique predictors of dyadic planning.

Neither patients' intention nor self-efficacy were bivariately or uniquely associated with partner-reported dyadic planning. This could have resulted from limited disclosure of patients' cognitions to partners.

Also, patients' positive affect was bivariately related with dyadic planning as reported by patients and their partners (Dunkel-Schetter & Skokan, 1990). Further indirect explanations for links between positive affect and dyadic planning come from two additional social psychological theories i.e., broaden-and-build theory (Fredrickson, 2001) and ego depletion theory (Baumeister, 2002). The former assumes that positive affect is positively linked to social relations to others (Fredrickson, 2001). Patients' positive affect could have helped them to mobilize planning support from their partners. The latter theory is seeing positive affect as a resource to facilitate self-regulatory efforts (e.g. planning one's health behavior), especially under stressful circumstances (Baumeister, 2002). Whereas patients' positive affect remained a unique correlate of patient-reported dyadic planning which is in line with findings by Knoll et al. (2011) on predictors of social support provision, it was non- significant in the full model that used partners' reports of dyadic planning as an outcome.

Patients' negative affect was negatively associated with patient-reports of dyadic planning (bivariate model only). Previous studies on predictors of social support provision yielded inconsistent findings. Whereas Bolger et al. (1996) found negative associations between breast cancer patients' distress and social support provision, a study with prostate cancer patients did not find significant associations (Knoll et al., 2011). Assigning distinct

negative affect states to meaningful clusters which might a) inhibit support (e.g. feeling hostile) or b) signal need for support (e.g. feeling scared) could shed more light on the direction of these associations.

Partner Factors as Correlates of Dyadic Planning

With regard to *partner factors*, significant negative relations between partners' negative affect and dyadic planning as reported by patients and partners emerged in bivariate models only. If partners' negative affect states were the result of depleted resources (Baumeister, 2002) or prior conflict with patients, engaging in dyadic planning with patients may have been less likely. Again, a more differentiated assessment of distinct negative affect states could yield more information on the nature of this association and even hint at antecedent attributions by partners (e.g., Weiner et al., 1988). Interestingly, partners' positive affect was significantly (bivariately) related to patients', but not partners' accounts of dyadic planning. From patients' perspectives, partners' higher positive affect might have facilitated patients' mobilization of partner-assistance in planning.

Taking all other potential predictors and covariates into account in Full Models 1 and 2, the only unique affect-dyadic planning association was between patients' positive affect and patient-reported dyadic planning. Resembling earlier findings on predictors of support provision (Knoll et al., 2011), none of the partner' affect states (partner factors) prevailed as unique effects. Because patients' affect variables were moderately correlated with partners', an overlap in predictor-variance might have been responsible for the few remaining unique relations of affect states with dyadic planning.

Relationship Factors and Dyadic Planning

Concerning *relationship factors*, the couple's time spent together can be considered as a necessary precondition for the occurrence of dyadic planning which was only supported by bivariate models. As about one half of the present sample was retired, couples tended to spend relatively much of their waking time together (range of means:

8.50 to 9.45 hours/day). Larger variation in this variable might have contributed to prevailing unique effects. However, only relationship satisfaction was uniquely associated with dyadic planning as reported by patients and partners. This is again in line with findings on predictors of support provision (Iida et al., 2008).

Limitations and Outlook

Some limitations have to be considered and amended by future research. First, predictive direction was not addressed in the present models which used simultaneous associations among predictors and outcomes and modelled them over time. A research design with more tightly spaced measurement lags could be used to test for lagged predictions. Second, shared variance among patients' and partners' dyadic planning of about 25% points to distinct perceptions or even distinct dyadic planning involvement by both partners. Within-couple differences in attentional focus might have contributed to this difference. During this critical phase of patients' rehabilitation, partners might have focused more on their role as support providers and thus been more aware of instances of dyadic planning when compared to patients who were likely more focused on their functional limitations. Third, partner factors should be extended to partners' self-regulation, e.g. their self-efficacy to support the patient. Finally, we examined heterosexual couples in the aftermath of prostatectomy, a context in which gender and role are confounded. Gender differences in predictors of dyadic planning should be investigated in other health contexts with both men and women as target persons.

Conclusion

This study provided initial evidence on potential predictors of dyadic planning in the context of prostate cancer patients' rehabilitation following surgery. Findings revealed that patient - and relationship domains included factors uniquely associated with patients' perspectives on dyadic planning, whereas context - and relationship domains included factors uniquely linked to partners'accounts of dyadic planning. In contrast, partner factors

were not uniquely associated with both dyadic planning perspectives. The present findings might contribute to a positioning of dyadic planning within behaviour change models.

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3

Individual and Dyadic Planning Predicting Pelvic Floor Exercise Among Prostate Cancer Survivors

Keller, J., Burkert, S., Wiedemann, A. U., Luszczynska, A., Schrader, M., & Knoll, N. (2015). Individual and dyadic planning predicting pelvic floor exercise among prostate cancer survivors. *Rehabilitation Psychology*, *60*(3), 222-231. doi:10.1037/rep0000047

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Abstract

Objective: Radical prostatectomy, a standard treatment for localized prostate cancer, is often followed by a recommendation to initiate and maintain pelvic floor exercise (PFE), to control post-surgery urinary incontinence. Previous studies showed that planning facilitated the uptake and maintenance of a new behavior. Whereas individual planning addresses the setting of plans by one person, dyadic planning refers to creating plans together with a partner on when, where, and how the individual target person will perform a behavior. Individual and dyadic planning of PFE, their development over time, and their associations with PFE were investigated.

Research Method: In a correlational study, 175 prostate-cancer patients provided data at 1, 3, 5, and 7 months following the onset of incontinence. Individual planning of PFE by patients and dyadic planning of PFE between patients and their partners, PFE, and incontinence were assessed by patients' self-reports.

Results: Two-level models with repeated assessments nested in individuals revealed stable levels of individual planning of PFE over time in patients with higher incontinence severity, whereas patients with receding incontinence showed decreases. Independent of incontinence severity, a curvilinear increase followed by a decrease of dyadic planning of PFE across time emerged. Sequential associations of both planning strategies with PFE were found. Whereas individual planning was steadily associated with PFE, associations between dyadic planning and PFE were non-significant in the beginning, but increased over time.

Conclusions: Findings point to the importance of individual planning for the adoption and maintenance of PFE, with dyadic planning being relevant for PFE maintenance only.

Keywords: action planning, dyadic planning, pelvic floor exercise, health-behavior change, prostate cancer

Introduction

The surgical removal of the prostate, i.e., radical prostatectomy, as one standard treatment for localized prostate cancer can cause sequelae including urinary incontinence which may challenge patients' quality of life. To control urinary incontinence, patients are advised to perform regular pelvic-floor exercise (PFE) in the months following surgery. Taking up this new health-relevant behavior and maintaining it during rehabilitation from incontinence requires self-regulatory effort and strategy use from patients, including planning the implementation and maintenance of PFE. During rehabilitation from the surgery's sequelae, patients are often assisted by their spouses in managing incontinence and recovery. Assistance may incorporate the provision of emotional and instrumental support (Gray, Fitch, Phillips, Labreque, & Fergus, 2000; Resendes & McCorkle, 2006) as well as social control (Knoll, Burkert, Scholz, Roigas, & Gralla, 2012). *Dyadic planning* of patients' regular PFE may be another means by which spouses assist patients in the initiation and maintenance of regular PFE (Burkert, Knoll, Luszczynska, & Gralla, 2012). Using Bodenmann's (2000) cascade model as a theoretical backdrop, we first examined the developments of individual and dyadic planning of PFE over time. Although a number of studies have evaluated interactive effects of individual and dyadic regulation in health-behavior change, including uptake and maintenance PFE (Burkert et al., 2012; Ochsner et al., 2014), there is less work on potential sequential effects of individual and dyadic planning on health-behavior change. Thus we investigated sequential associations between these two planning constructs and patients' PFE during rehabilitation from incontinence following radical prostatectomy.

Radical Prostatectomy, Urinary Incontinence, and PFE

Prostate cancer is now the most common cancer in European men (Aus et al., 2005). A standard treatment for localized prostate cancer is radical prostatectomy, in which the prostate gland including the tumor is surgically removed (Hegarty et al., 2010). For

prostate cancer patients, radical prostatectomy was shown to be associated with reduced prostate cancer mortality, reduced overall mortality, and reduced risk of metastases (Bill-Axelson et al., 2011). As a consequence of radical prostatectomy, however, patients are often faced with urinary incontinence and erectile dysfunctions (Resnick et al., 2013). In most patients, urinary incontinence sets in following the removal of a post-surgery catheter. Especially during the first 6 months post-surgery, patients' incontinence has a significant negative impact on their functional capacity and health-related quality of life, initially even more so than sexual dysfunctions (Eton & Lepore, 2002; Resendes & McCorkle, 2006). Incontinence then recedes within 6 to 12 months (Prabhu, Sivarajan, Taksler, Laze, & Lepor, 2014; Resnick et al., 2013). To control urinary incontinence and episodes of leakage, patients are instructed to perform regular PFE and learn to use their pelvic floor as an external sphincter. Recovery from incontinence is facilitated by performing regular PFE within a 6-month rehabilitation period following radical prostatectomy (MacDonald, Fink, Huckabay, Monga, & Wilt, 2007).

Individual Planning, Dyadic Planning, and Health-Behavior Change Processes

Individual planning, one key self-regulatory strategy, refers to making plans about when, where, and how to perform an intended behavior (Sniehotta, Schwarzer, Scholz, & Schüz, 2005). Such planning is thought to help translate goal intentions into behavior change (Gollwitzer, 1999; Hagger & Luszczynska, 2014; Leventhal, Singer, & Jones, 1965). While planning individually, a person is linking a situational cue (when/where) to an intended behavioral response (how) by way of mental simulation of anticipated future situations (Gollwitzer, 1999; Webb & Sheeran, 2007). Empirical evidence revealed that individual planning of a target-behavior is an efficient self-regulatory strategy to promote this behavior. This has also been shown for the uptake of regular physical activity (Belanger-Gravel, Godin, & Amireault, 2013; Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011) and regular PFE (Burkert et al., 2011).

Past research has examined the role of planning on health-behavior change mainly from the perspective of the individual (Belanger-Gravel et al., 2013), whereas less is known about how the social environment is affecting the planning process (Benyamini, Ashery, & Shiloh, 2011; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011; Prestwich, Conner, Lawton, Bailey, Litman, & Molyneaux, 2005; Prestwich, Conner, Lawton, Ward, Ayres, & McEachan, 2012, 2014). Underscoring the relevance of the latter approach, the majority of adults are living in stable relationships and partners are often highly involved in each other's health-behavior practices (Khan, Stephens, Franks, Rook, & Salem, 2013; Martire, Schulz, Helgeson, Small, & Saghafi, 2010). In the present paper, a conceptual extension of individual planning to the dyadic level (*dyadic planning*) is examined (Burkert et al., 2011). In dyadic planning, a target person is setting plans together with a partner on when, where, and how the target person will individually engage in behavior change. The concept of dyadic planning thus differs from the previous conceptualization of *collaborative implementation intentions* (Prestwich et al., 2005), where two persons make plans on how to enact a behavior *together*. Joint action, however, might impede goal attainment in terms of finding a time and location which is convenient for both partners. To avoid such additional situational barriers for behavior change and because performance of PFE behavior is recommended to the patient rather than to both partners, the present study focuses on dyadic planning of patients' regular PFE.

Compared to mostly positive effects of individual planning on health-behavior change (Belanger-Gravel et al., 2013), effects of dyadic planning (Burkert et al., 2011) as well as collaborative implementation intentions (Prestwich et al., 2012, 2014) remain equivocal. In this, effects of social forms of planning on behavior change so far seem as inconsistent as effects of reactive strategies of social regulation, such as social support or social control that may work only for subgroups (Knoll et al., 2012; Martire, Stephens, & Schulz, 2011; Scholz et al., 2013) or produce only small effects when used as intervention

strategies (Martire, Lustig, Schulz, Miller, & Helgeson, 2004; Martire et al., 2010). One possible explanation that has received comparatively little empirical attention so far concerns the notion that *timing* of the use of social regulation strategies may be important (Bodenmann, 2000).

Sequential Use of Individual and Dyadic Regulation Strategies

For the case of reactive self- and co-regulation strategies, that is, individual and dyadic coping in response to stressful situations, the assumption of sequential use has been proposed by Bodenmann (2000) in the *cascade model of the stress coping process*. The cascade model stipulates that individual and dyadic coping efforts come into play and are applied during sequential stages of an individuals' stress and coping process. Following the onset of a stressor, people start coping with the stressful situation on their own. In case of prolonged distress, individuals are then assumed to start utilizing social resources for coping, i.e., start coping dyadically, for instance by making use of support from their partner or close others. However, even with help from others, individuals will not quit their individual coping efforts (Bodenmann, 2000). Thus, whereas the cascade model specifies that persons will start out trying to manage a stressful situation individually, in case of prolonged stress, *individual* and *dyadic* actions are assumed to operate simultaneously at later points. Thus, the cascade model (Bodenmann, 2000) explicitly refers to individual regulation and co-regulation with others, that is, individual and dyadic coping in response to prolonged stress.

We propose that the cascade model and its assumptions about sequential effects may be applicable to the context of proactive regulation of the initiation and maintenance of health behavior. Both reactive (e.g., coping with a situational barrier) and proactive (e.g., planning initiation and maintenance of a new behavior such as PFE) self-regulation require effort and - if prolonged - may deplete an individuals' resources (Baumeister & Vohs, 2007). In the context of persisting functional limitations, such as urinary

incontinence following radical prostatectomy and relative uncertainty regarding the speed and extent of recovery (Boorjian et al., 2012), patients may at some point become aware of an impending gradual depletion of their resources (Baumeister & Vohs, 2007). This in turn might prompt them to start utilizing their partners' assistance in regulatory strategies, such as planning PFE dyadically. By these means, patients may seek to indirectly counteract an impending resource depletion by enhancing the quality and effectiveness of plans to perform regular PFE because these plans were developed together with their partners.

In the present study, individual planning of PFE refers to patients' independent attempts to plan exactly when, where, and how to perform PFE. Dyadic planning of PFE reflects the degree to which patients plan together with their partners when, where, and how patients will perform PFE on their own. Both strategies of planning PFE were shown to be positively associated in the context of post-prostatectomy recovery and rehabilitation (Burkert et al., 2012).

Aim and Hypotheses

Using Bodenmann's (2000) cascade model as a theoretical backdrop, we investigate the development of individual and dyadic planning of PFE within a time frame of 6-7 months of recovery from urinary incontinence following radical prostatectomy. Furthermore, we examine individual and dyadic planning as correlates of PFE over time.

In particular, we hypothesized distinct trajectories of individual and dyadic planning over time that differed as a function of severity of incontinence. For patients with severe incontinence continuously high levels of individual planning were expected, whereas for survivors with lower incontinence, decreases in individual planning were expected over time (Hypothesis 1). In terms of dyadic planning, we expected increases over time in patients with severe incontinence and decreases for patients with lower incontinence (Hypothesis 2). These assumptions derive from Bodenmann's (2000) proposition that in addition to their own continued efforts, individuals will gradually enlist

assistance while coming to terms with a self-regulatory challenge. Third, we assumed that individual and dyadic planning would show a specific pattern of sequential association with PFE over time. Shortly following its onset and throughout patients' rehabilitation from incontinence, individual planning would be continuously positively associated with PFE (Hypothesis 3a). For dyadic planning, we assumed that the strength of its association with PFE would increase over time (Hypothesis 3b).

Methods

Sample and Procedure

Data came from a longitudinal project with couples managing recovery following radical prostatectomy. Two-hundred and nine couples were recruited in two departments of urology in Germany and data were collected between 2009 and 2011. Inclusion criteria were patients' undergoing radical prostatectomy and living in a stable relationship with a partner. Patients were excluded if they did not give informed consent, did not have a partner, if the partner refused to participate in the study or give informed consent, or if one or both had insufficient knowledge of the German language. Enrolled couples received a compensation of 110 EUR. Parts of these data were previously analyzed (Knoll, Wiedemann, Schultze, Schrader, & Heckhausen, 2014; Knoll et al., 2015). Analyses were thus based on secondary data; nonetheless, we consider the research design and data appropriate for testing our present hypotheses.

Participants were approached by study staff at the departments of urology upon patients' admission to the hospital, one day prior to the operation. Informed consent procedures were conducted and respondents were asked to complete a first questionnaire on the same day (Time0; T0). Further questionnaires along with pre-addressed and stamped return envelopes were sent to participants' homes at 1 month (T1), 3 months (T2), 5 months (T3), and 7 months (T4) following removal of the post-surgery indwelling

catheter, i.e., the onset of incontinence. The study was approved by the Institutional Review Board.

Of the 209 couples enrolled in the study, 175 provided their data at T1, of those 169 provided data at all measurement points (see Figure 1 for more information on the participant flow). As all the central variables in this report stem from patients, patients' data are reported unless otherwise stated.

Of the 175 patients who returned questionnaires at T1, two patients did not provide socio-demographic information at baseline. Patients' mean age was 63.53 years (*SD* = 6.74, range 46 to 77). The majority of patients were married (87.30%), whereas the remaining participants were in a long-lasting relationship with a shared home. Patients reported a mean relationship duration of 32.45 years, *SD* = 14.08 years. Most patients (89%) reported having children. Regarding school education, 51.50% of patients reported more than ten years of schooling, the remainder reported nine or ten years of schooling. About half of the patients (57.60%) were retired. As patients' tumors varied in terms of progression, the TNM staging system was used for classification (T denotes tumor size and extension, N indicates whether or not lymph nodes are affected, M indicates the presence or absence of metastases). Patients were diagnosed with: T1 = small tumor: 1.10%; T2 = larger, but still confined to the prostate gland: 66.70%; T3 = larger, grown beyond the prostate gland: 32.20%. In 17 cases tumors had spread to lymph nodes (N1: 9.71%), and one had spread to more distant parts of the body (metastases; M1: 0.60%).

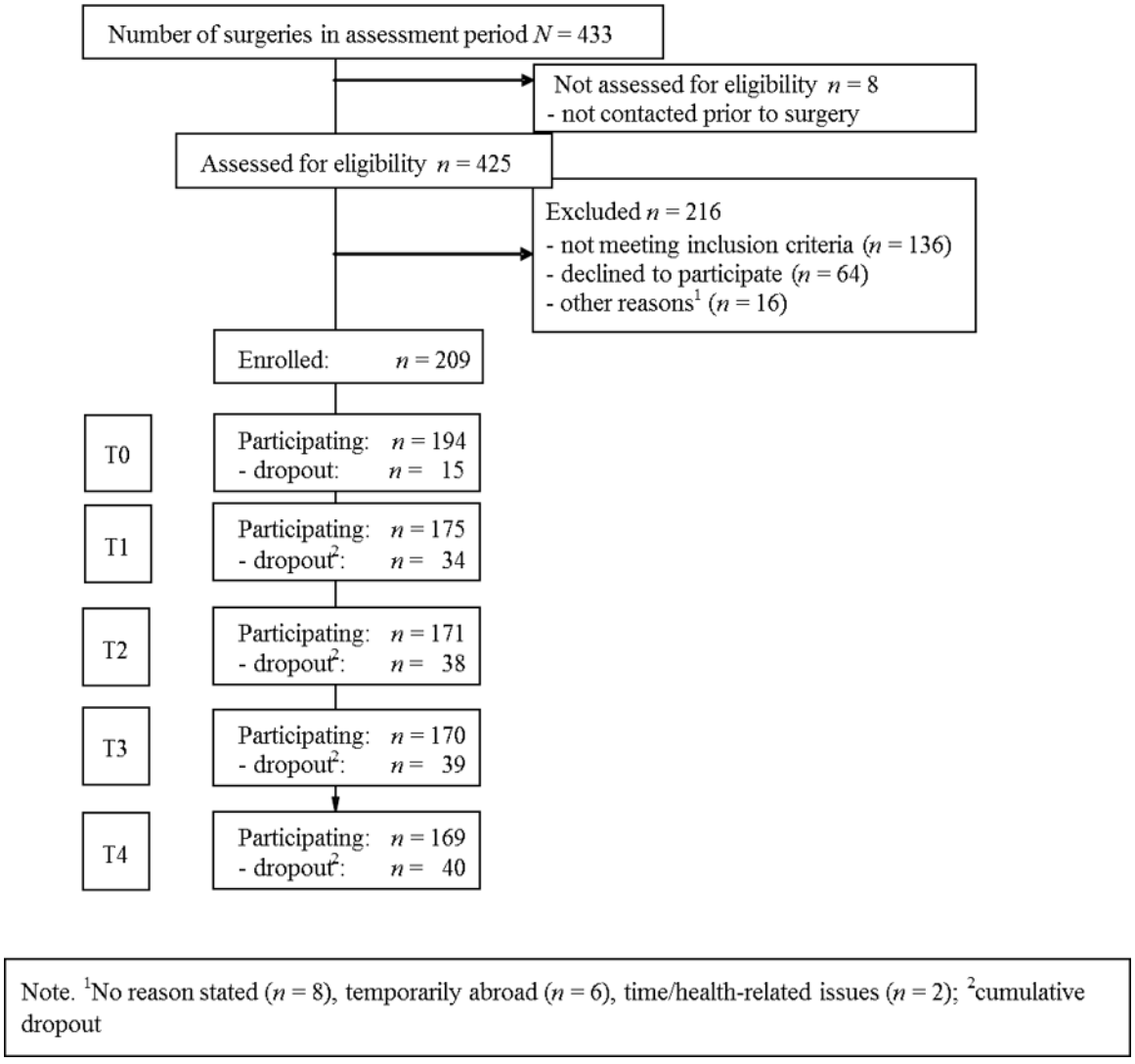

Figure 1. Participant flow (T = Time).

Measures

Across measurement points (from T1 through T4), patients' incontinence, individual action planning of PFE, dyadic (i.e., with their partners) action planning of PFE, and their PFE were assessed by means of self-report.

Individual planning was measured by two items using a 6-point Likert scale (1 "totally disagree" - 6 "totally agree"), adapted from Sniehotta, Schwarzer, et al. (2005). Items "I have made a detailed plan regarding when, where, and how I will perform pelvic floor exercise" and "I have made a detailed plan regarding good opportunities for action" were highly correlated: r = .89 at T1, r = .83 at T2, r = .80 at T3, r = .94 at T4. Mean scores were used.

Patients reported on dyadic planning together with their partners with two items on a 6-point Likert scale (1 “totally disagree” - 6 “totally agree”; Burkert et al., 2012). Items read “Together with my partner, I have made a detailed plan regarding when, where, and how I will perform pelvic floor exercise” and “Together with my partner, I have made a detailed plan regarding good opportunities for action”. Both items were again showing high inter-correlations: r = .90 at T1, r = .92 at T2, r = .93 at T3, r = .98 at T4. Mean scores were derived. Dyadic and individual planning zero-order correlations were r = .50 at each assessment, pointing to about 25% overlap in variance of the two constructs. These associations resemble findings by Burkert and colleagues (2012). Nevertheless, Burkert et al. also found evidence of a distinction between individual and dyadic planning as both loaded on separate, but inter-related factors in a principle components analysis. Principle components analyses using the present data on individual and dyadic planning also revealed a 2-factor solution, details are available from the first author upon request.

PFE was measured by asking patients the number of minutes per week they engaged in PFE outside of an organized rehabilitation program, e.g. at home, during the past week. Items assessed (a) on how many days, (b) how many times a day and (c) for how much time per unit PFE was performed. The three scores were multiplied to generate an overall indicator of PFE minutes during the past week. PFE scores more than 3.29 standard deviations (Tabachnick & Fidell, 2007) above the sample mean were considered to be outliers and, thus, were truncated (recoded to values one unit above the highest value within the valid range).

Patients’ urinary incontinence was assessed by the German short form of the International Consultation of Incontinence Questionnaire (ICIQ-SF; Karantanis, Fynes, Moore, & Stanton, 2004). The ICIQ-SF combines items measuring frequency of incontinence, amount of urine leaked, and burden by incontinence. The ICIQ-SF sum score

ranges from 0 to 21 with high values indicating high severity of incontinence. Cronbach's alpha for patients' urinary incontinence between T1 and T4 ranged from α of .67 to .73.

Data Analysis

Attrition analyses were performed with IBM SPSS Statistics Version 22. Differences for patients in the longitudinal sample (continuers: coded 1) were compared to those who dropped out (dropouts: coded 0) using *t*-tests for continuous variables and Pearson's χ^2-tests for dichotomous variables. Subsequently, unique effects of variables on study continuation were analyzed by a logistic regression analysis.

Using Mplus 7 (Muthén & Muthén, 1998-2012) and implementing a full information maximum likelihood procedure (FIML; Arbuckle, 1996) to account for dropout und missing values, means and standard deviations among study variables were computed. Subsequently, two-level models, with repeated assessments nested in individuals, were estimated using maximum-likelihood estimation with robust standard errors (MLR; Muthén & Muthén, 1998-2012). We first examined change patterns of patients' performance of PFE and levels of urinary incontinence from T1 to T4. After exploring linear and curvilinear change patterns in these models, we included a quadratic trend in our model for incontinence but not for PFE. For the PFE model (Model 1), linear TIME trends (coded in months after T1, centered at T1 = 0) and urinary incontinence were included as level-1 predictors. For the incontinence model (Model 2), both linear and quadratic time trends were included as level-1 predictors. Except for TIME trends, all level-1 predictors were grand-mean centered.

A similar procedure was used to investigate hypotheses 1 and 2 which involve modelling change patterns of individual and dyadic planning of PFE. In these models, TIME x incontinence interactions were included on level 1. Quadratic TIME trends were relevant for models predicting dyadic planning (Model 4) but not for models predicting individual planning (Model 3). Accordingly, the following time-varying level-1 predictors

were included in Model 3: TIME, patients' ratings of incontinence, and the TIME x incontinence interaction. Analogously, the following predictors of dyadic planning were included in Model 4: TIME, $TIME^2$, patients' ratings of incontinence, and the two interaction terms (TIME x incontinence and $TIME^2$ x incontinence). Subsequently, TIME x incontinence interactions of Model 3 and 4 were plotted (see Figure 2).

To investigate sequential correlations of individual and dyadic planning with PFE (Hypothesis 3, Model 5), level-1 predictors included TIME, patients' ratings of incontinence, individual planning, dyadic planning, as well as interactions of both planning constructs with TIME. In this model, a positive TIME x planning interaction would indicate increases in associational strength over time for the relationship between planning and PFE (for the interpretation of interactions between time and time-varying covariates in multilevel modeling see Singer & Willett, 2003). Multicollinearity was tested by computing variance inflation factors (VIF). As for this model VIFs ranged between 1.09 and 4.29; the degree of multicollinearity was considered acceptable (Zuur, Ieno, & Elphick, 2010).We then plotted model-derived strength of associations of PFE with individual planning and with dyadic planning to display how both planning strategies were associated with PFE over time (see Figure 3).

For each model (Model 1 to 5), level-2 models tested if the level-1 intercept and slopes of time-varying predictors varied significantly between patients. In a first step, random effects of the intercept and all predictors' slopes were specified, but retained only if significant. We did not include further between-subjects covariates at Level 2.

Results

Attrition Analyses

Attrition analyses showed differences for patients in the longitudinal sample compared to those who dropped out: patient-reported levels of depressive symptoms (lower in continuers; $t(172) = 2.46$, $p = .015$) and difficulty with performing activities of

daily life (lower in continuers; $t(172) = 3.18$, $p = .002$); number of partners' children (lower in continuers; $t(31.08) = 1.98$, $p = .057$) and whether children were living with the couple (less often in continuers; $\chi^2(1) = 4.37$, $p = .037$); partner-reported vocational training (degree from a school providing higher/extended vocational education: less often in continuing couples; $\chi^2(1) = 5.69$, $p = .017$), and partner-reported number of comorbidities (higher in continuers; $t(200) = -1.93$, $p = .055$). A logistic regression showed that unique effects emerged for difficulties with daily activities and partner-reported vocational training.

Patterns of Change in PFE and Incontinence

Means, standard deviations, as well as intercepts and slopes of the two-level models testing changes in PFE (Model 1) and incontinence (Model 2) are displayed in Table 1. PFE means were not decreasing as a function of the linear TIME trend, but rather as a function of incontinence. Means of incontinence were receding showing both a linear and a curvilinear TIME trend. Furthermore, we found random effects of the intercepts and TIME-trends predicting incontinence and PFE, thus, patients showed distinct starting points and linear change patterns of incontinence and PFE over time. Covariances among random intercepts and random TIME slopes pointed to a negative association between patients' initial levels of PFE and incontinence and their PFE and incontinence development over time. Thus, for PFE and incontinence respectively, patients with higher initial levels showed more marked decreases over time.

Table 1

Descriptive Statistics and Patterns of Changes for Pelvic Floor Exercise (Model 1) and Incontinence (Model 2)

		Model 1: Pelvic floor exercise [a] (0-473)			Model 2: Incontinence [b] (0-21)		
T1	*M (SD)*	133.08 (118.57)			10.94 (5.55)		
T2	*M (SD)*	119.06 (105.47)			8.47 (5.63)		
T3	*M (SD)*	107.71 (113.50)			7.01 (5.52)		
T4	*M (SD)*	101.23 (121.97)			6.49 (5.56)		
		Fixed effects	Random effect variance	Covariance with random intercept	Fixed effects	Random effect variance	Covariance with random intercept
Intercept	Estimate *(SE)*	126.50*** (8.23)	6,764.80*** (1,461.24)	--	10.94*** (0.42)	26.48*** (2.56)	--
TIME	Estimate *(SE)*	-0.27 (1.90)	208.44** (61.60)	-454.72† (257.62)	-1.48*** (0.16)	0.33*** (0.07)	-0.84* (0.35)
$TIME^2$	Estimate *(SE)*	[c]	[c]	[c]	0.12*** (0.02)	[d]	[d]
Incontinence	Estimate *(SE)*	5.08*** (1.00)	[d]	[d]	--	--	--
Residual variance	Estimate *(SE)*	3,415.07*** (589.55)			4.83*** (0.47)		

Note. $N = 175$. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$. T1: 1 month, T2: 3 months, T3: 5 months, T4: 7 months following the onset of incontinence. [a] values are indicating weekly minutes of pelvic floor exercise. [b] high values are indicating high severity of incontinence. [c] $TIME^2$ was not modelled as a predictor. [d] variable was modelled as a fixed effect predictor.

Patterns of Changes in Individual and Dyadic Planning

Means, standard deviations, as well as intercepts and slopes of the two-level models testing changes in individual planning (Model 3) and dyadic planning (Model 4) are displayed in Table 2. Hypothesis 1 assumed high levels of individual planning in presence of severe incontinence throughout, whereas lower incontinence was hypothesized to be associated with reduced individual planning over time. In accordance with this hypothesis, Model 3 yielded a positive TIME x incontinence interaction (Table 2). As highlighted by Figure 2, individual planning receded in patients who reported lower incontinence only.

In contrast, dyadic planning was assumed to increase over time for patients reporting higher levels of incontinence, whereas a decrease of dyadic planning was hypothesized for patients with lower incontinence over time. Partially in accordance with Hypothesis 2, results of Model 4 revealed a significant curvilinear TIME trend of dyadic planning, but no interactions of TIME (linear or quadratic) with incontinence. For patients with higher and lower incontinence severity alike, dyadic planning first increased slightly and then decreased again (see Figure 2).

Significant random effect variances of the intercept and slopes predicting individual planning (TIME, incontinence, and the TIME x incontinence interaction) and dyadic planning (incontinence) implied varying starting points and change patterns between patients (see Table 2). For individual planning as the outcome, we found significant negative associations between intercepts and slopes, indicating steeper declines for patients with higher initial levels of individual planning.

Table 2

Descriptive Statistics and Patterns of Changes for Individual (Model 3) and Dyadic Planning (Model 4)

		Model 3: Individual planning (1-6)			Model 4: Dyadic planning (1-6)		
T1	*M (SD)*	4.51 (1.71)			2.73 (1.97)		
T2	*M (SD)*	4.57 (1.75)			2.86 (2.09)		
T3	*M (SD)*	4.27 (1.92)			2.67 (2.12)		
T4	*M (SD)*	4.11 (2.00)			2.45 (2.08)		
		Fixed effects	Random effect variance	Covariance with random intercept	Fixed effects	Random effect variance	Covariance with random intercept
Intercept	Estimate *(SE)*	4.63*** (0.13)	1.67*** (0.18)	--	2.67*** (0.15)	2.25*** (0.31)	--
TIME	Estimate *(SE)*	-0.06* (0.03)	0.04** (0.01)	-0.06** (0.02)	0.14 (0.09)	[b]	[b]
$TIME^2$	Estimate *(SE)*	[a]	[a]	[a]	-0.03* (0.01)	[b]	[b]
Incontinence	Estimate *(SE)*	0.01 (0.02)	0.01** (0.01)	-0.06*** (0.02)	0.03 (0.02)	0.01* (0.01)	-0.02 (0.02)
TIME x incontinence	Estimate *(SE)*	0.01** (0.01)	0.01*** (0.01)	-0.01*** (0.01)	0.01 (0.01)	[b]	[b]
$TIME^2$ x incontinence	Estimate *(SE)*	[a]	[a]	[a]	0.01 (0.01)	[b]	[b]
Residual variance	Estimate *(SE)*	1.01*** (0.13)			1.46*** (0.17)		

Note. $N = 175$. * $p < .05$; ** $p < .01$; *** $p < .001$. T1: 1 month, T2: 3 months, T3: 5 months, T4: 7 months following the onset of incontinence. [a] $TIME^2$ was not modelled as a predictor. [b] variable was modelled as a fixed effect predictor. Coefficients < 0.01 rounded to 0.01.

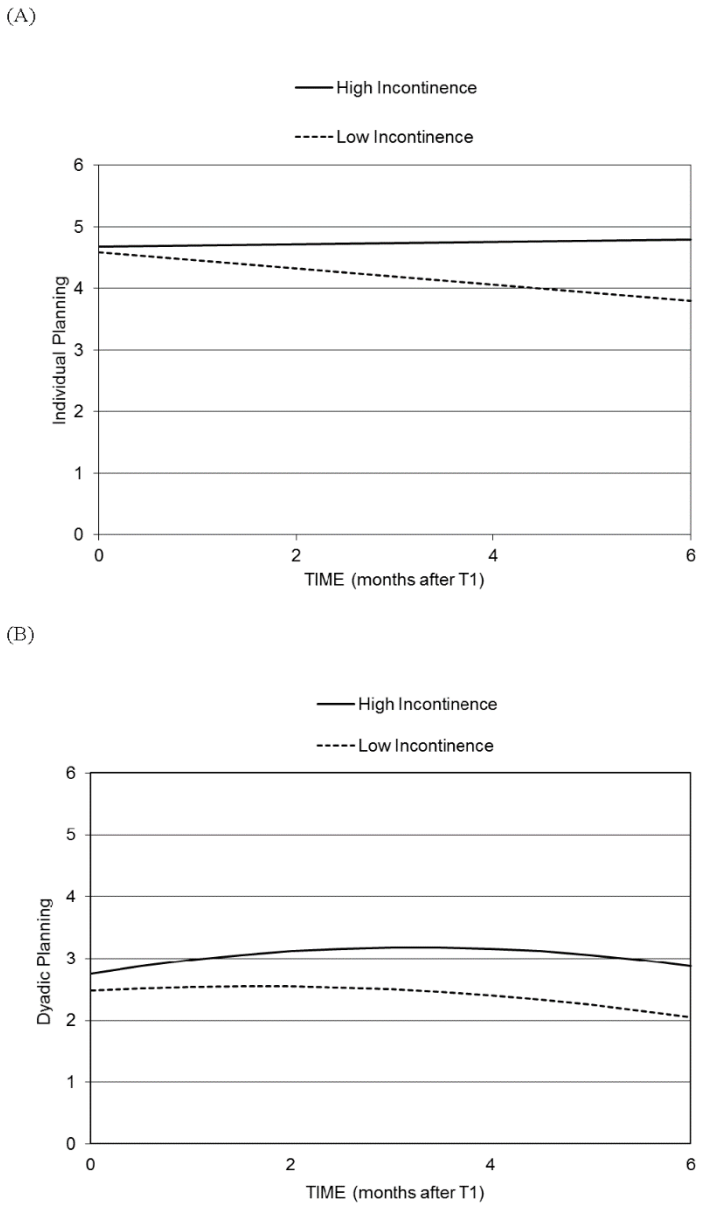

Figure 2. Plotted changes over time of individual planning (Panel A) and dyadic planning (Panel B) as a function of incontinence severity (*M* +/- 1 *SD*).

Sequential Associations of Individual and Dyadic Planning with PFE

Model 5 tested the hypothesized sequential associations of individual planning and dyadic planning with PFE (see Table 3) over time. The intercept and linear TIME slope showed significant between-person variation.

As hypothesized, results indicated a significant positive effect of individual planning (Hypothesis 3a) but a non-significant effect of dyadic planning on PFE. However, whereas the TIME x individual planning interaction was non-significant, a significant TIME x dyadic planning interaction emerged (Hypothesis 3b). Also, a positive effect of incontinence on PFE was found.

In the next step, model-derived associations of both planning variables with PFE over time were plotted (see Figure 3). Figure 3 indicates that both lines, representing associations between PFE and individual and dyadic planning, converged due to a growing association of dyadic planning with PFE over time. On the other hand, the association of individual planning with PFE remained steady over time.

Table 3

Individual Planning, Dyadic Planning, and their Interactions with Time Predicting Pelvic Floor Exercise (Model 5)

	Model 5: Pelvic floor exercise					
	Fixed effect *(SE)*	*p*	Random effect variance *(SE)*	*p*	Covariance with random intercept *(SE)*	*p*
Intercept	118.07 (8.06)	<.001	5,485.90 (1,464.01)	<.001		
TIME	0.49 (1.87)	.794	172.61 (58.55)	.003	-442.44 (245.87)	.072
Incontinence	4.67 (0.94)	<.001				
Individual planning	18.82 (4.87)	<.001				
Dyadic planning	-2.63 (4.61)	.568				
TIME x individual planning	-0.78 (1.17)	.508				
TIME x dyadic planning	2.27 (1.09)	.037				

Notes. $N = 175$. Level 1 residual variance σ^2 *(SE)* = 3,406.437 (639.429), $p < .001$.

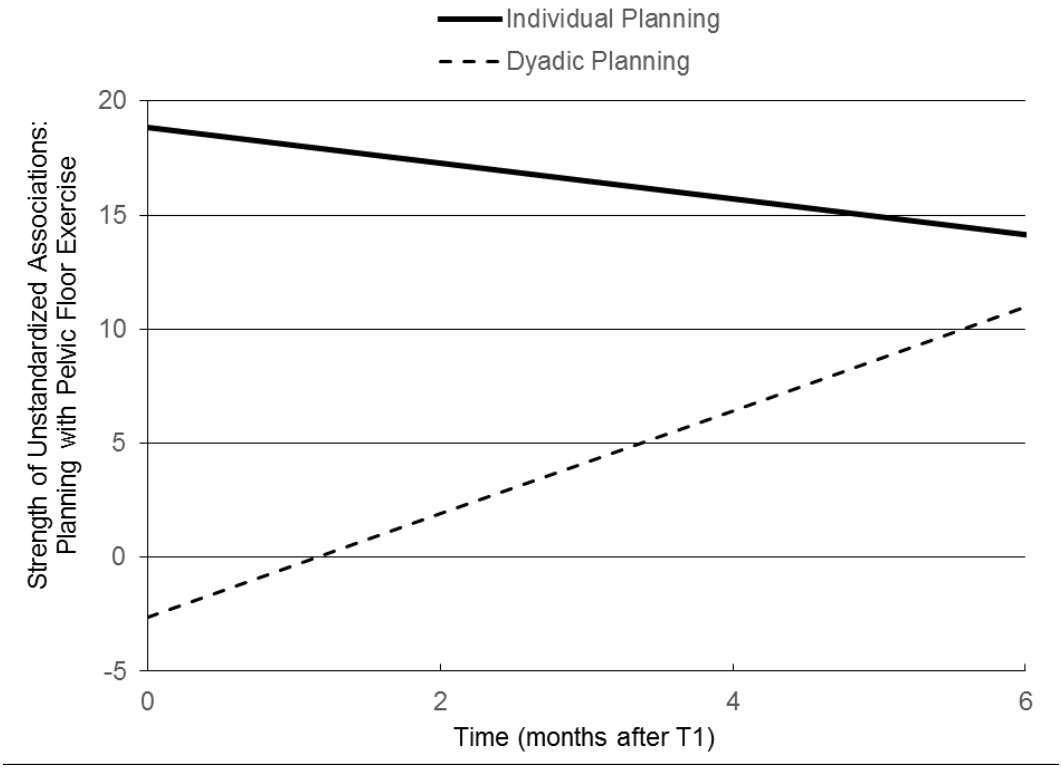

Figure 3. Plotted pelvic floor exercise associations with individual planning and dyadic planning over time.

Discussion

The present study provides novel insight into longitudinal trajectories of individual and dyadic planning as a function of patients' incontinence and evidence of sequential relationships of both planning strategies with prostate cancer patients' PFE performance over time. Patients reported the highest levels of incontinence following the removal of a post-surgery catheter. Incontinence generally receded over the following 6 months; however, changes were quadratic in that the decrease became less steep over time. This is in line with epidemiological findings indicating that steepest decreases in incontinence may occur during the first 6 months post-surgery and then level off (Resnick et al., 2013). Epidemiological evidence also indicates that about 10% of patients remain incontinent even after 12 months following prostatectomy (Prabhu et al., 2014). In line with previous research, we observed that contingent on receding levels of incontinence, pelvic-floor

training, which is a recommended rehabilitative exercise, decreased over time (MacDonald et al., 2007).

Applying assumptions of the cascade model (Bodenmann, 2000) to the context of planning the uptake and maintenance of a new health behavior, we hypothesized that patients with severe incontinence would use individual planning of PFE unchangingly over time, whereas patients with lower incontinence would reduce their individual planning efforts. Our findings support these assumptions. Incontinence that might serve as a cue for action in terms of planning of PFE or performing PFE was an important moderator explaining change trajectories of individual planning use. Also in accordance with Bodenmann's (2000) predictions, regulative efforts wore off once demands of the situation lessened, that is, once incontinence receded.

As for use of dyadic planning of PFE, increases over time were assumed for patients with more severe incontinence and decreases of dyadic planning were assumed for patients with less severe incontinence. However, findings indicated that the development of dyadic planning over time was not further moderated by severity of patients' incontinence, but rather yielded a curvilinear change pattern for all patients alike. Partly in line with present assumptions drawn from Bodenmann's cascade model (2000), dyadic planning of PFE initially increased, but then decreased. In contrast to individual planning of PFE, dyadic planning of PFE was not a function of patients' incontinence. A possible explanation could come from partners' changing involvement in prostate cancer recovery process. For instance, prior evidence suggested that early following radical prostatectomy partners provide most support to patients, but their assistance eventually wears off due to patients' progress in recovery (Knoll, Burkert, Roigas, & Gralla, 2011). However, as findings concerning our third hypothesis implied, partners' involvement in planning of PFE may have been particularly helpful during later phases of patients' recovery.

Extending assumptions of the cascade model (Bodenmann, 2000), we hypothesized that individual and dyadic planning would be sequentially associated with PFE. Results suggested that indeed patients' use of individual planning seemed to be a successful self-regulatory strategy for PFE uptake and maintenance, whereas dyadic planning's association with PFE was negligible at first, but increased over time. We did not investigate potential mediators, but several mechanisms may drive this process. Patients and partners seemed to engage in dyadic planning from the start, increasing the use of dyadic planning slightly before decreasing its use at later measurement points. It is possible that over time patients might have learned how to maximize the benefits of dyadic planning of PFE and may have begun to utilize available partners' assistance in planning more effectively. Delayed effectiveness of dyadic planning could also point to sequentially operating mechanisms that follow the planning process itself and that take time to develop, be tested, and optimized. For instance, dyadic planning may have triggered other, more specific forms of support for behavior initiation and maintenance (Burkert et al., 2011) that needed time to unfold.

Limitations and Outlook

Some limitations have to be considered and amended by future research. First, results from attrition analyses indicated that dropout was biased by patient-reported difficulty with performing activities of daily life and partner-reported vocational training which may limit generalizability of findings. Second, the present study investigated volitional strategies, behavior, and associated covariates by using a correlational design. Examining the relationships between individual and dyadic planning and behavior change using an experimental manipulation would be desirable. Third, it should be considered that measures of individual and dyadic planning might have prompted participants to set plans which they would not otherwise have made. Because reported associations involved simultaneous assessments, a potential impact of a mere measurement effect should only

affect measurement points following T1. However, because assessments were two months apart, bias due to mere measurement should be limited. Fourth, study variables were assessed via self-reports and might thus suffer from social desirability bias which has to be considered when interpreting present analyses. Future data assessments using self-reports should apply a measure of social desirability to examine a potential response bias. Also, to avoid potentially inflated conceptual overlap between individual and dyadic planning measures, future operationalizations should stress the distinction between planning alone and planning with others. Moreover, as the concept of dyadic planning is not limited to persons who are living in a stable relationship, future studies should also consider investigating dyadic planning with other family members or peers. Finally, to learn more about sequential effects of dyadic planning, sequentially operating mechanisms, and their impact on health-behavior change, future work should use interventional designs with a sufficient number of closely spaced follow-ups to test complex and sequential mediating mechanisms.

Conclusion

The interplay of individual and dyadic planning and their association with regular PFE were investigated among prostate cancer patients during a period of 6 to 7 months following the onset of post-surgery urinary incontinence. Findings showed that Bodenmann's (2000) proposal of divergent trajectories of individual and dyadic coping in response to an ongoing stressor may be applied also to individual and dyadic planning of PFE. Furthermore, findings revealed differential associations of both planning strategies with PFE over time, indicating that the utilization of partners' assistance in the planning process may not be essential for the initial uptake of PFE, but may help to retain the effectiveness of planning in the long run.

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4

Augmenting Fruit and Vegetable Consumption by an Online Intervention: Psychological Mechanisms

Keller, J., Motter, S., Motter, M., & Schwarzer, R. (2018). Augmenting fruit and vegetable consumption by an online intervention: Psychological mechanisms. *Appetite, 120,* 348-355. doi:10.1016/j.appet.2017.09.019

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Abstract

Objective: Fruit and vegetable (FV) intake was examined among men and women who participated in an online intervention. The psychological constructs involved were outcome expectancies, behavioral intention, planning, and self-efficacy. One purpose of the analyses was the evaluation of a self-efficacy treatment component. The other purpose of the analyses regarded the role of psychological mechanisms that might be responsible for individual differences in the process of behavior change.

Design: A two-arm online intervention with a standard and an enhanced intervention group focusing on FV planning was conducted to improve FV intake, followed up at two and four weeks. The intervention groups differed by the additional inclusion of a self-efficacy ingredient in the enhanced intervention. Linear mixed models examined the intervention effects, and a longitudinal structural equation model explored which psychological constructs were associated with changes in FV intake. Participants were N=275 adults of whom n=148 completed the four-week follow-up. Their age range was 18 to 81 years (M_{age}=32.50, SD_{age}=14.00).

Results: Analyses yielded an overall increase in self-reported FV intake. Moreover, a triple interaction between time, sex, and experimental groups on self-efficacy emerged, indicating that men, independent of treatment conditions, reported an increase in their confidence to improve FV intake, whereas women developed higher FV self-efficacy when being in the enhanced group instead of the standard group. Planning, self-efficacy, and intention mediated between outcome expectancies, and follow-up FV intake.

Conclusion: Both intervention arms produced overall improvements in FV intake. The enhanced intervention resulted in a steeper increase in self-efficacy in women compared to men, and compared to the standard intervention. A psychological

mechanism transpired that included a sequence leading from initial outcome expectancies via planning, self-efficacy, and intention towards FV intake.

Keywords: online intervention, planning, self-efficacy, intention, fruit and vegetable intake

Introduction

Although the World Health Organization has advised to eat at least five portions of fruit and vegetables (FV) per day, FV consumption was shown to be globally lower than recommended (Guilbert, 2003; Hall, Moore, Harper, & Lynch, 2009). A recent meta-analysis on the effect of FV intake on cardiovascular disease, cancer, coronary heart disease, and stroke, based on 95 prospective studies with more than two million participants, suggested that although five portions of FV a day reduced disease risk, ten servings a day would be even better (Aune et al., 2017). According to a study with *N*=7,010 German adults, aged 18 to 79 years, women consumed on average 3.1 and men 2.4 servings (Mensink et al., 2013). Only 15% of women and 7% of men met the recommendations to eat at least five portions a day (Mensink et al., 2013) which underscores the need of implementing effective interventions to increase FV consumption.

The application of health behavior theories (i.e., social cognition models; Conner & Norman, 2015) has enhanced the understanding of antecedent factors and associated processes that account for individual differences in FV consumption, and such models can serve as an underpinning of interventions. The present study focused on a selection of social-cognitive components, namely outcome expectancies, behavioral intention, self-efficacy, and planning (Schwarzer & Luszczynska, 2015; Shaikh, Yaroch, Nebeling, Yeh, & Resnicow, 2008). The self-efficacy and planning components can be used as active ingredients of straightforward and brief interventions (e.g., one's success story about the mastery of a goal, or planning sheets) to increase FV intake, and therefore randomized controlled trials have particularly applied the corresponding techniques (e.g., Kellar, & Abraham, 2005; Lhakhang, Godinho, Knoll, & Schwarzer, 2014).

Previous research has examined psychological mechanisms for FV intake in observational (e.g. Hamilton, Vayro, & Schwarzer, 2015; Reyes Fernàndez, Warner, Knoll, Montenegro, & Schwarzer, 2015) and experimental study designs using self-efficacy and planning intervention modules (e.g. Kreausukon, Gellert, Lippke, & Schwarzer, 2012; Lhakhang et al., 2014; Lin, Scheerman, Yaseri, Pakpour, & Webb, 2017; Luszczynska, et al., 2016). The study by Hamilton et al. (2015) examined Australian long-haul truck drivers and found a mediation sequence on FV intake that started with positive outcome expectancies, followed by self-efficacy, before an intention was generated. The study by Reyes Fernàndez et al. (2015) with students from Costa Rica replicated Hamilton et al.'s (2015) findings of intention operating as a mediator between self-efficacy and subsequent FV intake. The randomized controlled trial by Kreausukon et al. (2012) documented coping planning and self-efficacy as parallel mediators between intervention condition and FV intake. The randomized controlled trial by Luszczynska et al. (2016) underscored the role of self-efficacy as a mediator of the self-efficacy-only intervention (vs. control) and the role of planning as a mediator of the planning-only intervention (vs. control) for long-term FV intake.

The above outlined research examined a selection of psychological variables stemming from the health action process approach (HAPA; Schwarzer & Luszczynska, 2015). The present study extended this work by simultaneously investigating three HAPA variables as potential mechanisms of interventions, namely behavioral intention, self-efficacy, and planning. Furthermore, the present study might corroborate previous findings by testing whether combining self-efficacy with planning was superior to a planning-only intervention.

Potential Psychological Mechanisms for Fruit and Vegetable Consumption

Outcome expectancies are beliefs about the consequences of one's action, and such behavioral beliefs are regarded as being influential in developing an intention to change one's health behaviors (Bandura, 1997). Consequences of eating more FV could be imagined in terms of health benefits, fitness gains, weight control, feeling more attractive, or any social (e.g., my family appreciates healthy meals) or emotional outcomes (e.g., I feel good about my diet). Expecting such benefits of changing one's diet has been shown to enhance motivation and the likelihood of dietary changes (Shaikh et al., 2008).

Self-efficacy portrays individuals' beliefs in their capabilities to perform a specific action required to attain a desired outcome (Bandura, 1997). Different challenges could emerge during the course of dietary behavior change, and self-efficacy beliefs may be required to master these tasks successfully. Individuals with high levels of self-efficacy have been found to consume more FV than their lower scoring counterparts (Kreausukon, et al., 2012; King et al., 2010; Lhakhang et al., 2014; Luszczynska, Tryburcy, & Schwarzer, 2007). Moreover, self-efficacy and outcome expectancies predicted a 24-hour recall of actual FV consumption (Resnicow et al., 2000).

Planning pertains to making plans on when, where, and how to initiate an action. This includes to specify critical conditions (such as lunch break or while watching TV) and link them to goal-directed responses such as eating an adequate diet. Moreover, people may imagine possible barriers and generate alternative coping plans. Reviews on intervention studies have documented the effects of planning on dietary behaviors (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). For a general review on planning of health behaviors, see Hagger and Luszczynska (2014).

Behavioral intentions are often seen as a distal antecedent of health behavior and, therefore, other constructs are suggested to bridge the intention-behavior gap such as planning or self-efficacy (Schwarzer, 2008). On the other hand, further intention formation can also be a result of motivating treatments that are based on planning and self-efficacy which then makes the intention a more proximal predictor of behavior (Hamilton et al., 2015). This latter case was pursued in the present intervention study targeting the enhancement of an intention to eat more FV which, in turn, should facilitate subsequent FV intake.

In the HAPA model (Schwarzer, 2008), outcome expectancies are assumed as being particularly important for building up an intention to change a behavior (i.e., motivational stage). Planning and behavioral intentions are key constructs for behavior adoption and maintenance (i.e., volitional stage; Schwarzer, 2008). Self-efficacy beliefs are important for both the motivational and volitional stage of behavior change (Schwarzer, 2008).

Aims of the Study

The present two-arm online intervention study examined changes in FV intake among adult men and women. One arm of the intervention entailed the 'standard' treatment with a particular focus on the promotion of dietary outcome expectancies and dietary planning. The other arm, the 'enhanced' treatment, included the promotion of dietary self-efficacy in addition to the content of the standard intervention.

The first study aim addressed the effect of the intervention on subsequent FV intake and changes in social-cognitive variables. Planning interventions have been shown to support FV changes (Adriaanse et al., 2011), and both planning and self-efficacy promote FV intake (Luszczynska et al., 2016), giving rise to the expectation that a

combination of both would lead to even higher increases. It was thus hypothesized that the enhanced intervention arm would produce a higher increase in FV intake than the standard intervention (Hypothesis 1). Furthermore, as sex is known to make a difference in FV intake (e.g. Mensink et al., 2013), the interaction between sex, FV changes, and intervention group membership was examined.

The second aim and main purpose of the analyses regarded the role of psychological mechanisms that might be responsible for individual differences in the process of behavior change. These self-regulatory constructs influence how people adopt and maintain health-enhancing behaviors that are perceived as challenging such as making dietary changes (Schwarzer & Luszczynska, 2015). Based on Hamilton et al. (2015) and Reyes Fernàndez et al. (2015), the mediation sequence from initial positive outcome expectancies via self-efficacy and the development of behavioral intentions should lead to higher FV intake following the intervention (Hypothesis 2). Furthermore, the role of planning as a further psychological mechanism in this mediation sequence was explored.

Methods

Participants and Procedure

Participants were recruited by using reactive recruitment strategies such as mailing lists of two German universities, intranets of two companies, social network platforms as well as announcement and communication platforms. As an incentive for participation, they were promised a chance to win one voucher (out of six) with a value equivalent to 60 U.S. dollars. All participants who participated at each measurement point were entered into a lottery which then randomly assigned six persons to be the winner of one voucher, respectively. Such lottery-based incentives

have been found motivating to improve adherence to study participation in previous studies (e.g. Petry, Martin, Cooney, & Kranzler, 2000).

Two hundred and seventy-nine individuals provided informed consent, after which they were directed to an account for the online platform. Of the consenting participants, *N*=275 individuals (*n*=207 women, *n*=68 men; mean age=32.51 years, *SD*=14.00, range= 18-81; mean BMI=22.99, *SD*=3.82, range= 17.56-30.14) responded to a baseline questionnaire with behavioral and psychological items which was followed by the intervention (Time 1; duration for most of the participants: 25-35 minutes). Two weeks later, *n*=150 participants attended the Time 2 (T2) survey, and at Time 3 (T3), four weeks after the intervention, *n*=148 persons completed the final follow-up assessment (duration for both follow-ups: 7-12 minutes). Please see Figure 1 for the participant flow. The first author's institutional review board granted ethics approval for this study.

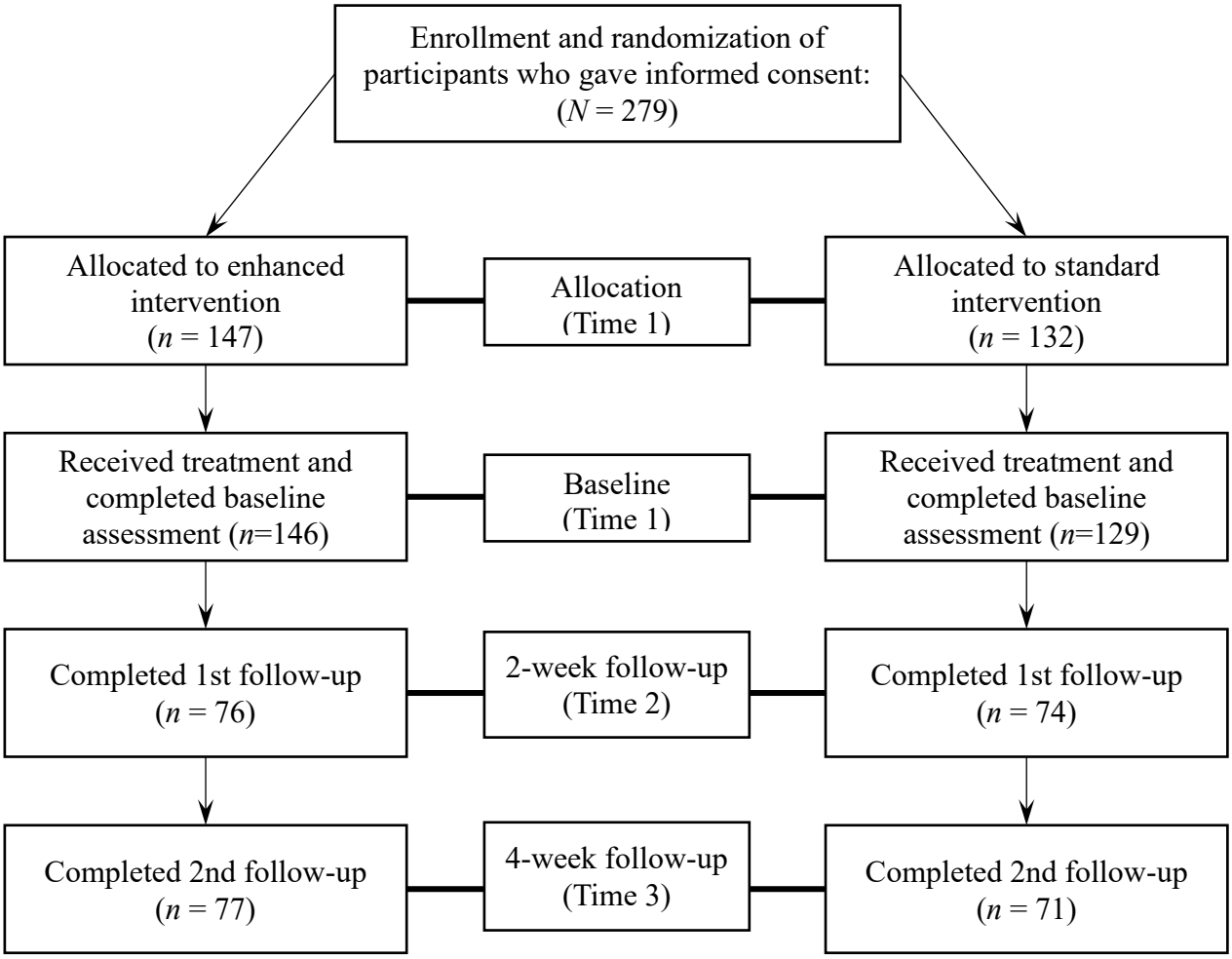

Figure 1. Participant flow

Intervention

The German-language online platform was developed using the LifeGuide open access authoring software (www.lifeguideonline.org) (Yardley et al., 2009), and it was designed to deliver an intervention that implemented theory-based behavior change components. The software-based algorithm assigned each person to either the standard group or the enhanced group with a respective chance of 50%. *N*=129 participants were randomized to the standard group and received treatment; *N*=146 were randomized to the enhanced and received treatment.

Participants in the standard as well as in the enhanced groups were informed about the common recommendations of eating five portions of FV per day. In the outcome expectancy module, participants were informed about positive consequences of FV

intake (behavior change technique [BCT 1] according to Michie et al., 2013) and instructed to formulate pros and cons of regular FV intake [BCT 9.2]. In the planning module, participants were asked to make concrete plans on when, where, and/or with whom they would eat which sort of fruit or vegetables in the future [action planning; BCT 1.4]. Individual action plans were then entered in a weekly calendar. Subsequently, participants were instructed to write down critical situations that might prevent them from eating FV as planned, followed by behavioral responses to cope with these situations [problem solving/coping planning; BCT 1.2]. Only in the self-efficacy module for the enhanced group, participants were provided with successful FV-related stories of older vs. younger or male vs. female testimonials (matched to their age and gender) which also included an encouraging statement by the testimonials addressed to the participants [vicarious reinforcement; BCT 16.3]. Matching in terms of sex and age generates role models with some level of similarity to the user. Participants were also asked to recall their own success experience with FV by checking some example statements or by documenting their own FV-related success stories [focus on past success; BCT 15.3]. Subsequently, they were encouraged to generate a self-motivating phrase that they could recall when being tempted to snack or otherwise being unmotivated to eat FV [prompting self-talk; 15.4].

Measures

At each measurement point, two retrospective items measured *FV intake* ("How many portions of fruit/vegetables have you eaten on average per day in the past two weeks?") (Gholami & Schwarzer, 2014). To assist participants in responding accurately, examples of what constituted one portion size were provided.

FV-specific intention was assessed by two prospective items at each measurement point and referred to the intended FV intake for the next two weeks ("How many portions of fruit/vegetables do you intend to eat on average per day in the following two weeks?").

At each measurement point, the psychological constructs outcome expectancies, planning, and self-efficacy were assessed with items adapted from Gholami and Schwarzer (2014) rated on a 6-point Likert scale ranging from (1) not at all true to (6) exactly true. Internal consistencies were represented by Cronbach's α (see Table 1).

Positive FV-specific outcome expectancies were measured by five items, introduced by the stem 'If I eat five servings of fruit and vegetables per day …' followed by statements regarding positive consequences, e.g. '…then I feel attractive', '…then I have beautiful skin', or '…then friends and parents will see that I am a health conscious person'.

FV-specific coping planning was assessed by four retrospective items with the stem 'During the past two weeks, I made concrete plans', followed by the response options: '…what to do if something interferes with my goal of eating required fruit and vegetables', '…what to do when there are not enough fruit or vegetables', '…how to cope with the family diet habits', and '…how to maintain fruit and vegetable intake despite other obligations or interests'.

FV-specific self-efficacy was measured by four items which included the item stem 'I am confident that I can regularly eat five servings of fruit and vegetables' which was followed by the statements: '…even if it is not always easy for me', '…even if it is expensive', '…even if it is time consuming', and '…even when it takes a long time to become part of my daily diet routine'.

Data Analysis

Using the SPSS 24 MIXED procedure, linear multilevel models were computed with three time points crossed in individuals (level 2) with restricted maximum likelihood (REML) estimation (Heck, Thomas, & Tabata, 2014; Hoffman, 2015). Level-1 dependent variables were FV consumption, intention, planning, and self-efficacy. Intervention conditions and sex served as level-2 time-invariant covariates. Cross-level interactions were computed to determine the interrelationships between intervention conditions (standard=0, enhanced=1), sex (coded as 0 [men], 1 [women]), and three time points (centered at baseline=0; 1st follow-up=1; 2ndfollow-up=2). The time x condition interaction tests differential changes between the two intervention arms. We additionally included interactions with sex as a control variable because sex differences in nutrition are well-known (e.g. Mensink et al. 2013). The within-person interdependence of the repeated assessments was accounted for by using the autoregressive covariance structure (AR1) for residual errors.

We then examined possible psychological mechanisms that may be responsible for individual differences in behavior change. A longitudinal structural equation model (SEM) was modelled with FV consumption (assessed at Time 3) as the outcome which was predicted by a set of antecedent psychological variables (i.e., outcome expectancies, planning, self-efficacy, and intention), and covariates (i.e., past behavior, sex, age, and body mass index). The final model (see Figure 6) consisted of Time 1 assessments of outcome expectancies, past behavior, sex, age, and BMI, as well as Time 2 assessments of self-efficacy, planning, and intention. Computations were carried out with AMOS 23 (Arbuckle, 2014). Model fit was evaluated in terms of chi-square, the comparative fit index (CFI), Tucker Lewis Index (TLI), and the root mean square error of approximation (RMSEA).

Results

Preliminary Descriptive and Attrition Analyses

The descriptive statistics of the main study variables are presented in Table 1. Out of all participants who completed the baseline assessment, a subsample of n = 148 reported their FV intake at Time 3. Analyses of variance with study drop-out as the independent variable and the baseline assessments as dependent variables were performed. The only significant difference between returning persons and those who dropped out was for age, with greater attrition evident for younger persons (drop outs: N=131, mean age=29.40 years, SD=11.35; remainers: N=148, mean age=35.26 years, SD=15.44; $F(1,274)=12.58$, $p<.01$).

Table 1. Ranges, sample sizes, means, standard deviations (*SD*), internal consistency of study variables.

Variables (range)	*N*	Mean	*SD*	Cronbach's alpha
Time 1: FV intake (1-16)	275	3.77	1.94	–
Time 2: FV intake (1-16)	150	4.83	1.93	–
Time 3: FV intake (1-16)	148	5.14	2.46	–
Time 1: Intention (2-16)	275	5.47	2.05	–
Time 2: Intention (1-16)	149	5.75	2.10	–
Time 3: Intention (0-16)	148	5.82	2.44	–
Time 1: Planning (1-6)	263	2.50	1.13	.81
Time 2: Planning (1-6)	150	3.89	1.24	.84
Time 3: Planning (1-6)	148	3.85	1.38	.91
Time 1: Self-efficacy (1-6)	264	3.84	1.06	.77
Time 2: Self-efficacy (1-6)	149	4.24	1.11	.87
Time 3: Self-efficacy (1-6)	148	4.16	1.19	.86
Time 1: Outcome expectancy (1-6)	264	4.25	0.84	.78
Time 2: Outcome expectancy (1-6)	149	4.41	1.02	.87
Time 3: Outcome expectancy (1-6)	148	4.39	1.14	.91
Time 1: Age (18-81)	275	32.54	13.99	–
Time 1: Body mass index (17.56-39.14)	205	22.99	3.82	–
Time 3: Body mass index (17.30-38.77)	137	22.26	3.05	–

Note: FV= fruit and vegetable.

Mean Level Changes

At the first step, the time x treatment interaction was computed to test whether the extended version was superior to the standard version. There was no such interaction for FV consumption, $t_{(34.35)}$=-0.10, p=.92, FV intention, $t_{(161.34)}$=-1.17, p=.24, and FV planning $t_{(97.82)}$=1.12, p=.23. Only for FV self-efficacy, the time x treatment interaction was significant ($t_{(158.82)}$=2.57, p=.01). Hypothesis 1 was not confirmed because both treatment arms were about equally successful in FV promotion. Therefore, sex was examined in subsequent analyses as a putative moderator of the time by treatment relationship. The findings of these linear mixed models are presented in Table 2 as well as in Figures 2 to 5, separately for FV consumption, intention to eat FV, planning, and self-efficacy.

Table 2. Results of linear mixed models: Dependent variables are fruit and vegetable (FV) consumption, intention, planning, and self-efficacy at three points in time.

FV consumption	Estimate	Std. Error	*df*	*t*	*p*	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	3.42	0.23	329.72	14.82	<.01	2.96	3.87
Time	0.75	0.13	89.54	5.88	<.01	0.50	1.01
Group	0.39	0.20	340.86	1.95	.05	0.01	0.78
Sex	0.34	0.23	325.17	1.48	.14	-0.11	0.78
Time * Sex * Group	-0.13	0.21	88.53	-0.60	.55	-0.55	0.29
Intention							
Intercept	5.09	0.27	276.82	18.57	<.01	4.55	5.63
Time	0.24	0.11	157.42	2.19	.03	0.02	0.45
Group	0.53	0.24	281.00	2.24	.03	0.06	1.00
Sex	0.16	0.27	273.37	0.61	.54	-0.37	0.69
Time * Sex * Group	-0.15	0.18	157.11	-0.85	.40	-0.50	0.20
Planning							
Intercept	2.52	0.15	238.90	17.35	<.01	2.23	2.80
Time	0.68	0.08	154.94	8.58	<.01	0.53	0.84
Group	0.04	0.13	253.94	0.31	.76	-0.21	0.29
Sex	0.18	0.14	251.17	1.24	.21	-0.10	0.46
Time * Sex * Group	0.09	0.13	154.08	0.69	.49	-0.17	0.35
Self-efficacy							
Intercept	4.00	0.14	263.39	28.91	<.01	3.73	4.27
Time	0.11	0.06	157.75	1.68	.09	-0.02	0.23
Group	-0.12	0.12	272.32	-0.99	.32	-0.35	0.12
Sex	-0.05	0.13	266.46	-0.38	.71	-0.32	0.21
Time * Sex * Group	0.24	0.10	157.73	2.26	.03	0.03	0.44

Note. Time coded as 0=baseline; 1=1st follow-up; 2=2nd follow-up; Group coded as 0=standard treatment, 1=enhanced treatment; sex coded as 0=men, 1=women.

Fruit and vegetable consumption. The intraclass correlation (ICC) was .38 which means that there was more variation at the within-person level (62%) than at the between-person level (38%). Time showed an increasing trend (b=0.75, p< .01). The triple cross-level interaction between time, sex, and groups (b=-0.13, p=.55) was not significant. Random intercept variance was 0.63 (p=.09) which means that there were no substantial inter-individual differences in baseline FV intake, whereas the random slope variance of 0.56 (p=.03) indicated that there was true variation in individual growth parameters.

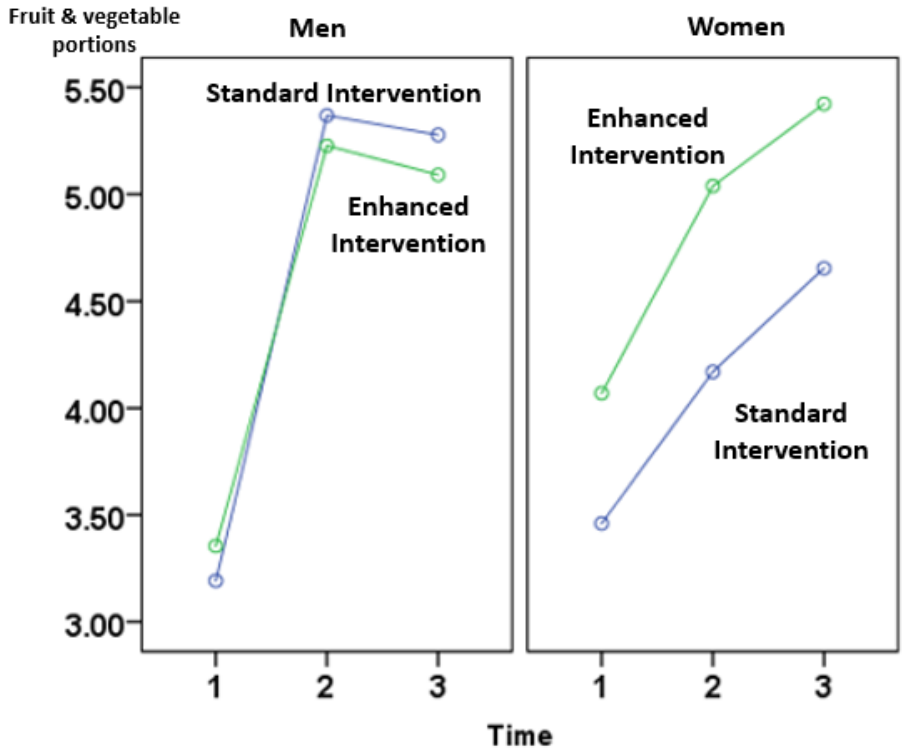

Figure 2. Mean level changes in self-reported fruit and vegetable (FV) consumption under two intervention conditions, separated by sex. Dependent variable is daily number of FV servings at three points in time (N = 148 adults with complete longitudinal data)

Intention to consume fruit and vegetables. The intraclass correlation (ICC) was .55 which means that there was less variation at the within-person level (45%) than at the between-person level (55%). Time showed an increasing trend (b=0.24, p=.03). The triple cross-level interaction between time, sex, and groups (b=-0.15,

p=.40) was not significant. Random intercept variance was 2.87 (*p*<.01) which means that there were substantial inter-individual differences in baseline intentions, whereas the random slope variance of -0.15 (*p*=.77) indicated that there was no true variation in individual growth parameters.

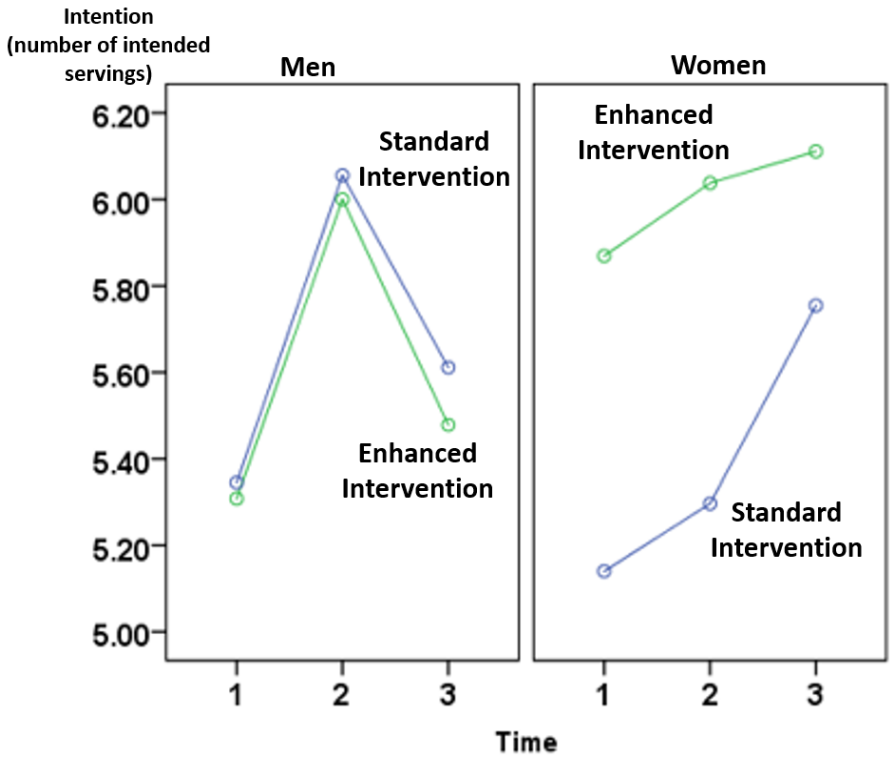

Figure 3. Mean level changes in the intention to eat fruit and vegetables (FV) under two intervention conditions, separated by sex. Dependent variable is the intended daily number of FV servings at three points in time (*N* = 148 adults with complete longitudinal data)

Fruit and vegetable planning. The intraclass correlation (ICC) was .23 which means that there was more variation at the within-person level (77%) than at the between-person level (23%). Time showed an increasing trend (*b*=0.68, *p*<.001). The triple cross-level interaction between time, sex, and groups (*b*=0.09, *p*=.49) was not significant. Random intercept variance was 0.52 (*p*=.24) which means that there were no substantial inter-individual differences in baseline planning, and the random slope variance of 0.01 (*p*=.96) indicated that there was no true variation in individual growth parameters.

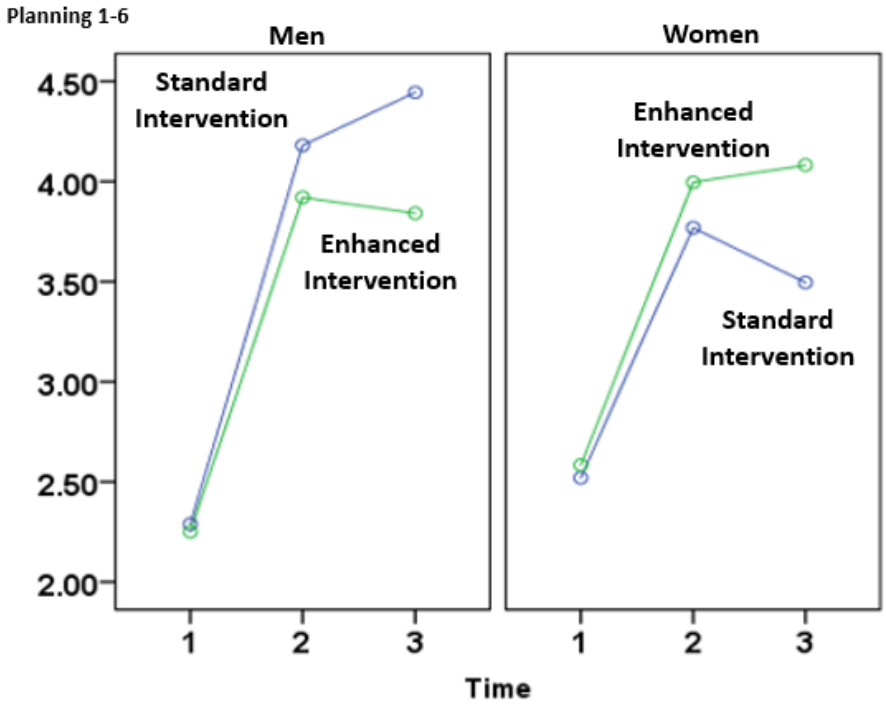

Figure 4. Mean level changes in the amount of planning under two intervention conditions, separated by sex. Dependent variable is the self-reported level of planning on a scale from 1 to 6 at three points in time (N = 148 adults with complete longitudinal data)

Fruit and vegetable self-efficacy. The intraclass correlation (ICC) was .42 which means that there was more variation at the within-person level (58%) than at the between-person level (42%). Time was not significant (b = 0.11, p =.09). The triple cross-level interaction between time, sex, and groups was significant (b = 0.24, p = .03) which pertains to the steeper increase in self-efficacy in women in the enhanced intervention condition. Random intercept variance was 0.63 (p=.02) which means that there were substantial inter-individual differences in baseline self-efficacy, whereas the random slope variance of -0.06 (p=.68) indicated that there was no true variation in individual growth parameters.

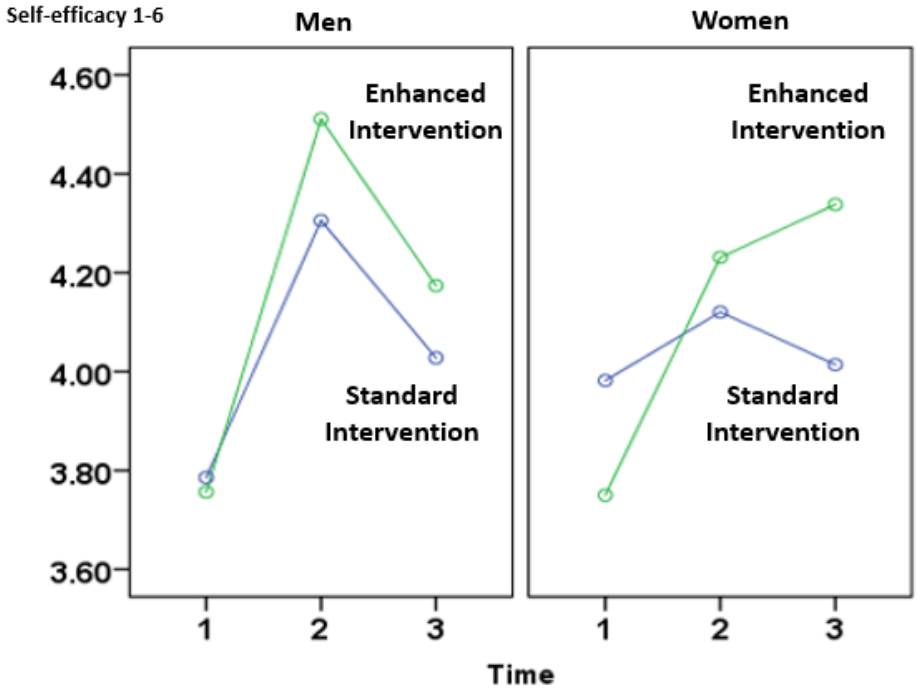

Figure 5. Mean level changes in the amount of self-efficacy under two intervention conditions, separated by sex. Dependent variable is the self-reported level of self-efficacy on a scale from 1 to 6 at three points in time (N = 148 adults with complete longitudinal data)

Psychological Mechanisms in the Process of Fruit and Vegetable Change

The previous analyses have examined effects of experimental conditions for men and women on four dependent variables over three measurement points in time. To examine the second aim of the study, psychological variables were chosen that allowed for a closer look at the possible mechanisms that might have been responsible for FV changes. Such mechanisms were examined with longitudinal structural equation models. To predict FV consumption at the 2nd follow-up (Time 3), baseline behavior was specified as a covariate along with sex, age, and body mass index. Initial positive outcome expectancies were specified as a distal antecedent, whereas planning and self-efficacy at Time 2 and intention at Time 2 were specified as sequential mediators. The rationale behind this was the assumption of a sequence which starts with study entry characteristics, followed by planning and self-efficacy

which reflect the focus of the intervention, and by the built-up intention at Time 2 as the most proximal predictor of follow-up FV intake.

Total sample analyses (N = 275) using the full information maximum likelihood procedure to account for missing values yielded the unstandardized parameter estimates given in Figure 6. The model fit to the data was satisfactory with $\chi^2_{(18)}$ =24.97, p=.13, CFI=0.98, TLI=.94, and RMSEA=.04. FV consumption at follow-up was jointly predicted by intention, planning, and self-efficacy. The psychological mediators operated in a sequential manner, starting from initial outcome expectancies via planning and self-efficacy to intention. Sex and body mass index had no direct effect on follow-up behavior but age was positively related to it. Of the T3 FV consumption variance, 47% was accounted for by the model. The explained variance for T2 FV intention was 36%, the one for self-efficacy was 14%, and the one for planning was 18%. Examination of the indirect effects of any model variable on T3 FV consumption yielded the following unstandardized parameter estimates: outcome expectancies with B=.32, self-efficacy with B=.29, planning with B=.28, sex with B=.37, and baseline FV consumption with B=.16.

Hypothesis 2, pertaining to the mediator model, was mainly confirmed although this model was not fully in line with theory which would have suggested planning to be specified as a mediator between intention and behavior. Such a perfectly theory-conform model was tested before, yielding a less satisfactory fit with $\chi^2_{(20)}$ =64.4, p<.01, CFI=0.90, TLI=.78, and RMSEA=.09, and less meaningful parameter estimates. For this reason, the better fitting model with intention as the most proximal predictor of FV intake was found valid in the present analyses.

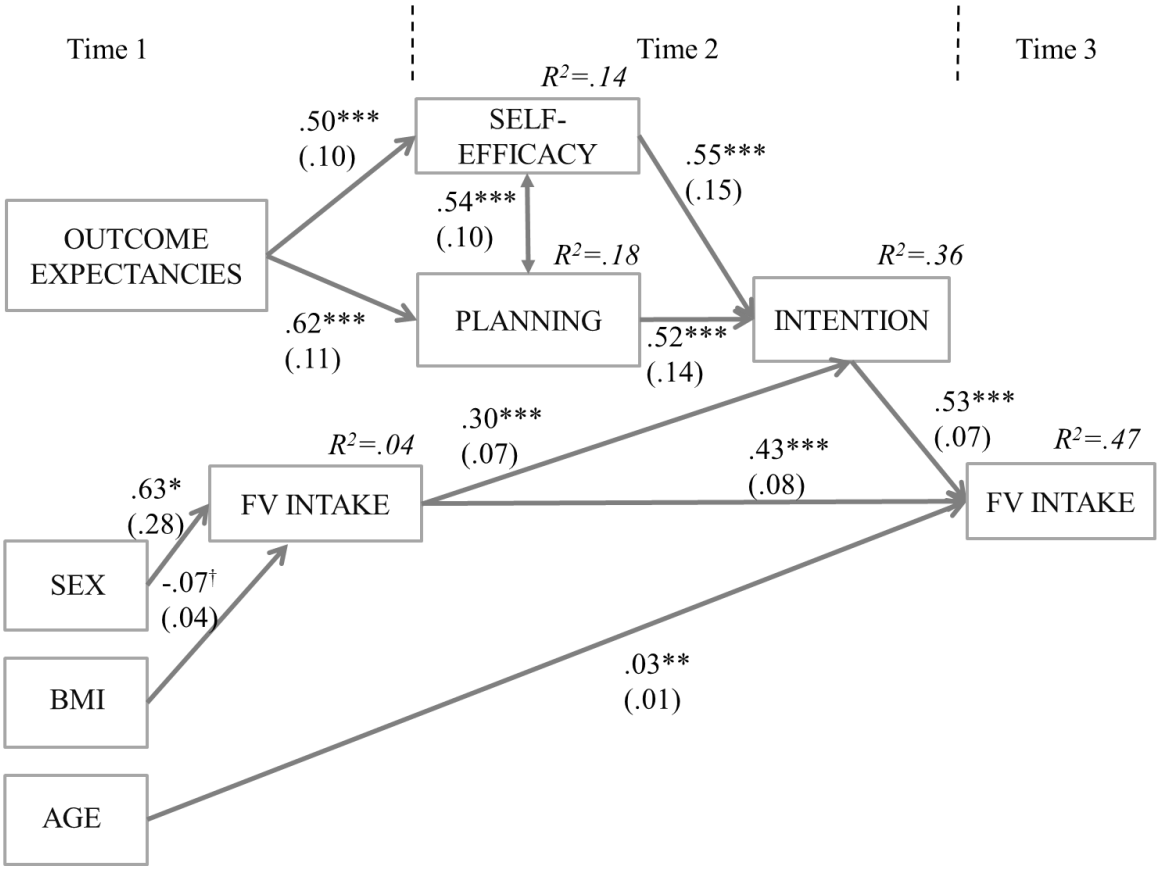

Figure 6. Mediation model examining psychological mechanisms of fruit and vegetable (FV) consumption covering three measurement points in time

Note: Structural equation model with standardized parameter estimates (standard errors in parentheses) based on full information maximum likelihood procedure. †$p < .10$,* $p < .05$, ** $p < .01$, *** $p < .001$. Covariances between exogenous baseline variables and non-significant paths on endogenous variables are omitted.

Discussion

The two aims of the present study were to test whether an enhanced treatment (with the self-efficacy module) would be superior to a standard planning treatment in promoting FV consumption (Hypothesis 1), and to examine the roles of social-cognitive variables in a mediation sequence for FV consumption (Hypothesis 2). The two-arm online intervention resulted in an overall increase in FV consumption for both groups which was not in line with Hypothesis 1. The SEM revealed two mediation sequences for increases in FV intake, namely an outcome expectancies-self-efficacy-intention sequence (in line with Hypothesis 2) as well as an outcome expectancies-planning-intention sequence.

The content of both intervention conditions was quite similar and differed only in terms of the self-efficacy add-on in the enhanced condition. We found overall pre- to post intervention improvements in FV intake, intention, planning, and self-efficacy, similar to findings from Kreausukon et al. (2012). Previous research had documented that planning- and self-efficacy-only interventions promoted FV consumption (Luszczynska et al., 2016). In the present study, combining both modules was not found to be superior compared to a planning-only intervention. Furthermore, even though participants in the standard group did not receive a self-efficacy treatment, we observed increases of men's self-efficacy only from T1 to T2, however, this gain was lost at T3. After planning a health-related behavior, the subsequent enactment could represent a mastery experience (Bandura, 1997) which, in turn, could lead to higher self-efficacy (cf. Keller, Gellert, Knoll, Schneider, & Ernsting, 2016). Planning as a single intervention component could therefore lead to both higher self-efficacy and behavioral levels. Other than for men, we observed higher self-efficacy increases for women in the enhanced group, but not in the standard group (see Figure 5 and the triple interaction in Table 2). Women might be more susceptible towards confrontation with self-efficacious role models or the female testimonials in the enhanced treatment were more convincing for women (vs. male testimonials for men).

The second aim of the current analyses was to examine the possible psychological mechanisms assuming mediator roles of self-efficacy, planning, and intention. The longitudinal structural equation model mainly confirmed the theoretical assumptions that were based on the HAPA model (Schwarzer, 2008). The mediation sequence starting with outcome expectancies via self-efficacy and intention on FV intake is in line with HAPA model assumptions (Schwarzer, 2008). Furthermore, it replicates findings by Hamilton et al. (2015) by using an extended study design with three measurement points in time and an experimental manipulation. The second mediation sequence with FV intake as the outcome showed that planning mediated between outcome expectancies and intentions. This is not

in line with the HAPA model (Schwarzer, 2008) where planning is a post-intentional, more proximal antecedent of behavior. However, augmented intentions can be an important correlate of FV intake which is reflected by higher bivariate associations of intention (vs. planning assessed at the same time) with subsequent FV intake in previous studies (e.g., Lange, Corbett, Lippke, Knoll, & Schwarzer, 2015). In the randomized controlled trial by Kellar and Abraham (2005), the intention level following a combined self-efficacy and planning intervention was the strongest predictor of subsequent FV intake. In the present study, high levels of daily planning following the planning intervention might have led to higher intentions to consume more FV in the following weeks, resulting in more consumed FV according to one's intention. This mediation sequence suggests a motivation-enhancing effect of planning. The intervention enforces planning which motivates to act according to one's plans. However, as planning, self-efficacy, and intention were specified at the second measurement point of data collection, no temporal or causal order could be established, which would be desirable to further elucidate the theoretical assumptions.

The findings of the current study need to be interpreted in light of their possible limitations. Demand characteristics due to self-reporting and recall bias due to retrospective assessment of behavior may have biased the reporting. Future research could instruct participants to photograph their prepared FV and send these photos to the research team. The portion sizes could then be coded as FV servings by the study personnel. Attrition may be an issue because the intervention has resulted in an overall increase in FV consumption in those participants who remained in the study at follow-up. One can speculate that those who have dropped out prematurely might have been less successful. The attrition rate is not surprising but commonly experienced by researchers in the area of online interventions, a phenomenon which was also discussed in the context of the "law of attrition" (Eysenbach, 2005). Due to the lack of control over active participation and the easiness of withdrawal, dropout rates are usually high when participants are anonymously

taking part in studies using online platforms. Moreover, a passive control group would have been an advantage in this study to gauge the effect of both interventions in comparison to untreated individuals. However, by testing a combined planning and self-efficacy intervention against a standard planning intervention and by examining psychological mechanisms, the current study extends the work of previous randomized controlled trials on FV intake. As regulation of dietary behavior is often occurring in the presence of close other persons (e.g. Prestwich et al., 2014), future studies could extend interventions by including dyadic or collaborative planning strategies.

Conclusions

The current study is unique as it represents a theory-based analysis of sequential mediation mechanisms in the context of FV promotion that may guide further research into this direction. Reports on intervention studies documented the usefulness of planning and self-efficacy as mediators (Cerin, Barnett, & Baranowski, 2009; Hagger & Luszczynska, 2014; Schwarzer & Luszczynska, 2015). It is of practical value, then, to translate this kind of research into theory-based interventions that focus on recalling the benefits of FV consumption, generating detailed planning skills, and aiming at self-efficacy improvement by the use of tailored testimonials.

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5

Which Characteristics of Planning Matter? Individual and Dyadic Physical Activity Plans and Their Effects on Plan Enactment

Keller, J., Fleig, L., Hohl, D. H., Wiedemann, A. U., Burkert, S., Luszczynska, A., & Knoll, N. (2017). Which characteristics of planning matter? Individual and dyadic physical activity plans and their effects on plan enactment. *Social Science and Medicine, 189*, 53-62. doi:10.1016/j.socscimed.2017.07.025.

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Abstract

Objective: Past research supports individual planning as an effective intervention strategy to increase physical activity in individuals. A similar strategy, dyadic planning, adds a planning partner who supports an individual's planning processes. Whether the two planning formats differ in terms of participants' entered plan content and whether and how different content characteristics are linked to plan enactment remains unknown. By investigating the content of generated plans, this study aimed at distinguishing plan characteristics of the two planning formats and examining their role as predictors of later plan enactment.

Methods: Secondary analyses of a three-arm RCT with German couples (data collection between 2013 and 2015). Couples were assigned to an individual (IPC, *n*=114) or dyadic planning condition (DPC, *n*=111) and formulated up to 5 physical activity plans for a target person. Couples assigned to a control condition were not included as they did not generate plans. The following characteristics were distinguished and coded for each plan: number of planned opportunities, presence of a planned routine, planned cue- or activity-related specificity, activity-related intensity, and chronological plan rank. One week before (T0) and two weeks following (T2) the intervention (T1), increase vs. no increase of the planned activity was coded as a dichotomous plan enactment variable. Multilevel logistic regressions were fit.

Results: Plan enactment was higher in dyadic than in individual planners. Findings indicated that routines (e.g. after work) were positively related to plan enactment, whereas a high specificity of when-cues (e.g. Friday at 6.30 pm) showed a negative relationship. None of the examined plan characteristics could explain differences in enactment between IPC and DPC.

Conclusions: Linking health behaviours to other behavioural routines seems beneficial for subsequent plan enactment. Dyadic planning was linked with higher enactment rates than

individual planning. However, as mechanisms underlying this effect remain unclear, they should be investigated further.

Keywords: implementation intentions, action plans, dyadic planning, physical activity, plan enactment, routines, plan specificity

Introduction

Regular physical activity has been shown to reduce the risk for various chronic diseases (Haskell et al., 2007). However, many motivated individuals fail to translate their intentions into action (e.g., Godin & Conner, 2008). To address this "intention-behaviour-gap" (Inauen, Shrout, Bolger, Stadler, & Scholz, 2016; Sheeran & Orbell, 1999), health behaviour models (e.g. Health Action Process Approach; HAPA; Schwarzer, 2008) include action planning as a predictor of behaviour change. Compared with health behaviours such as dental flossing, increasing physical activity is a far more complex endeavour. For instance, individuals can form plans on a variety of different forms of activities (e.g. transport-, household- or sports-related activities). A recent meta-analysis showed substantial positive links between planning and physical activity (Carraro & Gaudreau, 2013), however, more insights into complex mechanisms of planning-physical activity links are needed.

Gollwitzer (1999) conceptualized if-then planning (i.e. implementation intentions) as a mental simulation of anticipated contextual cues (when- or where-cues; if/when-part) which are linked to a planned behavioural response (what/how; then-part). For instance, the plan "When I am at home and finished with breakfast, (then) I will go running for 30 minutes" entails a where-cue ("I am at home"), a when-cue ("finished breakfast"), the planned behaviour ("running"), and details on how the behaviour will be executed ("for 30 minutes"). An extended form of planning individually one's own behaviour is dyadic planning, which refers to planning one's own behaviour together with a partner (Burkert, Scholz, Gralla, Roigas, & Knoll, 2011). Because here a planning partner with additional ideas, thoughts, and insights into the target person's daily life is involved, the content of dyadic plans could vary from individual plans. Similarly, the extent to which individuals successfully enact their plans might depend on the planning format. The goal of this study was to contrast the content of individual and dyadic plans as well as their subsequent

enactment. This was done by coding characteristics of plans written down by target persons assigned to two intervention conditions, namely an individual planning or a dyadic planning condition. Coded plan characteristics were then linked to a plan enactment indicator.

Planning in the Dyad

Hagger and Luszczynska (2014) divided formats of action planning into planning by oneself (here referred to as individual planning) and planning with others. The latter can take two different forms: collaborative implementation intentions (e.g. Prestwich et al., 2005) and dyadic planning (e.g. Burkert et al., 2011). Whereas a collaborative implementation intention addresses joint behavioural responses of both persons, a dyadic plan addresses the planned behavioural response for only one person (henceforth described as target person) and has thus much in common with an individual plan. While planning dyadically, the assisting person (henceforth described as planning partner) is assumed to provide plan-related ideas, to critically ask questions, or to support and encourage the target person in forming a feasible plan. As in previous research (Benyamini, Ashery, & Shiloh, 2011; Burkert, Knoll, Luszczynska, & Gralla, 2012; Burkert et al., 2011), the present study examines dyadic planning in adult couples because they share much time of their daily routines and often co-regulate their partners' behaviours (Martire, Schulz, Helgeson, Small, & Saghafi, 2010). Furthermore, this study aims to investigate content differences in dyadic and individual plans (Hagger et al., 2016) as well as how the content of dyadic and individual plans is associated with plan enactment.

Plan Enactment as a Proximal Behavioural Outcome

Physical activity studies testing the effectiveness of planning interventions most commonly used outcome measures which aggregate effects of planned and non-planned moderate-to-vigorous physical activity (MVPA; e.g. Luszczynska et al., 2016). However, a distinction between aggregated and planned behavioural outcomes might be crucial when

examining planning effects (Sniehotta, 2009). For instance, a person could generate a plan including the behavioural response "then I will go swimming". To evaluate the success of the formulated plan, one could either ask the target person to give an estimate of her or his MVPA (aggregated) or ask specifically about his/her swimming (planned behaviour). *Plan enactment* (de Vries, Eggers, & Bolman, 2013) captures the latter idea and refers to the extent to which individuals enact their plans. In two studies, plan enactment was positively related to smoking cessation (de Vries et al., 2013) and smoking-related care of general practitioners (Verbiest et al., 2014).

Conceptualizing Plan Characteristics and their Relations to Behavioural Outcomes

As characteristics of self-generated plans might vary across individuals, research attempted to elicit key characteristics of plans e.g., their specificity (de Vet, Gebhardt, et al., 2011; de Vet, Oenema, & Brug, 2011; Dombrowski, Endevelt, Steinberg, & Benyamini, 2016; Fleig et al., 2017; Osch, Lechner, Reubsaet, & Vries, 2009; Reinwand et al., 2016; Verbiest et al., 2014; Ziegelmann, Lippke, & Schwarzer, 2006). Based on the conceptual model of key characteristics of planning (Fleig et al., 2017), the present study focused on plan characteristics related to (a) contextual cues ("if/when"-part of a plan), (b) the planned behavioural response ("then"-part of a plan), and (c) the overall plan.

Contextual cues: opportunities, routines, specificity. Research underscores the importance of persons actually encountering and detecting pre-formulated, contextual cues as a precondition for the execution of the planned behavioural response (Sniehotta, 2009). One possibility to increase the likelihood to encounter cues is to plan a higher frequency of *opportunities*, such as, "on weekdays" as compared to "on Saturdays". Given a cue encounter is possible on five days a week (as compared to only one day), the likelihood to perform the planned behaviour should be increased.

A further characteristic of contextual cues relates to the presence of a *routine*, defined as a regularly occurring action sequence (Judah, Gardner, & Aunger, 2013). Pre-

existing routines are associated with physical activity automaticity (Fleig et al., 2016; Pimm et al., 2016). Furthermore, Judah et al. (2013) showed that individuals instructed to floss after teeth brushing (i.e., pre-existing routine) reported higher flossing levels compared to individuals instructed to floss before teeth brushing. As routines happen regularly and should be detected easily, including routines into plans should facilitate encountering contextual cues.

Specificity of cues is one of the most frequently investigated plan characteristics, but only few studies linked specificity to a health (behaviour) outcome. Moreover, some studies coded plan specificity based on text field entries for the overall plan (e.g. de Vet, Oenema, et al., 2011; Dombrowski et al., 2016). For instance, in the study by de Vet, Oenema, et al. (2011), one score point was coded for respective plan-related information in the following text fields: type of activity, day of the week, moment of the day, location of the activity, and duration of the activity. The sum of all points was then used to compute the specificity of the overall plan (i.e. assembling information on contextual cues and the behavioural response). However, plan specificity can also be investigated specifically for contextual cues and by distinguishing different forms of contextual cues (i.e., when, where). This was done in the study by Fleig et al. (2017) who found positive plan enactment relationships for the when-cue, but not for the where-cue. These findings partly support Gollwitzer's assumptions (1999) that high precision of a situational cue should facilitate cue detection when individuals encounter planned situations. However, these findings need further replication.

Behavioural response: specificity and activity intensity. Regarding the *specificity* of the behavioural response, empirical evidence is mixed: Whereas highly specific smoking-preventive actions were positively associated with smoking abstinence (Osch et al., 2009), Fleig et al.'s (2017) study yielded negative links between highly specific planned physical activities and plan enactment. These contradicting results might

be explained by the type of target behaviour – that is the uptake and maintenance of a health-promoting behaviour (i.e., physical activity; Fleig et al., 2017), in contrast to inhibiting/giving up a risk behaviour (i.e., smoking; Osch et al., 2009). For the physical activity context, flexibility in the planned activities might be important for plan enactment. For instance, when planning the medium-specific activity "[…], then I will do housework", individuals allow themselves to perform several household-related activities such as vacuum cleaning or dusting which, in turn, should have a higher likelihood for plan enactment.

Physical activity intensity as another plan characteristic categorizes physical activities based on a metabolic equivalent of task (MET) and differentiates between light (MET from 1 to 3), moderate (MET from 3 to 6), and vigorous activities (MET higher than 6). Research showed that activities with light to moderate intensity were more likely to be maintained than activities with high intensity (cf. Pate et al., 1995), possibly because vigorous activities carry a higher risk of injury which might trigger relapse into sedentary behaviour (Pollock et al., 1977).

Overall plan: chronological plan rank. When formulating multiple plans, the *plan rank* could be related to plan enactment. For instance, the first generated plan could be thought through most thoroughly and could, therefore, be the plan with the highest chance of enactment. On the other hand, individuals might show training effects with increasing plan rank and form plans with a better fit to their daily lives. However, a hypothesized relationship between linear plan rank (i.e., formulation of up to 3 plans was instructed) and plan enactment was not confirmed among rehabilitation patients (Fleig et al., 2017).

Aims and Hypotheses

Based on the framework distinguishing characteristics of if-then plans (Fleig et al., 2017), the present study examined relationships between plan characteristics and plan

enactment for individual and dyadic physical activity plans (for hypothesized plan enactment associations see Figure 1).

Because planning more opportunities should lead to a higher likelihood of encountering planned cues, a positive relationship between number of planned opportunities and plan enactment (Hypothesis 1) was assumed. Furthermore, it was hypothesized that plan enactment would be more likely when individuals included routines as contextual cues (Hypothesis 2). To date, most plan content studies only considered the specificity of the overall plan (e.g. de Vet, Oenema, et al., 2011). Following up on a study by Fleig et al. (2017), specificity of the contextual when- and where-cues and the specificity of the behavioural response were distinguished in the present study. Based on Fleig et al.'s (2017) findings, the following assumptions were made: positive plan enactment associations with the specificity of the when-cue (Hypothesis 3a), no associations with the specificity of the where-cue (Hypothesis 3b), and negative associations with the specificity of the behavioural response (Hypothesis 3c). Further, a negative association between plan enactment and activity intensity was assumed (Hypothesis 4). In contrast to the instruction of forming three plans in the study by Fleig et al. (2017) but in line with findings on dietary planning (Wiedemann, Lippke, & Schwarzer, 2012), participants were instructed to form up to five plans (see Methods section). As evidence on effects of the chronological plan rank is mixed and pertains to different health behaviour contexts, plan enactment relationships with the chronological plan rank were explored. Additionally, differences between individual and dyadic plans were explored regarding use of plan characteristics, successful plan enactment, and plan characteristic-plan enactment relationships.

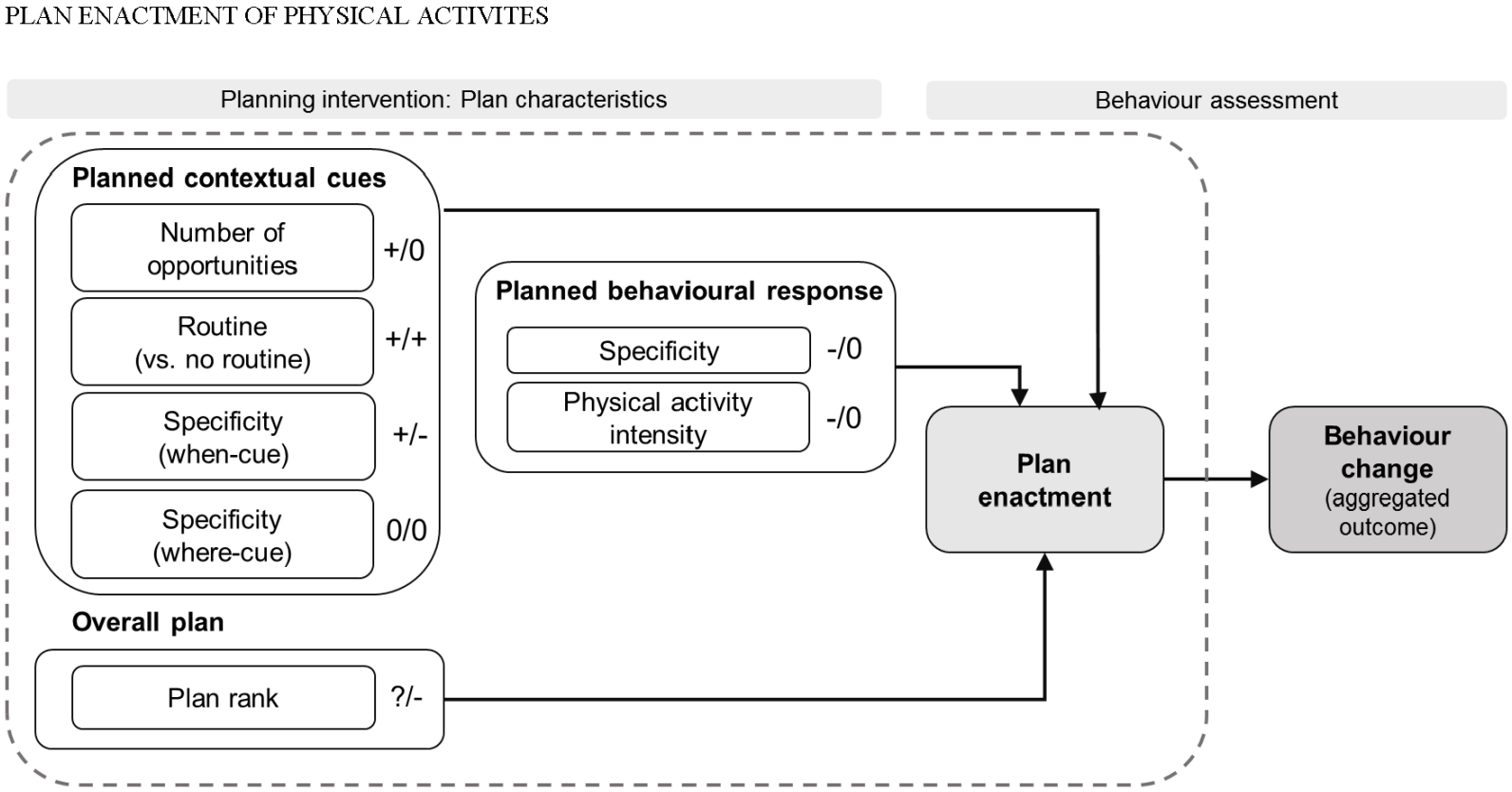

Figure 1. Conceptual model: Plan enactment and plan characteristics based on Fleig et al. (in press)

Note. --- focus of the present analyses; x/y represents x: relationships as hypothesized and y: relationships as found in study results. "+"positive relationship; "-"negative relationship; "0" non-significant relationship; "?"exploratory analyses.

Methods

Study Context, Design, and Participants

This study presents secondary data analyses of a larger randomized controlled trial (NCT01963494, https://clinicaltrials.gov/ct2/show/NCT01963494) which examined the effectiveness of a dyadic planning intervention for physical activity promotion in target persons and planning partners. Primary data analyses focused on direct and indirect effects of a planning intervention on target persons' and partners' objectively assessed overall physical activity (Knoll et al., 2017). In contrast, in the present secondary data analyses specific plan-content characteristics and their relations with plan enactment were examined. A total of *N*=346 healthy, adult, heterosexual, and cohabiting couples from a German metropolitan area were enrolled and data were collected between March 2013 and December 2015. Data used for analyses came from *n*=338 couples who, after receiving a general motivation intervention, were randomly assigned to one of three conditions: a dyadic planning condition (DPC, *n*=111), an individual planning condition (IPC; *n*=114), and a no-planning dyadic control condition (CC; *n*=113). Breaching randomization, data of couples from the no-planning dyadic control condition were not included in the present analyses, because CC-couples were not instructed to generate any plans, but asked to analyse photos of stone sculptures instead. For information about the recruitment process and the participant flow between T0 and T2 see Figure 2. Further details of inclusion and exclusion criteria, randomization checks, manipulation checks, and treatment duration of the randomized controlled trial are reported in Knoll et al. (2017).

In the present study, data from the two planning intervention groups were used and a secondary outcome (i.e. plan enactment) was analysed. It has to be noted that random allocation cannot be implied as only data of two (out of three) group conditions were analysed. Target persons (randomized within couples) responded to paper-pencil questionnaires one week before (T0) the intervention (T1) and two weeks following the

intervention (T2; IPC: *n*=113; DPC: *n*=111). The Institutional Review Board of the first author's institution approved this study.

In the IPC, mean age of target persons was 38.29 years (*SD*=14.72) and mean relationship duration was 10.40 years (*SD*=11.28). Furthermore, 37.70% were married, 43.90% had at least one child, 71.90% reported a high school diploma, and 36.60% a university degree. In the DPC, target persons reported a mean age of 38.46 years (*SD*=15.46) and a mean relationship duration of 12.20 years (*SD*=13.16). Moreover, 45.00% of the target persons were married, 41.40% had at least one child, 80.20% reported a high school diploma, and 50.50% a university degree. At baseline, participants from IPC and DPC did not differ in these respective characteristics.

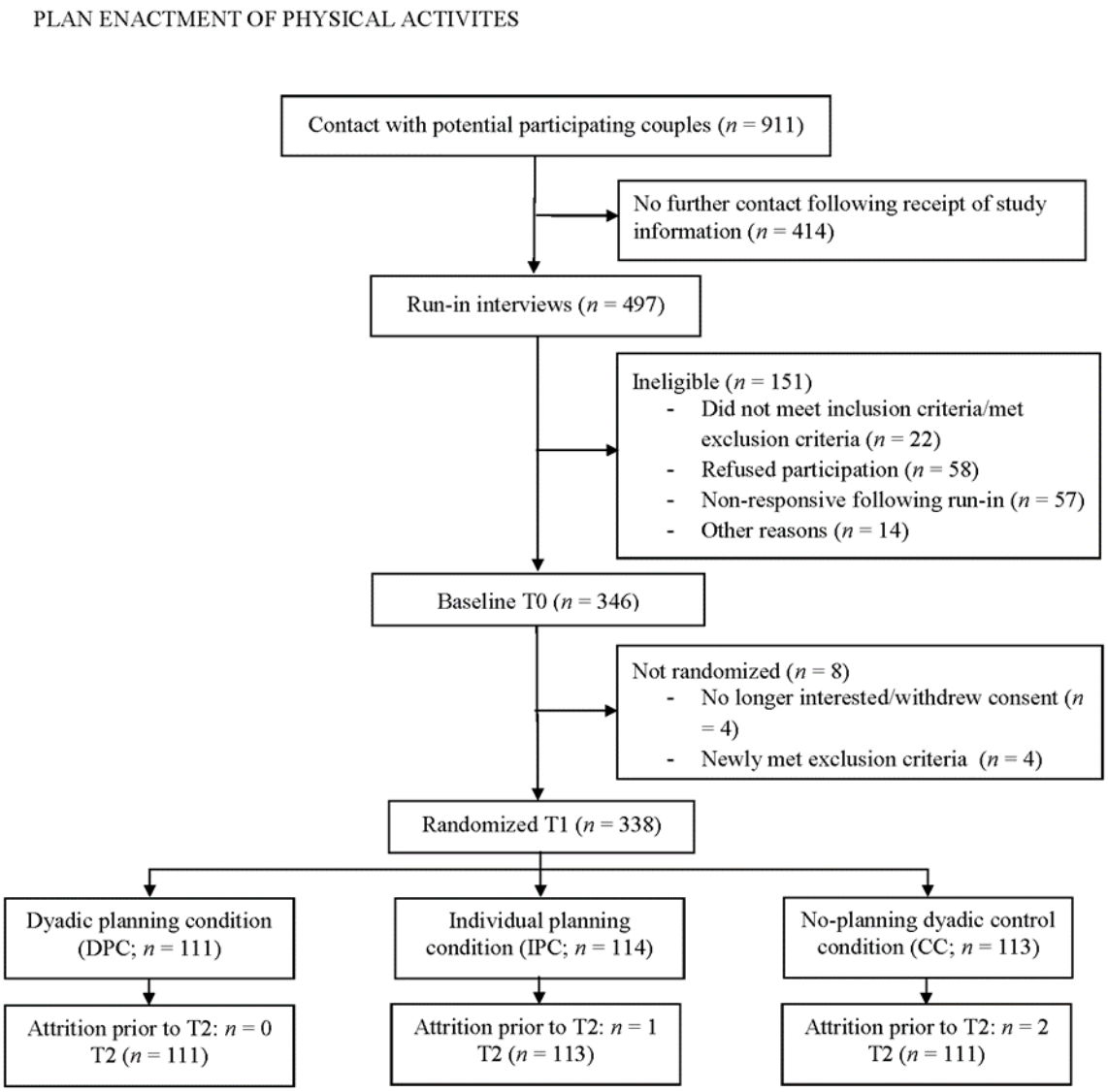

Figure 2. Flow diagram showing participant recruitment and attrition between T0 and T2. In the present study, data of the DPC and IPC were analysed. As reactive recruitment strategies, advertisements in newspapers, public transport, intranet of worksites, social media, press releases, and commercial spaces were used. As proactive strategies, potential participants were approached at public university events.

Intervention Session

Before allocation to the study conditions, all participants received a motivation treatment which instructed them to read a two-page leaflet with – among others – information

on health-related benefits of being more active and encouraging statements. This treatment aimed at increasing participants' physical activity-related intentions.

The planning materials given to participants of the DPC and IPC were parallel in structure: they included similar instructions (see below), information load, and had the same format. The crucial difference between groups was that IPC target persons were instructed to plan alone, whereas DPC target persons were asked to plan together with their partners. Applying existing planning intervention evidence, participants were instructed to form *up to 5 action plans* (based on a study on planning fruit and vegetable consumption; Wiedemann et al., 2012) *"as specifically as possible"* (cf. de Vet, Oenema, et al., 2011) for target persons to *increase* their daily physical activity. As part of the DPC, couples were encouraged to jointly determine in which context (*when* and *where*) target persons would increase a certain type of physical activity (*what*). While discussing plans with target persons, planning partners in the DPC were instructed to take notes on the protocol sheet (cf. Burkert et al., 2011). Subsequently, participants were asked to rephrase these when-where-how pieces of information in an if/when-then format: "When _____ (contextual cues, when/where), then _____ (behavioural response, how)." To clarify the instruction, an example was provided: "When I come home from work, then I will take a brisk walk in the park." Target persons were asked to imagine themselves in the specified situations enacting their plans (i.e. visualization of plan enactment). The intervention materials then encouraged couples to continue dyadic planning on their own in their daily life. In the IPC, target persons received parallel planning sheets with the difference that their partners were not present and instructions did not include the above mentioned planning partner tasks. Accordingly, there were no joint plan discussions and no protocolling in the IPC. While IPC target persons planned, their partners worked on a distraction task, involving stone-sculpture interpretation in a separate room (for more information, see Knoll et al., 2017). To refer the intervention content of the present study to the behavior change technique (BCT) taxonomy of Michie et

al. (2013), the motivation treatment consisted of the BCTs 1.1, 3.1, 4.1, 5.1, 5.3, 5.6, 6.2, 9.1, 9.2, 9.3, 15.1, 15.3, 15.4, and 16.3 which are further described in the supplemental material of Knoll et al. (2017). The planning material of both DPC and IPC addressed the BCTs "action planning" (BCT 1.4) and "mental rehearsal of successful performance" (BCT 15.2). Through the planning partner, DPC also addressed "social support" (BCT 3.2).

Measures

Intention. Target persons' intention to increase physical activity was assessed by 3 self-report items at T0 and at T1 (i.e. immediately following the motivational treatment) with responses ranging from 1 = "does not apply at all" to 6 = "applies exactly". A sample item read: "I intend to be more physically active during my leisure time" (Sniehotta, Scholz, & Schwarzer, 2005). Cronbach's alphas ranged between .63 and .73.

Plan completion and adherence to intervention material instructions. First, participants' plan entries were screened for completion and adherence to intervention instructions. Plans were coded as incomplete if no information was entered in a text field, and as non-adherent if the plan component was not completed and did not correspond to the intervention material instructions. For example, the plan "When I go running regularly, then I will feel fitter" is not in line with instructions as it does not entail a physical activity in the then-part. Two independent raters coded adherence of each plan component independently. As each coding was congruent, Cohen's kappa was 1.00. Only if a plan was complete and formulated in accordance with instructions, plan characteristics (as outlined below) were coded, otherwise plan characteristics were coded as missing. Completion and adherence rates to intervention materials were satisfactory (Appendix A1), with M=4.78 plans (SD=0.54) in the IPC and M=4.61 plans (SD=0.88) in the DPC (out of five plans) formulated as instructed. Whereas the first plan was adherently formulated by almost all target persons, lower completion and adherence rates were found for subsequent plans.

Plan enactment (the dependent variable). Plan enactment was operationalized by computing dichotomous scores referring to the planned type of physical activity and indicating an increase ("1") vs. no increase ("0") of the respective physical activity from prior to (T0) to following (T2) the intervention (T1). In a first step, the physical activity formulated in the then-part of the plan was coded and matched with the type of the respective activity reported by participants in the self-report questionnaires at T0 and T2. Physical activity self-reports were based on the Office in Motion Questionnaire (OIMQ; Mader, Martin, Schutz, & Marti, 2006) as well as the Physical Activity Frequency Questionnaire (PAFQ; Bernstein et al., 1998) and included a list of 55 transport-, work-, household-, and leisure-related activities. Participants reported on their average daily minutes of these 55 activities during the previous seven days. For example, if a participant referred to the following planned behavioural response as part of her or his action plan "…, then I will go running in the park" this was matched with participant's response to the questionnaire item "running" at T0 and T2. In a second step, pre- and post-intervention levels of the planned activity were compared. As the goal of the planning intervention was to encourage participants to increase their planned physical activity, an increase (T2-T0 > 0) was coded as 1 for plan enactment, whereas maintenance (T2-T0 = 0) and decreases (T2-T0 < 0) were coded as 0 for plan enactment. Frequencies of planned activities in the IPC and DPC which were used for plan enactment coding are provided in Appendices A2 and A3.

Because not all planned activities could be precisely matched to a questionnaire-reported activity, levels of plan enactment for these plans were coded as missing values. As displayed in Appendix A1, planned activities were successfully coded as plan enactment for M = 3.38 plans (SD=1.37) in the IPC and for M=3.49 plans (SD=1.18) in DPC. Both means did not differ (F(1, 223)=0. 41, p=.522). The treatment of missing values is described in the Data Analysis section.

Plan enactment (within-level) for planned light, moderate, and vigorous physical activities yielded low-to-medium correlations with respective T2 self-reports (between-level) on light (r=.41), moderate (r=.33), and vigorous (r=.39) physical activities.

Plan characteristics (the independent variables). Most of the plan characteristics of the conceptual model (see Figure 1) were coded based on newly prepared (for opportunities and routine ratings) or adapted (for specificity ratings) coding manuals (Fleig et al., 2017). Coding manuals for opportunities, the presence of routines, and specificity can be received upon request. Two researchers were trained in coding and used the coding manuals. Inter-rater reliability coefficients (Cohen's kappa) were calculated. In case of differences in coding, discussions between both raters were conducted to reach consensus which was then used as the final coding.

Opportunities were operationalized as the number of planned opportunities per week. For instance, a plan referring to a daily activity would be coded as "7", whereas a plan "When it is Monday […]" would be coded as "1". Pre-consensus inter-rater agreement (Cohen's kappa) across all plans and both planning formats had a mean of .66.

In the coding manual, the *presence of a routine* was defined as a regularly occurring action sequence and coded dichotomously with 1=routine and 0=no routine. The mean of Cohen's kappa across all plans and both planning formats was .68.

Specificity of the when-cue, where-cue, and the behavioural response were separately coded on a multiple-point scale with 1=unspecific, 2=medium specific, and 3=highly specific. The when-specificity was related to cue information about a time point, time frame, a routine, or an event. For example, the following if/when-parts of three different plans would be coded as (x): "When the weather is nice" (1), "When it is Monday" (2), and "When it is Monday at 6.30 p.m." (3). Location-related information of the cue was used to code the where-cue specificity, e.g. "When I am somewhere" (1), "When I am in a park" (2), and "When I am at home" (3). Information about the formulated activity in the then-part was used to code the

specificity of the behavioural response, e.g. “then I will become active” (1), “then I will do housework” (2), and “then I will do the vacuum cleaning” (3). Means of Cohen’s kappa across all plans and both planning formats were .89 (when-specificity), .94 (where-specificity), and .93 (specificity of the behavioural response).

Based on the metabolic equivalent of the planned activity (Ainsworth et al., 2011), the planned *activity intensity* was coded on a multiple-point scale with 1=light activity, 2=moderate activity, and 3=vigorous activity. On average the IPC plans consisted of about 28% light, 48% moderate, and 24% vigorous activities, whereas DPC plans entailed about 33% light, 44% moderate, and 23% vigorous activities.

The *linear plan rank* was coded as the plan position in target persons’ chronological planning process, centred at the first plan with 0=1st plan, 1=2nd plan, …, 4=5th plan.

Covariates. The following T0 covariates were included: target persons’ sex and age, a dummy-coded planning format variable (0=IPC; 1=DPC), and an intervention duration variable (i.e. time needed to complete the intervention material) in minutes of the IPC (*M*=15.61, *SD*=6.29, range: 4-32) and DPC (*M*=21.42, *SD*=8.45, range: 6-45).

Data Analyses

Applying IBM SPSS Statistics version 24.0, IBM Corp., Armonk, NY, USA, separate multivariate analyses of variance were used to test mean differences of baseline variables between IPC and DPC. The manipulation check was done via *t* test. Frequencies of completion and adherence rates for IPC and DPC plans were calculated. Means and standard deviations for plan characteristics and plan enactment were computed separately for each plan (1st, 2nd, …, 5th) as well as collapsed across all plans.

For subsequent analyses, three versions of two-level structured datasets with five plans crossed in target persons were created: an IPC dataset (*n*=114 target persons, *n*=570 observations), a DPC dataset (*n*=111 target persons, *n*=555 observations), and a combined IPC and DPC dataset (*n*=225 target persons, *n*=1125 observations). Using the combined IPC

and DPC dataset, potential missing mechanisms of non-coding of plan enactment were investigated by performing χ^2-tests, *t*-tests, and subsequent logistic regressions for baseline and T1 variables with the plan enactment coding variable (0=activity was not coded; 1= activity was coded). Variables that yielded unique associations in the logistic regression, indicating missingness at random, were included as covariates in the later model with plan enactment as the outcome.

IPC versus DPC differences for aggregated means were tested with Mplus 7 (Muthén & Muthén, 1998-2012) by computing single models for each plan characteristic and by constraining respective means to be equal in multi-group comparison models (IPC vs. DPC). Then, goodness of fit results from the Wald test were evaluated. In the next steps, two-level models with plans crossed in target persons were fit using maximum-likelihood estimation and applying multilevel univariate logistic models (Khan & Shaw, 2011) for dichotomous outcomes such as routines and plan enactment. To explore plan-rank links, a linear plan rank (centred at 0; 0=1st plan, …, 4=5th plan) was modelled as a single level-1 predictor of each plan characteristic and plan enactment, separately for the IPC and DPC datasets. Using the combined IPC and DPC dataset, multilevel univariate logistic models with plan enactment as the outcome included plan characteristics as level-1 predictors, and covariates as level-2 predictors. All predictors were grand-mean centred, except for dichotomous predictors or the linear plan rank. Potential random effects of level-1 predictors were tested in level-2 models, but only retained when their random effect variance was significant. To investigate whether plan characteristic--plan enactment relationships differed between IPC and DPC, interactions of each plan characteristic with these level-2 predictors were modelled in a stepwise manner. Because none of them were significant, they were not retained in the final model. In all Mplus analyses, a Full Information Maximum Likelihood procedure (Arbuckle, 1996) was used to account for missing data.

Results

Allocation of Target Persons (IPC vs. DPC) and Manipulation Check

Analyses of variance revealed no significant differences in target persons' baseline variable levels between the IPC and the DPC (each $p > .05$). Thus, target persons assigned to the IPC did not differ from target persons assigned to the DPC in baseline study variables (for the randomization check of the RCT, see Knoll et al., 2017). The motivation treatment led to a pre- to post-intervention increase in IPC and DPC target persons' intention levels (T0: M = 4.34, SD = 1.06, T1: M = 4.70, SD = 1.05, $t(224) = 6.09$, $p < .001$, $d = .14$).

Plan Characteristics: Correlations, Plan Rank Effects, and Mean Differences

Preliminary analyses examined correlations among plan characteristics. For both planning formats, positive low-to-medium sized correlations were found between opportunities and routines, indicating a higher likelihood to include both frequent opportunities and routine-related cues (Table 1). Routines and when-cue specificity were positively correlated due to overlapping rating guidelines, that is, plans with included routines were rated as at least medium-specific. Associations were weaker for opportunities and when-cue specificity (negative) as well as for the specificity of the behavioural response and activity intensity (positive).

Table 1. *Pearson or Spearman (Ranks) Correlations Among Plan Characteristics*

	Plans of the IPC				
	1	*2*[a]	*3*	*4*	*5*
1 Contextual cues: Opportunities	1				
2 Contextual cues: Routine[a]	.30***	1			
3 Contextual cues: Specificity (when)	-.12*	.40***	1		
4 Contextual cues: Specificity (where)	-.07	-.05	.13*	1	
5 Behavioural response: Specificity	-.10*	-.07	-.01	-.01	1
6 Behavioural response: PA intensity	-.14**	-.01	-.08	.01	.27***
	Plans of the DPC				
	1	*2*[a]	*3*	*4*	*5*
1 Contextual cues: Opportunities	1				
2 Contextual cues: Routine[a]	.35***	1			
3 Contextual cues: Specificity (when)	-.10*	.50***	1		
4 Contextual cues: Specificity (where)	.05	.01	.06	1	
5 Behavioural response: Specificity	.02	.01	.01	.01	1
6 Behavioural response: PA intensity	.01	.03	-.08	.06	.13*

Note. IPC (individual planning condition): *n* of observations ranged between 238 and 544 due to missing values. DPC (dyadic planning condition): *n* of observations ranged between 189 and 510 due to missing values. PA = Physical activity. [a] Spearman correlation. * $p < .05$; ** $p < .01$. *** $p < .001$.

Table 2. *Descriptive Statistics, Linear Plan Rank Effects, and Mean Differences among Plan Characteristics and Plan Enactment*

	Plan characteristics	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Linear plan rank[a]	Across 5 plans[a]	IPC vs. DPC[a]	
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*Est. (SE)*	*M (SD)*	Wald[b]	*p*
	Contextual cues									
IPC	Opportunities (1-14)	5.18 (2.22)	4.48 (2.31)	3.40 (2.51)	3.70 (2.68)	3.37 (2.81)	-0.48***(0.08)	4.09 (2.58)	0.44	.505
DPC	Opportunities (1-14)	5.29 (2.34)	4.52 (2.74)	3.94 (2.78)	3.15 (2.58)	3.73 (2.83)	-0.47***(0.09)	4.21 (2.73)		
IPC	% Routine	81.4 (39.1)	72.6 (44.8)	56.4 (49.8)	57.0 (49.7)	48.5 (50.2)	-0.48***(0.08)	63.6 (48.1)	7.44	.006
DPC	% Routine	76.9 (42.4)	65.1 (47.9)	45.2 (50.0)	45.9 (50.1)	41.1 (49.5)	-0.46***(0.08)	55.4 (49.7)		
IPC	Specific. when (1-3)	2.26 (0.51)	2.13 (0.49)	2.03 (0.64)	1.96 (0.57)	1.92 (0.58)	-0.09***(0.02)	2.06 (0.57)	10.55	.001
DPC	Specific. when (1-3)	2.01 (0.46)	2.04 (0.63)	1.84 (0.54)	1.94 (0.61)	1.92 (0.65)	-0.03†(0.02)	1.95 (0.58)		
IPC	Specific. where (1-3)	2.45 (0.56)	2.51 (0.56)	2.31 (0.70)	2.44 (0.67)	2.62 (0.64)	0.02 (0.03)	2.46 (0.63)	0.82	.364
DPC	Specific. where (1-3)	2.42 (0.56)	2.39 (0.66)	2.50 (0.74)	2.39 (0.72)	2.34 (0.81)	0.01 (0.03)	2.41 (0.68)		
	Behavioural response									
IPC	Specific. (1-3)	2.53 (0.70)	2.58 (0.59)	2.65 (0.61)	2.60 (0.61)	2.55 (0.61)	-0.01 (0.02)	2.58 (0.63)	6.37	.012
DPC	Specific. (1-3)	2.65 (0.59)	2.75 (0.46)	2.66 (0.55)	2.68 (0.62)	2.63 (0.62)	-0.02 (0.02)	2.67 (0.57)		
IPC	PA intensity (1-3)	2.16 (0.67)	2.04 (0.75)	2.09 (0.77)	2.02 (0.80)	2.13 (0.72)	-0.02 (0.03)	2.09 (0.74)	0.46	.500
DPC	PA intensity (1-3)	2.15 (0.69)	1.88 (0.75)	2.12 (0.73)	1.96 (0.79)	2.13 (0.81)	-0.01 (0.03)	2.05 (0.76)		
	Plan Enactment									
IPC	% Plan Enactment	45.5 (50.1)	45.1 (50.1)	30.4 (46.3)	24.4 (43.2)	36.2 (48.4)	-0.21*(0.09)	36.4 (48.1)	8.28	.004
DPC	% Plan Enactment	54.0 (50.1)	44.9 (50.1)	47.5 (50.3)	46.8 (50.2)	37.5 (48.8)	-0.17*(0.08)	46.5 (49.9)		

Note. IPC = Individual planning condition. DPC = Dyadic planning condition. IPC: *n* ranged between 50 and 114 due to missing values. DPC: *n* ranged between 38 and 111 due to missing values. a: results based on Mplus 7 models (Muthén & Muthén, 1998-2012. b: *df*=1. Specific. = Specificity. PA = Physical activity. Est. = Estimate. Coefficients = -0.001 rounded to -0.01. †*p*<.10. *p<.05. ***p<.001.

Next, effects of the linear plan rank on plan characteristics were investigated. Linear plan rank models yielded a decline between the 1st and the 5th plan for the number of opportunities (IPC and DPC), routines (IPC and DPC), and when-cue specificity (IPC; marginally in DPC), whereas the other plan characteristics were similar across plan ranks (Table 2).

Further, mean differences between plan characteristic levels of the IPC vs. the DPC were tested. Wald-test results indicated that plans formulated in the IPC differed from DPC plans in the occurrence of routines (higher in IPC), specificity of the when-cue (higher in IPC), and specificity of the behavioural response (higher in DPC). The remaining plan characteristics did not reveal mean differences between both planning formats (Table 2).

Plan Enactment: IPC vs. DPC Format, Plan Rank Effects, and Plan Characteristic Associations

Average plan enactment levels of 36% in the IPC and 46% in the DPC significantly differed between both planning formats (Table 2). Dyadic plans had a higher likelihood of being enacted. Negative plan rank associations in both IPC and DPC point to more successful enactment of plans formulated in the beginning compared to plans formulated at the end of the planning session.

Regarding coding of plan enactment, M=3.38 (SD=1.37) of planned activities in the IPC and M=3.49 (SD=1.18) of planned activities in the DPC were successfully coded. The following variables were unique predictors of successful plan enactment coding: number of planned opportunities (b=-0.08, SE=0.05, OR=0.92), activity intensity of the behavioural response (b=0.38, SE=0.18, OR=1.47), and smoking status (b=-0.97, SE=0.28, OR=0.38). The former two variables were already included in the final model, however, target persons' smoking status (yes = 1; no = 0; M=25%, SD=43% for IPC; M=19%, SD=39% for DPC) was added to the covariates to account for missing at random bias (Graham, 2009).

Results of the Final Model, analysing data from n=222 target persons with n=1054 observations, indicated non-significant plan enactment associations of the level-2

predictors: gender, age, intervention duration, and smoking status (Table 3). A positive association was found between planning format (0=IPC; 1=DPC) and plan enactment confirming Wald-test results from above.

None of the plan characteristics showed significant random variation (level 2) and were thus modelled as fixed effects predictors (level 1). A positive plan enactment association with routines (supporting Hypothesis 2) was found, whereas when-cue specificity (contrary to Hypothesis 3a) and the linear plan rank showed negative associations with plan enactment. Number of weekly opportunities (not in line with Hypothesis 1), where-cue specificity (confirming Hypothesis 3b), and the activity intensity (not in line with Hypothesis 4) were not associated with plan enactment. A stepwise exploration of planning format (IPC vs. DPC) x plan characteristic interactions did not reveal significant associations, indicating that plan enactment-plan characteristics associations were similar for both planning formats.

Table 3. *Associations of Plan Characteristics with Plan Enactment*

Final Model: Plan Enactment of Individual and Dyadic Plans			
Fixed effects (intercept, slopes)		Estimate (*SE*)	*p*
	Intercept	0.852 (0.334)	.011
Level 1	Contextual cues		
	Opportunities	0.052 (0.047)	.273
	Routine	0.819 (0.262)	.002
	Specificity when-cue	-0.448 (0.212)	.034
	Specificity where-cue	-0.025 (0.223)	.911
	Behavioural response		
	Specificity	-0.135 (0.195)	.490
	Physical activity intensity	-0.084 (0.138)	.543
	Overall plan		
	Linear plan rank	-0.146 (0.069)	.034
Level 2	Gender (0=female; 1=male)	-0.376 (0.306)	.220
	Age	0.004 (0.009)	.661
	Intervention duration	-0.018 (0.020)	.354
	Smoking status (0=non-smoker;	0.052 (0.318)	.871
	Planning format (0=IPC, 1=DPC)	0.642 (0.251)	.010
Residual variance			
	Residual	1.948 (0.319)	<.001

Note. n=222 target persons and n=1054 observations due to missing values. Coefficients are unstandardized. A repeated analysis with squared plan rank as a further level 1-predictor did not reveal a significant prediction.

Discussion

The present study investigated associations of established and newly conceptualized plan characteristics with enactment of physical activity plans formulated by target persons (with and without assistance from their partners) who were motivated to increase their physical activity. It was found that plan enactment was more likely when plans were generated in dyads, were among the first plans created, entailed routines

(supporting Hypothesis 2), and entailed less specific when-cues (contrary to Hypothesis 3a). Not in line with the present assumptions (Hypotheses 1, 3c, and 4), number of opportunities, specificity of the behavioural response, and activity intensity were unrelated to plan enactment. Non-significant associations of where-cue specificity with plan enactment supported Hypothesis 3b.

Target persons planned a variety of physical activities (see Appendix A2 and A3) by formulating many distinct situational cues and behavioural responses. Allowing target persons to plan any activity they wish is a strength of the present study which might have led to a strong variation of plan characteristics and underscores the complexity of physical-activity planning. The latter is likely in contrast to the planning of other health behaviours such as dental flossing and warrants further investigation.

Plan enactment operationalized as the successful performance of a distinctly planned behaviour shows some similarities with the concept of goal progress (e.g. Dugas, Gaudreau, & Carraro, 2012). Because it is specific to plan formulation (.e.g. "…, then I will go swimming"), however, failure of plan enactment does not necessarily imply failure to pursue one's overall goal (e.g. doing more sports). Other types of physical activity could be performed instead and not assessed by plan enactment. These issues should be considered when interpreting the present findings.

How Were Plan Characteristics Associated with Plan Enactment?

Positive links between routines and plan enactment were found. This confirms findings on the beneficial role of routines in the health behaviour change context (Fleig et al., 2016; Judah et al., 2013). Webb and Sheeran (2008) highlighted the role of cue accessibility as a determinant of goal achievement when planning a goal behaviour. Cue accessibility entails (a) encountering planned cues and (b) detecting cues in the planned context. A high number of planned opportunities might increase the likelihood of a cue encounter, however, cues still need to be detected. Similarly, highly specific time-related cues such as "Mondays at 6:30 p.m." will be encountered by each individual, but cue

detection could be difficult as one could miss the planned time point or will not find oneself in a suitable situation for the planned activity. In contrast, routines as actions which are often initiated by oneself should more likely be detected than external time stimuli (e.g., "the clock ticks 6:30 pm on a Monday"). Moreover, routines allow for more flexibility which circumvents potential barriers (e.g., working longer than expected). Similarly, Jackson et al. (2005) underline the importance of a suitable level of plan flexibility. Applying routines as contextual cues could represent a middle ground between too specific and too vague plans.

Chronological plan rank analyses indicated that rates of plan enactment showed a linear decrease over five plans. In contrast to findings reported in a randomized controlled trial where the number of plans varied in experimental conditions (i.e. instruction of 1, 2, …, 5 plans on fruit and vegetable consumption; Wiedemann et al., 2012), present findings indicated that plans formulated in the beginning were more beneficial than later plans. The first plan might have more regularly entailed a person's most accessible contextual cue-physical activity link (similar to the concept of attitude accessibility; e.g. Shen, Monahan, Rhodes, & Roskos-Ewoldsen, 2009). Furthermore, after weighing a number of plans against each other, target persons might have recorded their "most promising" plans first and others later. Future research might invite planners to comment on the chosen sequence of plans or assess perceived difficulty of plan-formulation.

Individual vs. Dyadic Planning Format

Findings indicated that the presence of a planning partner was associated with the formulation of less specific contextual cues (i.e. routines and when-specificity), but rather specific behavioural responses. The former could be due to the planning partner's attempts to keep the planned future situation as flexible as possible to circumvent anticipated barriers. The latter might signify the partner's attempts to help formulate a concrete activity of which both partners had a clear, unequivocal understanding.

DPC plans were more strongly associated with plan enactment than IPC plans. This finding cannot be explained by any of the examined plan characteristics, because DPC target persons either showed less beneficial levels on these characteristics or no differences between IPC and DPC were observed. Furthermore, plan enactment differences were not due to differences between IPC and DCP in plan characteristic--plan enactment associations. Consequently, other yet unassessed factors of the dyadic planning process, such as details on the joint collection of plan-related ideas or control processes should be assessed in future research by means of observational data on couple interaction. Moreover, target persons and partners might separately report on additional overall plan characteristics suitable to elucidate dyadic planners' higher plan enactment such as the anticipated probability that the plan will be enacted or plan instrumentality (Fleig et al., 2017).

Planning Instructions and Their Potential Impact on Plan Characteristics

Intervention materials were based on evidence which recommended the formulation of up to 5 plans (Wiedemann et al., 2012), requesting highly specific plans (de Vet, Oenema, et al., 2011), and providing a plan example to facilitate comprehension (Luszczynska, Sobczyk, & Abraham, 2007). Generally, present findings indicate that the former two instructions were followed.

Instructions included a plan example which started with: "When I come home from work, then […]". If coded, the example would obtain an opportunity rating of 5 (i.e. 5 workdays/week) and a routine rating of 1 (i.e. coming home from work is a routine). This provided example might have primed participants, as initial plans entailed frequent opportunities (mean ratings of 4-5) and mostly a routine. Furthermore, routines and opportunities showed a low-to-moderate association. Their interrelation may be explained by the definition of routines as a regularly occurring action sequence. The intervention instruction to form plans "as specifically as possible" was mirrored in high specificity means, especially for specificity of the behavioural response (see also Fleig et al., 2017).

Specificity of the when-cue decreased with plan rank which is in line with other plan content studies (e.g., de Vet, Oenema, et al., 2011). Finally, target persons' plans most often included physical activities of moderate intensity, followed by vigorous and light activities. Again, this might have been due to the provided example "[…], then I will take a brisk walk in the park" which included a moderate activity.

In sum, these findings may highlight the importance of sample plans included in instructions. The impact of a sample plan (vs. none) on instruction comprehension, plan content, and plan enactment should be investigated further.

Limitations and Outlook

The present study did not investigate several other potentially important plan characteristics. Next to those already discussed above, the duration of the planned activity (de Vet, Oenema, et al., 2011) should be assessed by the planning material. Regarding the coding procedure, inter-rater reliability was high for the specificity coding, but not for the coding of opportunities and the presence of a routine. Future studies might further develop the coding procedure and train the raters with more examples and coding decisions. Plan enactment was operationalised indirectly by computing increase vs. no increase scores from coded planned activities. This process produced missing values, however, it might have circumvented social desirability effects of directly asking participants about their plan enactment. Finally, these were secondary analyses of parts of the data from a larger randomized controlled trial (Knoll et al., 2017). In addition to breaching randomization by the exclusion of data from the no-planning dyadic control group, the study was not sufficiently powered for the present research questions. However, statistical power was maximized by using statistical methods accounting for all available data instead of listwise deleting cases with missings (Hoffman & Rovine, 2007).

Conclusion

Applying an innovative framework (Fleig et al., 2017), plan characteristics were categorized into (a) contextual cues, (b) the behavioural response, or (c) the overall plan.

The present study showed that incorporating routines as contextual cues in plans is beneficial whereas high specificity of when-cues may be counterproductive. In terms of planning formats, dyadic planning resulted in plans that were more likely to be enacted than those from individual planning, however, the mechanisms of this effect remain unclear and need further research.

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Appendix

Table A1. Completion and Adherence Rates of If-Then Plans for Individual and Dyadic Plans and Coding Rate of Plan Enactment.

	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Sum across 5 plans	
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*M*	*SD*
Individual planning condition (IPC)							
If-part: Contextual cue							
Completion	114 (100)	114 (100)	114 (100)	112 (98.2)	105 (92.1)		
Completion and adherence	112 (98.2)	111 (97.4)	110 (96.5)	109 (95.6)	100 (87.7)		
Then-part: Behavioural response							
Completion	113 (99.1)	113 (99.1)	113 (99.1)	110 (96.5)	104 (91.2)		
Completion and adherence	110 (96.5)	113 (99.1)	111 (97.4)	108 (94.7)	102 (89.5)		
				Completion and adherence of if-then plans		4.78[a]	0.54
Plan enactment (coding rate)	77 (67.5)	82 (71.9)	79 (69.3)	78 (68.4)	69 (60.5)	3.38[b]	1.37
Dyadic planning condition (DPC)							
If-part: Contextual cue							
Completion	110 (99.1)	110 (99.1)	109 (98.2)	101 (91.0)	99 (89.2)		
Completion and adherence	108 (97.3)	106 (95.5)	103 (92.8)	95 (85.6)	93 (83.8)		
Then-part: Behavioural response							
Completion	109 (98.2)	109 (98.2)	107 (96.4)	101 (91.0)	98 (88.3)		
Completion and adherence	103 (92.8)	104 (93.7)	105 (94.6)	98 (88.3)	96 (86.5)		
				Completion and adherence of if-then plans		4.61[a]	0.88
Plan enactment (coding rate)	87 (78.4)	69 (62.2)	80 (72.1)	79 (71.2)	72 (64.9)	3.49[b]	1.18

Note. *n* of IPC = 114; *n* of DPC = 111. [a] Completion and adherence rates of if-then plans marginally differed between IPC and DPC: $F(1, 222) = 2.95$, $p = .087$. [b] Coding rate of plan enactment did not differ between IPC and DPC: $F(1, 223) = 0.41$, $p = .522$.

Table A2. Frequencies of Coded Physical Activities in the Individual Planning Condition.

Planned and coded physical activities	Plan 1 *n*	Plan 2 *n*	Plan 3 *n*	Plan 4 *n*	Plan 5 *n*	Sum across all plans
Bicycling (transport)	14	21	20	14	9	78
Walking normally	10	16	17	18	9	70
Walking quickly or uphill	17	9	6	8	6	46
Running	9	9	9	6	10	43
Climbing up stairs	12	10	9	6	4	41
Swimming	5	5	4	9	2	25
Weight lifting	6	1	1	4	8	20
House keeping	0	2	2	5	5	14
Gardening	2	3	3	2	3	13
Dancing (ballet, aerobics, rock)	0	2	1	1	5	9
Athletic Walking	0	2	1	0	1	4
Walking while carrying heavy baggage	0	1	1	1	1	4
Soccer	0	0	1	0	2	3
Basketball	0	0	2	0	0	2
Tennis or Badminton	0	0	0	0	2	2
Golf	0	0	2	0	0	2
Roller skating	0	0	0	1	1	2
Using public transport	1	1	0	0	0	2
Bicycling (sports)	1	0	0	0	0	1
Cross-country skiing	0	0	0	1	0	1
Splitting logs	0	0	0	1	0	1
Playing music	0	0	0	1	0	1
Cooking	0	0	0	0	1	1

Note. Plans of $n = 114$ target persons in the individual planning condition.

Table A3. Frequencies of Coded Physical Activities in the Dyadic Planning Condition.

Planned and coded physical activities	Plan 1 *n*	Plan 2 *n*	Plan 3 *n*	Plan 4 *n*	Plan 5 *n*	Sum across all plans
Walking normally	13	23	14	18	12	80
Bicycling (transport)	19	10	11	14	13	67
Walking quickly or uphill	16	10	8	7	4	45
Climbing up stairs	11	5	14	7	7	44
Running	12	5	6	6	4	33
Swimming	6	2	6	7	10	31
Weight lifting	5	4	6	4	3	22
House keeping	1	3	3	7	6	20
Gardening	0	3	5	4	2	14
Dancing (ballet, aerobics, rock)	1	1	5	1	3	11
Athletic Walking	1	0	0	2	2	5
Bicycling (sports)	0	2	0	1	0	3
Soccer	0	1	0	0	1	2
Playing music	1	0	0	0	1	2
Handy work	0	0	1	0	1	2
Walking while carrying heavy baggage	1	0	1	0	0	2
Squash	0	0	0	1	0	1
Ballroom dancing	0	0	0	0	1	1
Cooking	0	0	0	0	1	1
Using public transport	0	0	0	0	1	1

Note. Plans of $n = 111$ target persons in the dyadic planning condition.

6

General Discussion

General Discussion

The major aims of this thesis were to investigate (1) the occurrence of spontaneous individual and dyadic planning at baseline and over time (Chapters 2-5), (2) predictors of dyadic planning (Chapter 2), (3) behavioural links of individual and dyadic planning over time (Chapter 3), (4) ex-situ mechanisms of an individual planning intervention (Chapter 4), as well as (5) in-situ mechanisms of an individual and a dyadic planning intervention (Chapter 5). This was done by analysing data from three study projects on three different health behaviour contexts: prostate cancer patients' pelvic floor exercises [PFE; *Lines of Defense* (LoD), adults' fruit and vegetable consumption (*Happy* 5), and adult couples' physical activity (*Days in motion* (DiM). The main findings of the empirical chapters are summarised and integrated into the literature below.

Summary of Findings and Integration into the Literature

(1) Occurrence of spontaneous individual and dyadic planning. As the first aim of this thesis, the occurrence of spontaneous individual and dyadic planning at baseline and over time was examined which led to the following results and implications.

Regarding individual and dyadic planning occurrence at baseline, individual planning was more frequently used than dyadic planning in LoD and DiM. A plausible explanation is that joint planning is more resource-intense because resources are needed from both the target person and the partner. Also, target persons might not want to occupy the partner's resources and it might be an additional barrier (as compared to individual planning) to find appropriate situations in which the couple jointly plans the target person's health behaviour. Differences between individual and dyadic planning were more pronounced in the PFE context compared to the physical activity context. Male prostate cancer patients might predominantly prefer to regulate their PFE on their own. This is similar to findings from Lange, Corbett, Lippke, Knoll, and Schwarzer (2015) which indicated that autonomy beliefs are particularly important for men's planning and less important for women's planning.

According to individual and dyadic planning occurrence over time, LoD results showed that dyadic planning was increasingly used in the beginning of prostate cancer patients' rehabilitation (Chapter 3), possibly because the partner took over an increasingly active role in times of patients' highest need. This is supported by another study with prostate cancer patients in which partners' support provision was shown to be highest in the beginning of patients' rehabilitation (Knoll, Burkert, Roigas, & Gralla, 2011). Both individual and dyadic PFE-planning receded at later stages of prostate cancer patients' rehabilitation, indicating lower efforts in long-term PFE maintenance. The occurrence of individual and dyadic planning might thus be construed as dynamic processes, especially in contexts in which the motivation for health behaviour execution is based on fluctuating changes of a stressor.

(2) Predictors of dyadic planning (Chapter 2). This thesis also aimed at investigating dyadic planning predictors that make the occurrence of dyadic planning more likely. For the context of prostate cancer patients' rehabilitation from surgery (Chapter 2), the following results and implications were derived.

Unique positive dyadic PFE-planning links were found for patients' positive affect, PFE-related self-efficacy (marginal effect), both partners' relationship quality, and partners' other-reports on patients' urinary incontinence severity. In contrast, patients' intention, negative affect, partners' negative affect, positive affect, and patients' self-reports on urinary incontinence severity did not show unique dyadic planning associations. The results in Chapter 2 underscore the importance to include reports from both partners on study variables (Martire, Schulz, Helgeson, Small, & Saghafi, 2010). Among established predictors of individual planning (e.g., HAPA; Schwarzer, 2008), patients' self-efficacy was superior to patients' intentions in predicting dyadic planning, indicating the importance of patients' confidence in their PFE-related capabilities before planning on PFE. Regarding partner factors, the affective needs of the partner played a minor role for dyadic planning, possibly because the high need for care of a loved one might have

overruled needs of the caregiver (Knoll, Burkert, Luszczynska, Roigas, & Gralla, 2011). In line with findings from Knoll et al. (2017), relationship quality reflects a highly relevant factor for dyadic planning. The results that only partners' other-reports on urinary incontinence severity were linked to dyadic planning underline the importance to involve both target person's and partner's perspectives when conducting dyadic planning studies.

(3) Behavioural links of individual and dyadic planning over time (Chapter 3). The next aim of this thesis addressed associations of spontaneous individual and dyadic PFE-planning with prostate cancer patients' PFE over time. The following results and implications were derived from Chapter 3.

The findings of Chapter 3 indicated that PFE associations of individual and dyadic planning were divergent in their trajectories. Individual planning was a constant and positive PFE correlate, whereas dyadic planning became increasingly important for PFE over 6 months. The former finding converges with results from a meta-analysis which revealed that spontaneous individual planning has an overall medium-to-large effect on general physical activity for measurement lags ranging between 0 to 6 months (Carraro, & Gaudreau, 2013). The latter finding needs to be considered together with results on the occurrence of dyadic planning over time; that is, prostate cancer patients' dyadic PFE-planning initially increased, but then decreased at later stages of patients' rehabilitation process. One could assume that patients and their partners initially tested and increased the use of dyadic planning, learnt which plans were successfully leading to regular PFE, and then only kept successful dyadic plans for the longer term. As prostate cancer patients and their partners have not yet made experiences with dyadic planning in the beginning of patients' rehabilitation (as reflected by low baseline levels), partners might need time to go through a learning process and optimise their dyadic planning. Figure 5 illustrates the summarised findings of research questions (2) and (3).

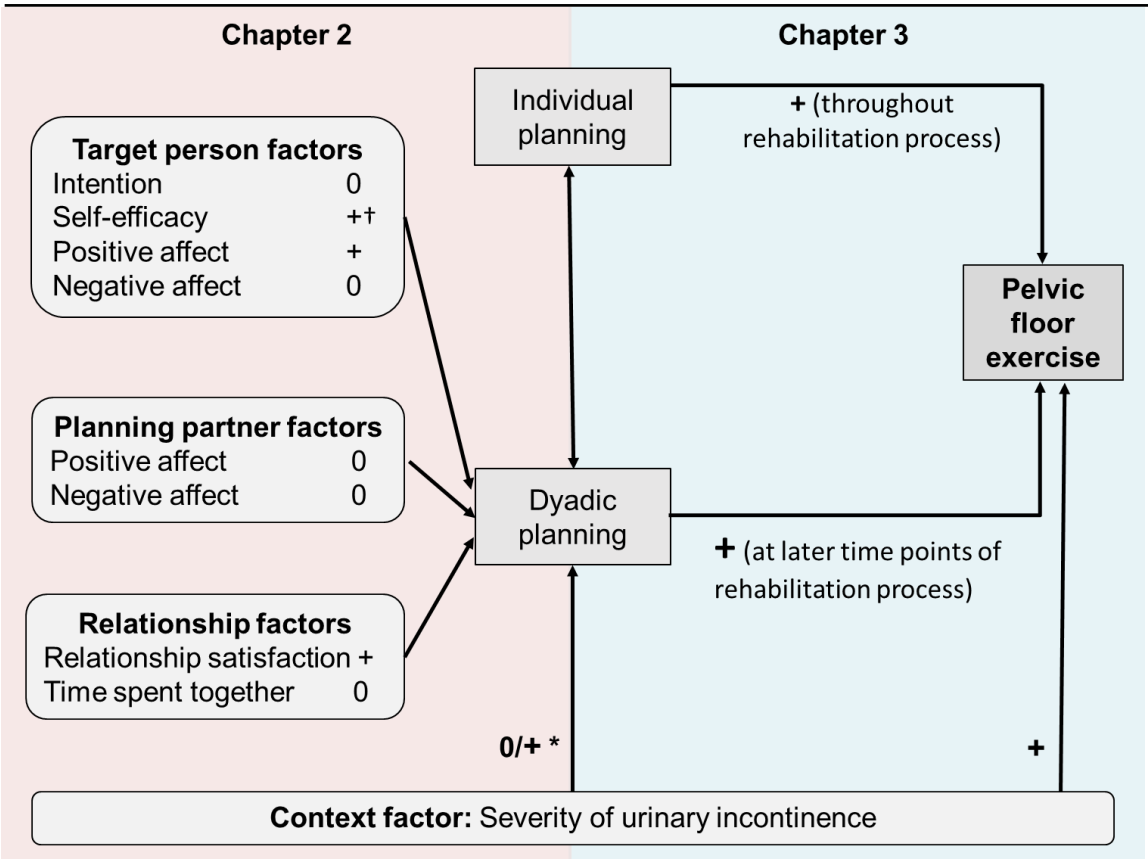

Figure 5. Schematic results on dyadic planning predictors and behavioural links of individual and dyadic planning (Study project: Lines of Defense).

Note. † $p < .10$. "+"positive relationship; "0" non-significant relationship. Target person: prostate cancer patient. *partners' reports on patients' severity of urinary incontinence were linked to dyadic planning, whereas patients' reports were not.

(4) Ex-situ mechanisms of an individual planning intervention (Chapter 4). This thesis also aimed at examining the ex-situ mechanisms of an individual planning intervention for adults' fruit and vegetable consumption. Ex-situ mechanisms refer to psychosocial factors that follow the planning intervention, and are assessed at follow-ups. In Chapter 4, the following results and implications were drawn from the randomised controlled trial named Happy 5.

The two interventions with individual planning modules successfully promoted adults' fruit and vegetable consumption. Path model results showed that baseline outcome expectancies were related with fruit and vegetable consumption via a) individual planning

and intention formation, as well as b) self-efficacy and intention formation. Previous model testing steps showed that relationships of individual planning and self-efficacy with behaviour were not in line with hypothesized HAPA model paths (Schwarzer, 2008). The final model revealed that intention formation was the most important predictor for fruit and vegetable consumption. Furthermore, intention formation mediated effects from individual planning and self-efficacy on behaviour. These findings revealed that intention formation reflects a key construct for persons' fruit and vegetable intake, consistent with findings by Hamilton, Vayro, and Schwarzer (2015).

(5) In-situ mechanisms of individual and dyadic planning interventions (Chapter 5). The next aim of this thesis addressed the investigation of in-situ mechanisms of an individual and a dyadic planning intervention. In-situ mechanisms refer to characteristics of written plans which were formed during a planning intervention. Studies which examined these factors aimed at producing more knowledge on the question "What defines a good plan?" (e.g., Fleig et al., 2017), however, dyadic plans were not yet analysed. Analyses of individual and dyadic physical activity plans from the DiM project (Chapter 5) led to the following results and implications.

Similar to the study by Fleig et al. (2017), a plan characteristics framework of if-then plans was developed and a number of plan characteristics were coded and linked to a plan enactment outcome. Plan enactment was more likely for first plans (vs. later plans), when plans entailed a routine, and when the time-cue was less specific. This confirms empirical evidence that existing routines are particularly important for behaviour changes (Judah, Gardner, & Aunger, 2013). In contrast to highly specific time-cues such as "Tuesdays on 5:30 pm", routines such as "after coming home from work" rather facilitate plan flexibility and circumvent potential barriers (e.g., working longer than expected). Also, participants started with their most promising plans, in line with findings from Wiedemann, Lippke, and Schwarzer (2012). Non-significant plan enactment links were found for: the number of planned opportunities, where-cue specificity, specificity of the behavioural response, and

activity intensity. These results were only partially consistent with Fleig et al. (2017)'s findings. Regarding plan enactment rates of both planning formats, dyadic plans were more likely to be enacted than individual plans. In contrast, primary results of the same study project (Knoll et al., 2017) showed that individual and dyadic planning interventions were comparable in general physical activity change over time. Plan enactment and general physical activity might show a theoretical overlap, however, both should be analysed as two distinct behavioural measures. In the context of fruit consumption, plan enactment showed medium-sized bivariate associations with fruit intake (Kasten, van Osch, Eggers, & de Vries, 2017). Furthermore, the results yielded that plan characteristics-plan enactment links did not differ across individual and dyadic plans. Figure 6 illustrates summarised findings of research questions (4) and (5).

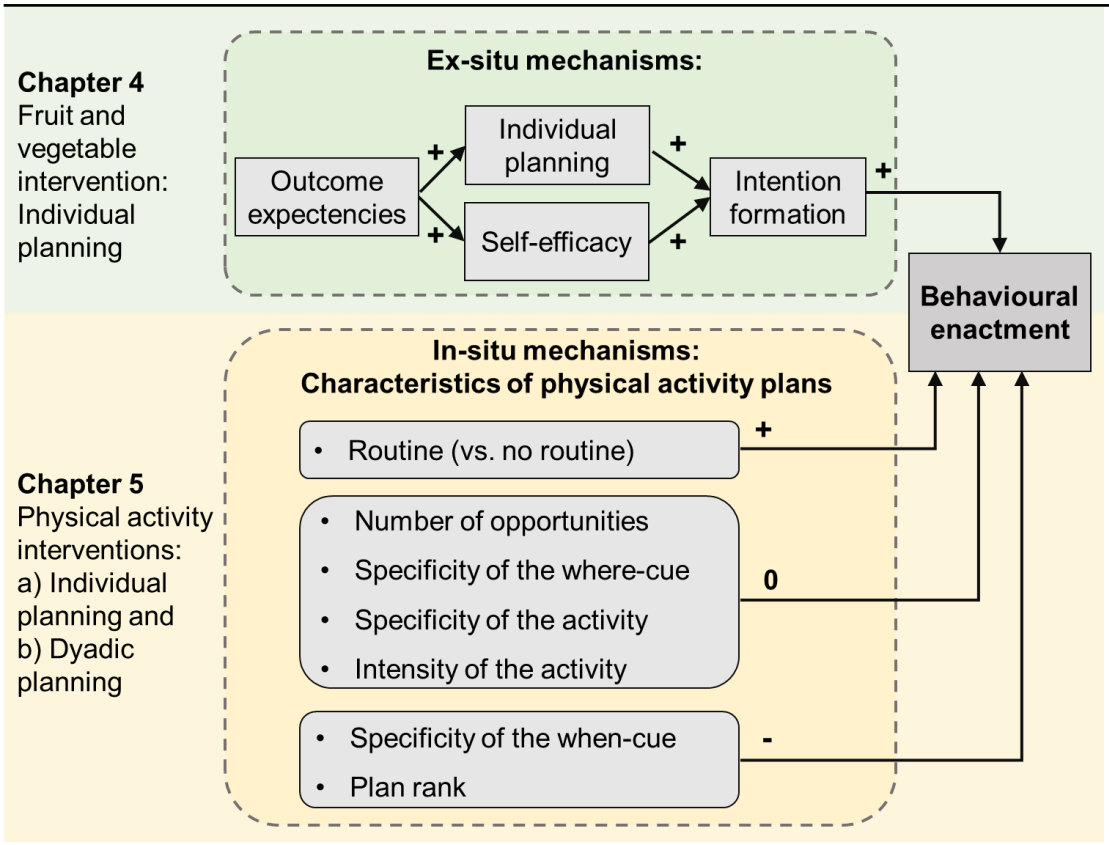

Figure 6. Schematic results on mechanisms of individual and dyadic planning interventions

Note. IPC: Individual planning condition. DPC: Dyadic planning condition. "+"positive relationship; "-"negative relationship; "0" non-significant relationship.

Strengths and Limitations

The strengths and limitations are addressed below and sorted by theoretical background, sample and attrition, study design, measures, and data analyses.

Theoretical background. Underscoring the complexity of self-regulation and co-regulation of health behaviour, the following three theoretical backdrops are used in this thesis: the HAPA model (Chapters 2 to 5; Schwarzer, 2008), the taxonomy of social support predictor domains (Chapter 2; Dunkel-Schetter & Skokan, 1990) and the cascade model from Bodenmann (2000) (Chapter 3). The HAPA focuses on individuals' health behaviour change process by primarily making assumptions on how several constructs related to one person are linked with each other (i.e. actor effects; Bolger & Laurenceau,

2013). The dyadic context of health-related regulation goes beyond HAPA assumptions because the constructs of one person can also influence another's, and vice versa (i.e. partner effects; Bolger & Laurenceau, 2013). Future research can address individual and dyadic planning with a comprehensive health behaviour change model for dyads, which accounts for both actor- and partner effects among health behaviour-related constructs (Stadler et al., 2017).

Sample and attrition. As a strength of this thesis, three different samples and health behaviour contexts were investigated. The context of prostate cancer survivors, who might be highly motivated to plan regular PFE, as well as their partners, who might be highly motivated to provide PFE-planning assistance, should be a well-fitting context to examine dyadic planning research questions (Chapters 2 and 3). This was different for the DiM project (Chapter 5) in which the physical activity promotion for highly active couples did not show the same clinical relevance. Possibly, this was one of the reasons why the individual and dyadic planning intervention conditions were not superior to the control condition (Knoll et al., 2017). A sample with persons of certain levels of motivation (i.e., a prerequisite of planning), but not meeting public guidelines could improve the potential of individual and dyadic planning interventions. As a general strength of all study projects, large sample sizes were examined which increased statistical power for data analyses. As a general limitation of the LoD and DiM study project, only heterosexual couples were examined which limits generalisability of the findings. Future studies should also investigate dyadic forms of planning in homosexual couples.

The attrition rates of the DiM and LoD study projects were low, whereas attrition was higher in Happy 5 (see Figures 2, 3, and 4 in the General Introduction). Participants with an initial interest in the Happy 5 study project might have lost interest after the baseline session. Higher dropout rates in online studies are well known due to the anonymous participation and the easiness of withdrawal (Eysenbach, 2005). However, this

issue should be targeted by, for instance, adding face-to-face sessions or offering incentives for active participation (Petry, Martin, Cooney, & Kranzler, 2000).

Study design. The designs of the three projects consisted of longitudinal observations and enabled the investigation of changes over time. As a strength of the LoD study project, the four measurement points in time covered the rehabilitation phases in which prostate cancer patients suffer at most from post-surgery urinary incontinence (Resnick et al., 2013). Both Happy 5 and DiM are randomised controlled trials which allowed the testing of mechanisms of planning interventions. In Happy 5, longer-term follow-ups would have been desirable to investigate mechanisms of long-term fruit and vegetable consumption. Also, as many persons in Happy 5 and DiM formed plans for the next day, immediate behavioural effects could be assessed by daily assessments for the first week following the intervention.

Measures. As a strength, the couple projects LoD and DiM assessed the perspectives of both the patient/target person and the partner which was not addressed by previous collaborative and dyadic planning studies (Prestwich et al., 2005, 2012, 2014; Benyamini, Ashery, & Shiloh, 2011). The main outcome of the Happy 5 study project was based on responses to two items regarding frequency of participants' fruit and vegetable consumption. Additional objective measures such as meal photographs taken by participants will improve future study designs (Sharp & Allman-Farinelli, 2014). A strength of Chapter 5 refers to the variety of plan characteristics that were coded and related to plan enactment, thus shedding more light into the question how a well-working plan should be formed. However, a self-report measure of plan enactment at follow-up sessions should also be assessed (Fleig et al., 2017).

Data analyses. As a strength of data analyses in Chapter 5, multilevel modelling took into account that plans were crossed in persons which went beyond data analyses of earlier plan content studies (e.g., de Vet, Oenema, & Brug, 2011). Another strength refers

to the stepwise testing of random slopes in multilevel models (Chapters 2, 3, and 5). The final model thus included as many random slopes as possible (Barr, Levy, Scheepers, & Tily, 2013). In Happy 5, data were analysed using manifest path models. To correct for potential measurement errors, variables should be analysed on the latent level (Hoyle, 2005).

Implications for Future Research

This section of the General Discussion provides implications for future research on planning in general and particularly focusses on collaborative and dyadic planning. As this relatively young, but promising field in health psychology needs time to develop, research on collaborative and dyadic planning should be continued (Hagger & Luszczynska, 2014; Hagger et al., 2016).

General methodological requirements. General recommendations for future collaborative and dyadic planning studies should be derived from meta-analyses on couple-based intervention studies (Arden-Close & McGrath, 2017; Martire et al., 2010), summarised by the following six points. First, as mentioned in the section "Strengths and Limitations", collaborative and dyadic planning studies should be based on a health behaviour change model for dyads (Stadler et al., 2017). Second, future collaborative and dyadic planning studies should analyse relationship functioning or relationship quality as a covariate or mechanism (cf. Knoll et al., 2017), and examine the change of relationship factors over time (Martire et al., 2010). Third, and not consistently done by previous studies (e.g., Prestwich et al., 2005), perspectives of both dyad members need to be assessed, preferably by measuring each variable as a self-report from each person (Martire et al., 2010). Fourth, persons' cognitions, emotions, and behaviours might be correlated between dyad members which should be accounted for by dyadic data analyses (Howland et al., 2016; Kenny, Kashy, & Cook, 2006). Fifth, for intervention studies, the intervention content should be specified (Arden-Close & McGrath, 2017), for instance, by using the

taxonomy of behaviour change techniques by Michie et al. (2013). Sixth, randomised controlled trials should consist of at least three arms (Arden-Close & McGrath, 2017). With that, the effects of a dyad-related planning intervention can be better evaluated by comparing them with effects of an individual planning intervention (i.e. controlled for planning) and a dyad-related control condition (i.e. controlled for the dyad's interaction). The following passages go through a number of specific methodological points which can guide researchers when planning a study on collaborative and/or dyadic planning.

Contexts and samples. To date, a variety of health contexts were examined by collaborative and dyadic planning studies. In studies on gender-specific health behaviours in the context of secondary prevention (e.g., breast self-examination; Benyamini et al., 2011; Prestwich et al., 2005) or tertiary prevention (e.g., prostate cancer patients' PFE; Burkert, Knoll, Luszczynska, & Gralla, 2012; Burkert, Scholz, Gralla, Roigas, & Knoll, 2011), the health behaviour of one person was primarily addressed, whereas the other person was assumed to act as support provider or caregiver. In contrast, studies on health behaviours of primary prevention (physical activity, Knoll et al., 2017; Prestwich et al., 2012; nutrition, Prestwich et al., 2014) addressed behavioural increases of both persons. One can assume that dyadic planning shows a better conceptual fit to contexts in which only one person is targeted, whereas collaborative planning will better fit contexts in which both persons' behaviour change is targeted. However, this needs to be tested in future research.

Currently, there are collaborative and dyadic planning study projects that are either enrolling participants (Luszczynska, 2016), or initiated the planning of participant recruitment (Radtke, 2017). In the former study project (Luszczynska, 2016), physical activity-related collaborative and dyadic planning interventions are examined in patients with cardiovascular disease or diabetes and their healthy partners (e.g., a family member or a friend; Luszczynska, 2016). Although the patient might be primarily targeted by the physical activity intervention (i.e. tertiary prevention; Bowman, Gregg, Williams,

Engelgau, & Jack, 2003), the healthy partner could also become more physically active (i.e. primary prevention) which makes this context a mix of above mentioned context distinctions. The latter project aims to examine physical activity-related individual and collaborative planning interventions amongst peers of adolescents (Radtke, 2017). As peers of adolescents might prefer to plan and perform their physical activity together as sport companions (Rackow, Scholz, & Hornung, 2014), it was decided to conduct a collaborative planning intervention, but not a dyadic planning intervention.

In general, future planning studies should investigate samples that are particularly in need to increase certain health behaviour(s). As an example for physical activity studies, an exclusion criterion can be determined (e.g., meeting official guidelines; Luszczynska, 2016) which ensures that an improvement in participants' physical activity is clinically relevant. In the DiM study project (Knoll et al., 2017), such an exclusion criterion was not present which led to a very active sample of adults (i.e., baseline moderate-to-vigorous physical activity means above 55 minutes per day).

Study design: Add ecological momentary assessment. As mentioned as a limitation of Chapters 4 and 5, immediate effects of the planning intervention were not captured, although participants could have targeted changes immediately following the intervention. The dynamics of short-term effects on health behaviours can be assessed by daily assessments (i.e., ecological momentary assessment (EMA; Shiffman, Stone, & Hufford, 2008). This will better inform intervention developers about how much time needs to elapse for a hypothesised effect of variable Y after intervening on X (Cole & Maxwell, 2003). Also, between- and within-person effects of an intervention can be analysed (Bolger, & Laurenceau, 2013). However, the investigation of longer-term effects of planning interventions still remains a main objective as long-term maintenance of health behaviours is highly important for health benefits (Muller-Riemenschneider, Reinhold, Nocon, & Willich, 2008). Thus, EMA phases in the beginning of an intervention study (e.g., 1 week prior to and 1 week following the intervention) should be combined with

longer-term survey assessments in future planning intervention studies. Also, spontaneous planning of health behaviours can fluctuate over time (e.g., planning to eat a salad each day, but then change to two salads as this appears feasible). In observational studies, these fluctuations can also be measured by EMA methods (e.g., daily assessments over 1 week) and combined with longer-term assessments.

As a specific type of EMA method, device-contingent designs can be used to observe psychosocial and behavioural processes "just in time" and as naturally as possible, ideally without interrupting naturalistic processes (Bolger & Laurenceau, 2013). Examples that can be applied in collaborative and dyadic planning studies include data collection by audio recordings (Mehl, Pennebaker, Crow, Dabbs, & Price, 2001) or text messages (Irvine et al., 2017). Such assessments will go beyond plan content studies that analyse lab-based planning (see Chapter 5) as they will provide insights into how both persons are planning in their natural environments.

Measures. In the following, suggestions for measures are listed which should be examined in future collaborative and dyadic planning studies.

Joint behavioural performance. Beyond assessments of individual health behaviour, joint behavioural performance reflects an important theoretical outcome or mechanism in collaborative and dyadic planning studies. In the DiM project, couples from the dyadic planning condition planned physical activities for only the target person. However, in some couples, the partner might have joined the target person in some activities, possibly leading to an increase of the partners' individual activities. The degree of joint behavioural performance could thus be an important moderator for individual physical activity and should be added as a measure in future collaborative and dyadic planning studies. For instance, measures on joint physical activity (Henriksen, Ingholt, Rasmussen, & Holstein, 2016; Rhodes et al., 2015; Schoeppe & Trost, 2015) or joint nutrition (Schoeppe & Trost, 2015) from the parental support literature can be adapted to the adult context. As another

option to assess joint behavioural performances, frequency questionnaires can be adapted to the level of the dyad by, for instance, asking participants to report on a number of jointly performed physical activities (Berli, Bolger, Shrout, Stadler, & Scholz, in press). Also, joint physical activities can be objectively assessed by combining same-time accelerometry of dyad members with same-location data (Dunton et al., 2012).

Ex-situ planning mechanisms. There are a number of mechanisms which were not yet tested for collaborative and dyadic planning. Future studies might consider to add these measures in their study designs as they might explain how and for whom collaborative and dyadic planning works. Important psychosocial mechanisms of individual planning (cf. Chapter 4) can be tested for collaborative and dyadic planning such as target persons' self-efficacy (Luszczynska, Schwarzer, Lippke, & Mazurkiewicz, 2011), intention formation (Chapter 4), or habit strength (Webb, Sheeran, & Luszczynska, 2009). Also, mechanisms of collaborative planning such as forgetfulness (Prestwich et al., 2005) and enjoyment (Prestwich et al., 2014) should be tested as mechanism for dyadic planning. As another possibility, dyadic forms of established mechanisms of individual planning could be mechanisms of collaborative and dyadic planning such as dyadic intentions or dyadic self-efficacy (Sterba et al., 2011).

In-situ planning mechanisms. Plan content studies mostly investigated the question "Which characteristics of the plan led to its successful enactment?" in individual plans. As a start to also examine the content of dyadic plans, both individual and dyadic plans were analysed in Chapter 5. This can be followed by a study which compares plan characteristics across individual, collaborative, and dyadic plans. Also, new plan characteristics can be developed and tested. For instance, collaborative and dyadic plans could entail the planning partner as a cue-to-action in the if/when-part which would be coded as a plan characteristic (i.e. 0=partner not included; 1= partner included). As another plan characteristic, the planning material can instruct participants to report their plan-specific individual self-efficacy (Scholz, Sniehotta, Schüz, & Oeberst, 2007) and plan-

specific dyadic self-efficacy after forming the plan. Furthermore, plans need to be concordant to personal interests and values (Koestner, Lekes, Powers, & Chicoine, 2002), thus, participants' perception of plan-specific self-concordance and plan-specific dyad-concordance can be assessed.

Improvement of dyadic planning interventions. In dyadic planning study contexts in which both persons could be the target person, an additional randomisation step is included to assign each partner to one study role: target person or partner (see Chapter 5; Knoll et al., 2017). With this procedure, only the target person's health behaviour is planned. Another idea would be the change of roles after initial dyadic planning, that is, the planning partner is subsequently becoming the target person and with that, health behaviours of both persons' are planned. In such a procedure, one partner would be randomly assigned being the first target person, whereas the other partner would be the second target person. Future dyadic planning intervention studies might consider such a procedure.

Regarding the increasingly effective use of dyadic planning found in Chapter 3, a potential dyadic planning learning process was assumed. Such a learning process can be experimentally examined by including dyadic planning booster interventions which would instruct participants to update their plans (cf. Scholz, Ochsner, & Luszczynska, 2013). With that, one can investigate within-person changes of plan characteristics between the main intervention and the booster intervention(s). Variables could be coded reflecting which plans have been dropped, modified, how they were modified, and which plans are completely new. These variables could then be linked to plan enactment which would provide insights into effective vs. non-effective plan adjustments.

Implications for Practice

In this section of the General Discussion, implications on how practitioners can apply individual, collaborative and dyadic planning are provided.

Planning instructions. When intervention developers design material for health behaviour planning based on Gollwitzer's (1999) if-then planning, findings from the plan content study in Chapter 5 should be taken into account. For instance, persons can be recommended by plan instructions to relate their planned behaviours to existing daily routines. This is underscored by the finding that participants were more likely to implement regular dental flossing in their daily lives when flossing was instructed following teeth brushing as a daily routine (vs. prior to teeth brushing; Judah et al., 2013).

The potential of the planning partner. Dyadic planning interventions in previous studies largely focussed on the target person. However, the planning partner could be a valuable resource and should be more involved in the intervention. In a couple-based researcher-assisted planning study (Voils et al., 2013), study personnel initially planned together with patients and subsequently informed their partner about patients' plans and taught partners how to best provide plan-related support. Intervention developers can consider adding an intervention module which solely focusses on increasing the partner's planning- and support-related competences. In the first step, partners can be informed about advantages of joint planning - for instance, two persons will generate more plan-related ideas and the partner can critically question target person's plan formulation (see Chapter 5). In a second step, communication skills (Badr, 2017) such as techniques of motivational interviewing (i.e., empathetic listening and motivating statements; Miller & Rollnick, 2002; Ziegelmann, Lippke, & Schwarzer, 2006), can be taught to partners. Subsequently, target persons and partners will form dyadic plans for the target person. Similar to the study by Voils et al. (2013), the partners and research personnel will then work on strategies how the partner will provide plan-related support within the following days. Such a planning intervention with extended partner involvement should be evaluated regarding effectiveness, but also regarding potential improvements in plan content quality (cf. Chapter 5) through improvements in partners' plan assistance competences.

Just in time adaptive interventions. In Chapter 4, an increased level of intentions was the most important predictor for later fruit and vegetable consumption. That is, when persons' would show lower intention levels, a lower subsequent fruit and vegetable intake will be more likely. Nutritionists, who assess data on persons' intention levels, can consider planning interventions for fruit and vegetable whenever a person shows a significant drop in intention levels. This form of tailored and context-specific interventions are called "*just in time adaptive interventions*" (JITAIs; Nahum-Shani et al., 2016).

JITAIs can also be combined with device-contingent data collection and plan content analyses (see Chapter 5). For instance, the plan of a person "When I come home from work on Monday evening, I will go for a run" can be coded to derive a reminder algorithm. That is, whenever this person arrives at home (detected via GPS signalling) on Mondays between 5pm and 9 pm, the person's smartphone would send a plan reminding message. An example plan which entails another person as the situational cue can be: "When my boyfriend comes home from grocery shopping, we will prepare a healthy meal". Based on both persons' GPS signals and home GPS coordinates, the following message can be provided on target person's smartphone: "Did your boyfriend come home from grocery shopping? If yes, why not preparing a healthy meal?". For both applied examples, plan content studies such as the study in Chapter 5 provide a theoretical framework of how complex health-related plans could be disentangled into smaller pieces (e.g., when-cues, where-cues, and person-cues). In general, JITAIs are increasingly applied by software developers as data collection and interventions can be easily conducted via applications on smartphones (Nahum-Shani et al., 2016). However, evaluations of such interventions are important. The data analysis procedure which was applied in Chapter 5 (i.e., multilevel modelling as plans are crossed in persons) can also be transferred to the context of evaluating plan enactment of such JITAIs.

Conclusions

Recalling the research questions posed in the General Introduction, the following conclusions can be drawn:

1. How frequent are individual and dyadic planning used at baseline and over time? (Chapters 2 to 5)

   → Overall, participants used individual planning more often. Regarding planning use over time, prostate cancer patients used individual and dyadic planning of their rehabilitative exercises more often in the beginning of their rehabilitation, whereas individual and dyadic planning use was lower at later stages. The planning of patients' rehabilitative exercises reflects a dynamic process, possibly related to dynamic changes of post-surgery stressors.

2. Developing a framework of dyadic planning predictors: How are psychosocial and contextual factors linked to dyadic planning? (Chapter 2)

   → The framework might inspire future studies to examine further dyadic planning predictors and embed them into predictor domains. Relevant unique predictors of dyadic planning in the context of prostate cancer patients' rehabilitation from surgery were patients' positive affect and self-efficacy, patients' and their partners' relationship quality, as well as partners' reports on patients' urinary incontinence severity. Relevant dyadic planning predictors should be considered when intervening on dyadic planning.

3. Which behavioural links show individual and dyadic planning and how do these links change over time? (Chapter 3)

   → Individual planning was a constant and positive correlate of prostate cancer patients' rehabilitative exercise. Dyadic planning became increasingly important for PFE over time, possibly reflecting a learning process of patients and their partners regarding the effective use of dyadic planning.

4. Which ex-situ mechanisms of an individual planning intervention explain health behaviour changes? (Chapter 4)

   → As an important mechanism, intention formation following the intervention was found to mediate between individual planning and fruit and vegetable intake as well as between self-efficacy and fruit and vegetable intake. Booster interventions should target the longer term maintenance of high intention levels to, in turn, maintain high levels of fruit and vegetable consumption.

5. Developing a framework of plan characteristics as in-situ mechanisms of participant-generated plans: How can the content of individual and dyadic plans be characterized? Which plan characteristics are associated with plan enactment? Which enactment rates show individual and dyadic plans? Are there differences between plan characteristic-plan enactment links across individual and dyadic plans? (Chapter 5)

   → The framework might inspire future studies to examine further plan characteristics of if/when-then plans and link them to plan enactment. The presence of a routine was positively linked to plan enactment, whereas specificity of a time-cue showed negative plan enactment associations, indicating that planned behaviours should be rather related to existing routines than to highly specific time-cues. Dyadic plans were more likely enacted as compared to individual plans. No indication was found that plan characteristics-plan enactment associations are different across individual and dyadic plans.

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Sterba, K. R., Rabius, V., Carpenter, M. J., Villars, P., Wiatrek, D., & McAlister, A. (2011). Dyadic efficacy for smoking cessation: Preliminary assessment of a new instrument. *Nicotine & Tobacco Research, 13*(3), 194-201. doi:10.1093/ntr/ntq236

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Curriculum Vitae

Jan Keller

Education

05/2014 – present	PhD-Student at the division of Health Psychology (Prof. Nina Knoll) at the Freie Universität Berlin Study projects: "Days in motion": A planning intervention study with couples to enhance daily physical activity "PrevOP": Preventing the impairment of primary osteoarthritis by high impact long-term physical exercise regimen
01/2013	Master of Science in Psychology at the Freie Universität Berlin
10/2010	Bachelor of Science in Psychology at the Freie Universität Berlin
06/2007	A-levels in Frankfurt (Oder)

Positions

04/2015 – present	Teaching assignments at the Freie Universität Berlin for Bachelor and Master students
02/2013 – present	Research associate at the division of Health Psychology (Prof. Nina Knoll) at the Freie Universität Berlin
10/2010 – 01/2013	Student research assistant at the division of Health Psychology (Prof. Ralf Schwarzer / Prof. Nina Knoll) at the Freie Universität Berlin

Honors and Grants

2017	Conference grant funded by the German Academic Exchange Service (Italy)
2017	Quinn Exchange Fellowship of the Department of Psychology: Research visit at University of British Columbia, Vancouver, Canada; Supervisor: Prof. Christiane Hoppmann
2016	CREATE Tandem Grant of the European Health Psychology Society: Research visit at Columbia University, New York City, USA; Supervisor: Prof. Niall Bolger
2015	Conference grant funded by the German Academic Exchange Service (Cyprus)

Berlin, December 2017

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Jan Keller

List of Publications

ARTICLES IN PEER-REVIEWED JOURNALS (* indicates those that are part of the thesis)

2015 - 2018

* Keller, J., Motter, S., Motter, M., & Schwarzer, R. (2018). Augmenting fruit and vegetable consumption by an online intervention: Psychological mechanisms. *Appetite, 120*, 348-355. doi:10.1016/j.appet.2017.09.019

Boberska, M., Szczuka, Z., Kruk, M., Knoll, N., Keller, J., Hohl, D. H., & Luszczynska, A. (2017). Sedentary behaviours and health-related quality of life. A systematic review and meta-analysis. *Health Psychology Review*, 1-16. doi:10.1080/17437199.2017.1396191

Fleig, L., Gardner, B., Keller, J., Lippke, S., Pomp, S., & Wiedemann, A. U. (2017). What contributes to action plan enactment? Examining characteristics of physical activity plans. *British Journal of Health Psychology, 22*(4), 940-957. doi:10.1111/bjhp.12263

* Keller, J., Fleig, L., Hohl, D. H., Wiedemann, A. U., Burkert, S., Luszczynska, A., & Knoll, N. (2017). Which characteristics of planning matter? Individual and dyadic physical activity plans and their effects on plan enactment. *Social Science and Medicine, 189*, 53-62. doi:10.1016/j.socscimed.2017.07.025

* Keller, J., Wiedemann, A. U., Hohl, D. H., Scholz, U. Burkert, S., Schrader, M., & Knoll, N. (2017). Predictors of dyadic planning: Perspectives of prostate cancer survivors and their partners. *British Journal of Health Psychology, 22*(1), 42-59. doi:10.1111/bjhp.12216

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Hohl, D., Knoll, N., Wiedemann, A., Keller, J., Scholz, U., Schrader, M., & Burkert, S. (2015). Enabling or Cultivating? The Role of Prostate Cancer Patients' Received Partner Support and Self-Efficacy in the Maintenance of Pelvic Floor Exercise Following Tumor Surgery. *Annals of Behavioral Medicine,* 1-12. doi:10.1007/s12160-015-9748-6

* Keller, J., Burkert, S., Wiedemann, A. U., Luszczynska, A., Schrader, M., & Knoll, N. (2015). Individual and dyadic planning predicting pelvic floor exercise among prostate cancer survivors. *Rehabilitation Psychology, 60*(3), 222-231. doi:10.1037/rep0000047

MISCELLANEOUS

Berli, C., Keller, J. (2016). Dyadic health behaviour change: A Tandem project on couples' co-regulation of physical activity. *European Health Psychologist, 18*(5), 212-125.

SELECTED PRESENTATIONS (first authorships only)

Keller, J., Motter, S., Motter, M., & Schwarzer, R. (2017). *Augmenting Fruit and Vegetable Consumption by an Online Intervention: Psychological Mechanisms.* Oral presentation at the 31st of the European Health Psychology Society, 29th August - 02nd September 2017 in Padua, Italy.

Keller, J., Hohl, D.H., Burkert, S., Hosoya, G., Scholz, U. & Knoll, N. (2017). *One-year follow-up effects of a dyadic planning intervention to increase physical activity: A randomized controlled trial with healthy couples.* Oral presentation at the 13. Kongress der Fachgruppe Gesundheitspsychologie, 22-25 August 2017 in Siegen, Germany.

Keller, J., Pauly, T., Hohl, D. H., Knoll, N., & Hoppmann, C. (2017). *Physical Activity Synchrony in Couples' Accelerometer Data.* Poster presentation at the 5th Conference of the Society of Ambulatory Assessment, 15-17 June 2017 in Esch an der Alzette, Luxembourg.

Keller, J., Hohl, D. H., Knoll, N., Fleig, L., Wiedemann, A., & Burkert, S. (2016). *Umsetzung von Handlungsplänen zur körperlichen Aktivität: Individuelle Pläne vs. dyadische Pläne.* Oral Presentation at the 50. Kongress der Deutschen Gesellschaft für Psychologie, 18-22 September 2016 in Leipzig, Germany.

Keller, J., Hohl, D. H., Knoll, N., Fleig, L., Wiedemann, A., & Burkert, S. (2016). *Plan Enactment of physical activities: Individual planning vs. Dyadic planning.* Oral Presentation at the 30th Conference of the European Health Psychology Society, 23-27 August 2016 in Aberdeen, UK.

Keller, J., Knoll, N., Wiedemann, A., Hohl, D.H., Schrader, M., & Burkert, S. (2015). *Gemeinsam schaffen wir das: Dyadisches Planen von Beckenbodentraining für Männer.* Oral Presentation at the 12. Kongress der Fachgruppe Gesundheitspsychologie, 17-19 September 2015 in Graz, Austria.

Keller, J., Wiedemann, A. U., Burkert, S., Hohl, D. H., Schrader, M., & Knoll, N. (2015). *Predictors of dyadic planning of pelvic floor exercise: Perspectives of prostate cancer survivors and partners.* Oral Presentation at the 29th Conference of the European Health Psychology Society, 02-05 September 2015 in Limassol, Cyprus.

Keller, J., Wiedemann, A. U., Burkert, S., & Knoll, N. (2014). *Sequentieller Einsatz individueller und dyadischer Planungsstrategien zur Steigerung des Beckenbodentrainings bei Patienten nach radikaler Prostatektomie.* Oral Presentation at the 49th Kongress der Deutschen Gesellschaft für Psychologie, 21-25 September 2012 in Bochum, Germany.

Keller, J., Knoll, N., Wiedemann, A. U., & Burkert, S. (2014). *Individual and dyadic planning as correlates of pelvic-floor training: A study with prostate cancer patients.* Oral Presentation at the 28th Conference of the European Health Psychology Society, 26-30 August 2014 in Innsbruck, Austria.

Keller, J., Gellert, P., Knoll, N., Schneider, M. & Ernsting, A. (2013). *A brief workplace health promotion program for physical activity: Self-efficacy and planning as longitudinal predictors.* Oral Presentation at Health Psychology Workshop, 16 October 2013 at Newcastle University, UK.

Keller, J., Gellert, P., Knoll, N., Schneider, M., & Ernsting, A. (2013). *A brief workplace health promotion program for physical activity: Self-efficacy and planning as longitudinal predictors.* Oral Presentation at the 27th Conference of the European Health Psychology Society, 16-20 July 2013 in Bordeaux, France.

Keller, J., Gellert, P., Ernsting, A., & Schneider, M. (2012). *Körperlich aktiver werden trotz höheren Alters?.* Poster Presentation at the 48th Kongress der Deutschen Gesellschaft für Psychologie, 23-27 September 2012 in Bielefeld, Germany.

Erklärung

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

Unterschrift (Jan Keller)

Berlin, Dezember 2017