

Looking Back and Moving Forward: A Meta-Analytic Review and Two Original Studies  
Examining the Role of Action Planning and Coping Planning in Promoting Physical  
Activity Behaviour

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Thesis submitted to the  
Faculty of Graduate and Postdoctoral Studies  
in partial fulfillment of the requirements  
for the Doctorate of Philosophy degree in Clinical Psychology

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## General Abstract

Physical activity (PA) offers numerous physical and mental health benefits. Unfortunately, most people struggle to lead an active lifestyle, particularly when they are concurrently striving to balance other pursuits that may interfere with their engagement in PA. The self-regulatory strategies of action planning (AP) and coping planning (CP) have been proposed as a means of helping people initiate and maintain PA, though inconsistent findings have been observed to this effect. The primary objectives of the present dissertation, achieved by way of two original articles, were to (a) review the extant planning for PA literature in order to summarize and synthesize knowledge in the area to date, and (b) examine AP and CP in relation to more than one goal at a time, while testing the relevant moderator of academic goal conflict. The first article comprised a meta-analysis of correlational ( $k = 19$ ) and experimental ( $k = 21$ ) studies on planning for PA, which revealed a medium-to-large summary effect for correlational studies, and a small summary effect for experimental studies. Furthermore, AP and CP emerged as partial mediators in the relation between behavioural intention and PA. Numerous moderators were also found. Among other key findings, this article cast light on the fact that, despite multiple goal pursuit being the rule rather than the exception, most studies reviewed examined a single goal in isolation. Further, the summary effects found were more modest than expected and highly heterogeneous, pointing to the value to testing relevant moderators. Thus, the second article contained two studies that examined the moderating role of academic goal conflict on the relations between AP and CP with PA using samples of university

students concurrently pursuing an academic and a PA goal. Study 1 ( $N = 317$ ) used a 6-week prospective design, and Study 2 ( $N = 97$ ) used a 1-week daily diary design and measures of self-reported PA behaviour and goal progress. Across both studies, it was found that academic goal conflict moderated the influence of planning on PA outcomes. AP and CP were found to play differential roles in predicting PA when students were experiencing goal conflict: AP related to better PA outcomes at *lower* levels of academic goal conflict, whereas CP related to better PA outcomes at *higher* levels of academic goal conflict. These two self-regulatory strategies appear to play a different, yet complementary role in the goal pursuit process. Overall, the present dissertation contributes to knowledge synthesis in the area of planning for PA. In addition, novel research findings are presented which specifically target identified gaps in the literature. Theoretical, methodological, and practical implications are discussed, and future research avenues are proposed.

## Acknowledgements

I can still remember my first day in the LAMRA lab, which was still in its infancy at the time. Perhaps sensing the slight apprehension of the young students in the group, my advisor and director of the lab, Dr. Patrick Gaudreau, looked to a painting of a forest hung on our lab wall, and offered the image as an analogy for research. He explained that, initially, it is difficult to see the forest from the trees, with a thick fog and vegetation seeming to obscure more complete understandings and clear ways forward. Over time, through a focus on mastering the process of research (not outcomes – these would emerge naturally as a result of devotion to the former), a path would emerge from the thick foliage to reveal a breathtaking scene, he assured us.

As I progressed through the doctoral program in Clinical Psychology and the process of writing the present dissertation, at times, I have felt like I was on a nature walk on a beautiful day; other times, I have felt like I was traipsing through a wild jungle, struggling to forge ahead. A number of people have supported me in a variety of important ways throughout this journey who bear special mention here.

To Dr. Patrick Gaudreau, my advisor and mentor, thank you for your invaluable wisdom, guidance, and encouragement over the years. Patrick, I have learned so much from you, both directly through your teachings, and indirectly through your leading by example. You have always provided an engaging environment in which I could learn and grow. You will forever be a role model to me for how to be a competent researcher, caring and effective supervisor, and consummate professional.

A big thank you to my committee members, Drs. Michelle Fortier, Shaelyn Strachan, and Cristina Atance, for your helpful comments and kind words during my proposal defence. Thank you also to my external committee member, Dr. Paule Miquelon, for providing a set of fresh eyes on the dissertation in its final stages.

Many thanks to the members of the LAMRA lab (Marie-Claude, Adam, Véro, Kristina, Alex, Katie, Mélodie, and Amanda) for providing feedback on manuscripts and presentations, sharing ideas, traveling to conferences together, and for your camaraderie. Thanks also to Eve-Marie Blouin-Hudon, Michelle Downie, and Michelle Dugas for double coding goals and elements of the meta-analysis. I would like to thank the research participants who took the time to take part in the studies. I am also thankful to SSHRC and OGS for funding my doctoral research.

Thank you to my dear friends and colleagues Sara, Laura, Katie, Jess, Keegan, Lyzon, Steph, and Andrew for your invaluable support and friendship. I look forward to the next chapter of our adventure. Thanks also to Julzie, Elem, Claudia, SK, Savannah, Jess, and the rest of “the fam” for your precious encouragement and understanding as I worked long hours. A huge thank you to my family, Carole, Benito, Mario, Sergio, Sara, Denieve, Logan, Ava, Norah, and the Bearas for being there for me at each step of this huge undertaking.

Finally, I am indebted to my precious husband, Stevan Beara. Stevi, thank you for believing in me when I doubted myself, for encouraging me when I despaired, for rejoicing in my successes, and for supporting me in every way. You are my safe haven and secure base forever. I love you.

### Statement of Co-Authorship

The two articles included in this dissertation were prepared in collaboration with my dissertation supervisor, Dr. Patrick Gaudreau. I was the first author, and Dr. Gaudreau was the second author for both articles. The first article, entitled “Spontaneous and Experimentally Induced Action and Coping Planning for Physical Activity: A Meta-Analysis”, and an associated corrigendum, is published in *Psychology of Sport and Exercise*. To facilitate readability, the corrigendum material is integrated in the article itself, and therefore differs from the published article. The second article, entitled “Predicting Physical Activity Outcomes during Episodes of Academic Goal Conflict: The Differential Role of Action Planning and Coping Planning”, was received very positively, and given a decision of revise and resubmit in *Personality and Social Psychology Bulletin*.

As the first author, I took the leadership role in each step of the realization of this research project. This included but was not limited to: conducting literature reviews; conceptualizing research questions and methods; preparing submissions for ethics review; measure selection; participant recruitment and longitudinal follow-up; data collection; preparation of the databases for analysis; data analysis and interpretation; as well as writing the articles and preparing them for publication. As my dissertation advisor and second author, Dr. Gaudreau provided invaluable guidance and assistance in all aspects of the project, especially in the conceptualization and refinement of the research questions and methods; planning, execution, and interpretation of statistical analyses; and editing of the articles.

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## CHAPTER 1: Background to the Dissertation

### Self-Regulation of Health Behaviour

Social and applied psychologists are becoming increasingly interested in the study of health behaviour, no doubt because of the striking shift in causes of morbidity and mortality in the Western world over the last hundred years. As noted by a number of researchers (e.g., Maes & Gebhardt, 2005; Mokdad, Marks, Stroup, & Gerberding, 2004), at the start of the 20<sup>th</sup> century, the most prominent causes of death in Western countries were communicable diseases such as influenza, pneumonia, and tuberculosis, which are caused by certain microorganisms. After the Second World War, the leading causes of death in Western countries became chronic illnesses such as cardiovascular problems and chronic obstructive pulmonary diseases, which have causes that are primarily behaviourally based. Such behaviours include smoking, high alcohol consumption, poor stress-management, unhealthy diet, and – of principal interest for the present research – lack of physical activity and sedentary lifestyle (Mokdad, et al., 2004). Indeed, the primary determinants of ill health today appear to stem largely from difficulties in regulating our behaviour (Baumeister & Heatherton, 1996; Baumeister, Heatherton, & Tice, 1994).

*Self-regulation* refers to the various processes – whether conscious and deliberate or automatic and operating outside of conscious awareness – by which individuals pursue and attain goals (Mann, De Ridder, & Fujita, 2013). Self-regulation is no easy task, as exemplified by the quintessential challenge of many people to achieve their New Year's resolutions. Approximately half of North American adults set New Year's resolutions, the most common of which relate to smoking cessation, weight loss, and physical activity behaviour initiation

(Norcross, Ratzin, & Payne, 1989). Of those who set New Year's resolutions, the available data show that only about 45% manage to attain continuous success on their resolutions at six-month follow up, a figure that likely overestimates success rates due to demand characteristics and other threats to the validity of such studies (Norcross, Mrykalo, & Blagys, 2002). These findings are one example of how self-regulatory efforts often do not fully materialize. Indeed, Baumeister and Heatherton (1996) have outlined the many ways in which self-regulation can break down. For instance, they note that people may lose sight of their goals, neglect to monitor their behaviour, or give in to temptation. Moreover, people's capacity for self-regulation appears to be a limited resource, and people may become *ego depleted*—that is, temporarily expelled of their available self-regulatory strength at a given moment in time. Thus, it would appear that the old weightlifter's adage "Ain't nothin' to it but to do it" is not reflective of most people's realities when attempting to change their health behaviour.

### **Self-Regulation of Physical Activity Behaviour**

*Physical activity behaviour* is defined by the World Health Organization (WHO, 2014) as "any bodily movement produced by skeletal muscles that requires energy expenditure" (p. 1). This includes daily activities and recreational pursuits. Physical activity is notoriously difficult to initiate, change, and maintain (Maes & Gebhardt, 2005). Despite this difficulty, it has been noted that, in Canada, where the current doctoral research was conducted, reducing physical inactivity may hold the greatest potential of any single behavioural change to prevent early death, lower the incidence of many chronic diseases, promote independent living in an aging population, and contain the economic costs of preventing and treating disease through other medical means (Katzmarzyk, Gledhill, & Shephard, 2000). The study of self-regulation for

physical activity behaviour is therefore extremely important, both because there is a strong need to support those people exerting self-regulatory effort toward this challenging health behaviour target, and because it holds such promise and power as a way of improving the lives of Canadians and people more globally.

Young adults and university students are a particularly important population to study in regards to self-regulation for physical activity. First, the majority of university students do not engage in sufficient levels of physical activity to bring themselves in line with public health recommended guidelines (Bray & Kwan, 2006). There is evidence to suggest that the poor behavioural patterns established as a young adult persist well into adulthood, thereby carrying forward the health risks associated with sedentary lifestyle and physical inactivity (Kwan, Cairney, Faulkner, & Pullenayegun, 2012). Second, the transition to university is particularly precarious (Bray & Born, 2004), with most students both gaining weight and experiencing a decline in their physical activity levels within the first year of their studies. It has been found that the rate of weight gain that Freshman students experience is nearly six times that reported for the general population, and would render them obese ( $BMI \geq 30$ ) if sustained for several years (Mihalopoulos, Auinger, & Klein, 2008). In turn, obesity in adulthood has been associated with an increased risk of various non-communicable diseases such as hypertension, cardiovascular disease, Type II diabetes, as well as some cancers (WHO, 2010). Third, students may choose to spend their discretionary time engaged in sedentary behaviours (e.g., school-related computer use, reading, studying) that are more readily and immediately reinforced by the academic environment than are physical activity behaviours (Epstein & Roemmich, 2001). They are thus faced with having to operate within environments that may not necessarily

favour engagement in a healthy lifestyle. Finally, although often considered overrepresented in psychological research (Peterson, 2001), university students are also considered a neglected but important target for health promotion/prevention efforts (Brown, Bray, Beatty, & Kwan, 2014). For example, the university campus provides a promising avenue for health promotion initiatives as it provides an avenue for targeting health-related messages to a relatively self-contained population (Buckworth & Nigg, 2004). In sum, studying self-regulation strategies within the university student population is a worthy research avenue.

### **Planning as a Self-Regulatory Strategy for Physical Activity Behaviour**

Planning is one self-regulatory strategy that has been considered particularly compelling in terms of improving theoretical explanations of health behaviour, and as a fruitful intervention target for health behaviour change (Head & Noar, 2014). More specifically, over the last three decades, research has provided support for *implementation planning* – defined as the formation of specific contingency plans linking opportunities for action with concrete goal-directed behaviours – as an effective self-regulatory strategy for facilitating health behaviour in general (e.g., Gollwitzer & Sheeran, 2006), and physical activity behaviour in particular (e.g., Kwak, Kremers, van Baak, & Brug, 2007). The salutary impact of implementation planning on physical activity behaviour has been demonstrated in studies using various designs (e.g., Brickell & Chatzisarantis, 2007; Sniehotta, Scholz, Schwarzer, et al., 2005), populations (e.g., Latimer, Ginis, & Arbour, 2006; Sniehotta, Scholz, & Schwarzer, 2006), and age groups (e.g., Ziegelmann, Lippke, & Schwarzer, 2006) across varying lengths of time (e.g., Lippke, Ziegelmann, & Schwarzer, 2005) and methods of assessment (e.g., Kwak, et al., 2007). Contrary to the weightlifter's adage mentioned previously to simply enact one's intentions, such findings

suggest there may be more truth to the words of Carl W. Buechner, who proclaimed: “Fail to plan, and you plan to fail”.

**Limitations and gaps in our understanding of planning for physical activity behaviour.**

Although the aforementioned results are encouraging, they by no means point to implementation planning as the panacea for a sedentary lifestyle (de Vet & Penseu, 2009). In addition, many gaps remain regarding our collective understanding of planning for physical activity (Hagger & Luszczynska, 2014). First, inconsistent findings have been noted in the extant literature. Some studies on the relation between implementation planning and physical activity behaviour have reported null findings (e.g., Scholz, Nagy, Schüz, & Ziegelmann, 2008), and others have reported unexpected negative effects (e.g., Budden & Sagarin, 2007). Second, even in the case of studies reporting positive results, less is known about what might account of the variability in the effectiveness of implementation planning across different circumstances (i.e., moderation; Gollwitzer, Wieber, Myers, & McCrea, 2010) and how it fits into existing theoretical frameworks (i.e., mediation). Third, recent theoretical advances by Sniehotta and his colleagues (Sniehotta, 2009; Sniehotta, Schwarzer, Scholz, & Schüz, 2005) have called for the differentiation of two forms of planning: *action planning* and *coping planning*. Action planning refers to specifying when, where, and how a goal will be pursued (e.g., I will run on Mondays, Wednesdays, and Fridays at 6pm after work. I will run for 45 minutes continuously at the park). Coping planning refers to identifying obstacles to goal striving and specifying how they will be managed (e.g., If I am too tired after work, I will run for 20 minutes around the neighbourhood instead). Action planning and coping planning are postulated to have differential effects on physical activity behaviour at different moments of a specific temporal sequence, and to be

distinct from implementation planning. Fourth, it is surprising to note that despite the knowledge that individuals regularly pursue multiple goals concurrently (e.g., Austin & Vancouver, 1996), the overwhelming majority of research on planning involves the study of singular goals in isolation, which limits our understanding of this strategy in real-world goal pursuit. Finally, most studies on planning have been carried out at the between-person level, leaving gaps in our understanding of planning at the intrapersonal level, a crucial area of inquiry in modern health research (e.g., Scholz, Keller, & Perren, 2009).

**How the present dissertation addresses extant limitations and gaps.** This dissertation sought to address the limitations and gaps identified above in two primary ways. First, by “looking back” on the extant literature on planning for physical activity to garner a summary and synthesis of our understanding of this area to date. This included distinguishing action planning and coping planning as well as testing theoretically driven mediating processes and moderating variables. Second, by using the insights gleaned from this review to “move forward” in novel research directions that include examining the moderating role of conflict stemming from the pursuit of a concurrent goal in the relations between action planning and coping planning with physical activity, at both the between- and within-person levels of analysis. From a theoretical standpoint, this research should facilitate a deeper understanding of the relation between planning and physical activity outcomes. From an applied perspective, this should assist in contributing to identifying priorities for further research aimed at developing planning interventions to help people lead a more physically active lifestyle in the real world. Ultimately, it is hoped that this work will contribute meaningfully to a sound research foundation upon

which to inform effective, evidence-based strategies for promoting sustained participation in a physically active lifestyle.

The next chapter will begin with a review of the problem of lack of physical activity and its significance, followed by a brief historical overview of role the motivational variable of intention as way of increasing physical activity. Next, theoretical arguments for considering planning as a means of bridging the gap between intention and physical activity will be provided. Following this will be a discussion on distinguishing between various forms of planning and a review of the evidence for planning for physical activity to date. Next, the rationale for researching planning within a multiple goal context and at multiple levels of analysis will be considered. Finally, the objectives of this dissertation will be identified.

## CHAPTER 2: General Introduction

### **The Problem: Lack of Physical Activity and Sedentary Lifestyle**

The physiological and psychological benefits of regular physical activity are well documented and widely accepted (e.g., Stathopoulou, Powers, Berry, Smits, & Otto, 2006; Warburton, Nicol, & Bredin, 2006). In a recent systematic review, Warburton et al. (2010) found “incontrovertible evidence” that regular physical activity is an effective preventative strategy against premature mortality, cardiovascular disease, stroke, hypertension, colon cancer, breast cancer, and type 2 diabetes (p. 212). Furthermore, there is strong evidence to suggest that the more physical activity is performed, the greater the health benefits (Warburton, et al., 2010). In addition to these physical health benefits, significant mental health benefits of physical activity have also been identified, including reduction of depression and anxiety symptoms (Paluska & Schwenk, 2000). Clearly, fostering higher physical activity levels in the Canadian population is an important public health objective.

Notwithstanding the aforementioned benefits, over the past several decades, it has been found that the physical activity and fitness levels of Canadians have decreased, whereas overweight and obesity, along with their numerous associated comorbidities, have increased (Colley, et al., 2011a; Shields, et al., 2010). Recently, Canada joined several other countries in revising their recommendations for physical activity. The latest recommendation is that adults should engage in at least 150 minutes per week of moderate-to-vigorous physical activity, accumulated in bouts of at least 10 minutes (Tremblay, et al., 2011). Analysis of accelerometer data from a representative sample of almost 3000 Canadians showed that a mere 15% of Canadian adults (17% of men and 14% of women) met this recommendation (Colley, et al.,

2011a). There is a clear need to support community partners and health professionals in providing helpful guidance to Canadians about the most effective ways to promote physical activity. Accordingly, public health agencies have called for research to determine how psychological factors can facilitate individuals' adoption and maintenance of a more physically active lifestyle (e.g., Surgeon General, 1996).

### **Behavioural Intentions as a Strategy for Increasing Physical Activity**

In line with calls for the examination of psychological factors that promote healthy living, researchers have emphasized motivational strategies, such as setting personal goals, as an important means of fostering physical activity behaviour (Shilts, Townsend, & Dishman, 2013). *Personal goals* are mental representations of desired end states (Austin & Vancouver, 1996) that reflect the proactive efforts of individuals to shape their lives in positive new directions (Sheldon, Kasser, Smith, & Share, 2002); *behavioural intentions* represent a person's commitment to act in the pursuit of such goals (Ajzen, 1991).

Two prominent theories of health behaviour, the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (Ajzen, 1985), both of which stem from the Reasoned Action Approach, posit that intention is the most proximal and important predictor of behaviour. Recently, these theories have been heavily critiqued, with much heated debate as to whether and how they should be amended (e.g., Head & Noar, 2014; Rhodes, 2014; Schwarzer, 2014), or even retired all together (Sniehotta, Pesseau, & Araújo-Soares, 2014). Although several areas of improvement have been identified (Head & Noar, 2014; Ogden, 2003), the principal critique centers around the *intention-behaviour gap*, which refers to the phenomenon that many people who intend to perform a behaviour fail to do so ("inclined abstainers";

Sheeran, 2002), which is in contrast to the central prediction of reasoned action theories. Furthermore, the results of a meta-analysis of experimental studies by Webb and Sheeran (2006) showed that a large increase in intentions produces only a small increase in associated behaviour. Of note, the pursuit of physical activity goals is particularly vulnerable to failure (De Ridder & De Wit, 2007). For example, the majority of people who begin an exercise program relapse into inactivity within the first six months (Marcus, et al., 2000). Hence, one task of modern health psychology researchers has been to identify and better understand the reasons for the discrepancy between people's intentions to engage in physical activity and their actual behaviour, as well as test the usefulness of various strategies aimed at bridging the intention-behaviour gap.

### **Theoretical Considerations Useful for Understanding the Intention-Behaviour Gap**

**Goal setting and goal striving.** One way of understanding the intention-behaviour gap relates to the distinction between two sets of processes in the goal pursuit process – one relating to motivation, and the other to action or volition. Kurt Lewin (Lewin, Dembo, Festinger, & Sears, 1944) was the first person to subdivide the psychology of goals into two broad components: goal setting and goal striving. *Goal setting*, a motivational task, involves establishing which goals to pursue as well as the criteria to be used in determining the degree of success in attaining them. *Goal striving*, a volitional task, refers to planning and carrying out actions that promote goal attainment as well as shielding goals from obstacles and barriers. Several contemporary self-regulation theorists and researchers continue to draw on the distinction between goal setting and goal striving (see Diefendorff & Lord, 2008 for a historical overview). For example, the Health Action Process Approach (HAPA; Schwarzer, 2008) considers

the adoption, initiation, and maintenance of health behaviours to be part of a process comprised of a goal setting/motivational phase, and a goal striving/volitional phase. Mann, De Ridder, and Fujita (2013) recently provided a review of goal setting and goal striving processes for health behaviour. One of the key overarching themes of this review was that, “successful self-regulation entails *both* [emphasis added] selecting desired goals with appropriate criteria for success (i.e., goal setting), and engaging in those strategies and behaviours necessary to procure that outcome (i.e., goal striving)” (p. 488). Hence, it is understandable that intention alone is insufficient for bringing about goal-directed behaviour, as it is focused on only one part of the “equation” for engendering successful goal outcomes.

**The Model of Action Phases.** The Model of Action Phases (MAP; Gollwitzer, 1990; Heckhausen, 1991) is a theoretical framework for the study of goal pursuit that is also useful for understanding the discrepancy between intentions and behaviour. The MAP maintains the goal setting and goal striving distinction, but includes it within a single theoretical framework and places it in a horizontal temporal sequence (Gollwitzer, 1990). According to this model, goal pursuit involves performing a number of consecutive steps. The first step is to decide amongst one’s many desires which specific goals to pursue. This process of weighing alternatives and ultimately committing to a behavioural intention occurs during the *pre-decisional stage*. The second step is to plan out the specifics of implementing goal-directed behaviour. This process of creating plans to help initiate goal pursuit occurs during the *pre-actional phase*. The third step is to perform goal-directed behaviours and respond to barriers that can thwart goal attainment. This process of actively working toward and protecting a goal occurs during the

*actional phase*. The final step involves evaluating the extent to which the goal has been attained and whether it was worthwhile. This appraisal occurs during the *post-actional stage*.

From this perspective, one reason for the gap between intention and behaviour is that setting a goal (which occurs during the *pre-decisional stage*) is merely the first step toward goal attainment (Gollwitzer & Sheeran, 2006). Additional steps, such as planning how to achieve the goal (in the *pre-actional phase*), are also needed to translate intentions into action (Gollwitzer, 1990; Heckhausen, 1991). These additional steps are needed because a host of different obstacles are encountered during goal pursuit (i.e., *actional stage*) that must be successfully resolved in order for goal progress to occur. As summarized by Gollwitzer and Sheeran (2006), one problem concerns getting started with goal striving. People may forget to act, allow good opportunities to slip away, or decide not to act on their intentions in the face of competing alternatives. Another problem concerns staying on track while pursuing one's goals. People may get distracted, fall into old habits, succumb to temptation, or simply be too drained of their personal resources to act according to their intentions. One way of circumventing problems occurring in the actional stage of goal pursuit is to devise pre-actional plans designed to help successfully manage issues that threaten goal pursuit before they are actually encountered.

### **A Strategy for Bridging the Intention-Behaviour Gap: Implementation Planning**

*Implementation planning* has been proposed as a simple, effective strategy for dealing with problems in goal pursuit (e.g., Gollwitzer, 1996, 1999; Gollwitzer & Sheeran, 2006).

Implementation plans are designed to support behavioural intentions by linking opportunities to act with relevant goal-directed behaviour. Gollwitzer (1999) has argued that implementation plans have an "if-then" contingency structure and take the following format: "If situation x

arises, then I will perform action  $y$ ". He claims that, by way of this structure, implementation plans create a strong link, or mental association, between a specified situation and goal-directed behaviour. Much research supports this contention by showing that people who form implementation plans are better able to detect, attend to, and recall the situations specified in their plans (e.g., Webb & Sheeran, 2004). Furthermore, research has shown that once these situations are encountered, goal-directed behaviour is elicited swiftly and with minimal conscious effort (e.g., Brandstätter, Lengfelder, & Gollwitzer, 2001; Gollwitzer & Brandstätter, 1997).

There is mounting evidence for the effectiveness of implementation planning in promoting behaviour across a variety of domains. To date, four meta-analyses have estimated its overall impact (Gollwitzer & Sheeran, 2006; Koestner, et al., 2006; Koestner, Lekes, Powers, & Chicoine, 2002; Sheeran, 2002). These meta-analytic studies report overall effect size estimates of  $d = .65$ ,  $.28$ ,  $.54$ , and  $.70$  for the effect of implementation planning on behaviour and goal attainment across a broad range of topic areas. Gollwitzer and Sheeran (2006) also reported an effect size of  $d = .59$  for health behaviour in particular. Results have also been promising in the area of health behaviour. Studies report the beneficial impact of implementation planning on reducing alcohol consumption (e.g., Armitage, 2009), regular breast self-examination (e.g., Orbell, Hodgkins, & Sheeran, 1997), cervical cancer screening (e.g., Sheeran & Orbell, 2000), fruit and vegetable intake (e.g., Chapman, Armitage, & Norman, 2009), and promoting healthy eating (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011). In their meta-analytic review, Gollwitzer and Sheeran (2006) report a mean effect size estimate of  $d = .59$  for studies on implementation planning for health behaviours (as compared to the

overall estimate of  $d = .65$ ) conducted between 1990 and 2003. This work is limited, however, as it does not provide a specific estimate for physical activity behaviour, nor does it distinguish between action planning and coping planning.

Regarding implementation planning for physical activity behaviour, the results of empirical studies have been mixed. Correlational studies on implementation planning for physical activity report effect sizes ranging from as low as  $r = .13$  (Sniehotta, Gorski, & Araújo-Soares, 2010) to as high as  $r = .67$  (Norman & Conner, 2005; Rise, Thompson, & Verplanken, 2003). Field studies testing implementation planning interventions designed to increase physical activity also show a great deal of variability, with some studies showing positive results (e.g., Ziegelmann, et al., 2006) and others reporting null (e.g., Skår, Sniehotta, Gerard, Prestwich, & Araújo-Soares, 2011) or even negative effects (e.g., Budden & Sagarin, 2007). Overall, these mixed results suggest that the role of implementation planning in facilitating physical activity behaviour remains to be better understood.

### **Distinguishing Action Planning and Coping Planning**

Recently, explanations for the inconsistent findings in the literature on implementation planning for physical activity have begun to emerge. For one, Sniehotta (2009) noted that the majority of research on implementation planning conducted outside the health domain has been carried out in the laboratory and involved plans assigned by the researcher. In contrast, research on implementation planning for physical activity has typically been conducted in the field and involved plans set by the participants themselves. Hence, the quality of the content of participants' plans (either the "if" or "then" component, or both) in field studies remains unknown. In addition to content, the structure of field study participants' implementation plans

may not be worded as a conditional if-then statement, which has been found to be optimal (Chapman, et al., 2009). Finally, it has been suggested that people may experience problems in goal striving in some domains more than others (Gollwitzer, et al., 2010). As mentioned, physical activity behaviour involves recurrent action, at longer durations, over longer periods of time than do other health behaviours (e.g., performing 20-30 minutes of physical activity 3-4 times per week, each week versus getting an annual physical check-up). It also involves rewarding consequences and positive and negative reinforcements that are more distal (e.g., losing weight, reduced health risks; see Maes & Gebhardt, 2005 for a more detailed account on the nature of health targets). Given the complex nature of physical activity as a target for behaviour change, people may be more likely to experience action control problems in this area – problems for which implementation plans may have weaker or less consistent effects.

As an additional consideration, Sniehotta and his colleagues (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005) have argued that a lack of theoretical and conceptual clarity has confounded research in the area of implementation planning for physical activity behaviour. More specifically, they recently made the distinction between action planning and coping planning. *Action planning* involves specifying when, where, and how to perform goal-directed action. For example, for the goal intention to perform physical activity, a suitable action plan could be: “At the end of the work day, I will go jogging along the canal by bringing by running clothes with me to work”. Action planning and implementation planning are often used interchangeably in the literature. *Coping planning*, on the other hand, involves anticipating barriers to goal attainment and linking them to appropriate coping responses. For example, for the goal intention to perform physical activity, a possible coping plan could be “If I am tired

after work, then I will take a short walk after dinner instead of jogging”. Sniehotta and his colleagues have argued that action planning and coping planning involve different antecedents, outcomes, and mediating mechanisms from each other and from implementation planning (Hagger & Luszczynska, 2014), and that they follow a temporal sequence in which action planning precedes coping planning in the process of striving toward physical activity goals (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005). Finally, the magnitude of the impact of action planning and coping planning on physical activity behaviour change likely varies according to various relevant moderators.

### **Refining Action Planning and Coping Planning for Physical Activity: Considering the Natural “Ecosystem” of Goal Pursuit**

Michie, West, and Spring (2013) have recently provided an important account of how to more optimally support the advancement of theory and interventions in health psychology. One recommendation they put forward was for theories to include constructs that are clearly defined and used consistently. The work of Sniehotta et al. (2005; 2009), in clarifying and elaborating the nature of action planning and coping planning for physical activity, is in line with this recommendation and has helped advance the progression of research in this area. Since its publication, other researchers have continued to work toward refining operational definitions of various forms of planning and providing recommendations for future research on the basis of these clarifications (Hagger & Luszczynska, 2014). Another area of improvement suggested by Michie and her colleagues was for researchers to strive toward greater *context sensitivity* as well as consideration of the *dynamic* nature of intervention targets in health psychology research. One way to achieve greater context sensitivity is to consider the actual climate within

which physical activity goals are pursued. Most people working toward a physical activity goal are also concurrently pursuing additional goals from other life domains, as most people strive toward more than one goal at a time (e.g., Austin & Vancouver, 1996). Relatedly, one way of better capturing the dynamic nature of planning within this multi-goal context is to avail oneself of modern methods of data collection that closely capture participants' moment-to-moment experiences (e.g., experience sampling, daily diaries) of relevant constructs (Mehl & Conner, 2012). Each of these opportunities for theoretical and applied advancement is discussed in greater detail below.

### **Multiple Goal Pursuit: Goal Conflict and Facilitation**

Most studies on planning for physical activity have focused on a single physical activity goal in isolation. The same is true for most theorizing and research on goal setting and goal striving, which have often focused on one goal at a time (Gebhardt, 2007). Although this line of research has led to important findings on the unique properties of singular goals, it has been argued that for a more ecologically valid prediction of behavioural change, there is a definite need to consider the behaviour under study within the broader context of other goals an individual is pursuing (Austin & Vancouver, 1996; Carver & Sheier, 1998). Consideration of one or two alternative behaviour(s) next to the behaviour under study has been found to greatly increase predictive power, while ensuring the everyday reality of the reported findings (Sheppard, Hartwick, & Warshaw, 1988).

Indeed, goal pursuit does not occur in a vacuum. In everyday life, individuals regularly pursue multiple goals concurrently (Austin & Vancouver, 1996; Louro, Pieters, & Zeelenberg, 2007). Together, these multiple strivings make up an idiosyncratic and hierarchically-organized

set of personal goals (e.g., Carver & Sheier, 1998; Kruglanski, et al., 2002). These personal goal hierarchies are arranged both vertically and horizontally. For example, a lower-order goal of “performing 20 minutes of vigorous physical activity, three times per week” might be subsumed under a higher order goal of “being physically fit on a regular basis”, which may, in turn, be subsumed under yet a higher order goal of “being healthy” or “losing weight”. Therefore, a single behaviour or set of goal-directed behaviours can be understood as being embedded within a vertical hierarchical chain that also includes horizontal branches containing other goal-directed behaviours which, in turn, have their own hierarchical organization within the larger goal system.

The structural interrelatedness of the goal system means that goals are in constant interaction with one another. The result is that the pursuit of one goal influences – for better or worse – the likelihood of attaining other goals within the system (Carver & Sheier, 1998; Emmons & King, 1988). This point highlights the competitive nature of goal pursuit, in that limited resources – whether they be cognitive (Kruglanski, et al., 2002) or related to time, energy, and financial resources (Riediger & Freund, 2004) – generate situations in which advancement on one goal may either prevent or promote (i.e., inhibit or facilitate) advancement on other goals, depending on the relations between the goals involved.

One way that goals relate to one another is to enter into conflict (Riediger, 2001; Riediger & Freund, 2004). Conflict between goals, or *goal conflict*, occurs when progress on one goal is, in some way, impaired by the pursuit of other goals (Gebhardt, 2007). Riediger and Freund (2004) have outlined two primary sources of goal conflict. The first stems from *resource limitations* in time and energy. For example, goal conflict can occur when the time and energy

needed to perform a one-hour vigorous workout to meet one's physical activity goal comes at the expense of successfully pursuing one's other endeavours. The second source stems from *logical incompatibilities* between goals. This occurs when the attainment of one goal results in the direct non-attainment of another goal. For instance, when one sleeps in an additional hour only to miss out on the only opportunity to work out that day: in the early morning. In this case, the goal of getting more sleep de facto precludes progress on the goal of performing physical activity.

Goal conflict of various forms has been found to relate negatively to a number of adverse outcomes across a variety of populations. For example, Amstad, Meier, Fasel, Elfering, and Semmer (2011) recently conducted a meta-analysis of work-family conflict in which they analyzed work-family conflict bidirectionally (i.e., work interfering with family and family interfering with work). They assessed three categories of potential outcomes: work-related outcomes (e.g., work satisfaction and performance, burnout), family-related outcomes (e.g., marital satisfaction, family-related stress), and domain-unspecific outcomes (e.g., life satisfaction, depression, health problems). Results showed that work-to-family conflict and family-to-work conflict were consistently negatively related to all three types of outcomes. In addition to quantitative studies such as those included in the above meta-analytic review, recent qualitative work has been carried out to extract key themes in the area of goal conflict. For example, a recent qualitative study examined physicians' experience of goal conflict during a clinical consultation (Presseau, Sniehotta, Francis, & Campbell, 2009). It was found that physicians perceived certain routine goal-directed behaviours they perform while meeting with patients (e.g., addressing medication, treating acute illness) to interfere with their performing

certain evidence-based behaviours, such as providing advice about physical activity to their patients. Clearly, goal conflict has a deleterious impact on various cognitive, affective, and behavioural/performance outcomes.

Not all goals create conflict or interference and they can, in fact, be beneficial to one another. *Goal facilitation* refers to both the degree of *instrumentality* between goals (i.e., the pursuit of the physical activity goal sets the stage for the realization of the academic goal) and the *overlap of means* used to attain the goals (e.g., doing something in the pursuit of a physical activity goal is simultaneously beneficial for an academic goal, such as going to campus for class where one's gym is also located). Goal facilitation has received less research focus than goal conflict. Nonetheless, prospective correlational studies have found evidence for both a direct and indirect positive association between goal facilitation and health behaviour (Presseau, Sniehotka, Francis, & Gebhardt, 2010; Riediger & Freund, 2004), making it an important variable to consider when examining multiple goal pursuit.

### **Goal Conflict for Physical Activity**

Goal conflict is a particularly salient barrier to physical activity behaviour. Bailis et al. (2011) specified two preconditions for goal conflict. One is that the alternate goal must be likely to create tension within the goal system. In other words, people should desire to pursue this goal (if a goal is neither desired nor important it is unlikely to create tension within one's goal system). The second is that there must be another important goal with the potential to be activated concurrently. Several converging lines of evidence indicate that these conditions for goal conflict are present and pervasive. First, physical activity is both sought out and gratifying. Large-scale surveys of industrialized nations show that physical activity goals are routinely

ranked first among other health goals, suggesting that exercise is desired and believed to yield positive health benefits (Bailis, Segall, & Chipperfield, 2003). Similarly, physical activity goals are consistently among the top New Year's resolutions (Bushman, 2013). Physical activity is also rewarding, yielding positive mood states and emotions both in the moments immediately following exercise (Kanning & Schlicht, 2010) and as a result of habitual performance (Pasco, et al., 2011). Finally, lack of time and interference from other commitments are consistently cited as primary barriers to physical activity in the general population (Trost, Owen, Bauman, Sallis, & Brown, 2002). Hence, the preconditions for goal conflict appear to be common and widespread.

Indeed, an emerging line of empirical evidence suggests that goal conflict is likely a key barrier to adopting and maintaining regular engagement in physical activity (e.g., Gebhardt, 2007; Gebhardt & Maes, 2001; Penseau, Sniehotta, Francis, & Little, 2008). The results of numerous studies demonstrate significant negative associations between goal conflict and both objective measures of physical activity (e.g., Riediger & Freund, 2004) and subjective ratings of progress on physical activity goals (e.g., Gebhardt & Maes, 1998). One study (Gebhardt, 1997 as cited in Gebhardt, 2007) showed that goal conflict was a significant predictor of whether participants initiated and maintained physical activity behaviour over a 12 months period. It was found that participants who were sedentary, but had become regular exercisers by the one-year follow-up point, reported perceiving less goal conflict at baseline than those who remained sedentary. Also, participants who exercised regularly three or more times per week, but relapsed to inactivity one year later, reported more goal conflict at baseline than those who continued to exercise regularly.

### **Planning and Goal Conflict**

As reviewed earlier, most of the studies on planning have examined its effects on a focal goal without considering the possible conflicting impact of other goals within the larger goal system. In line with the recommendations of Michie, West, and Spring (2013), one way of building on prior planning research in a useful way is to give greater consideration to the *context* in which planning is utilized. Because people pursue more than one goal at a time in their everyday lives, theoretical understandings and opportunities for interventions could be optimized if planning were considered within this climate. Thus, examining the role of planning in the multiple goal context of everyday life is a highly salient research avenue.

Recent experimental studies and field trials have generally yielded mixed results for planning in multiple goal situations. In one study, it was found that implementation plans work well in a multi-goal context because they help people identify specified cues or opportunities for goal-directed action specified in the plans, at the expense of alternative goal-relevant cues (Parks-Stamm, Gollwitzer, & Oettingen, 2007, Experiment 1). In contrast, Dalton and Spiller (2012) found that forming implementation plans for a set of goals led people to perceive the execution of those goals as more difficult, which in turn, undermined their goal attainment through decreasing their commitment (Study 1). However, they also found that participants who were led to believe that managing multiple goals would be easier, attained more of their goals if they formed implementation plans compared to goal intentions alone (Study 3). Hence, findings to date have been inconsistent, suggesting that the investigation of relevant moderators is warranted. Furthermore, these studies did not make the distinction between

action planning and coping planning, which may play different roles under conditions of goal conflict.

From a conceptual and empirical point of view, action planning and coping planning are conceptually distinct but empirically related self-regulatory strategies that might, be particularly helpful for people to manage their goal pursuit. As noted, action planning, with its similarities to implementation planning, may help goal strivers notice opportunities to enact their intended goal-directed behaviours (Parks-Stamm, et al., 2007), and to do so more swiftly and efficiently when opportunities are encountered (Brandstätter, et al., 2001). Hence, by rendering goal striving more efficient and less taxing on one's conscious self-regulatory capacities (Gollwitzer & Schaal, 1998), action planning may help preserve self-regulatory resources that can then be used for the successful pursuit of multiple goals. Coping planning, in the same way that it shields goal pursuit from temptations, obstacles, and distractions (Sniehotta, Schwarzer, et al., 2005), may also protect against potential interference stemming from the concurrent pursuit of other goals.

The general consensus is that action planning and coping planning have provided a useful expansion of motivational models of health behaviour change by serving as a bridge to volitional processes (e.g., Noar & Head, 2014; Rhodes, 2014). Nevertheless this does not preclude opportunities for action planning and coping planning to also be expanded and elaborated in meaningful ways. In fact, recent calls have been made to further refine our understanding of the conditions under which planning processes and effect operate by examining relevant mediators and moderators (Schwarzer, 2014). Regarding the latter, the examination goal conflict as a moderator of the relations between action planning and coping

planning with physical activity seems particularly justified, given the salience of goal conflict as a barrier to goal pursuit and mixed and undifferentiated results in the literature to date.

### **Planning and Goal Conflict at the Within-Person Level**

Just as most of the studies on planning have tended to focus on a single goal in isolation, so too have these studies tended to be analyzed exclusively at the between-person level. As a result, we know that individuals who are more likely to use planning strategies are also likely to be more physically active than the average in the population (i.e., between-person differences). However, we have less of an understanding of whether planning can help explain why individuals are more active on some days than others (i.e., within-person differences). In line with the recommendations of Michie, West, and Spring (2013), another way of building on prior planning research in a meaningful way is to give greater consideration to the *dynamic* nature of planning. Capturing the dynamic nature of planning can be achieved by availing oneself of modern methods of data collection that more closely capture participants' moment-to-moment experiences of planning that allow for the exploration of within-person research questions (Mehl & Conner, 2012).

There are theoretical reasons for studying conflict at the within-person level. Conceptually, a variable takes on different meanings at different levels of measurement and analysis (e.g., Hitt, Beamish, Jackson, & Mathieu, 2007). At the between-person level, individuals are compared to *one another*. For example, a study might consider how people who experience greater goal conflict fare with their physical activity goals as compared to individuals with lesser goal conflict. However, perceptions of goal conflict can be considered inherently subjective and idiosyncratic. In evaluating their perceptions of goal conflict, people are likely

inclined to reference *their own* habitual experiences. As such, studies using within-person designs are warranted to capture people's subjective, idiosyncratic experiences of goal conflict. Such studies would serve to create better alignment between the level of conceptualization and how goal conflict is empirically measured and analyzed (Rousseau, 1985).

As noted by Nezlek (2001), a crucial feature of relationships analyzed at the between- and within-person levels is that they are *independent*. That is, within-person relationships may be negative whereas between-person relationships may be positive, and vice versa. With respect to within-person relations between planning and physical activity, Scholz, Keller, and Perren (2009) assessed a sample of 265 university students every two weeks for a total of nine measurement points. They found a non-significant within-person relation between action planning and physical activity – a result that diverges from a substantive body of between-person findings. In another study, both action planning and coping planning were significantly positively correlated with running behaviour at the within-person level (Scholz, Nagy, et al., 2008). On a given day during which these participants used action planning and coping planning more than their own usual level, they were also more physically active on that day compared to their own typical level.

Recent studies have also started to compare the effects of goal conflict and goal facilitation for physical activity across the between- and within-person levels of analysis. As noted by Penseau and his colleagues (2013), at least three prospective studies have failed to show a between-person relationship between perceived goal conflict and physical activity (e.g., Li & Chan, 2008; Penseau, et al., 2010). However, constructs conceptually similar to goal conflict (i.e., daily hassles and job demands) have been negatively related to physical activity at

the within-person level (e.g., O’Conner et al 2008; Payne et al 2010). In their study examining accelerometer-assessed physical activity, Penseau et al. (2013) have found that perceived level of goal facilitation, but not goal conflict, significantly predicted physical activity over and above intention and perceived behavioural control at the between-person level. Individuals who experienced more goal facilitation were more physically active than those who experienced goal facilitation to a lesser extent. Conversely, at the within-person level, they found that the amount of time spent in the pursuit of conflicting goals was negatively associated with physical activity, again controlling for intention and perceived behavioural control. In other words, the more people pursued conflicting goals on a given day, the less they engaged in physical activity on that day. Overall, these findings highlight the importance of testing the associations between planning and conflict constructs with physical activity at both the between- and within-person levels, as the effects may not necessarily converge.

### **The Present Dissertation**

**Objectives.** The present thesis has two main objectives. The first objective is to “look back” at the planning for physical activity literature to summarize and synthesize our understanding to date, particularly in light of recent distinctions between action planning and coping planning. This will include the examination of theoretically driven mediating processes and moderators. The second objective is to “move forward” by addressing gaps in the planning for physical activity literature to date—namely, to study action planning and coping planning in relation to more than one goal at a time, while examining the relevant moderator of goal conflict and both the between-and within-person level of analysis.

**Overview of the studies.** The objectives of the dissertation are addressed by way of a meta-analytic review and two original studies comprising two articles. The first article, designed to address the objective of "looking back" on the extant literature, is a meta-analysis of correlational and experimental studies on planning for physical activity behaviour. Given the recent distinction between action planning and coping planning, the first aim of the meta-analysis was to estimate unique overall effect sizes for action planning and coping planning separately so as to clarify their distinct influences on physical activity behaviour. The second aim was to perform a series of moderation analyses in order to elucidate for whom and under what conditions action planning and coping planning are most effective in facilitating physical activity. The third aim was to explore key theoretical postulates by testing mediation models using meta-analytical path analysis. Specifically, Sniehotta and colleagues' (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005) proposed sequence from intention, to action planning and coping planning, to physical activity behaviour was examined. The final aim of the meta-analysis was to provide several ideas for future research in the area of planning for physical activity by drawing on the broader implementation planning literature pertaining to other health behaviours and life domains.

The second article, designed to address the objective of "moving forward", contained two original studies which investigated the extent to which action planning and coping planning are associated with physical activity when students are experiencing conflict between their academic and physical activity goals, both at the between- (Study 1) and within-person (Study 2) levels. In Study 1, a prospective design was used to examine whether academic goal conflict experienced during the midterm exam period moderates the relationship of action planning

and coping planning with progress made in the pursuit of physical activity goal 8 weeks later. Study 2 replicated and extended the results of Study 1 by examining the moderating role of daily academic goal conflict on the relation between daily action planning and coping planning and two indicators of daily physical activity behaviour at the within-person level. Examining the potential moderating role of goal conflict at both the between-person and within-person level is a theoretically fertile and clinically relevant research avenue to determine for whom and when action planning and coping planning are more effective in promoting physical activity.

**Organization of the remainder of the dissertation.** The remainder of the dissertation is organized into three chapters. *Chapter 3* comprises the first journal article entitled “Action Planning and Coping Planning for Physical Activity: A Meta-Analysis”. This article is published in *Psychology of Sport and Exercise*. A corrigendum for this article was published but for the sake of clarity and parsimony we have included only an amended version in which all errors are directly corrected. *Chapter 4* presents the second manuscript entitled “Predicting Physical Activity Outcomes during Episodes of Academic Goal Conflict: The Differential Role of Action Planning and Coping Planning”. This paper has received a decision of revise and resubmit in *Personality and Social Psychology Bulletin*. Both articles have been either accepted or are under review for publication in scientific journals and are therefore formatted accordingly. In *Chapter 5*, the overall findings from both articles are discussed, integrated, and used as a springboard for a discussion of study limitations, implications, and future research directions. Finally, the various appendices referenced throughout the text are provided.

Spontaneous and Experimentally Induced Action Planning and Coping Planning for Physical

Activity: A Meta-Analysis

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### Abstract

**Objectives:** The main objective of this review was to provide summary effects for spontaneous and experimentally induced action planning (AP) and coping planning (CP) for physical activity (PA). These summary effects were then used to test key theoretical postulates using meta-analytic path analysis, and examine possible boundary conditions via moderation analyses.

**Design:** This review employed a quantitative research synthesis design. **Method:** Using the method of Lipsey and Wilson (2001), fixed- and random-effects meta-analysis was performed on over 150 effect sizes from 19 correlational and 21 experimental studies. The method of Viswesvaran and Ones (1995) was used to test two mediation models using the correlational meta-analytic data. Group comparisons and meta-regression were used to test moderation.

**Results:** Among the correlational studies, findings indicated a medium-to-large summary effect of spontaneous AP ( $\phi = .41$ ) and CP ( $\phi = .38$ ) on PA. Among the experimental studies, results revealed a small summary effect ( $\phi = .12$ ) when comparing all experimental conditions versus all controls and a small summary effect ( $\phi = .07$ ) when comparing purely planning conditions versus neutral controls. Support was found for AP and CP as partial mediators in the relation between intention and PA. Numerous significant moderators emerged. **Conclusion:** This review offers the first meta-analytic estimates of both spontaneous and experimentally induced AP and CP for PA, while supporting the role of both spontaneous AP and CP as mediators in both a multiple and sequential mediation model. Relevant moderators will serve to inform future research in this area.

**Keywords:** action planning, coping planning, physical activity, health behavior, meta-analysis

## **Spontaneous and Experimentally Induced Action Planning and Coping Planning for Physical Activity: A Meta-Analysis**

The physiological and psychological benefits of regular physical activity (PA) are well documented and widely accepted (e.g., Stathopoulou, Powers, Berry, Smits, & Otto, 2006; Warburton, Nicol, & Bredin, 2006). Nevertheless, most people across Europe and North America are insufficiently active to accrue health benefits (e.g., Cameron, Wolfe, & Craig, 2007). *Action planning* (AP) and *coping planning* (CP)—whether people create them spontaneously in their everyday life or as part of an intervention—have been proposed as an effective way to increase PA. Notwithstanding promising findings, results of individual studies have been inconsistent, and a comprehensive meta-analytic review is warranted to better understand the extent to which AP and CP are respectively associated with PA. Given the pressing demand for simple, cost-effective interventions for promoting PA, and the key role of theory in developing and refining such interventions (Michie & Abraham, 2004), there is a clear need to understand the specific role of AP and CP within existing theoretical frameworks and the degree of universality of their effects. Hence, the objectives of this review were to (a) provide specific summary effects for the relation of spontaneous (i.e., correlational studies) and experimentally induced AP and CP with PA, (b) test key theoretical postulates using meta-analytic path analysis, and (c) examine boundary conditions of the effects via theoretically driven moderation analyses.

### **Action Planning and Coping Planning: A Conceptual and Empirical Overview**

In social cognition models, like the Theory of Planned Behavior (TPB; Ajzen, 1991), motivational factors such as people's *intention* to perform a particular behavior are considered

the most proximal determinants of that behavior. However, the majority of people who intend to adopt and regularly perform desired health behaviors struggle to do so, and ultimately fail to transform their intention into concrete action (Sheeran, 2002). Changing health behaviors can be challenging, but planning precisely how to enact one's intentions and how to deal with difficulties in goal pursuit is a promising strategy for bridging the proverbial "intention-behavior gap" (Webb & Sheeran, 2005).

Two conceptually distinct forms of planning have been identified in the health domain (Sniehotta, 2009; Sniehotta, Schwarzer, Scholz, & Schüz, 2005; Ziegelmann, Lippke, & Schwarzer, 2006) on the basis of the broader literature on *implementation intentions/plans* (Gollwitzer, 1999). *Action planning (AP)* involves specifying the details of when, where, and how to act in the service of one's intentions. *Coping planning (CP)* involves identifying how one will cope with potential barriers or obstacles that could get in the way of the goal striving process.

Correlational and experimental studies of AP and CP address two different yet complementary volitional processes. Correlational designs are used to examine the extent to which naturally formulated plans, called *spontaneous* or *self-set* AP and CP, can explain variance in health behaviors such as PA. Participants are asked to indicate the extent to which they have *spontaneously* planned when, where, and how to perform goal directed behaviors and cope with obstacles within a specified period of time (Rise, Thompson, & Verplanken, 2003). Experimental studies involve *experimentally inducing*, or directly instructing and intervening on the process of setting action and/or coping plans. Participants are instructed, via paper-and-pencil exercises or interaction with an experimenter, to indicate when, where, and how they plan to perform PA (i.e., AP) and deal with anticipated obstacles (i.e., CP). Spontaneous and

experimentally induced planning could potentially interact—for example, people already forming spontaneous plans in their daily life may not benefit (at all or as much) from interventions designed to promote planning. These two streams of research on the natural and induced occurrence of planning for PA have yet to be described, summarized, and quantified into one integrative review of the extant correlational and experimental literatures.

Furthermore, an inclusive, systematic meta-analytic review of the literature is warranted to reflect upon the inconsistent results observed in the PA literature. Given the complex nature of PA as a target for behavior change (Maes & Gebhardt, 2005), people may be more likely to experience difficulties regulating their goal striving in this area, resulting in weaker or less consistent effect sizes. Indeed, correlational studies on AP and CP reported bivariate correlations ranging from as low as .13 (Sniehotta, Gorski, & Araújo-Soares, 2010) to as high as .67 (Norman & Conner, 2005). Field studies on planning interventions for PA also showed great variability, with some showing positive results (e.g., Sniehotta, Scholz, & Schwarzer, 2006; Ziegelmann, et al., 2006) and others reporting null (e.g., Skår, Sniehotta, Gerard, Prestwich, & Araújo-Soares, 2011) or even negative effects (e.g., Budden & Sagarin, 2007).

A recent meta-analysis has begun to pave the way toward a better understanding of the experimental literature on AP for PA (Bélanger-Gravel, Godin, & Amireault, 2011). Notably, this review connected AP within the broader literature on psychosocial interventions for PA. Decisions about data abstraction were reported transparently, and important moderating variables (e.g., intervention delivery method, operational definitions of ‘implementation intentions’) were considered to offer a nuanced portrait on the effect of AP on PA. This review also offered a detailed description of sample, physical activity, and intervention characteristics,

thereby allowing readers to more readily identify both strengths and areas in need of further improvement in the literature.

Our meta-analysis complements and extends the review of Bélanger-Gravel et al. (2011) in several ways. First, the prior review focused exclusively on experimental studies of AP for PA. In line with the most the most recent theorizing by leading researchers in the area of planning for PA, the present review included *both* correlational and experimental studies. Notably, as observed by Sniehotta (2009), the majority of research on implementation planning conducted outside the health domain has been carried out in the laboratory and involved plans assigned by the researcher. In contrast, research on planning for physical activity has typically been conducted in the field and involved plans set by the participants themselves. Hence, the structure and content of participants' self-set plans studied in field research remains unknown, and may partially explain the mixed results observed in the planning for PA literature. Second, the prior review focused almost exclusively on AP as CP was examined only briefly in a subgroup analysis. In the current meta-analysis, we conducted distinct analyses for self-set AP and CP. As mentioned previously, the decision to examine both AP and CP was driven by various calls toward greater theoretical and conceptual clarity, which can only be achieved by examining both AP and CP (e.g., Sniehotta and others have argued that AP and CP likely involve different antecedents, outcomes, and mediating mechanisms; (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005). As such, moderating analyses were performed separately for each type of planning whenever sufficient information was available to appropriately examine the effect of a moderator.

In their review, Bélanger-Gravel et al. highlighted the importance of theory in designing

and implementing PA interventions. Our review tried to move one step further by using the available data to investigate the mediating role of AP and CP in the intention-behavior relation—an important theoretical issue in the intention and planning literatures (see the mediation section of this Introduction).

Past studies have often used longitudinal designs with multiple time points, outcome measures, experimental conditions, and control groups. Although it would be easier to create average effects across all conditions, we followed the recommendation of Higgins and Altman (2008) by making deliberate efforts to avoid introducing potential bias in the meta-analytic results by coding and taking into consideration the time lags, outcomes, and experimental/control conditions of the individual studies in our reported statistical analyses. To mitigate the risk of bias, we also corrected the effect sizes of individual studies for measurement error – a feature that Bélanger-Gravel et al. (2011) have identified as important to consider in future meta-analyses. Finally, we coded all of the experimental studies for study quality in order to help readers evaluate the potential risk of bias currently attached to the experimental planning literature for PA. These unique conceptual, theoretical, and methodological features should maximize the novelty and significance of the synthesis offered in the current meta-analysis.

### **Mediation: Testing Theoretical Postulates**

Research on the motivational determinants of health behavior has clearly elucidated the predictors of intention (see Conner & Norman, 2005 for a review). Less is known, however, about post-intentional processes such as the specific working mechanisms between intention and behavior. Planning has been proposed as an effective means of translating intention into

action by initiating goal directed behaviors and shielding them from obstacles (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006). In support of this proposition, studies have shown that AP partially mediates the relation between intention and PA (Norman & Conner, 2005, Study 2; Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008; Sniehotta, Scholz, & Schwarzer, 2005), though other studies have not supported this hypothesis (e.g., Norman & Conner, 2005, Study 1).

Beyond these mixed results, another important conceptual issue concerns the specific role of CP in the sequence from intention to PA. The *Health Action Process Approach* (HAPA; Schwarzer, 2008), a prominent theory of health behavior, places AP and CP on an equal plane—that is, both are theorized as proximal determinants of behavior initiation. As depicted in Figure 1a, neither form of planning precedes the other in the HAPA model. Rather, AP and CP are conceived as two distinct mediators likely to respectively transfer the influence of intention on PA in a pattern hereafter referred to as a *dual mediation model*. This model predicts that both AP (controlling for CP) and CP (controlling for AP) should uniquely mediate the relation between intention and PA.

Conversely, Sniehotta (2009) and Sniehotta, Schwarzer, et al. (2005) have argued that AP temporally precedes CP. Accordingly, it could be reasoned that AP exerts its influence earlier in the behavior change process by facilitating the initiation of action. Coping planning, on the other hand, should be more influential later in the behavior change process, once individuals have accrued sufficient experience to identify relevant barriers. On the basis of this reasoning, AP and CP would be chronologically ordered in a model hereafter referred to as a *sequential mediation model* (Taylor, MacKinnon, & Tein, 2008). Such a model predicts that the relation between intention and PA is mediated by a temporal sequence in which intention initially

facilitates the formation of AP, which eventually leads to the creation of CP likely to positively influence PA (see Figure 1b). Given the above, the second goal of this review was to use the summary effects derived from the correlational data to examine two meta-analytic path models: (a) a dual mediation model and (b) a sequential mediation model.

### **Moderation: Testing Possible Boundary Conditions**

In addition to estimating summary effects and testing mediation, the third aim of this review was to investigate theoretically based moderators which could act as potential boundary conditions of the effects of spontaneous and experimentally induced AP and CP. Specifically, moderation analyses were performed separately on the summary effect sizes from the correlational and experimental studies to determine whether they respectively vary as a function of the following factors:

- a) *Action planning composition*. The question of whether a greater number of components included in the action plans yields stronger effects than less specific action plans—as reported in at least two recent studies (Gollwitzer, Wieber, Myers, & McCrea, 2010; van Osch, Lechner, Reubsaet, & De Vries, 2010)—was explored;
- b) *Time lag*. The time lag between assessment points was investigated to determine whether the effect of planning diminishes with the passage of time, as was demonstrated in one small-scale meta-analytic study of planning for self-set goals (Koestner, et al., 2006);
- c) *Intention*. Stage theories like the *Model of Action Phases* (Heckhausen & Gollwitzer, 1987) posit that planning for a specific behavior should only be effective if the individual actually intends to perform that behavior. Previous research has shown that AP and CP tend to be more effective for individuals who have formed intentions to act than in those with lower

levels of intentions (Norman & Conner, 2005; Sheeran, Webb, & Gollwitzer, 2005).

However, as observed by Shüz, Sniehotta, Mallach, Wiedemann, and Schwarzer (2009), there is mounting evidence that planning processes are important throughout all levels of intention. For example, Shüz et al. found that AP was the sole significant predictor of transitioning from pre-intentional to intentional stages of interdental hygiene, thus indicating that planning might facilitate health behaviors even when people have yet to form strong behavioral intentions. Also, some studies have failed to report a significant interaction between intention and planning (e.g., Sniehotta, Schwarzer, et al., 2005), thus suggesting that the salutary impact of AP and CP may not be limited to people in the more advanced stages of change. Therefore, this meta-analysis will reexamine the moderating role of intention in the relation of AP with PA.

- d) *Age*. Both AP and CP interventions have been found to significantly increase PA in rehabilitation patients of varying ages (Sniehotta, et al., 2006; Ziegelmann, et al., 2006). However, remembering to perform future actions has been found to be sensitive to age (Park, 1999). Therefore, it seemed important to examine the moderating effect of age because diminishing executive function may make it more difficult to remember specified plans later in life.
- e) *Sample type*. Gollwitzer and Sheeran (2006) reported consistent effects of planning across various types of samples (i.e., students, members of the general public, individuals suffering from a physical illness). Nevertheless, the strength of the AP and/or CP effects may vary according to whether participants were *healthy* or had suffered some form of physical ailment requiring *rehabilitation*.

Additional moderators were only tested in the experimental studies, either because they were only relevant in an intervention-based context (i.e., mode of delivery of planning intervention), or because the data to be abstracted was only available in the experimental studies (i.e., sample type [active versus sedentary], coping planning approach, outcome type, and publication status). The potential moderating role of *mode of delivery of the planning intervention* (e.g., paper-and-pencil, interviewer-assisted) was tested as was an additional *sample type* variable, that is, whether study participants were considered *active* or *sedentary* prior to the planning intervention. The potential moderating role of the *coping planning approach used* in experimental conditions was also examined to test whether effect size varied according to whether coping plans were *nomothetic* (i.e., anticipated barriers suggested by the experimenter or imbedded in self-report questionnaires) or *idiographic* (i.e., barriers identified by participants themselves). Other moderators tested included *outcome type*, in light of a study by Roberts, Maddison, Magnusson, and Prapavessis (2010) which found that AP explained 30% variance in self-reported PA, but a mere 6% in objective PA behavior, and *publication status*, given the upward bias of published studies (e.g., Rosenthal, 1995). These two moderators were not tested in the correlational studies because all the correlational studies were published and reported subjective outcome information.

## Method

### Eligibility Criteria

A study was considered for inclusion in this review if it met the following criteria: (a) measured (i.e., correlational) or induced (i.e., experimental) planning as an antecedent (i.e., any type of AP or CP comprised of such components as *when*, *where*, or *how* an action is to be

performed and/or the ways in which barriers to goal attainment are to be overcome); (b) contained PA as an outcome (i.e., any objective or self-reported exercise behavior or progress on a PA goal); (c) had independent effect size(s) that could be transformed into Pearson's  $r$ , and (d) was written in French or English. No restrictions were placed on country, type of population, or publication status. Studies reporting only the results of regression analyses were deemed ineligible and were therefore excluded.

### **Search Strategy**

A literature search was performed in PsycINFO, Medline, PsycARTICLES, MEDLARS, Social Science Index, Index Medicus, SPORTDiscus, Physical Education Index, Système Universitaire de Documentation, Web of Science, Conference Papers Index, and Dissertation Abstracts International for all available years up to February 2010. Keywords used were *implementation intention(s)*, *implementation plan(s, ning)*, *planning*, *action plan(s, ning)*, *coping plan(s, ning)*, *PA*, *exercise behavior*, *physical exercise*, and *active living*. Authors who published more than one article on planning for PA were contacted to request relevant works. Manual cross-referencing of bibliographies was also completed.

### **Screening and Data Abstraction**

Studies were initially screened by the first author (N.C.) based on the title, abstract, and key words. Relevant studies were subsequently read in their entirety and deemed eligible or ineligible by two independent reviewers (N.C. and P.G./Michelle Downie for the correlational studies; N.C. and Michelle Dugas) for the experimental studies; see Figure 2). Data were extracted using a pre-defined coding scheme (Appendix A in the supplementary file). Any and all discrepancies were noted and discussed by the coders until 100% agreement was reached.

From 225 initial abstracts obtained from the search, 154 abstracts were excluded at the outset because they either did not pertain to action/coping planning and physical activity or were duplicates, thus leaving 71 full text papers containing 76 independent samples. Thirty-three *correlational studies* were retrieved containing 37 independent samples, of which 19 met inclusion criteria (see Figure 2). Thirty-eight *experimental studies* were retrieved containing 39 independent samples, of which 21 met inclusion criteria (see Figure 2). The extracted effect size data and associated information from the 19 correlational and 21 experimental samples included in the meta-analysis are displayed in Tables 1 and Table 2, respectively. Finally, given the importance of assessing the possible risk of bias in intervention studies, the 21 experimental studies were coded for study quality using the Cochrane method (Higgins & Altman, 2008). The study quality coding can be found in Appendix B of the supplementary file.

### **Statistical Procedure**

First, a set of statistically independent effect sizes was gathered. If a study reported more than one effect size per construct of interest, either a single effect size was selected or an average effect size was computed. As outlined by Higgins and Altman (2008), there may be different time points at which a specific outcome has been measured, or there may be different instruments used to measure outcome at the same time point. We conducted separate analyses using the effect sizes for the shortest delay (e.g., Time 1 → Time 2), the longest delay (e.g., Time 1 → Time 3), and the average delay across all time points. This procedure ensured that only one independent effect size per study was included in any given analysis while taking full consideration of the multiple time points available in longitudinal studies. Analyses for the average time delay included both concurrent and prospective planning-PA relations whereas

the analyses for the shortest and longest delays included only the prospective planning-PA relations. Also, if a single sample reported more than one PA outcome (e.g., one objective and one subjective, two subjective) the effect sizes associated with each outcome were either combined for summary effect analyses or analyzed separately in analyses looking at the moderating role of outcome type. Pearson's  $r$  and Cohen's  $d$  were selected as the effect size statistics for the correlational and experimental studies, respectively. However,  $d$  values are presented in  $r$  format in this review so as to facilitate comparisons across experimental and correlational studies.  $R$  values of .10, .30, and .50 are considered to be small, medium, and large, respectively (J. Cohen, 1988).

Using the method of Lipsey and Wilson (2001), fixed- and random-effects meta-analysis was performed using proper procedures for weighting (by sample size), transformation (to Fisher's  $Z$ ), and correction for measurement error. For the correlational studies, measurement error in both variables contributing to the correlation was corrected; for the experimental studies, measurement error in the dependent variable was corrected (Fan, 2003). All corrections were based on the reliability coefficients (i.e.,  $\alpha$  or  $r$ ) reported in the studies or a published validation study for the measure. In cases with single or missing reliabilities,  $r = .70$ —a conservative yet acceptable judgment of reliability (J. Cohen & Cohen, 1983)—was used as done in Rhodes et al. (2009). In cases where only standardized factor loadings were available, the method of Hancock (2001) was used to calculate a reliability coefficient. When effect sizes were already corrected for unreliability (i.e., derived from SEM), no further correction for measurement error was applied. This procedure yielded fully corrected estimates ( $\phi$ ).

95% confidence intervals ( $CI_{95}$ ) were calculated. Both  $Q$  and  $I$ -squared statistics were used to determine the heterogeneity of the summary effects. Whereas  $Q$  speaks to the presence versus absence of heterogeneity, the  $I$ -squared index *quantifies* the dispersion.  $I^2$  values of 25, 50, and 75 are considered low, moderate, and high, respectively (Higgins & Thompson, 2002). A fail-safe sample size ( $N_{FS}$ ) was computed as a way of ruling out publication bias. The fail-safe  $N$  denotes the number of unpublished studies with null results that would be needed to reduce a statistically significant meta-analytic result to a trivial value, which refers to the smallest effect deemed to be of substantive importance (defined herein as .10; Rosenberg, 2005). Moderators were tested using weighted regression analysis (i.e., meta-regression) for continuous variables and subgroup analysis with  $Q_{b/w}$  for categorical variables. The above analyses were computed using Comprehensive Meta-Analysis 2.0 (Borenstein, Hedges, Higgins, & Rothstein, 2005).

### **Summary Effect Computation**

As previously mentioned, correlational and experimental studies examine distinct volitional processes: spontaneous and experimentally induced planning. Therefore, separate summary effect sizes were computed for the correlational and experimental studies. This approach was deemed more prudent than calculating an overarching summary effect (all correlational and experimental studies together) in order to prevent researchers from misleadingly citing an overly inclusive effect size. Similarly, theoretical rationale and empirical studies have proposed and found AP and CP to be conceptually and factorially distinct (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005; Ziegelmann, et al., 2006). Therefore, summary effects were computed separately for spontaneous AP and CP in the correlational studies. Whereas AP and CP were often measured/computed separately in the correlational

studies (using subscales of self-report measures), they tended to be included in the same experimental conditions in the experimental studies. Hence, it was not possible to create “pure” comparisons between experimental conditions involving AP only and their respective controls or CP only and their respective controls. As an alternative, moderation analyses were performed on the experimental data to determine whether experimental conditions whose AP composition included items tapping CP were different than the experimental conditions whose AP composition did not include items tapping CP.

### Testing Mediation

Using the procedure of Viswesvaran and Ones (1995), two mediation models were tested using the correlational meta-analytic data (see Figures 1a and 1b). First, a matrix was created using the meta-analytically-derived correlations. The matrix for the *dual mediation model* included concurrent correlations (e.g., Time 1 AP to Time 1 PA); the matrix for the *sequential mediation model* included all prospective correlations (e.g., Time 1 AP to Time 2 PA). Next, the harmonic mean of the sample sizes was computed using the formula  $N / (1/a_1 + 1/a_2 + 1/a_3 + 1/a_4 + \dots + 1/a_N)$  where  $a$  = the individual effect size and  $N$  = the sample size. This provides the most conservative  $N$  value for the analysis. The resultant matrix and harmonic mean were then used to run the path analytic model using the Mplus 6.04 software (Muthén & Muthén, 1998-2010), allowing for the decomposition of the total effect of the independent variable on the dependent variable into its direct and indirect effects (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Even with the more conservative harmonic mean, a stringent alpha of  $p < .01$  was used.

### Testing Moderation

For the correlational data, moderation analyses were conducted separately for AP and CP. At times, it was not possible to test certain moderating factors using the CP summary effect due to an insufficient number of studies. Moderation analyses involving *group comparisons* can be performed when only one sample is available in any particular condition, whereas *meta-regression* analyses, by definition, require more than one sample to be performed. For both the correlational and experimental data, when group comparisons were performed and only one sample was available for a given comparison group, we performed the analysis and highlighted the need for caution in interpreting the results. When meta-regression was performed and only one sample was available, we did not perform the analysis and highlighted the fact that it was impossible for us to do so. Additional details regarding some specific analyses are presented in the results section to facilitate interpretation of moderating analyses.

## Results

### Correlational Studies

**Summary effects.** The summary effects for all bivariate relationships are displayed in Table 1 for the average, shortest, and longest time delays. The fully corrected summary effect for the AP to PA relationship was .41 for the average time delay (see Table 3, section 1). The fail-safe *N* value showed that 64 studies reporting null results would be needed to reduce this estimate to a trivial value. The summary effect was highly variable,  $Q(18) = 113.63, p < .05, I^2 = 84.16$ , suggesting the presence of moderating variables. The fully corrected summary effect for the relation between CP and PA was .38 for the average time delay (see Table 3, section 2). The fail-safe *N* showed that 18 null effects would be needed to reduce the finding to a trivial value.

Heterogeneity tests showed significant variation in the individual effect sizes,  $Q(5) = 17.51, p < .05, I^2 = 71.45$ , justifying moderation analyses that could explain this variability. Finally, the fully corrected summary effect for the relation between AP and CP was .61 for the average time delay (see Table 3, section 3). The fail-safe  $N$  showed that 31 null effects would be needed to reduce the finding to a trivial value. Heterogeneity tests showed significant variation in the individual effect sizes,  $Q(4) = 30.70, p < .05, I^2 = 86.97$ .

**Mediation.** The meta-analytically derived correlation matrix used in each mediation model is presented in the supplementary file (see Appendix D). Results of the *dual mediation meta-analytic path model* (Figure 2a) revealed that intention significantly predicted PA (i.e., total effect) as well as AP and CP which, in turn, each predicted PA. Action planning and CP were also positively related. After accounting for planning, the relation between intention and PA was reduced but remained significant (direct effect  $\beta = .22, p < .01$ ). More importantly, the specific indirect effects of intention through AP ( $\beta = .08, p < .01$ ) and CP ( $\beta = .04, p < .01$ ) were both significant. Thus, both the AP and CP mediational pathways are uniquely predictive of PA.

Results of the *sequential mediation meta-analytic path model* (Figure 2b) showed that intention significantly predicted PA (i.e., total effect) as well as AP but not CP. Action planning significantly predicted CP and PA. CP was also a significant predictor of PA. After accounting for planning, the relationship between intention and PA decreased but remained significant (direct effect  $\beta = .21, p < .01$ ). The specific indirect effect of AP in the relation between intention and PA was significant ( $\beta = .09, p < .01$ ), whereas the indirect effect of CP was not significant ( $\beta = -.007, p > .01$ ). Of note, the indirect effect of a sequence from intention to AP to CP to PA was significant ( $\beta = .04, p < .01$ ). Moreover, the specific indirect effect of CP in the relation between

AP and PA was also significant ( $\beta = .11, p < .01$ ). Hence, while CP alone did not mediate the relation between intention and PA, the prospective sequence from AP to CP to PA was responsible for transmitting the effect of intention on PA.

### **Moderation.**

**AP composition.** To test whether the *type* and *number* of planning components moderated the observed effects, the exact planning items used in each study were coded (see Appendix C in supplementary file). AP was defined as containing the following components: *What* (e.g., To what extent did you make specific plans regarding what to do to be physically active over the last  $x$  weeks?), *when* (e.g., time of day and/or day of week), *where*, *with whom*, and *how to carry out the intention* (e.g., To what extent did you make specific plans regarding how to reach your goal?). CP was defined as consideration of how to overcome barriers, obstacles, temptations, or distractions. Based on this operational definition, three subgroups of studies were created, measuring either: *pure action planning* (see Table 3, section 1), *pure coping planning* (see Table 3, section 2), or *combined action planning and coping planning* (see below).

Using the average time delay, no significant differences emerged between studies measuring pure AP ( $\Phi = .41, CI = .39 - .44, Q(18) = 113.63, p < .05, I^2 = 84.16$ ) and those measuring combined AP and CP ( $\Phi = .43, CI = .38 - .47, Q(2) = 101.65, p < .05, I^2 = 98.03$ ). Regarding the number of AP components, a weaker effect ( $Q_{b/w}(3) = 13.54, p < .05$ ) was reported in studies in which the AP measure contained two ( $\Phi = .22, CI_{95} = .02 - .40, Q(0) = 0, p = .036, I^2 = 0.00$ ) compared to four ( $\Phi = .41, CI_{95} = .38 - .45, Q(10) = 47.64, p < .05, I^2 = 79.00$ ) or

five components ( $\Phi = .44$ ,  $CI_{95} = .40 - .49$ ,  $Q(5) = 52.46$ ,  $p < .05$ ,  $I^2 = 90.45$ ). This result should be interpreted with caution, because only one sample contained AP with two components.

**Time lag.** The effect size of each study was examined on the basis of the shortest delay (e.g., Time 1 to Time 2) and the longest delay (e.g., Time 1 to Time 3). In the analyses pertaining to the shortest delay, the average time lag between AP and PA was 7.80 weeks ( $SD = 6.04$ ). Results of meta-regression analyses indicated that time lag was not a significant moderator of the relation between AP and PA when based on the shortest time delay ( $\beta_1 = -.0005$ ,  $p = .82$ ,  $\beta_0 = .42$ ). In the analyses pertaining to the longest delay, the average time lag between AP and PA was 9.23 weeks ( $SD = 7.27$ ). In these analyses, time lag significantly reduced the strength of the relation between AP and PA ( $\beta_1 = -.008$ ,  $p < .05$ ,  $\beta_0 = .53$ ;  $Q(1) = 10.95$ ,  $p < .05$ ).

The average time lag between CP and PA was 10.75 weeks ( $SD = 7.63$ ) in the analyses pertaining to the shortest delay whereas it was 16.25 weeks ( $SD = 7.68$ ) in the analyses for the longest delay. Results indicated that time lag was not a significant moderator in the relation between CP and PA using either the shortest ( $\beta_1 = .003$ ,  $p = .80$ ,  $\beta_0 = .36$ ) or the longest time delays ( $\beta_1 = -.006$ ,  $p = .25$ ,  $\beta_0 = .42$ ).

**Age.** The average age of the sample was coded in each of the studies. Meta-regression revealed that mean sample age had a significant attenuating influence on the AP to PA relation in the analyses pertaining to the shortest ( $\beta_1 = -.007$ ,  $p < .05$ ,  $\beta_0 = .72$ ;  $Q(1) = 34.96$ ,  $p < .05$ ) and longest delays ( $\beta_1 = -.007$ ,  $p < .05$ ,  $\beta_0 = .74$ ;  $Q(1) = 34.58$ ,  $p < .05$ ). Hence, for every one-year increase in the age of a sample, the AP to PA relation reduced by a value of .007. For CP, age was a significant moderator only when considering the longest time delays (shortest:  $\beta_1 = -.001$ ,  $p = .65$ ,  $\beta_0 = .43$ ; longest:  $\beta_1 = -.006$ ,  $p < .05$ ,  $\beta_0 = .64$ ;  $Q(1) = 8.97$ ,  $p < .05$ ).

**Intention.** The mean sample score of intention was noted in each of the studies. Because studies have used different rating scales, the value of each study was transformed on a percentage scale (i.e., mean divided by scale upper bound multiplied by 100). These values were also squared to test quadratic effect of intention. The mean level of intention across the samples was high ( $M = 83.82$ ,  $SD = 7.38$ , range = 62.57 – 96.75). Weighted regression (i.e., weighted by the sample size of each sample) was performed using intention as a predictor and the fully corrected effect size of the AP to PA relation using the average time delay. Results revealed that intention was a significant moderator of the AP to PA relation; as intention scores increased, the strength of the observed relation decreased ( $\beta = - 5.02$ ,  $p < .05$ ,  $R^2 = .52$ ). Further, results showed that the moderating influence of intention was best modeled in quadratic terms ( $\beta = 4.30$ ,  $p < .05$ ,  $\Delta R^2 = .07$ ). This result indicates that the strength of the AP to PA relation was stronger for samples with lower levels of behavioral intention compared to samples with moderately high levels of behavioral intention (90<sup>th</sup> point on the percent scale). The relation between AP and PA was nonetheless stronger from samples with highest values of behavioral intention compared to those with moderately high values of behavioral intention<sup>1</sup>.

**Sample type: Rehabilitation status.** Studies were divided in two groups on the basis of whether they contained a normative sample (i.e., university students, white collar workers, and Internet users) or a rehabilitation sample (i.e., people in orthopedic or cardiac rehabilitation). Using the average time delay, results indicated that the magnitude of the effect size between AP and PA was significantly greater in the normative ( $\Phi = .45$ ,  $CI_{95} = .41 - .48$ ,  $Q(10) = 88.25$ ,  $p <$

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<sup>1</sup> The potential moderating role of intention on the strength of the CP-PA relation was not tested, as this has not been postulated in the literature.

.05,  $I^2 = 88.67$ ) as compared to the rehabilitation samples ( $\Phi = .36$ ,  $CI_{95} = .32 - .40$ ,  $Q (7) = 14.41$ ,  $p < .05$ ,  $I^2 = 51.46$ ;  $Q_{b/w} (1) = 10.96$ ,  $p < .05$ ).

Regarding the CP to PA relation, no significant difference was found between the normative and rehabilitation samples using the average time delay (normative:  $\Phi = .36$ ,  $CI_{95} = .28 - .44$ ,  $Q (2) = 1.09$ ,  $p = .58$ ; rehabilitation:  $\Phi = .39$ ,  $CI_{95} = .33 - .45$ ,  $Q (2) = 15.95$ ,  $p < .05$ ,  $I^2 = 87.46$ ;  $Q_{b/w} (1) = 0.47$ ,  $p = .49$ ). Note that this result should be interpreted with caution as the rehabilitation group contained only one sample.

### Experimental Studies

**Summary effects.** The fully corrected summary effects for the experimental studies are displayed in Table 4. The type of experimental and control conditions in these studies could influence the results obtained and were thus coded and categorized in the following manner. Some experimental conditions involved interventions with *multiple components* (e.g., SMS reminders, self-monitoring) in addition to planning (see sections 1, 2, and 3 of Table 4). Other experimental conditions (see section 4 of Table 4) involved interventions that were *purely planning based* (i.e., AP only, CP only, or both). Regarding control conditions, some contained potentially *active* components (e.g., psychoeducation, decisional balance sheet), which might reduce the size of the summary effect (see section 2 of Table 4). Conversely, other control conditions were *neutral* (e.g., crossword puzzle, no task at all), which might increase the size of the summary effect (see section 2 and 4 of Table 4). Finally, all results are presented for *All Experimental versus All Control* conditions (see section 1 of Table 4), which provides an estimate for the comparison between all experimental conditions (regardless of whether they contain multiple interventions or planning only) and all control conditions (regardless of

whether they are active or neutral) in order to leverage as much of the data as possible. In addition, all results are presented for *Purely Planning conditions versus Neutral Control* conditions to isolate more precisely the effect of planning (see section 4 of Table 4). Of note, no samples included a purely planning condition versus an active control condition.

As shown in section 1 of Table 4, meta-analysis of the 21 samples that compared *All Experimental Conditions* (i.e., multi-component interventions that included planning or purely planning interventions) with *All Control Conditions* (i.e., active or neutral control conditions that did not include planning) revealed a small summary effect based on the average time delay (fixed:  $\phi = .12$ ,  $CI_{95} = .10 - .15$ ) with a fail-safe  $N$  of 6. Heterogeneity test revealed high variability in the individual effect sizes,  $Q(20) = 73.89$ ,  $p < .05$ ,  $I^2 = 72.93$ .

Different types of control groups—whether they contain neutral or active interventions—could also influence the effect of AP and CP on PA. As shown in sections 2 and 3 of Table 4, stronger effects were reported when *All Experimental Conditions* were compared to control conditions that involved neutral activities (fixed:  $\phi = .14$ ,  $CI_{95} = .11 - .18$ ) rather than active components (fixed:  $\phi = .12$ ,  $CI_{95} = .08 - .17$ ).

Finally, to isolate the impact of planning on PA, meta-analysis of the nine studies that compared *Purely Planning Conditions* to *Neutral Control Conditions* was performed (see section 4 of Table 4). Results indicated a small effect of planning on PA using the average time delay (fixed:  $\phi = .07$ ,  $CI_{95} = .03 - .12$ ). The fail-safe  $N$  could not be computed as the effect size was lower than the pre-determined trivial value. Again, a high degree of heterogeneity was found,  $Q(8) = 43.20$ ,  $p < .05$ ,  $I^2 = 81.48$ .

**Quality.** The inter-coder reliability for the quality coding was 90%. Results, which are

presented in Appendix B of the supplementary file, indicated that 82% of the codes were marked “unclear”; 17% were marked “yes”, indicating a low risk of bias; and, 1% were marked “no”, indicating a high risk of bias. Overall, an *unclear risk of bias* was found in the experimental studies. Across these studies, most of the information obtained was from studies at low or unclear risk of bias. This indicates a plausible risk of bias that raises some doubt about the experimental results. In other words, this plausible risk of bias should be considered when interpreting the meta-analytic findings, as it somewhat lowers confidence in the estimated effect.

### **Moderation<sup>2</sup>.**

**AP composition.** Using the comparisons for *All Experimental Conditions* versus *All Control Conditions*, it was found that the interventions containing four AP components ( $\phi = .18$ ,  $CI_{95} = .13 - .23$ ) yielded significantly greater effect sizes than those including three components ( $\phi = .04$ ,  $CI_{95} = -.02 - .09$ ;  $Q_{b/w}(1) = 15.06$ ,  $p < .01$ ), but not two components ( $\phi = .15$ ,  $CI_{95} = .10 - .20$ ;  $Q_{b/w}(1) = 0.79$ ,  $p = .38$ ). Also, AP interventions with two components yielded significantly greater effect sizes than those with three components ( $Q_{b/w}(1) = 9.18$ ,  $p < .01$ ). Changing the unit of analysis (Cooper, 2010), no significant difference was found between interventions that included CP ( $\phi = .13$ ,  $CI_{95} = .08 - .17$ ) and those that did not ( $\phi = .12$ ,  $CI_{95} = .09 - .16$ ).

Using the comparisons between *Purely Planning Conditions* and *Neutral Control Conditions*, AP with four components ( $\phi = .10$ ,  $CI_{95} = .04 - .17$ ) yielded significantly greater effect sizes than those with three components ( $\phi = -.05$ ,  $CI_{95} = -.13 - .02$ ;  $Q_{b/w}(1) = 9.64$ ,  $p <$

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<sup>2</sup> All moderation analyses were performed on *All Experimental Conditions* versus *All Control Conditions* (Table 4, section 1) and *Purely Planning Conditions* versus *Neutral Control Conditions* (Table 4, section 4) for the sake of parsimony.

.01). However, interventions containing two components ( $\phi = .37$ ,  $CI_{95} = .24 - .48$ ) reported significantly greater effect sizes than those with three ( $Q_{b/w} (1) = 30.67$ ,  $p < .01$ ), or four components ( $Q_{b/w} (1) = 12.90$ ,  $p < .01$ ). Changing the unit of analysis, the results demonstrated no significant difference between interventions that included CP ( $\phi = .07$ ,  $CI_{95} = .02 - .13$ ) and those that did not ( $\phi = .07$ ,  $CI_{95} = -.007 - .15$ ).

**Time Lag.** Meta-regression was used to elucidate whether the summary effect for *All Experimental Conditions* versus *All Control Conditions* varied as a function of time lag. No moderating influence of time lag was found using the shortest ( $\beta_1 = .0004$ ,  $p = .68$ ,  $\beta_0 = .11$ ) or longest time delays ( $\beta_1 = .0008$ ,  $p = .41$ ,  $\beta_0 = .12$ ). Using the comparison between *Purely Planning Conditions* and *Neutral Control Conditions*, the effect of the purely planning interventions became stronger with increasing time lag when considering the shortest time delay ( $\beta_1 = .02$ ,  $p < .05$ ,  $\beta_0 = -.01$ ), but not the longest delay ( $\beta_1 = .003$ ,  $p = .20$ ,  $\beta_0 = .03$ ).

**Age.** Weighted regression analysis was used to test whether the summary effect of *All Experimental Conditions* versus *All Control Conditions* varied as a function of mean sample age. Results indicated no moderating influence of mean age ( $\beta_1 = .0006$ ,  $p = .56$ ,  $\beta_0 = .12$ ). Similar results were found when meta-regressing age on the comparison between *Purely Planning Conditions* and *Neutral Control Conditions* ( $\beta_1 = .001$ ,  $p = .47$ ,  $\beta_0 = .06$ ).

**Intention.** Weighted regression analysis was used to test whether the summary effect of *All Experimental Conditions* versus *All Control Conditions* varied as a function of intention. Results revealed no significant moderating effect of intention ( $\beta_1 = .03$ ,  $p = .86$ ,  $\beta_0 = .08$ ). Similar results were found when meta-regressing intention on the comparison between *Purely Planning Conditions* and *Neutral Control Conditions* ( $\beta_1 = .23$ ,  $p = .37$ ,  $\beta_0 = -.16$ ).

**Sample type: Rehabilitation status.** Results indicated no significant difference ( $Q_{b/w}(1) = 2.15, p = 0.14$ ) between the effect sizes for interventions administered to rehabilitation samples ( $\phi = .17, CI_{95} = .10 - .23$ ) compared to normative samples ( $\phi = .11, CI_{95} = .08 - .15$ ) when comparing *All Experimental Conditions* versus *All Control Conditions*. Analyses comparing *Purely Planning Conditions* to *Neutral Control Conditions* yielded similar findings, with no significant difference in effect size ( $Q_{b/w}(1) = 2.32, p = 0.13$ ) between the rehabilitation samples ( $\phi = .12, CI_{95} = .04 - .19$ ) and the normative samples ( $\phi = .04, CI_{95} = -.02 - .10$ ).

**Sample type: Previous level of PA.** Six studies were classified as containing sedentary samples whereas the remaining 15 studies did not specify participants' previous level of PA. Presumably, the 15 studies with unspecified previous behavior contain a mixture of sedentary and non-sedentary participants. Results pointed to a significantly greater effect size ( $Q_{b/w}(1) = 17.42, p < .01$ ) for sedentary ( $\phi = .29, CI_{95} = .21 - .37$ ) compared to the "mixed" samples ( $\phi = .10, CI_{95} = .07 - .13$ ) when comparing *All Experimental Conditions* versus *All Control Conditions*. Analogous results were found using *Purely Planning Conditions* vs. *Neutral Control Conditions*, with sedentary samples ( $\phi = .32, CI_{95} = .21 - .43$ ) reporting significantly greater effect sizes than mixed ( $\phi = .03, CI_{95} = -.03 - .08; Q_{b/w}(1) = 20.80, p < .01$ ).

**Mode of delivery of intervention.** Studies comparing *All Experimental Conditions* versus *All Control Conditions* were grouped according to whether their interventions involved solitary paper and pencil exercises ( $\phi = .09, CI_{95} = .06 - .13$ ) or interviewer-assisted exercises ( $\phi = .23, CI_{95} = .17 - .29$ ). Results indicated a significant difference between the two groups ( $Q_{b/w}(1) = 15.59, p < .01$ ), with assisted plans showing a greater effect size. Similar results were found using *Purely Planning Conditions* versus *Neutral Control Conditions*, with assisted plans ( $\phi = .19,$

$CI_{95} = .07 - .30$ ) showing a greater effect size than interventions using paper-and-pencil planning exercises ( $\phi = .05$ ,  $CI_{95} = -.001 - .10$ ;  $Q_{b/w} (1) = 4.45$ ,  $p < .05$ ).

**CP approach.** Samples including CP were separated into two groups according to whether the plans were idiosyncratic (set by participants themselves) or nomothetic (proposed by the researcher or imbedded in the questionnaire). Analysis of the studies comparing *All Experimental Conditions* versus *All Control Conditions* showed no significant difference between idiosyncratic ( $\phi = .12$ ,  $CI_{95} = .07 - .17$ ) and nomothetic ( $\phi = .16$ ,  $CI_{95} = .04 - .28$ ;  $Q_{b/w} (1) = 0.28$ ,  $p = .60$ ) coping plans (Cooper, 2010). Results also demonstrated no significant difference between interventions that included CP ( $\phi = .13$ ,  $CI_{95} = .08 - .17$ ) and those that did not ( $\phi = .12$ ,  $CI_{95} = .09 - .16$ ). With regard to the *Purely Planning Conditions* versus *Neutral Control Conditions*, all studies involved planning interventions containing CP in which barriers were idiosyncratic ( $\phi = .07$ ,  $CI_{95} = .01 - .13$ ). Again, no significant difference was found between interventions that included CP ( $\phi = .07$ ,  $CI_{95} = .02 - .13$ ) and those that did not ( $\phi = .07$ ,  $CI_{95} = -.007 - .15$ ).

**PA outcome.** Shifting the unit of analysis (Cooper, 2010), and using the comparison between *All Experimental Conditions* versus *All Control Conditions*, results indicated that the effect of planning interventions did not differ according to whether outcomes were assessed objectively ( $\phi = .15$ ,  $CI_{95} = .07 - .23$ ) or subjectively ( $\phi = .11$ ,  $CI_{95} = .08 - .14$ ). Analysis of the *Purely Planning Conditions* versus *Active Control Conditions*, yielded similar results, with no significant difference in effect sizes for studies in which PA was measured subjectively ( $\phi = .06$ ,  $CI_{95} = .02 - .11$ ) versus objectively ( $\phi = .05$ ,  $CI_{95} = -.04 - .15$ ).

**Publication status.** Comparison of *All Experimental Conditions* versus *All Control*

*Conditions* showed that the effect of planning interventions in published studies ( $\phi = .13$ ,  $CI_{95} = .10 - .16$ ) was significantly greater than those reported in unpublished studies ( $\phi = .02$ ,  $CI_{95} = .09 - .13$ ;  $Q_{b/w} (1) = 4.07, p < .05$ ). In conditions comparing *Purely Planning Conditions* to *Neutral Control Conditions*, no significant difference was observed between published ( $\phi = .08$ ,  $CI_{95} = .03 - .13$ ) and unpublished studies ( $\phi = .04$ ,  $CI_{95} = -.08 - .15$ ;  $Q_{b/w} (1) = .41, p = .52$ ).

**Discussion**

The primary aims of this meta-analysis were to (a) provide specific summary effects for AP and CP for PA, (b) test key theoretical postulates using meta-analytical path analysis, and (c) examine boundary conditions via theoretically driven moderation analyses. Over 150 effect sizes from 19 correlational and 21 experimental studies were reviewed. This review offers the first meta-analytic estimates of *both* spontaneous and experimentally induced planning for *both* AP and CP in the PA domain, while supporting the role of both spontaneous AP and CP as mediators in the relation between intention and PA.

**Summary Effects**

Among the correlational studies, fixed effect meta-analysis correcting for sampling error and measurement bias revealed a medium-to-large summary effect of both spontaneous AP ( $\phi = .41$ ,  $CI_{95} = .39 - .44$ ) and CP ( $\phi = .38$ ,  $CI_{95} = .33 - .43$ ). Notably, the summary effects for AP and CP are similar and not significantly different, highlighting the importance of each form of planning in facilitating PA. Among the experimental studies, fixed effect meta-analysis indicated a small fully corrected summary effect ( $\phi = .12$ ,  $CI_{95} = .10 - .15$ ) when comparing all

experimental conditions versus all controls, and a small summary effect ( $\phi = .07$ ,  $CI_{95} = .03 - .12$ ) when comparing purely planning conditions versus neutral controls.

Also notable among the experimental studies is the low to unclear quality of the individual studies. For example, in many studies, the type and or the process by which randomization was conducted was not explicitly reported. Also, it is important to report that all of randomized control trials were unregistered. The low to unclear quality of the experimental studies included in this review introduces a plausible risk of bias that should be considered when interpreting the meta-analytic findings because it somewhat lowers confidence in the estimated effect. Future studies should aim to improve the quality of their studies (i.e., improved randomization, allocation concealment, etc.) by making a specific effort to clearly report their procedures to facilitate the design of future research and the work of policy makers evaluating the effectiveness of planning interventions.

Previous meta-analyses on implementation planning for various behaviors (Gollwitzer & Sheeran, 2006,  $d = .65$ ,  $r = .31$ ) and self-set goals (Koestner, Lekes, Powers, & Chicoine, 2002,  $d = .54$ ;  $r = .26$ ) have reported medium effects. Similar results were found in prior meta-analyses examining a mixture of health behaviors with minimal representation of PA (Gollwitzer & Sheeran, 2006,  $d = .59$ ,  $r = .28$ ; Sheeran, 2002,  $d = .70$ ,  $r = .33$ ). Adriaanse et al. (2011) also found a medium effect of planning for promoting healthy eating ( $d = 0.51$ ,  $r = .25$ ). Bélanger-Gravel, et al. (2011), in their recent meta-analysis of experimentally induced AP for PA, revealed small-to-medium effects at post-intervention ( $d = 0.31$ ,  $r = .15$ ) and follow-up ( $d = 0.24$ ,  $r = .12$ ). The summary effects reported in this review are comparable to those found in the meta-analysis of Bélanger-Gravel, but are smaller than those found in prior meta-analyses examining

other self-set goals and health behaviors as outcomes<sup>3</sup>. This finding is perhaps not surprising given the complex nature of PA as a target for behavior change. People may experience problems in goal striving in some domains more than others (Gollwitzer, et al., 2010). Physical activity behavior involves recurrent action, at longer durations, over longer periods of time than do some other health behaviours. It also involves rewarding consequences and positive and negative reinforcements that are more distal (e.g., losing weight, reduced health risks; see Maes & Gebhardt, 2005 for a more detailed account on the nature of health targets). Given these considerations, people may be more likely to experience action control problems in relation to PA—problems for which AP or CP may have weaker or less consistent effects.

### **Mediation**

Prior meta-analyses have examined either the relationship between intention and behavior (e.g., Webb & Sheeran, 2006) or the relation between planning and behavior (e.g., Gollwitzer & Sheeran, 2006). This review offers the first meta-analytic account of the mediating role of AP and CP in the intention-behavior relation. As such, this review goes beyond prior reviews by clarifying our theoretical understanding of key processes responsible of transmitting the effect of intention on PA. Results from the *dual mediation model* showed that both AP and CP were unique partial mediators in the intention to PA relation. This result is consistent with the predictions of the HAPA model, in which both forms of planning are proximal predictors of PA initiation. Results of the *sequential mediation meta-analytic path model* also supported the proposed sequence from intention to AP to CP to PA. Hence, it appears that both forms of

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<sup>3</sup> Of note, notwithstanding these parallels, no prior meta-analyses made the explicit distinction between AP and CP, thus precluding the comparison of our findings regarding CP with other meta-analyses.

spontaneous planning can operate both uniquely and sequentially as part of a self-regulatory chain that ultimately culminates in PA. These results provide support for the emerging idea that planning is important at various points in the goal pursuit process (Shüz, et al., 2009). As suggested in the HAPA model, it may be that once individuals intend to pursue a PA goal, they may spontaneously create action and coping plans to respectively help them carry out the logistics of goal striving and to protect their intentions against temptations, obstacles, and distractions. It may also be the case that once individuals have created action plans to support their intentions they create additional coping plans to support not only their intentions but also their action plans.

Sniehotta (2009) and Sniehotta, Schwarzer, et al. (2005) have suggested that AP should be more influential earlier in goal striving, whereas CP should be more influential later in goal striving. Although it might be true that people gain a better sense of their idiosyncratic barriers as they engage in goal pursuit, they may still possess sufficient knowledge and past experience to form plans to cope with anticipated barriers at the onset of the goal striving process. PA goals, in particular, have a high failure rate (De Ridder & De Wit, 2007), which makes it likely that most people can rely on their past attempts and failures to anticipate barriers that could circumvent their current goal striving and action plans. Nevertheless, obstacles and barriers are likely to change over time, which might explain that having good coping plans can protect individuals with the difficult task of maintaining PA in the long haul. In addition to considering when coping plans are formed, it may be important to consider the extent to which individuals are capable of revising them to accommodate changing barriers. Ultimately, future research should use a cross-lagged panel design with multiple time points in order to estimate the

relative effect of AP and CP earlier and later in the goal striving process using more stringent designs.

### **Moderation**

Numerous moderators of the observed summary effects were examined. Across both the correlational and experimental studies, the *number of components* included in the assessment of AP influenced the magnitude of the summary effect. For correlational studies, action plans comprised of four or five components yielded significantly greater effects than those comprised of only two components. For the experimental studies, comparing all experimental versus all control conditions, planning interventions with four components yielded greater effect sizes than those with three, but not two components. A greater number of components may yield better results by increasing the *specificity* of the plans. For example, in a study of smoking cessation, van Osch, et al. (2010) found that participants who formed specific plans were more likely to remain abstinent from smoking at seven-month follow-up. These findings are in line with health promotion studies showing that more detailed action plans were linked to higher PA behavior six months later (e.g., Ziegelmann, et al., 2006). Notably, analyses of the pure planning versus neutral control conditions in the experimental studies showed that planning interventions with two components yield the greatest effect size, perhaps because they could be more easily recalled. Hence, future research comparing the number of AP components could further clarify the optimal number of planning components, perhaps also clarifying whether the content of the particular components matters and to what degree and or/in what combination.

Researchers have measured AP in ways that either combined or separated AP and CP. Notably, spontaneous AP and CP were found to be strongly related ( $\phi = .61$ ), which may reflect

true conceptual overlap and/or inflation due to shared method variance (Podaskoff, MacKenzie, Jeong-Yeon, & Podaskoff, 2003). More importantly, the association between spontaneous planning and PA did not significantly differ between samples using only AP versus those using both AP and some form of CP. At first glance, these results might suggest that AP and CP could be combined in a parsimonious composite variable without losing much information. However, this conclusion might be premature given that CP may play a distinct role in the goal striving process. As such, it could be fruitful to reconsider the moderating role of spontaneous CP in a *moderated mediation model* from intention to AP to PA, as it may be that AP mediates the intention-PA relation, but only at higher levels of CP. Regarding the experimental data, no significant difference was found between conditions involving only AP and those which combined AP and CP. This is inconsistent with the findings of Bélanger-Gravel et al. (2011) who reported a superior effect of experimentally induced AP when action plans were supplemented with barrier management (i.e., CP). It is unclear, however, how their results were obtained, as they had found no significant difference between the conditions before adding two previously omitted studies to their analysis. Future research comparing a 'purely AP' condition, a 'purely CP' condition, and a 'combined AP/CP' condition will help elucidate the role of CP in planning interventions.

Our results from the correlational studies revealed a significant attenuation of the effect of AP with increasing time lag, which is consistent with results found in a prior meta-analytic study of planning for self-set goals (Koestner, et al., 2006). This finding was not replicated in the experimental studies, which generally showed no moderating influence of time delay on experimentally induced plans. This is in line with the findings of Bélanger-Gravel et al. (2011),

who found that the effect of planning interventions were generally well-maintained no-contact follow-up periods.

The relation between spontaneous AP and PA in the correlational studies was attenuated as a function of *age*, perhaps reflecting the changes in cognitive functioning that tend to occur with ageing (Park, 1999). Conversely, the effect of AP in the experimental studies did not vary as a function of age. Notably, however, older samples tended to also be rehabilitation samples (normative  $M_{age} = 26.76$ ; rehabilitation  $M_{age} = 55.06$ ). It might be that the additional structure, guidance, and support offered by the rehabilitation programs can serve to offset the attenuating influence of both time delay and age, and maintain the effect of AP over the long haul.

Regarding the moderating role of intention, results differed across correlational and experimental studies. In the correlational studies, a buffering interaction was observed in which the effect of AP was stronger in the samples with the lowest level of intention. Spontaneous planning is probably used by individuals once they have developed a strong intention for a particular behavior (see mediation models in Figure 1). Therefore, the fact that spontaneous AP has a stronger effect in samples with lower levels of intention is unexpected. However, this finding nonetheless indicates that deciding to spontaneously create action plans might circumvent some of the debilitating effects associated with lower levels of intention. In the experimental studies, no moderating effect of intention was found. Some studies have shown AP to be more strongly predictive of exercise behaviour in participants with moderate to high levels of intention (e.g., Conner, Sandberg, & Norman, 2010, Study 2). A more recent study with longer follow ups, however, reported no significant moderating role of intention on AP or CP

with PA (Skår, et al., 2011). Further well-control studies are warranted to understand the nuanced potential moderating role of intention in experimentally induced planning for PA.

Some other moderating effects were different or opposing depending on study type. For instance, among the correlational studies, the relationship of both AP and CP to PA were significantly stronger in the *normative groups* than the *rehabilitation groups* whereas rehabilitation status had no moderating role among the experimental studies. The stronger summary effect in normative versus rehabilitation samples observed in the correlational studies is perhaps a reflection of the fact that individuals are not trained to plan or to cope. In such conditions, the stronger effects in the normative groups could be attributable to the fewer/less debilitating obstacles that they face compared to their rehabilitative counterparts who often suffer from chronic pain and other complications (Latimer, 2005). In contrast, the maintained/unaffected summary effect in the rehabilitation versus normative samples observed in the experimental studies could be explained by the multifaceted psychoeducation, support, and monitoring that usually accompanies planning intervention in rehabilitation programs that may offset their additional challenges.

Another moderating characteristic of the *sample type was the sedentary versus active status* of the samples. Results comparing sedentary samples to a “mixed” sample of sedentary and not sedentary participants showed a significantly greater effect for the sedentary samples. Such a finding is consistent with claims from the broader implementation planning literature that planning is especially beneficial for people with chronic difficulties in regulating their behavior (Gollwitzer & Sheeran, 2006). It is also consistent with the findings of Bélanger-Gravel et al. (2011), in which it was found that AP interventions were significantly more effective

among samples of clinical populations (and students) as compared to samples of the general population of adults. The strength of the planning to PA effect differed according to *mode of delivery of the intervention*. It was found that people do benefit from the assistance of another person when formulating their plans, which perhaps emphasizes that planning is a skill that people may benefit from support in learning at first. Notably, the effect size for self-administered planning was nevertheless significant, which suggests that planning may still lend itself well to cost-effective self or online administrations that could be widely disseminated, though there may be some trade-off in terms of effectiveness.

An important consideration for applied psychologists is to determine whether clients should be provided with a list of barriers and obstacles to facilitate the creation of their coping plans (i.e., *CP approach*). Our results from the experimental studies revealed no significant differences between the samples according to whether the coping plans were idiographic or nomothetic. This finding is tentative, however, as it could only be tested across few samples and the nomothetic CP group contained few samples. It would appear important to investigate this issue further given recent findings, such as those of Adriaanse et al. (2009), showing that action plans are effective only when linked to personally relevant reasons for pursuing diet goals (see also Koestner et al., 2006). In a recent study in which participants created coping plans by selecting from a nomothetic list of common barriers to smoking cessation, Van Osch et al. (2010) noted that the nomothetic approach might have restricted the degree of *personalization* or personal meaningfulness of the situations specified in the plans. Although an idiographic approach might facilitate personalization of the plans, it might also reduce their quality or their instrumentality as one quarter of the participants in the study of Van Osch et al.

(2010) generated a non-instrumental coping response. As such, these researchers suggested that future work should examine the trade off between personalization and instrumentality, which we agree is a fruitful research direction.

*Self-report versus objective measure of PA* could also alter the strength of the planning effect. All of the correlational studies that we reviewed used self-reported measures of PA, thus raising the need to use objective measures in future studies. Moderation analyses of the experimental studies revealed no significant moderating effect of self-reported versus objective outcomes. This finding is inconsistent with that of Sheeran (2002) who reported that planning studies using self-report measures ( $r = .35$ ) showed significantly greater effects than those employing objective measures ( $r = .26$ ). Regarding these latter findings, problems with retrospective bias and shared method variance might account for inflating the planning effects in studies using one-occasion self-report measures of PA. Future work using daily diary methods that sample multiple measurements of PA behavior on several occasions, in multiple situations, could help circumvent potential limitations and provide a way to triangulate findings of both objective data and traditional self-reports (Moskowitz, Russell, Sadikaj, & Sutton, 2009).

Finally, it was found that *publication status* plays a significant moderating role with published experimental studies generally reporting greater effects than unpublished experimental studies. This finding suggests the possibility of publication bias, in which case it is important to consider the likelihood that the observed summary effects are overestimated (Chiu, Lynch, Chan, & Berven, 2011). This task is accomplished by examining the *fail-safe N* for the analysis, which in the case of the All Experimental versus All Control comparison, showed that six studies with a null result added to the analysis would render the summary effect

"trivial" ( $\phi < .10$ ). This shows that a certain measure of caution should be exercised when interpreting the results, as the size of the summary effect might be overestimated (Borenstein, Hedges, Higgins, & Rothstein, 2009).

### **Future Research Directions**

An important issue to address in future work on AP and CP for PA concerns the measurement and operationalization of planning constructs. A detailed account of the components of planning was provided in this review (see Appendix C of the supplementary file). First, this breakdown highlights the marked heterogeneity in the measurement of planning across studies, which may be contributing to the inconsistent results documented in the literature. Second, it underscores the need for greater conceptual clarity as proposed by Sniehotta (2009). Van Osch et al. (2010, p.353) refer to the differentiation between AP and CP as a mere "distinction in terminology". Conversely, Sniehotta et al. (2005, 2009) propose that action plans and coping plans are conceptually distinct from each other, which has been shown in factor analyses (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005; Ziegelmann, et al., 2006), and also that they are conceptually distinct from Gollwitzer's implementation intentions, which is an issue awaiting empirical scrutiny. Notably, within the broader literature on implementation intentions, the differentiation has been made between implementation plans designed to promote action initiation, and those designed to prevent derailment from ongoing goal pursuit (Gollwitzer, 1990; Gollwitzer & Sheeran, 2006), which mirrors the AP/CP distinction. Interestingly, within that literature, differential effects have been found for implementation intentions designed to increase desired behavior (e.g., eating more healthily) versus decrease unwanted behavior (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011).

Most studies on AP and CP cite the evidence base of implementation intentions in their theoretical rationale and operational definitions, but the actual measurement of action and coping plans does not reflect this, which has implications for the conclusions drawn. Implementation intentions/plans (Gollwitzer, 1999) have an *if-then contingency structure* in which critical situations (i.e., when, where, how) stipulated in the “if” component are linked to goal directed responses in the “then” component. Participants are instructed to form if-then plans that adhere to a specific contingency format (i.e., if [cue], then [goal directed response]). Considerable support for a “strategic automaticity” mechanism has been reported in social cognition literature, in which specified cues for goal-directed action are highly accessible and strongly linked to intended behavior, such that the latter is elicited efficiently and reliably when the cue is encountered (e.g., Webb & Sheeran, 2007). Conversely, the precise structure of action plans and coping plans remains less clear (Sniehotta, 2009). Experimentally induced action and coping plans rarely have an if-then format. Spontaneous action and coping plans could conceivably have an if-then format, but few studies have explicitly examined the structure of people’s spontaneous plans. A recent study by Chapman et al. (2009) showed that self-set plans with an if-then structure were more effective at promoting fruit and vegetable consumption than were more ‘global’ plans (when/where). In the event that people’s spontaneous plans do, in fact, tend to have a contingency structure, questions have been raised as to whether a single cue-response link would be sufficient to engender lasting changes in complex health behaviors such as PA via strategic automaticity (Wiedemann, Lippke, Reuter, Ziegelmann, & Schwarzer, 2011). Indeed, less is known about the mediating mechanisms of spontaneous plans, though research is beginning to emerge in this area (e.g., Dugas, Gaudreau,

& Carraro, 2012). Future research elucidating the structure and content of spontaneous action and coping plans, their mediating mechanisms, and potential additive and interactive effects is an exciting and much needed future research direction.

### **Conclusion**

This review provides summary effects for AP and CP for PA for both correlational and experimental studies, at different time delays, and for various comparisons. In addition, this review provides a contribution to the development of theory in this area via the exploration of theory-driven meta-analytical path analyses. Finally, several key moderators were identified which provide crucial information regarding for whom and under what conditions these forms of planning are most effective. Continued theoretical and methodological advances in research on AP and CP will feed into the development of increasingly effective interventions aimed at helping people live a more physically active lifestyle. It is our hope that this review will provide a useful roadmap that should help researchers in planning their subsequent experimental and correlational studies on AP and CP for both PA and other health-related behavior.

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Table 1

*Correlational Studies of the Relation between AP/CP and PA Included in the Meta-Analysis*

Authors	Participants	# AP/CP items	AP/CP $\alpha$	PA outcome measure	PA reliability	AP/CP-PA relation	$r$	$r_+$	Lag
Araújo-Soares, McIntyre, MacLennan, and Sniehotta (2009a)	Elementary school students (N) = 105 $M_{age} = 12.04$ , $SD_{age} = .95$ % male = 47.80	AP (4) & CP (4)	AP $\alpha = .92$ CP $\alpha = .80$	IPAQ (S)	$r = .61^b$	T1 AP $\leftrightarrow$ T1 PA	.25	.33*	0
						T2 AP $\leftrightarrow$ T2 PA	.25	.33*	0
						T1 AP $\rightarrow$ T2 PA	.33	.44*	8
						T1 AP $\rightarrow$ T3 P	.30	.40*	20
						T2 AP $\rightarrow$ T3 PA	.27	.36*	1
						AP $\rightarrow$ PA shortest	.33	.44*	8
						AP $\rightarrow$ PA longest	.33	.44*	20
						T1 CP $\leftrightarrow$ T1 PA	.14	.20*	0
						T1 CP $\rightarrow$ T2 PA	.25	.36*	8
						T1 CP $\rightarrow$ T3 PA	.33	.47*	20
						T2 CP $\leftrightarrow$ T2 PA	.20	.29*	0
						CP $\rightarrow$ PA shortest	.25	.36*	8
						CP $\rightarrow$ PA longest	.33	.47*	20
						Blanchard (2008)	Coronary heart disease patients (R) $N = 76$ $M_{age} = 62.60$ , $SD_{age} = 11.0$ % male = 76.00	AP (4)	AP $\alpha = .91$
T2 AP $\rightarrow$ T3 PA	.49	.52*	24						
AP $\rightarrow$ PA shortest	.23	.31*	12						
AP $\rightarrow$ PA longest	.39	.31*	24						
Brickell, Chatzisarantis	University students (N)	AP (5)	AP $\alpha = .94$	Single item (S)	$\alpha = .70^d$	T1 AP $\rightarrow$ T2 PA	.59	.73*	4
						AP $\rightarrow$ PA shortest	.59	.73*	4

, and Pretty (2006)	$N = 162$ $M_{\text{age}} = 23.15,$ $SD_{\text{age}} = 6.05$ % male = 39.00					AP → PA longest	.59	.73*	
Carraro and Gaudreau (2011)	University students (N) $N = 205$ $M_{\text{age}} = 19.50,$ $SD_{\text{age}} = 4.50$ % male = 24.00	AP (5)	AP $\alpha = .95$	3 PA GP items (S)	$\alpha = .93^e$	T2 AP ↔ T2 PA	.54	.54* <sup>l</sup>	0
Carraro and Gaudreau (2010)	University students (N) $N = 111$ $M_{\text{age}} = 19.62,$ $SD_{\text{age}} = 3.69$ % male = 27.00	AP (5)	AP $\alpha = .95$	3 PA GP items (S)	$\alpha = .94^e$	T1 AP → T2 PA AP → PA shortest AP → PA longest	.39 .39 .39	.41* .41* .41*	4 4 4
Lippke, Wiedemann, Ziegelmann, Reuter, and Schwarzer (2009)	Internet (N) $N = 812$ $M_{\text{age}} = 36.69,$ $SD_{\text{age}} = 12.2$ % male = 26.00	AP (3)	AP $\alpha = .90$	GLTEQ (S)	$r = .62^c$	T2 AP ↔ T2 PA	.33	.44*	0
Lippke, Ziegelmann, and Schwarzer (2004a)	Orthopaedic rehabilitation patients (R) $N = 509$ $M_{\text{age}} = 45.75,$	AP (5)	AP $\alpha = .90$	mins/wk fitness, weights, & sports (S)	$\alpha = .70^d$	T1 AP ↔ T1 PA T1 AP → T3 PA T1 AP → T4 PA T2 AP → T3 PA T2 AP → T4 PA	.21 .19 .27 .17 .18	.26* .24* .34* .21* .21*	0 5 8 5 2

	$SD_{age} = 11.7$ % male = 38.00					T2 AP → T4 PA	.18	.23*	5
						T3 AP ↔ T3 PA	.26	.33*	0
						T3 AP → T4 PA	.26	.33*	3
						T4 AP ↔ T4 PA	.33	.42*	0
						AP → PA shortest	.17	.21*	2
						AP → PA longest	.27	.34*	8
Norman and Conner (2005)	University students (N) $N = 76$ $M_{age} = 20.80$ , $SD_{age} = 3.85$ % male = 19.61	AP (2)	AP $\alpha = .86$	LTPA items (S)	$\alpha = .70^d$	T1 AP ↔ T1 PA	.51	.66*	0
						T1 AP → T2 PA	.67	.86*	1
						AP → PA shortest	.67	.86*	1
						AP → PA longest	.67	.86*	1
Rhodes, Blanchard, Matheson, and Coble (2006)	University students (N) $N = 230$ $M_{age} = 22.26$ , $SD_{age} = 6.04$ % male = 30.00	AP (4)	AP $\alpha = .94$	GLETQ (S)	$r = .62^c$	T1 AP → T2 PA	.52	.52* <sup>l</sup>	2
						AP → PA shortest	.52	.52* <sup>l</sup>	2
						AP → PA longest	.52	.52* <sup>l</sup>	2
Roberts, et al. (2010)	Secondary and high school students (N) $N = 72$ $M_{age} = 16.92$ , $SD_{age} = 0.66$ % male = 47.20	AP (4)	AP $\alpha = .95$	PAQ-A (S) & Yamax SW200 (O)	$\alpha = .83^h$	T1 AP → T2 PA	.35	.39*	1
						AP → PA shortest	.35	.39*	1
						AP → PA longest	.35	.39*	1
Scholz, Nagy, Schüz, and Ziegelmann	Internet (N) $N = 27$ $M_{age} = 41.20$ ,	AP (4) & CP (4)	AP $\alpha = .89$ CP $\alpha = .92$	Mins running /wk (S) &	$\alpha = .70^d$	T1 AP ↔ T1 PA	.19	.24	0
						T1 AP → T2 PA	.15	.19	22
						AP → PA shortest	.15	.19	22

(2008)	$SD_{age} = 8.65$ % male = 13.30			marathon time (O)		AP → PA longest	.15	.19	22
						T1 CP ↔ T1 PA	-.12	-.15	22
						T1 CP → T2 PA	.38	.47*	22
						CP → PA shortest	.38	.47*	0
						CP → PA longest	.38	.47*	22
Scholz, et al. (2008)	Internet (N) $N = 334$ $M_{age} = 37.00$ , $SD_{age} = 9.90$ % male = 18.60	AP (4) & CP (4)	AP $\alpha = .85$ CP $\alpha = .87$	IPAQ (S)	$r = .80^e$	T1 AP ↔ T1 PA	.27	.27*	0
						T1 AP → T2PA	.28	.28*	5
						AP → PA shortest	.28	.28*	5
						AP → PA longest	.28	.28*	5
						T1 CP ↔ T1 PA	.36	.36*	0
						T1 CP → T2 PA	.39	.39*	5
						CP → PA shortest	.39	.39*	5
						CP → PA longest	.39	.39*	5
Schwarzer, et al. (2007)	Internet (N) $N = 365$ $M_{age} = 37.01$ , $SD_{age} = 9.99$ % male = 19.00	AP (3)	AP $\alpha = .83$	Freq & duration of muscle strength activities (S)	$\alpha = .70^d$	T2 AP ↔ T2 PA	.22	.29*	0
Sniehotta, et al. (2010)	Coronary heart disease patients (R) $N = 95$ $M_{age} = 63.00$ , $SD_{age} = 10.3$ % male = 72.80	AP (5)	AP $\alpha = .94$	GLTE Q (S)	$r = .62^c$	T1 AP ↔ T1 PA	.20	.26*	0
						T1 AP → T2 PA	.13	.17	8
						AP → PA shortest	.13	.17	8
						AP → PA longest	.13	.17	8

Sniehotta, Schwarzer, et al. (2005)	Cardiac rehabilitation patients (R) $N = 352$ $M_{age} = 58.50$ , $SD_{age} = 10.0$ % male = 79.00	AP (4) & CP (5)	AP $\alpha = .94$ CP $\alpha = .91$	KPAS (S)	$r = .84^j$	T1 AP $\rightarrow$ T2 PA	.19	.21*	10
						T1 AP $\rightarrow$ T3 PA	.24	.27*	18
						T2 AP $\leftrightarrow$ T2 PA	.27	.30*	0
						T2 AP $\rightarrow$ T3 PA	.27	.30*	8
						T3 AP $\leftrightarrow$ T3 PA	.36	.41*	0
						AP $\rightarrow$ PA shortest	.27	.30*	8
						AP $\rightarrow$ PA longest	.24	.27*	18
						T1 CP $\rightarrow$ T2 PA	.16	.18*	10
						T1 CP $\rightarrow$ T3 PA	.19	.22*	18
						T2 CP $\leftrightarrow$ T2 PA	.16	.18*	0
						T2 CP $\rightarrow$ T3 PA	.30	.34*	8
						T3 CP $\leftrightarrow$ T3 PA	.31	.36*	0
						CP $\rightarrow$ PA shortest	.30	.34*	8
						CP $\rightarrow$ PA longest	.10	.22*	18
Sniehotta, Scholz, and Schwarzer (2005)	Cardiac rehabilitation patients (R) $N = 307$ $M_{age} = 59.00$ , $SD_{age} = 9.98$ % male = 80.00	AP (4)	AP $\alpha = .95$	Aggregate of LTPA (S) & rehab PA (S)	$\alpha = .66^e$	T2 AP $\rightarrow$ T3 PA	.44	.44* <sup>l</sup>	8
						AP $\rightarrow$ PA shortest	.44	.44* <sup>l</sup>	8
						AP $\rightarrow$ PA longest	.44	.44* <sup>l</sup>	8
Wiedemann, Schüz, Sniehotta, Scholz, and Schwarzer (2009)	Coronary heart disease patients (R) $N = 124$ $M_{age} = 60.30$ , $SD_{age} = 10.4$ % male = 81.70	AP (4)	AP $\alpha = .93$	IPAQ (S)	$r = .80^k$	T1 AP $\rightarrow$ T2 PA	.36	.42*	16
						AP $\rightarrow$ PA shortest	.36	.42*	16
						AP $\rightarrow$ PA longest	.36	.42*	16

Ziegelmann and Lippke (2007) – Sample 1	Orthopaedic rehabilitation patients (R) $N = 199$ $M_{age} = 38.50,$ $SD_{age} = 7.00$ % male = 30.20	AP (5) & CP (4)	AP $\alpha = .94$ CP $\alpha = .92$	PA goal attain't (S)	$\alpha = .66^e$	T3 AP → T4 PA	.38	.48*	24
						AP → PA shortest	.38	.48*	24
						AP → PA longest	.38	.48*	24
						T4 CP ↔ T4 PA	.38	.49*	0
Ziegelmann and Lippke (2007) – Sample 2	Orthopaedic rehabilitation patients (R) $N = 169$ $M_{age} = 58.00,$ $SD_{age} = 5.80$ % male = 47.00	AP (5) & CP (4)	AP $\alpha = .94$ CP $\alpha = .92$	PA goal attain't (S)	$\alpha = .66^e$	T3 AP → T4 PA	.29	.37*	24
						AP → PA shortest	.29	.37*	24
						AP → PA longest	.29	.37*	24
						T4 CP ↔ T4 PA	.41	.53*	0

*Note.* (N) = Normative sample; (R) = Rehabilitation sample;  $N$  = number of participants;  $M_{age}$  = mean sample age;  $SD_{age}$  = age standard deviation; % male = percentage of males; # AP/CP items = type of planning and number of items; AP/CP  $\alpha$  = average (across all study time points) Cronbach's alpha coefficient for AP/CP measure; n/a = not available (i.e., not reported in the paper) or not applicable (i.e., alpha for scale with single item); S = self-report; O = objective;  $r$  = raw uncorrected correlation;  $r_+$  = correlation corrected for measurement error; IPAQ = International Physical Activity Questionnaire (Craig, et al., 2003); PA GP = PA goal progress; LTPA = leisure time PA; NPAQ = Norfolk Physical Activity Questionnaire (Wareham, et al., 2002); PAQ-A = Physical Activity Questionnaire for Adolescents (Kowalski, Crocker, & Kowalski, 1997); GLTEQ = Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985); KPAS = Kaiser Physical Activity Survey (Ainsworth, Sternfeld, Richardson, & Jackson, 2000); PA goal attain't = PA

goal attainment; Yamax SW200 = pedometer; T1/2/3/4 AP/CP  $\leftrightarrow$  T1/2/3/4 PA = concurrent relation between Time 1/2/3/4 AP/CP and Time 1/2/3/4 PA; T1/2/3 AP/CP  $\rightarrow$  T2/3/4 PA = prospective relation between Time 1/2/3 AP/CP and Time 2/3/4 PA; AP/CP  $\rightarrow$  PA shortest = prospective AP/CP-PA relation with shortest time lag; AP/CP  $\rightarrow$  PA longest = prospective AP/CP-PA relation with longest time lag; Lag = time lag (in weeks) separating prospective assessment of AP/CP and PA.

a = mean alpha for all spontaneous AP measures; b = mean reported test retest reliability for IPAQ; c = test retest  $r$  for GLTEQ (Jacobs, Ainsworth, Hartman, & Leon, 1993); d =  $r = .70$  reliability suggestion (Cohen & Cohen, 1983); e = reported Cronbach's alpha; g = test retest  $r$  for NPAQ (Wareham, et al., 2002); h = alpha for PAQ (Kowalski, et al., 1997); i = transformed alpha from correlation between 2 items; j = test retest  $r$  for PA index of KPAS (Ainsworth et al., 2000); k = test retest  $r$  for IPAQ (Craig et al., 2003); l = not corrected because derived from structural equation models.

\*  $p < .05$ .

Table 2

*Experimental Studies on Planning for PA*

Authors	Participants	Experimental group(s)	Control groups(s)	PA outcome measure	PA reliability	Comparison	<i>d</i>	<i>r</i>	<i>r<sub>+</sub></i>	<i>N</i>	Lag
Araújo-Soares, McIntyre, MacLennan, and Sniehotta (2009b)	Internet (N) <i>M</i> <sub>age</sub> = 12.13 <i>SD</i> <sub>age</sub> = 1.01 % male = 47.40	Exp1 (multi) = AP + CP within larger manualized intervention	Ctrl1 (neutral) = no activity	PA freq x duration (S)	<i>r</i> = .70 <sup>a</sup>	Exp1 (multi) vs. Ctrl1 (neutral)	0.14	.07	.08	291	2
						Exp1 (multi) vs. Ctrl1 (neutral)	0.22	.11	.13	291	12
						Exp1 (multi) vs. Ctrl1 (neutral)	0.45*	.22*	.26*	195	36
Arbour and Ginis (2004)	University students and bank employees (N) <i>M</i> <sub>age</sub> = 46.00 <i>SD</i> <sub>age</sub> = n/a % male = n/a	Exp1 (multi) = AP + health education + self- monitoring	Ctrl1 (active) = health education + self-monitoring	# of weeks participant did 30 + mins of PA 2x per week (S) &	<i>r</i> = .70 <sup>a</sup>	Exp1 (multi) vs. Ctrl1 (active)	0.14	.07	.08	43	8
						Exp1 (multi) vs. Ctrl1 (active)	0.19	.09	.11	43	8
Budden and Sagarin (2007)	Blue/white collar workers (N) <i>M</i> <sub>age</sub> = n/a <i>SD</i> <sub>age</sub> = n/a % male = 40.00	Exp1 (plan) = AP	Ctrl1 (neutral) = no activity	PA freq x duration (S)	<i>r</i> = .70 <sup>a</sup>	Exp1 (plan) vs. Ctrl1 (neutral)	-.03*	-.13*	-.16*	274	1
Chatzisarantis, Hagger, and Thøgersen-Ntoumani (2008)	University students (N) <i>M</i> <sub>age</sub> = 20.71 <i>SD</i> <sub>age</sub> = 6.95 % male = 27.56	Exp1 (plan) = AP	Ctrl1 (neutral) = AP for unrelated activity	GLETQ (S)	<i>r</i> = .62 <sup>b</sup>	Exp1 (plan) vs. Ctrl1 (neutral)	0.76*	.35*	.45*	126	5
Darker, French, Eves, and Sniehotta (2010)	Internet (N) <i>M</i> <sub>age</sub> = 40.60 <i>SD</i> <sub>age</sub> = 10.84 % male = 29.20	Exp1 (multi) = AP + CP + self- monitoring	Ctrl1 (neutral) = waitlist	NL-1000 Pedometer (O)	<i>r</i> = .70 <sup>a</sup>	Exp1 (multi) vs. Ctrl1 (neutral)	0.90*	.41*	.49*	118	1
				NPA (S)	<i>r</i> = .79 <sup>c</sup>	Exp1 (multi) vs. Ctrl1 (neutral)	0.09	.05	.05	98	1
						Exp1 (multi) vs. Ctrl1 (neutral)	0.20	.10	.11	98	5
de Vries, Kremers, Smeets, Brug, and Eijmael (2008)	Internet (N) <i>M</i> <sub>age</sub> = 49.00 <i>SD</i> <sub>age</sub> = 10.60 % male = 45.00	Exp1 (multi) = AP + tailored health information + health education	Ctrl1 (active) = health education  Ctrl2 (active) = tailored health info + health education	SQUASH (S)	<i>r</i> = .58 <sup>d</sup>	Exp1 (multi) vs. Ctrl1 (active)	0.17*	.08*	.11*	1331	36
Hill, Abraham, and Wright (2007)	Secondary school - high school (N) <i>M</i> <sub>age</sub> = 16.97	Exp1 (multi) = AP + motivational	Ctrl1 (active) = exercise-related filler activity	1 LTPA item (S)	<i>r</i> = .70 <sup>a</sup>	Exp1 (multi) vs. Ctrl1 (neutral)	0.46*	.22*	.26*	245	3
						Exp1 (multi) vs. Ctrl2 (active)	0.14	.07	.08	244	3
						Exp1 (multi) vs. Ctrl3 (active)	0.24	.12	.14	248	3

	$SD_{age} = 1.40$ % male = 49.00	intervention									
			Ctrl2 (active) = motivational intervention								
			Ctrl3 (active) = incentive + motivational intervention + quiz								
Kwak, Kremers, van Baak, and Brug (2007)	Academic hospital employees (N) $M_{age} = n/a$ $SD_{age} = n/a$ % male = n/a	Exp1 (plan) = AP	Ctrl1 (neutral) = AP for unrelated activity	Stair use (O)	$r = .70^a$	Exp1 (plan) vs. Ctrl1 (neutral)	0.39	.19	.23	87	0
Latimer, Ginis, and Arbour (2006)	People with neurological impairment (R) $M_{age} = 40.61$ $SD_{age} = 10.89$ % male = 43.24	Exp1 (multi) = AP + motivational intervention + self-monitoring + revision	Ctrl1 (active) = motivational intervention + self-monitoring	PARA-SCI (S)	$r = .72^e$	Exp1 (multi) vs. Ctrl1 (active)	0.52	.25	.30	37	8
Lippke, Ziegelmann, and Schwarzer (2004b)	Orthopaedic rehabilitation patients (R) $M_{age} = 45.56$ $SD_{age} = 11.71$ % male = 38.00	Exp1 (plan) = AP + CP	Ctrl1 (neutral) = no activity	KPAS (S)	$r = .84^f$	Exp1 (plan) vs. Ctrl1 (neutral) Exp1 (plan) vs. Ctrl1 (neutral)	0.05 0.20*	.02 .10*	.02 .11*	340 441	2 4
Luszczynska (2006)	Uncomplicated myocardial infarction (R) $M_{age} = 54.25$ $SD_{age} = 6.85$ % male = 64.00	Exp1 (multi) = AP + feedback	Ctrl1 (neutral) = no activity	1 LTPA item (S)	$r = .70^g$	Exp1 (multi) vs. Ctrl1 (neutral)	0.37*	.18*	.22*	114	24
Milne, Orbell, and Sheeran (2002)	University students (N) $M_{age} = 20.04$ $SD_{age} = 2.23$ % male = 27.00	Exp1 (multi) = AP + motivational intervention	Ctrl1 (neutral) = non-exercise- related filler activity	4 LTPA items (S)	$r = .70^g$	Exp1 (multi) vs. Ctrl1 (neutral) Exp1 (multi) vs. Ctrl2 (active)	0.56* 0.43*	.27* .21*	.32* .25*	155 172	1 1
Prestwich, Lawton, and Conner (2003)	Students and white collar workers (N) $M_{age} = 21.31$ $SD_{age} = 4.39$ % male = 48.80	Exp1 (multi) = AP + decision- balance sheet + self-monitoring + feedback	Ctrl1 (active) = self-monitoring	time per week in mins (S)	$r = .70^g$	Exp1 (multi) vs. Ctrl1 (active) Exp1 (multi) vs. Ctrl2 (active) Exp1 (multi) vs. Exp2 (multi) Exp2 (multi) vs. Ctrl1 (active) Exp2 (multi) vs. Ctrl2 (active)	0.46 0.31 0.49 -0.06 -0.24	.23 .15 .24 -.03 -.12	.27 .18 .28 -.04 -.14	37 32 37 36 31	4 4 4 4 4
		Exp2 (multi) = AP + self- monitoring	Ctrl2 (active) = decision- balance sheet + self-monitoring	freq of PA (S)	$r = .70^g$	Exp1 (multi) vs. Ctrl1 (active) Exp1 (multi) vs. Ctrl2 (active) Exp1 (multi) vs. Exp2 (multi) Exp2 (multi) vs. Ctrl1 (active) Exp2 (multi) vs. Ctrl2 (active)	0.49 0.41 0.50 -0.01 -0.10	.24 .20 .24 -.003 -.05	.28 .23 .29 -.01 -.06	37 32 37 36 31	4 4 4 4 4

				time per PA session (S)	$r = .70^a$	Exp1 (multi) vs. Ctrl1 (active)	0.16	.08	.10	37	4
						Exp1 (multi) vs. Ctrl2 (active)	-0.52	-.25	-.30	32	4
						Exp1 (multi) vs. Exp2 (multi)	-0.04	-.02	-.02	37	4
						Exp2 (multi) vs. Ctrl1 (active)	-0.14	-.07	-.08	36	4
						Exp2 (multi) vs. Ctrl2 (active)	-0.54	-.26	-.31	31	4
				fitness - average heart rate measured in beats per minute (O)	$r = .70^a$	Exp1 (multi) vs. Ctrl1 (active)	-0.58	-.28	-.33	37	4
						Exp1 (multi) vs. Ctrl2 (active)	-.82*	-.37*	-.45*	32	4
						Exp1 (multi) vs. Exp2 (multi)	-1.01	-.45*	-.54*	37	4
						Exp2 (multi) vs. Ctrl1 (active)	0.50	.24	.29	36	4
						Exp2 (multi) vs. Ctrl2 (active)	0.24	.12	.14	31	4
Prestwich, Perugini, and Hurling (2009)	University students (N) $M_{age} = 23.76$ $SD_{age} = 4.64$ % male = 41.94	Exp1 (multi) = AP + motivational intervention + SMS + revision  Exp2 (multi) = AP + motivational intervention + revision	Ctrl1 (active) = motivational intervention  Ctrl2 (active) = motivational intervention + SMS + revision	table specifying type of PA and number of times performed (S)	$r = .70^a$	Exp1 (multi) vs. Ctrl1 (active)	0.52*	.23*	.28*	94	4
						Exp1 (multi) vs. Ctrl2 (active)	0.33	.16	.20	60	4
						Exp1 (multi) vs. Exp2 (multi)	0.40	.20	.23	58	4
						Exp2 (multi) vs. Ctrl1 (active)	0.09	.04	.05	94	4
						Exp2 (multi) vs. Ctrl2 (active)	-0.09	-.04	-.05	60	4
Ransom-Flint (2007)	University students (N) $M_{age} = 19.71$ $SD_{age} = n/a$ % male = 28.26	Exp1 (multi) = AP + CP + health education + self-monitoring + relapse prev  Exp2 (multi) = AP + health education + self-monitoring	Ctrl1 (active) = health education + self-monitoring  Ctrl2 (active) = health education + self-monitoring + relapse prevention	PA freq (S)	$r = .70^a$	Exp1 (multi) vs. Ctrl1 (active)	0.12	.06	.07	44	1
						Exp1 (multi) vs. Ctrl1 (active)	-0.39	-.19	-.23	44	2
						Exp1 (multi) vs. Ctrl1 (active)	-0.41	-.20	-.24	44	3
						Exp1 (multi) vs. Ctrl1 (active)	-0.20	-.10	-.12	44	4
						Exp1 (multi) vs. Ctrl2 (active)	-0.24	-.12	-.14	49	1
						Exp1 (multi) vs. Ctrl2 (active)	-0.17	-.08	-.10	49	2
						Exp1 (multi) vs. Ctrl2 (active)	-0.18	-.09	-.11	49	3
						Exp1 (multi) vs. Ctrl2 (active)	-0.21	-.11	-.13	49	4
						Exp1 (multi) vs. Exp2 (multi)	-0.31	-.15	-.18	49	1
						Exp1 (multi) vs. Exp2 (multi)	-0.32	-.16	-.19	49	2
						Exp1 (multi) vs. Exp2 (multi)	-0.49	-.24	-.28	49	3
						Exp1 (multi) vs. Exp2 (multi)	-0.19	-.09	-.11	49	4
						Exp2 (multi) vs. Ctrl1 (active)	0.37	.18	.22	43	1
						Exp2 (multi) vs. Ctrl1 (active)	0.10	.05	.06	43	2
						Exp2 (multi) vs. Ctrl1 (active)	0.04	.02	.02	43	3
						Exp2 (multi) vs. Ctrl1 (active)	0.02	.01	.01	43	4
						Exp2 (multi) vs. Ctrl2 (active)	0.02	.01	.01	48	1
						Exp2 (multi) vs. Ctrl2 (active)	0.10	.05	.06	48	2
						Exp2 (multi) vs. Ctrl2 (active)	0.23	.11	.14	48	3
						Exp2 (multi) vs. Ctrl2 (active)	-0.02	-.01	-.01	48	4
Rhodes and Matheson (unpublished manuscript)	University students (N) $M_{age} = 22.15$ $SD_{age} = 6.70$ % male = 24.00	Exp1 (plan) = AP	Ctrl1 (neutral) = unspecified	GLETQ (S)	$r = .62^b$	Exp1 (plan) vs. Ctrl1 (neutral)	0.04	.02	.03	178	2
				total mins of PA (S)	$r = .70^a$	Exp1 (plan) vs. Ctrl1 (neutral)	0.12	.06	.07	178	2
Scholz, Knoll, Sniehotta, and Schwarzer (2006)	Cardiac rehabilitation patients (R) $M_{age} = 58.50$	Exp1 (multi) = AP + CP + self-monitoring	Ctrl1 (neutral) = No activity	Adapted IPAQ (S)	$r = .80^c$	Exp1 (multi) vs. Ctrl1 (neutral)	0.54*	.26*	.29*	198	16
						Exp1 (multi) vs. Ctrl1 (neutral)	0.55*	.27*	.30*	198	24

		$SD_{age} = 10.60$ % male = 82.30										
Skår, Sniehotta, Gerard, Prestwich, and Araújo-Soares (2011)	University students (N) $M_{age} = 22.80$ $SD_{age} = 6.70$ % male = 36.60	Exp1 (plan) = AP + CP	Ctrl1 (neutral) = unspecified	GLETQ (S)	$r = .62^b$	Exp1 (plan) vs. Ctrl1 (neutral)	0.03	.02	.02	375	8	
						Exp1 (plan) vs. Exp2 (plan)	0.02	.01	.01	337	8	
						Exp1 (plan) vs. Exp3 (plan)	0.07	.04	.05	339	8	
		Exp2 (plan) vs. Ctrl1 (neutral)	0.01			.005	.01	338	8			
		Exp2 (plan) vs. Exp3 (plan)	0.06			.03	.04	302	8			
		Exp3 (plan) vs. Ctrl1 (neutral)	-0.05			-.02	-.03	340	8			
			Exp2 (plan) = AP	Gym attendance (O)	$r = .70^a$	Exp1 (plan) vs. Ctrl1 (neutral)	0.08	.04	.05	375	8	
						Exp1 (plan) vs. Exp2 (plan)	0.06	.03	.04	337	8	
						Exp1 (plan) vs. Exp3 (plan)	0.11	.05	.06	339	8	
			Exp2 (plan) vs. Ctrl1 (neutral)			0.01	.006	.01	338	8		
			Exp2 (plan) vs. Exp3 (plan)			0.05	.03	.03	302	8		
			Exp3 (plan) vs. Ctrl1 (neutral)			-0.05	-.02	-.03	340	8		
Sniehotta, Scholz, and Schwarzer (2006) <sup>j</sup>	Cardiac rehabilitation patients (R) $M_{age} = 59.30$ $SD_{age} = n/a$ % male = 78.00	Exp1 (plan) = AP + CP	Ctrl1 (neutral) = No activity	Cycling (S)	$r = .70^a$	Exp1 (plan) vs. Ctrl1 (neutral)	0.35*	.17*	.20* <sup>i</sup>	143	8	
						Exp1 (plan) vs. Exp2 (plan)	0.25*	.12*	.15* <sup>i</sup>	130	8	
						Exp2 (plan) vs. Ctrl1 (neutral)	0.09	.05*	.06*	149	8	
		Exp2 (plan) = AP	PA minutes (S)			Exp1 (plan) vs. Ctrl1 (neutral)	0.64*	.30*	.36* <sup>i</sup>	143	8	
						Exp1 (plan) vs. Exp2 (plan)	0.43*	.21*	.25*	130	8	
						Exp2 (plan) vs. Ctrl1 (neutral)	0.14*	.07*	.09*	149	8	
Sniehotta, Scholz, Schwarzer, et al. (2005) <sup>j</sup>	Cardiac rehabilitation patients (R) $M_{age} = 57.70$ $SD_{age} = 10.30$ % male = 81.50	Exp1 (multi) = AP + CP + self-monitoring		Ctrl1 (neutral) = No activity	Adapted KPAS (S)	$r = .80^h$	Exp1 (multi) vs. Ctrl1 (neutral)	0.27	.13	.15	156	8
							Exp1 (multi) vs. Ctrl1 (neutral)	0.36*	.18*	.20*	144	16
							Exp1 (plan) vs. Ctrl1 (neutral)	0.57*	.27*	.30*	147	8
		Exp2 (plan) = AP + CP	phone interview – 4 items (S)	Exp1 (plan) vs. Ctrl1 (neutral)			0.15	.07	.08 <sup>i</sup>	135	16	
				Exp1 (multi) vs. Ctrl1 (neutral)			-0.08	-.04	-.05	105	6	
							Exp1 (plan) vs. Ctrl1 (neutral)	0.03	.02	.02	114	6
Exp2 (plan) = CP		Ctrl1 (neutral) = non-exercise-related filler activity			$r = .70^g$	Exp1 (multi) vs. Ctrl1 (neutral)	-0.08	-.04	-.05	105	6	
				Exp1 (plan) vs. Ctrl1 (neutral)		0.03	.02	.02	114	6		
				Exp2 (plan) vs. Ctrl1 (neutral)		0.03	.02	.02	114	6		

*Note.*  $r$  = raw uncorrected correlation;  $r+$  = correlation corrected for measurement error;  $N$  = total sample size; (N) = normative sample; (R) = rehabilitation sample;  $M_{age}$  = mean sample age;  $SD_{age}$  = standard deviation for age; % male = percentage of males; Exp1 = experimental condition containing the highest number of intervention components; Exp 2/3 = experimental conditions containing fewer intervention components than Exp1; Ctrl1 = Most “neutral” control condition or only control condition in the study; Ctrl2/3 =

control conditions containing a greater number of components than Ctrl1; (multi) = experimental condition with multiple intervention components, including but not limited to AP, CP, or AP & CP; (plan) = experimental condition containing AP, CP, or AP & CP exclusively; (neutral) = control condition that is unlikely to contain any active intervention component (e.g., non-PA-related filler activity); (active) = control condition that is likely to contain an active intervention component (e.g., self-monitoring of PA behavior); S = subjective; O = objective;  $d$  = standardized mean difference; PARA-SCI = Physical Activity Recall Assessment for People with Spinal Cord Injury (Ginis, Latimer, Hicks, & Craven, 2005); SQUASH = Short Questionnaire to Assess Health-Enhancing Physical Activity (Wendel-Vos, Schuit, Saris, & Kromhout, 2003); NPA = Neighborhood Physical Activity Questionnaire (Giles-Corti, et al., 2006); KPAS = Kaiser Physical Activity Survey (Ainsworth, Sternfeld, Richardson, & Jackson, 2000); IPAQ = International Physical Activity Questionnaire (Craig, et al., 2003); GLTEQ = Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985); Lag = time lag (in weeks) separating the planning intervention and subsequent follow-up.

$a = r = .70$  reliability suggestion (Cohen & Cohen, 1983);  $b$  = test retest  $r$  for GLTEQ from Jacobs et al. (1993);  $c$  = mean of the test retest  $r$ s provided in Giles-Corti et al. (2006) for LTPA performed within and outside the neighborhood;  $d$  = test retest  $r$  provided in Wendel-Vos et al. (2003);  $e$  = test retest  $r$  for PARA-SCI provided in Ginis et al. (2005);  $f$  = test retest  $r$  for the PA index of the KPAS from Ainsworth et al. (2000);  $g$  = test retest  $r$  for the IPAQ from Craig et al. (2003);  $h$  = test retest  $r$  for the PA index of the KPAS from Ainsworth et al. (2000);  $i$  = correlation corrected for measurement error was  $> 1.00$  thus value was set at .99 so that CMA could converge.  $j$  = Baseline SD values were used as only SE values were available at each time point. \*  $p < .01$ .

Table 3

*Overall Effect Size Estimates for all Correlational Bivariate Relationships at Average, Short, and Long Time Delays*

			Fixed effect model		Random effects model		Heterogeneity			
	<i>k</i>	<i>N</i>	$\phi$	<i>CI</i> <sub>95</sub>	$\phi$	<i>CI</i> <sub>95</sub>	<i>N</i> <sub>FS</sub>	<i>Q</i>	<i>df</i>	<i>I</i> <sup>2</sup>
1. Action planning & PA										
Average time delay	19	4330	.41*	.39 - .44	.43*	.37 - .50	64	113.63*	18	84.16
Shortest time delay	16	2948	.40*	.37 - .43	.44*	.36 - .53	51	145.19*	15	89.67
Longest time delay	16	2948	.41*	.38 - .44	.44*	.35 - .53	55	127.47*	15	88.81
2. Coping planning & PA										
Average time delay	6	1186	.38*	.33 - .43	.39*	.38 - .48	18	17.51*	5	71.45
Shortest time delay	4	500	.37*	.30 - .43	.37*	.30 - .43	12	0.95	3	0.00
Longest time delay	4	500	.33*	.27 - .39	.37*	.23 - .49	10	10.05*	3	70.15
3. Action planning & Coping planning										
Average time delay	5	1159	.61*	.57 - .64	.62*	.51 - .71	31	30.70*	4	86.97
Shortest time delay	3	473	.53*	.46 - .59	.53*	.46 - .60	15	2.88	2	30.65
Longest time delay	3	473	.53*	.46 - .59	.53*	.46 - .60	15	2.88	2	30.65

*Note.* Analyses for the average time delay included both concurrent and prospective planning-PA relations whereas the analyses for the shortest and longest delays included only the prospective planning-PA relations. *k* = number of effect sizes in the meta-analysis; *N* = sample size of the meta-analysis;  $\phi$  = mean overall effect size corrected for sampling and measurement error; *CI*<sub>95</sub> = 95% confidence interval; *N*<sub>FS</sub> = fail-safe *N*; *Q* = *Q* statistic; *I*<sup>2</sup> = I-squared; *df* = degrees of freedom.

\*  $p < .05$ .

Table 4

*Overall Effect Size Estimates for all Experimental Study Comparisons at Average, Short, and Long Time Delays*

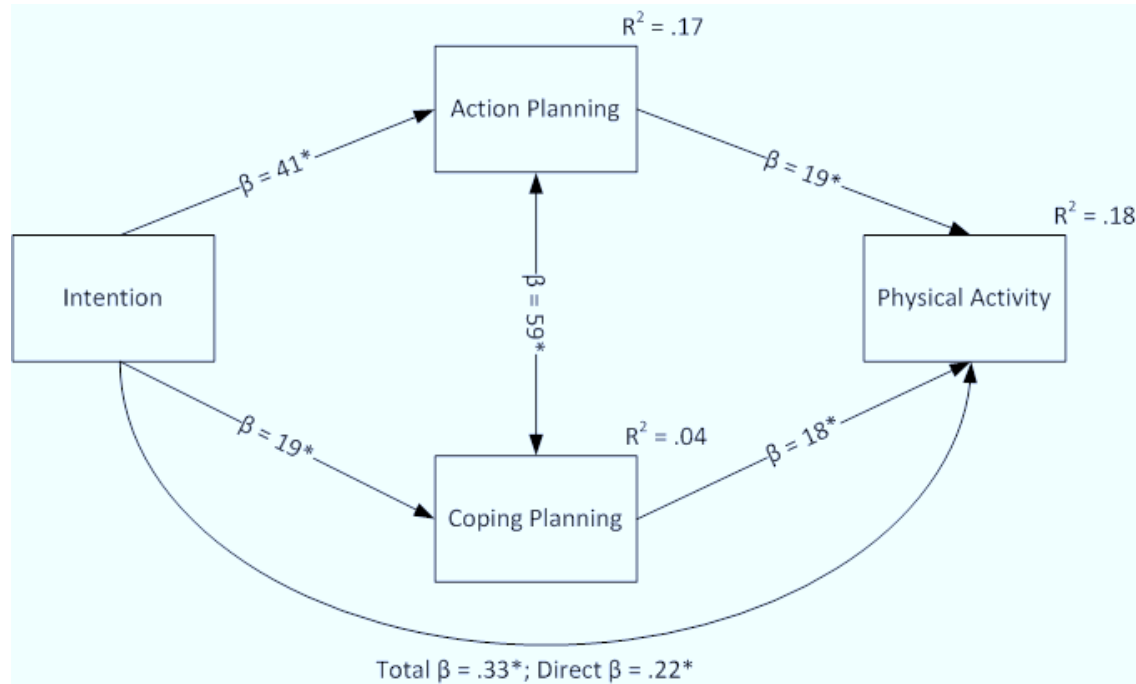
Comparison	k	N	Fixed effect model		Random effects model		N <sub>FS</sub>	Heterogeneity		
			$\phi$	CI <sub>95</sub>	$\phi$	CI <sub>95</sub>		Q	df	I <sup>2</sup>
1. All Experimental vs. All Control										
Average time delay	21	4467	.12*	.10 - .15	.15*	.09 - .21	6	73.89*	20	72.93
Shortest time delay	21	4451	.12*	.09 - .15	.15*	.08 - .21	4	75.75*	20	73.60
Longest time delay	21	4444	.13*	.10 - .16	.16*	.09 - .22	7	76.93*	20	74.00
2. All Experimental vs. Neutral Control										
Average time delay	15	2890	.14*	.11 - .18	.18*	.09 - .26	7	76.71*	14	81.75
Shortest time delay	15	2877	.13*	.10 - .17	.17*	.08 - .26	6	80.23*	14	82.55
Longest time delay	15	2870	.15*	.12 - .19	.18*	.10 - .27	9	78.05*	14	82.06
3. All Experimental vs. Active Control										
Average time delay	8	1986	.12*	.08 - .17	.12*	.08 - .17	2	5.04	7	0.00
Shortest time delay	8	1986	.12*	.08 - .17	.12*	.08 - .17	2	5.29	7	0.00
Longest time delay	8	1986	.12*	.08 - .16	.12*	.08 - .16	2	6.42	7	0.00
4. Purely Planning vs. Neutral Control										
Average time delay	9	1808	.07*	.03 - .12	.11	-.002 - .22	n/a <sup>a</sup>	43.20*	8	81.48
Shortest time delay	9	1763	.07*	.03 - .12	.12	-.001 - .24	n/a	50.00*	8	84.00
Longest time delay	9	1852	.07*	.03 - .12	.10	-.006 - .21	n/a	41.68*	8	80.81

*Note.* k = number of effect sizes in the meta-analysis; N = sample size of the meta-analysis;  $\phi$  = mean overall correlation corrected

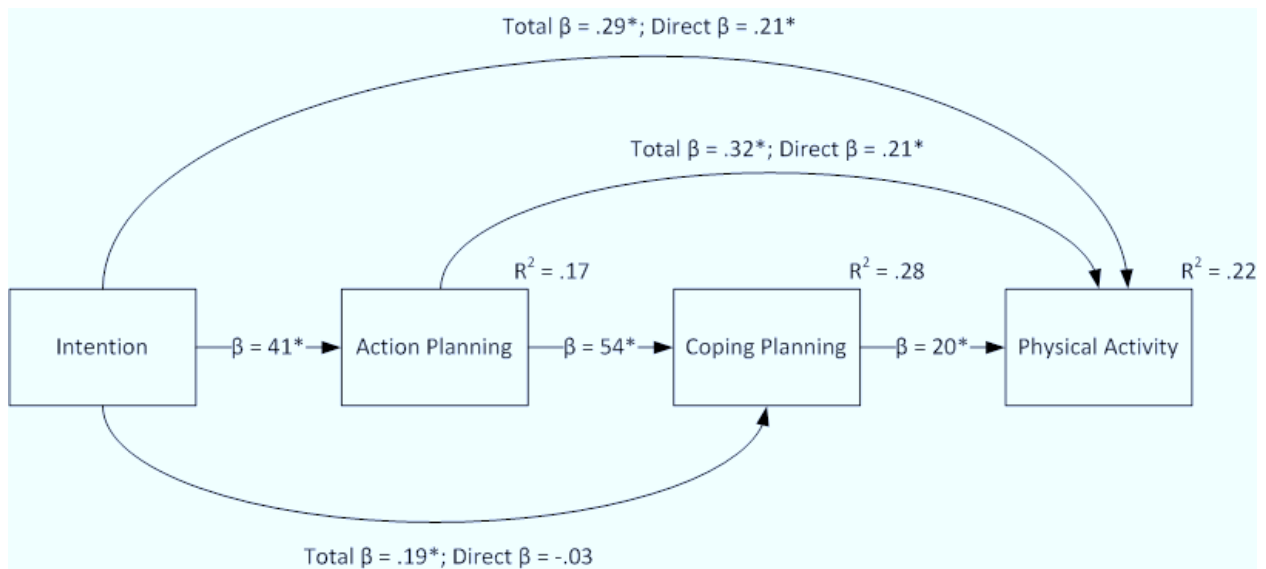
for sampling error and measurement error; CI<sub>95</sub> = 95% confidence interval; N<sub>FS</sub> = fail-safe N; Q = Q statistic; df = degrees of freedom;

I<sup>2</sup> = I squared. \* p < .01

<sup>a</sup>Could not be computed because the overall effect size was lower than the identified trivial value.



Panel A



Panel B

Figure 1. Results from meta-analytical path analyses. Panel A displays the dual mediation model (AP-CP concurrent relation). Panel B displays the sequential mediation model (AP-CP prospective relation). \*  $p < .01$

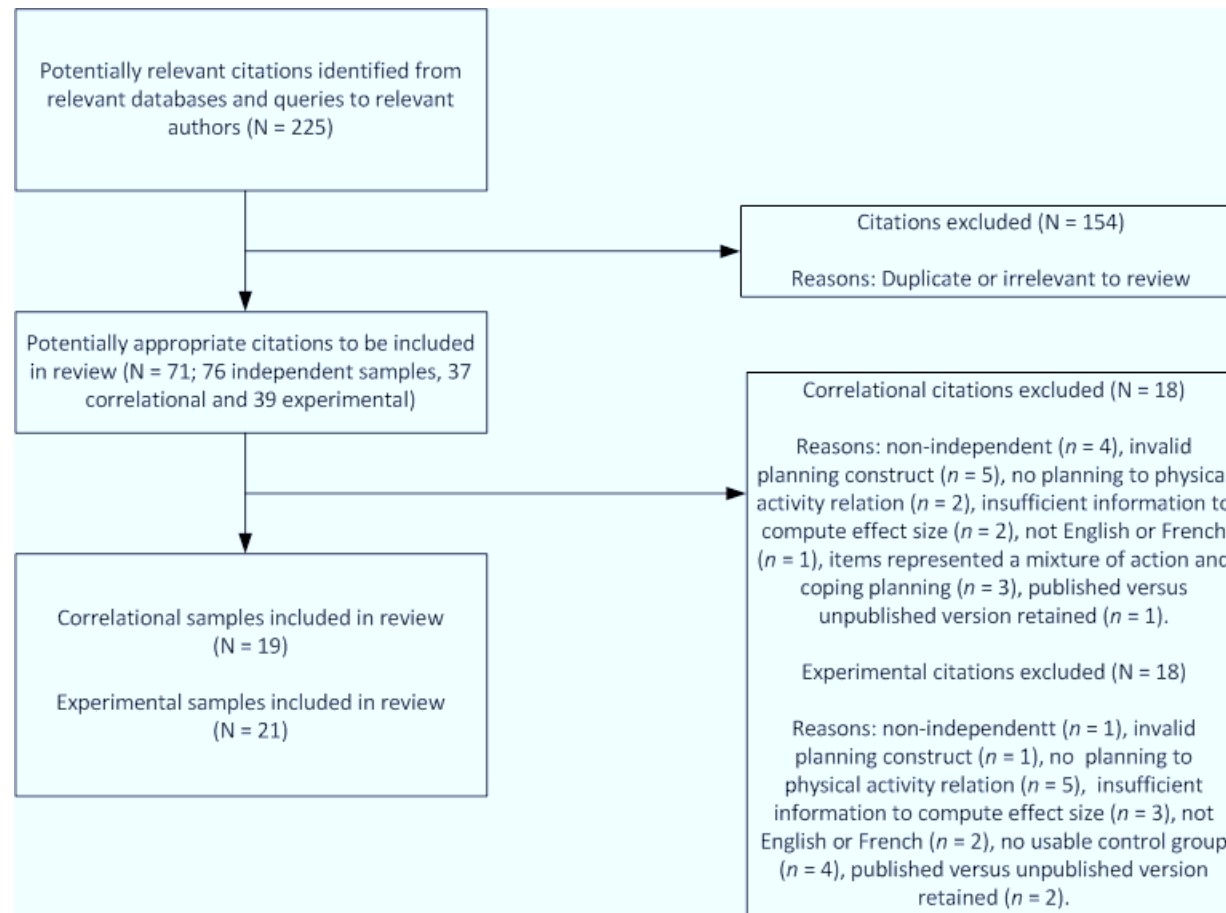


Figure 2. MARS flowthrough diagram.

Predicting Physical Activity Outcomes during Episodes of Academic Goal Conflict: The  
Differential Role of Action Planning and Coping Planning

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### Abstract

The moderating role of academic goal conflict on the relations between action planning (AP) and coping planning (CP) with physical activity (PA) was tested using samples of university students concurrently pursuing an academic and a PA goal. In Study 1 ( $N = 317$ ), AP was found to positively relate to PA goal progress at low, but not at high levels of goal conflict. CP trended toward being positively related to goal progress at high, but not at low levels of goal conflict. Study 2 ( $N = 97$ ), using a one-week daily diary design and measures of self-reported PA behavior and goal progress, showed that daily AP positively related to daily PA outcomes on days when students experienced lower, but not higher levels of goal conflict relative to their average. Conversely, CP positively related to daily PA outcomes on days when students experienced higher, but not lower levels of goal conflict.

**Keywords:** action planning, coping planning, dual goal pursuit, physical activity, goal conflict

## **Predicting Physical Activity Outcomes during Episodes of Academic Goal Conflict: The Differential Role of Action Planning and Coping Planning**

Most of us have had the experience of juggling multiple goals at one time. We aim to maintain a healthy lifestyle, succeed at school or work, enjoy hobbies, and spend time with significant others. When life gets busy, physical activity (PA) goals are often among the first to be shifted to the backburner. Recent meta-analyses have confirmed that planning is generally a useful strategy for helping people increase their PA behavior (Bélanger-Gravel, Godin, & Amireault, 2011; Carraro & Gaudreau, 2013), but the majority of studies included in these reviews considered a single PA goal in isolation. Given that individuals regularly pursue multiple goals concurrently (e.g., Austin & Vancouver, 1996), it is important to examine whether planning can help people reach their PA goals in a real-world context, where goal striving is threatened by the pursuit of other goals (Presseau, Tait, Johnston, Francis, & Sniehotta, 2013; Scholz, Keller, & Perren, 2009). Hence, the aim of the present research was to examine, at both the between- and within-person levels of analysis, whether action planning and coping planning can help individuals move toward their PA goals, even at times of higher goal conflict.

### **Goal Conflict**

Multiple goal pursuit is the norm rather than the exception (Austin & Vancouver, 1996). Although pursuing multiple goals allows people to strive toward numerous desired ends in various areas of their lives, it also means their many goals may *conflict* with one another (Riediger, 2001; Riediger & Freund, 2004) in such a way that progress on a focal goal is somehow impaired by the pursuit of another goal. Riediger and Freund (2004) have outlined two primary sources of *goal conflict*: one stems from resource limitations in time and energy

(e.g., feeling too fatigued from working to exercise); the other stems from logical incompatibility between goals (e.g., exercising self-care by resting a sprained ankle versus playing in one's team's softball game). Goal conflict is likely a key barrier to adopting and maintaining regular engagement in PA (Gebhardt, 2007; Gebhardt & Maes, 2001). Studies have demonstrated significant negative associations between goal conflict and both objective measures of PA (e.g., Riediger & Freund, 2004) and subjective ratings of progress on PA goals (e.g., Gebhardt & Maes, 1998). Conversely, *goal facilitation* refers to both the degree of instrumentality between goals (i.e., the pursuit of the PA goal sets the stage for the realization of the academic goal), and the overlap of means used to attain the goals (e.g., doing something in the pursuit of a PA goal is simultaneously beneficial for an academic goal, such as going to campus for class where one's gym is also located). The latter shares multiple features with the broader concept of *multifinality* (Kruglanski, et al., 2002), which is the notion that a single behaviour can serve multiple goals. Studies have shown the positive impact of goal facilitation in the PA domain (Presseau, Sniehotta, Francis, & Gebhardt, 2010; Riediger & Freund, 2004), making it an important factor to consider when examining multiple goal pursuit.

Goal conflict as a barrier to PA behavior may be of particular importance when considering the university student population. Developmental studies show that, although most North Americans become increasingly sedentary with age, the sharpest decline in PA occurs between late adolescence and young adulthood – the age range of most university students (Stone, McKenzie, Welk, & Booth, 1998). University students may be particularly vulnerable to goal conflict stemming from their academic goals and activities. Students report stringent time constraints associated with their school duties as primary barriers to exercising regularly

(Gyurcsik, Bray, & Brittain, 2004), and they exercise less than their usual amount during busy periods such as examinations (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996). Hence, research is needed to elucidate what happens to the effectiveness of self-regulation strategies to promote PA when students experience goal conflict stemming from their academic activities.

### **The Role of Planning in Multiple Goal Pursuit**

Action planning and coping planning are self-regulatory strategies that may provide university students with a way of managing their goal pursuit. *Action planning* (AP) specifies when, where, and how goals will be pursued (Sniehotta, Schwarzer, Scholz, & Schüz, 2005). AP has been shown to help goal strivers notice opportunities to enact their intended goal-directed behaviors (Parks-Stamm, Gollwitzer, & Oettingen, 2007), and to do so more swiftly and efficiently when opportunities are encountered (Brandstätter, Lengfelder, & Gollwitzer, 2001). Hence, because AP renders goal striving more efficient and less taxing on one's conscious self-regulatory capacities (Gollwitzer & Schaal, 1998), this strategy may help preserve self-regulatory resources that can then be used for the successful pursuit of multiple goals. *Coping planning* (CP) is defined as anticipating obstacles to goal striving and pairing them with coping responses. In the same way that CP shields goal pursuit from temptations, obstacles, and distractions (Sniehotta, et al., 2005), it may also facilitate the pursuit of PA goals even in a context in which university students have to concurrently contend with their academic goals.

Two recent meta-analyses highlight the positive impact of planning on PA. Carraro and Gaudreau (2013), in their meta-analysis of AP and CP on PA, found a medium-to-large summary effect of both spontaneous AP and CP among the correlational studies included for review. Among the experimental studies, results pointed to a small summary effect for planning on PA.

Similarly, Bélanger-Gravel, et al. (2011), in their meta-analysis of experimental studies, revealed small-to-medium effects of AP for PA at post-intervention and follow-up time points. Both meta-analyses pointed to the significant heterogeneity of the effect size, indicating the need for further research examining potential moderators of the association of AP and CP with PA. Relatedly, calls have been made, both several years ago (Austin & Vancouver, 1996; Emmons & King, 1988; Locke, Smith, Erez, Chah, & Schaffer, 1994) and more recently (e.g., Vancouver, Weinhardt, & Schmidt, 2010) to enhance our understanding of goal pursuit in real world conditions by studying its processes as they exist within each of us—that is, as part of a larger, interconnected system (Shah & Kruglanski, 2002). The present studies are an attempt to join these cutting edge lines of research by examining the potential moderating impact of goal conflict in the relationships of AP and CP with PA outcomes of university students who are naturally engaged in a multiple goal context.

### **Intra-Individual Planning and Goal Conflict**

Research has mainly focused on the relation between planning and PA at the between-person level of analysis. As reviewed above, it can be concluded that individuals using more AP and CP are more likely to be more physically active than those individuals using less AP and CP. As noted by Nezlek (2001), a crucial feature of relationships analyzed at the between- and within-person levels is that they are *independent*. That is, within-person relationships may be negative whereas between-person relationships may be positive, and vice versa. For example, Scholz, Keller, and Perren (2009) found a non-significant within-person relation between AP and PA – a result which diverges from a substantive body of between-person findings. In another study, both AP and CP were significantly positively correlated with running behavior at the

within-person level (Scholz, Nagy, Schüz, & Ziegelmann, 2008), suggesting that when individuals use AP and CP more than their own usual level, they seem to increase their PA behaviors relative to their own typical level. Inconsistencies in the literature on the link between planning and physical activity outcomes could be caused by random error and/or reflect bona fide differences between self-regulation processes at the between-and within-person levels.

There are theoretical and practical reasons to testing the generalizability of findings across levels of analysis. Conventional health behaviour theories and the associated methods to study them are focused on explaining relations between a person's typical (i.e., aggregated) self-regulation and their typical (i.e., aggregated) behaviour. They can be limited by the fact that typical self-regulation or behaviour over a period of time is a statistical construction that may or may not resemble self-regulation or behaviour at a given point in time (Conroy, Elavsky, Doerksen, & Maher, 2013). Taking the daily variability in physical activity behaviour into account can help yield more complimentary estimates of both within- and between-person physical activity (Tudor-Locke, et al., 2005), and, hopefully, more pointed recommendations for physical activity interventions and policy.

From an empirical perspective, regarding goal conflict and goal facilitation, as noted by Penseau and his colleagues (2013), at least three prospective studies have failed to show a between-person relationship between perceived goal conflict and PA (e.g., Li & Chan, 2008; Penseau, et al., 2010). However, constructs conceptually similar to goal conflict (i.e., daily hassles and job demands) have been negatively related to health behaviors, including PA (e.g., O'Conner et al 2008; Payne et al 2010), at the within-person level. Penseau et al., in their study examining accelerometer-assessed PA, found that perceived goal facilitation, but not goal

conflict, significantly predicted PA over and above intention and perceived behavioral control at the between-person level. Conversely, at the within-person level, they found that the amount of time spent in the pursuit of conflicting goals was negatively associated with PA, again controlling for intention and perceived behavioral control. In other words, the more people pursued conflicting goals on a given day, the less they engaged in PA on that day. Overall, these findings highlight the importance of testing the associations between planning and conflict constructs with PA at both the between- and within-person levels, as they may not necessarily converge.

### **The Current Studies**

Examining the *potential moderating role of goal conflict* at both the between-person and within-person level appears to be a theoretically fertile and policy-relevant avenue to determine the circumstances under which AP and CP are more effective in promoting PA. Relative to experimental studies, which involve explicit instructions from the experimenter on how to create implementation plans, we know less about how people generate spontaneous AP and CP in the real world (Sniehotta, et al., 2005). It is conceivable that people fail to sufficiently consider their alternative goals when creating plans for a focal goal, thereby leaving them vulnerable to goal conflict. For example, the time and energy allocated to schoolwork on a particular day might interfere with the plan to attend an exercise class after school. In this scenario, the person experiencing conflict from the academic domain would not be able to enact the plans as intended, which could hinder their capacity to progress on their PA goal.

In this research, we explored the extent to which AP and CP are associated with PA when students are experiencing conflict between their academic and PA goals, both at the

between- (Study 1) and within-person (Study 2) levels. In Study 1, we used a prospective design to examine whether academic goal conflict<sup>1</sup> experienced during the midterm exam period moderates the relationship of AP and CP with progress made in the pursuit of PA goal six weeks later. In Study 2, we replicated and extended Study 1 by examining the moderating role of daily academic goal conflict on the relation of daily AP and CP with two indicators of daily PA behavior at the within-person level. The PA goal progress measure used in Study 1 was supplemented with an additional PA measure capturing daily self-reported energy expenditure.

### **Study 1**

The aim of Study 1 was to examine the extent to which academic goal conflict influenced the strength and direction of the relations of AP and CP with PA goal progress. We also controlled for goal facilitation in light of past empirical evidence showing that it is a consistent positive predictor of subjective (Gebhardt & Maes, 1998; Penseau, et al., 2010) and objective PA behavior (Penseau, et al., 2013; Riediger & Freund, 2004). In line with burgeoning research on the boundary conditions of AP (e.g., Dalton & Spiller, 2012) and recent meta-analyses showing heterogeneous effects, it was hypothesized that the positive association between Time 1 AP and Time 2 PA goal progress would be significantly stronger for individuals experiencing lower, compared to higher, levels of academic goal conflict (Hypothesis 1). Coping becomes even more important when obstacles arise. “When the going gets tough”, having proactively created coping plans is likely to become even more salient. Therefore, we expected the positive association between Time 1 CP and Time 2 PA goal progress to be

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<sup>1</sup> In this article, we are using the term “academic goal conflict” to refer to goal conflict, as defined by Riediger and Freund (2004), stemming from the pursuit of the academic goal that produces interference, or conflict with the pursuit of the physical activity goal.

significantly stronger for individuals experiencing higher, compared to lower, levels of academic goal conflict (Hypothesis 2).

## Method

### Participants

Participants were undergraduate students recruited in classrooms and via an introductory psychology participant pool at a large Canadian university. Only participants providing a relevant PA and academic goals were included in the study. Two independent coders assessed goal relevance with high agreement ( $\kappa$  PA goals = .93;  $\kappa$  academic goals = .97). Any discrepancies were discussed until agreement was reached. Of the initial sample ( $n = 371$ ), 54 participants were excluded on the basis of either failing to report a goal or providing an irrelevant (e.g., “Get my life in order”) or unrealistic goal (e.g., “I want to lose 30 pounds”). Of the participants with relevant goals ( $n = 320$ ), 92 did not complete the Time 2 questionnaires, yielding a 71% retention rate. Three participants failed to complete relevant Time 1 measures and were excluded. Attrition analyses indicated no significant mean differences between the sample with complete data ( $n = 226$ ) and the attrition sample ( $n = 91$ ) on Time 1 AP,  $F(1, 316) = 3.38, p = .28$ , and Time 1 CP,  $F(1, 316) = 0.77, p = .57$ .

The final sample was comprised of 317 participants (73% female) ranging from 17 to 38 years of age ( $M = 19.0, SD = 2.23$ ). Participants were ethnically diverse (69% Caucasian, 4% African-Canadian, 14% Asian-Canadian, and 13% “Other”). Ninety-nine percent of students were enrolled in their studies full-time. Approximately 35% of students received full financial support from their parents during their studies, while 42% received partial support, and 23% received no support. Thirty-eight percent of students reported working outside of school for an

average of 15 hours per week. In both Study 1 and Study 2, participants were treated in accordance with APA/CPA ethical guidelines, as approved by the university Research Ethics Board, and they provided informed consent before starting the study.

### **Design and Procedure**

This study used a two-wave prospective design. Classroom participants were invited to participate by providing their email on a sheet that was circulated in the classroom while the recruiter stepped out. Participant pool participants were invited to participate in the study among many others on the participant pool website. No differences were found between participants recruited in class versus the participant pool. At Time 1, participants set both an academic goal and a PA goal and completed a measure of AP and CP regarding their PA goal. Six weeks later, at Time 2, participants completed a questionnaire that measured goal conflict and facilitation, and a measure of PA goal progress. All questionnaires were completed online via a secure website. Following completion of the Time 2 questionnaires, participants were debriefed and informed about empirically supported guidelines for optimizing goal pursuit to thank them for their participation. Participants recruited in classrooms received a small monetary compensation, and those recruited via the participant pool received two participation points.

### **Measures**

**Physical activity and academic goal (Time 1).** Participants were asked to report a specific, meaningful, and measurable goal for both their PA behavior and their academic behavior to pursue during the semester. Personal goals were defined as “projects and concerns that people think about, plan for, carry out, and sometimes (though not always) complete or succeed at” (Koestner, Lekes, Powers, & Chicoine, 2002). Participants set goals such as: “I want

to go jogging 3 times per week” (i.e., physical activity goal) and “To complete the practice problems for all my courses” (i.e., academic goal).

**Action planning and coping planning for physical activity (Time 1).** AP was assessed using five items adapted from the measure of Rise, Thompson, and Verplanken (2003). Using a scale from 1 (*not at all*) to 7 (*totally*), participants indicated the extent to which they formed plans about *when* to work toward their PA goal (i.e., “I made detailed plans about the day(s) on which to perform my physical activity behaviour” and “I made detailed plans about the time of the day on which to work on my physical activity behavior”), *where* to work toward their goal (i.e., “I made detailed plans about “where” to work on my physical activity behavior”), *how* they made time for their goal (i.e., “I made detailed plans about “how” to find the time to work on my physical activity behavior”), and *what* they did in the service of their goal (“I made detailed plans about “what” to do to work on my physical activity behavior”). Prior work has reported high (> .90) internal consistency for this measure in the exercise domain (Brickell, Chatzisarantis, & Pretty, 2006; Rise, et al., 2003), as well as support for the factorial validity of the scale in a sample of university students (Brickell, et al., 2006).

CP was assessed with a version of Sniehotta and colleagues’ (2005) scale adapted for PA goals. Participants used a scale from 1 (*not at all*) to 7 (*totally*) to rate the extent to which they formed plans to address potential *obstacles* (i.e., ‘I tried to find ways of dealing with obstacles that could otherwise interfere with my physical activity behavior’), *temptations* (i.e., ‘I made a detailed plan about ways to deal with temptations that could otherwise hurt my progress on my physical activity behavior’), *distractions* (i.e., ‘I prepared a plan of action to cope with distractions that could otherwise interfere with my physical activity behavior’), *external events*

(i.e., 'I prepared a coping plan to deal with external events that could otherwise create conflict with my physical activity behavior'), and *bad habits* (i.e., 'I tried to think about ways to prevent bad habits from interfering with my physical activity behavior'). Prior work has supported the factorial validity of the scale (Sniehotta, et al., 2005).

**Academic goal conflict and facilitation (Time 2).** Participants were asked to pair their academic goal with their PA goal to respond to an adapted version of the Inter-Goal Relations Questionnaire (IRQ, Riediger, 2001). In this study, we were interested in the conflicting and facilitative impact of students' academic goal on their PA goal. As such, the IRQ items were adapted to reflect this. Using a scale from 1 (*not at all true or never/very rarely*) to 5 (*very true or very often*), participants were asked to answer items with reference to their life over the last few weeks. Four items were used to measure academic goal conflict (e.g., How often did it happen that, because of the pursuit of your academic goal, you do not invest as much time/energy/money into your physical activity goal as you would have liked to? How often did it happen that you did something in the pursuit of your academic goal that was incompatible with your physical activity goal?), and four items were used to measure academic goal facilitation (e.g., How often did it happen that you did something in the pursuit of your academic goal that was simultaneously beneficial for your PA goal?). In addition to excellent internal consistency ( $\alpha = .94$ ) Reidiger and Freund (2004) provided good evidence for the factorial, predictive, and discriminant validity of the IRQ.

**PA goal progress (Time 2).** PA goal progress was assessed using five items rated on a scale from 1 (*not at all*) to 7 (*totally*). Referring to the last few weeks, participants indicated the extent to which: they progressed on their goal; they moved forward in the pursuit of their goal;

they came closer to reaching their goal; they made progress toward the realization of their goal; and, they advanced toward their goal. This scale has demonstrated high internal consistency in prior studies (e.g., Carraro & Gaudreau, 2009).

### **Plan of analyses**

Descriptive statistics and multiple imputations were carried out in SPSS 21. Assuming the data were missing at random, multiple imputation ( $m = 50$  imputations) was used to handle the missing data (Enders, 2006; Graham, Olchowski, & Gilreath, 2007). Multiple imputation is preferable to listwise deletion because it is associated with minimized risks of generating biased parameter estimates while maximizing the statistical power of the analyses (Schlomer, Bauman, & Card, 2010). It has been recommended that the number of imputations should at least correspond to the percentage of missing data (e.g., Bodner, 2008) because increasing the number of imputations is important to minimize biases in the standard error of parameter estimates and, hence, their  $p$  value. Although adding the number of imputations can be computationally demanding, our analyses were conducted with 50 imputed datasets.

Moderated hierarchical regression analyses were conducted in MPLUS (version 7.01) using robust maximum likelihood estimation in order to take into account the non-normality of the data. The predictors and the moderators were centered. A two-step approach was used in which AP, CP, goal conflict, and goal facilitation were entered in the first step and the AP  $\times$  goal conflict and CP  $\times$  goal conflict multiplicative terms were added in the second step. The significance of the block of predictors at step 1 and step 2 (and the incremental change from step 1 to step 2) were calculated using a Wald Statistic (distributed like a chi-square with degrees of freedom corresponding to the number of predictors). Significant interactions were

decomposed using simple slope analyses (Cohen, Cohen, West, & Aiken, 2003). Simple slopes at low and high levels of goal conflict were calculated at one standard deviation below and above the mean, respectively.

### Results

The database of 318 participants<sup>2</sup> was screened for outliers. Visual inspection of bivariate scatterplots for all combinations of variables revealed two potential outlying cases, one between AP and PA goal progress, and one between CP and PA goal progress. Using the Mahalanobis distance critical value for two variables,  $\chi^2(2) = 13.816, p < .001$ , the case identified between AP and PA goal progress was confirmed as a significant outlier and therefore removed from the analyses (Meyers, Gamst, & Guarino, 2006). Descriptive statistics, reliability estimates, and correlations between the variables are reported in Table 1.

The results of the moderated hierarchical regression analyses showed significant main effects for goal conflict and goal facilitation, but not for AP and CP (see Table 2). The interaction AP x goal conflict was significant whereas the interaction CP x goal conflict was marginally significant (see Table 2). The two interactions explained 2% of unique variance over and above the main effects. As illustrated in Figure 1 (see panel A), simple slope analyses revealed that AP was significantly related to goal progress at low, but not at high levels of school-to-physical activity goal conflict, thereby supporting Hypothesis 1. Conversely, simple slope analyses showed that CP was not significantly related to goal progress at low levels of conflict, but showed a trend toward being positively related to goal progress at high levels of conflict. These results, shown in Figure 1 (see panel B), partially supported Hypothesis 2.

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<sup>2</sup> Please note that the descriptive information reported in the Participants section is based on the final sample of N = 317 that excludes the multivariate outlier.

### **Brief Discussion**

Study 1 pointed to a pattern of results in which AP and CP produced divergent associations with PA goal progress in the presence of academic goal conflict, while controlling for academic goal facilitation. AP was positively related to PA goal progress, but only for individuals who experienced lower levels of conflict stemming from their academic goal pursuit. This finding is consistent with an emerging line of research examining the boundary conditions for AP (Dalton & Spiller, 2012). Conversely, a trend emerged in which CP was related to PA goal progress, but only for individuals with higher levels of academic goal conflict. Given that coping plans are designed to address barriers to goal pursuit, it makes sense that these plans would be related to goal progress for individuals who are experiencing such barriers, but more inconsequential for those experiencing such barriers to a weaker extent. Notably, as illustrated in Figure 1, when considering either form of planning, students made greater progress toward their PA goals when academic goal conflict was lower.

### **Study 2**

Study 2 was designed to examine the moderating role of goal conflict at the within-person level with data collected in a seven-day daily diary study. Compared to the design used in Study 1, daily measurement provides a number of distinct advantages, such as enhanced ecological validity (by assessing representative activities in daily life), reduced memory recall biases (by conducting assessments close in time to actual behavior), and greater external validity (by having measures that are generalizable to real-life experience; Shiffman, Huffard, & Patty, 2001). Foremost, this design enabled us to investigate the relationship between planning and PA at the within-person level (Moskowitz, Russell, Sadikaj, & Sutton, 2009).

We also added a measure of self-reported PA behavior in order to complement the goal progress measure used in Study 1. The measure of goal progress can be seen as idiosyncratic because it reflects the amount of progress on each participant's PA goal. Levels of PA and goal progress are empirically related but conceptually distinct outcomes (Dugas, Gaudreau, & Carraro, 2012). Ultimately, someone may have attained his or her goal of performing PA for 30 minutes while still being less physically active than someone who had only partially attained his or her goal of performing PA for an hour. For these reasons, daily goal progress and daily self-reported PA behavior were both measured in this study to offer a more comprehensive examination of the moderating role of goal conflict.

In line with results from previous studies looking at planning and PA at the within-person level (e.g., Scholz, et al., 2008), we expected positive associations of daily AP and CP with daily goal progress and self-reported PA behavior. In other words, it was expected that individuals would be more physically active and make more progress on their goals on days during which their level of AP and CP were higher than their own habitual level. Consistent with Study 1, our main hypothesis was that the relationship of daily AP with daily PA goal progress (Hypothesis 1a) and daily self-reported PA behaviour (Hypothesis 1b) would be weaker on days when students experienced higher academic goal conflict than their own average. Conversely, the within-person association of daily CP with daily PA goal progress (Hypothesis 2a) and daily self-reported PA behaviour (Hypothesis 2b) was expected to be stronger on days during which students experienced higher academic goal conflict than their own average.

## Method

### Participants

Participants were undergraduate students recruited in classrooms and via an introductory psychology participant pool at a large Canadian university. Of the initial recruited sample of 136 participants, 115 completed baseline measures. As in Study 1, only participants providing relevant PA goal and academic goal were included in the study. Two independent coders assessed goal relevance with satisfactory agreement ( $\kappa$  PA goals = .69;  $\kappa$  academic goals = .80). Any discrepancies were discussed with the help of a third expert until agreement was reached. Of the participants with complete baseline data and valid goals, 14 failed to complete any daily diaries. All remaining participants completed at least 1 valid daily diary. On average, participants completed an average of 3.9 ( $SD = 1.75$ ) daily diaries. The percentage of daily diaries completed is as follows: one diary (12.4%), two diaries (17.5%), three diaries (8.2%), four diaries (15.5%), five diaries (23.7%), and six diaries (22.7%).

The final sample was comprised of 97 participants (68% female) ranging from 17 to 52 years of age ( $M = 20.45$ ,  $SD = 4.61$ ) mainly in their first-year at the university (59%). Participants were ethnically diverse (71% Caucasian, 4% African-Canadian, 15% Asian-Canadian, and 10% "Other"). Ninety-six percent of students were enrolled in their studies full-time. Approximately 32% of students received full financial support from their parents during their studies, while 39% received partial support, and 29% received no such support. Forty-two percent of students reported working outside of school for an average of 14 hours per week. Participants recruited in classrooms received monetary compensation (i.e., \$5 for the baseline questionnaire and \$2 per daily diary completed and had their name entered into a draw for a \$25 gift certificate to a local mall), and those recruited via participant pool received two participation points.

## Design and Procedure

The study followed a time contingent daily diary design (Moskowitz, et al., 2009), with measures taken on a fixed interval schedule (i.e., daily for one week). All questionnaires were completed online via a secure website, with the baseline questionnaire being completed on a Monday and six daily diaries being completed each evening the subsequent Tuesday to Sunday. The baseline questionnaire took approximately 15 minutes to complete, and contained measures of demographics, goal setting, and control variables. For the next six days, participants were asked to log into the secure website each evening, between 7:00 pm and 3:00 am the following morning, to complete a series of measures that took five to seven minutes. The website was inaccessible outside of these specified hours, and participants' responses were time-stamped. Participants were sent an email every day at 5:00 pm with a friendly reminder to complete the daily diary in order to improve compliance (Shiffman, et al., 2001). Following the completion of the final daily questionnaire, participants were debriefed and provided with empirically supported guidelines for optimizing goal pursuit.

## Measures

**PA and academic goal (baseline).** As in Study 1, participants were asked to report a specific, meaningful, and measurable PA goal and academic goal. All aspects of the goal setting procedure were identical to Study 1, but participants were instructed to set a goal that could be pursued and assessed each day over the course of one week. Participants set goals such as: "I will walk for 30 minutes each day", and "I would like to review my schoolwork outside of class for at least one hour each evening".

**Action planning and coping planning for physical activity (daily).** AP and CP were assessed in a manner identical to that of Study 1, except participants were asked to respond to items as they related to the present day (i.e., Please refer to what you have been doing *today* regarding your physical activity goal).

**Academic goal conflict and goal facilitation (daily).** The method of assessing academic goal conflict and facilitation was identical to that used in Study 1, save items were again modified to reflect daily measurement. For example, “To what extent did it happen *today* that because of the pursuit of your academic goal, you did not invest as much effort into your physical activity goal?”

**PA goal progress (daily).** The method of assessing PA goal progress was identical to Study 1, again with the exception that items were modified to reflect daily measurement (e.g., “To what extent did you come closer to reaching your academic/physical activity goal *today*?”)

**Self-reported PA behavior (daily).** Daily self-reported PA behavior was assessed using the Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985), which distinguishes between *strenuous* (i.e., heart beats rapidly and quickly results in sweating), *moderate* (i.e., not exhausting and takes time before leading to sweating), and *mild* (i.e., does not necessarily lead to sweating and requires little effort) forms of exercise. Each evening, participants were asked to indicate the number of times they engaged in each form of exercise for at least 15 minutes that day. A daily level of PA index was computed using the weighted sum of scores for each form of exercise [i.e., (9 x Strenuous) + (5 x Moderate) + (3 x Mild)].

### Overview of analyses

The data generated by this daily diary study are hierarchically organized, with daily assessments of AP, CP, goal conflict and facilitation, PA goal progress, and self-reported PA behavior (Level 1) nested within people (Level 2). Multilevel modeling (MLM) is considered the most appropriate statistical analysis for hierarchical data, as it allows for the simultaneous but independent investigation of variability at the within- and between-person levels (Raudenbush & Bryk, 2002). The HLM 6.04 software with full information maximum likelihood robust estimation was used to analyze the data. Descriptive statistics are presented in Table 3.

The first step in performing the analyses was to run the *null/unconditional model (Model 1)*. The results of this model allowed for the calculation of the intra-class correlation (ICC), which identifies the proportion of total variance in the outcomes that is attributable to variation between individuals; the remainder of the total variance is therefore attributable to variability within individuals across days (Raudenbush & Bryk, 2002). A chi-square statistic is computed to determine whether the between-person variance significantly differs from zero.

The second step was to examine main effects by adding four Level 1 predictors (*Model 2*): Daily AP, CP, and goal conflict, and goal facilitation. All predictors were *group mean centered*, such that the intercept of each individual represented his or her average score on the dependent variables (either PA goal progress or self-reported PA behavior) over the six days.

The third step was to create and incorporate two Level 1 interaction terms following the guidelines of Cohen et al. (2003): AP  $\times$  goal conflict and CP  $\times$  goal conflict. These product terms were not centered (Model 3). Significant interactions were probed with simple slope analyses estimating the effect of daily AP and daily CP at low (i.e., 1 SD below) and high (i.e., 1 SD above)

daily goal conflict<sup>3</sup>. Pseudo  $R^2$  values were computed for Models 2 and 3 to determine the percentage of within-person variance explained by the predictors.

## Results

### Daily PA Goal Progress

As shown in Table 4 (see model 1), the within-person variance ( $\sigma^2$ ) was 2.88 and the between-person variance ( $\tau_{00}$ ) was 1.73. The ICC indicated that 38% of the variance in PA goal progress was attributable to between-person variability. This means that a greater proportion of variability in PA goal progress (68%) is attributable to daily variations. The addition of the Level 1 predictors showed that the within-person slopes for AP ( $\beta_{10}$ ), CP ( $\beta_{20}$ ), goal conflict ( $\beta_{30}$ ), and goal facilitation ( $\beta_{40}$ ) were all significantly different from zero (see Table 4, model 2). These four predictors explained 57% of the variance in PA goal progress. As expected, both daily AP and daily CP were significantly and positively associated with PA goal progress. Next, the two interaction terms were added. As shown by the tests of the  $\beta_{60}$  and  $\beta_{70}$  coefficients (see Table 4, model 3), both AP X goal conflict and the CP X goal conflict interactions have reached statistical significance, which explained 1% of additional and unique variance in daily PA goal progress.

Simple slope analyses revealed that daily AP was positively associated with daily goal on days during which individuals experienced lower goal conflict from their academic goal. The relation between daily AP and daily PA goal progress was significant, but substantially weaker on days during which individuals experienced higher goal conflict, which provides support for Hypothesis 1a (see Figure 2, panel A).

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<sup>3</sup> We used the average within-person standard deviation as recommended by Nezlek (2012)

Daily CP was not significantly associated with daily goal progress on days during which individuals experienced lower goal conflict. However, the relation between daily CP and daily progress was positive and significant on days during which individuals experienced higher goal conflict, which supports Hypothesis 2a (see Figure 2, panel B).

### **Daily Self-Reported PA Behavior**

As shown in Table 5 (see model 1), the within-person variance ( $\sigma^2$ ) was 96864 and the between-person variance ( $\tau_{00}$ ) was 80134. The ICC indicated that 45% of the variance in self-reported PA behavior was attributable to between-person variability; 55% of the variance is therefore attributable to daily variations. The addition of the Level 1 predictors showed that the within-person slopes for AP ( $\beta_{10}$ ), CP ( $\beta_{20}$ ), goal conflict ( $\beta_{30}$ ), and goal facilitation ( $\beta_{40}$ ) were all significantly different from zero (see Table 4, model 2). These four predictors explained 52% of variance in self-reported PA behavior. As expected, both daily AP and daily CP were positively and significantly associated with daily self-reported PA behavior. Finally, only the AP x goal conflict ( $\beta_{60}$ ) reached statistical significance (see Table 5, model 3), thus supporting hypothesis 1b but not 2b.

Simple slope analyses for the significant AP x goal conflict interaction showed that daily AP was positively associated with daily self-reported PA behavior on days during which individuals experienced lower goal conflict. The relation between daily AP and daily self-reported PA behavior was not significant on days during which individuals experienced higher goal conflict (see Figure 2, panel C).

### **Brief Discussion**

The results of this daily diary study offered additional support for the moderating role of goal conflict in the respective relation of AP and CP with PA outcomes. Consistent with the results of Study 1, our results lent credence for the differential role of AP and CP in predicting PA outcomes when students are experiencing goal conflict. On the one hand, the positive relation between daily AP and daily PA outcomes was stronger on days during which the students experienced lower levels of goal conflict. On the other hand, the positive relation between daily CP and daily PA goal progress was stronger on days during which the students experienced higher levels of goal conflict. Overall, these findings supported three of the four hypotheses – this time, in a study looking at the within-person association of AP and CP with two indicators of PA behavior.

### **Discussion**

The aim of these two studies was to examine, at both the inter- and intra-individual levels of analysis, whether AP and CP could help individuals progress toward their PA goals, even when they experience conflict stemming from concurrent academic goal pursuit. These studies contribute to of an emerging line of research that examines the pursuit of more than one goal at a time, so as to more closely capture how people strive toward valued aims in their everyday lives. Two studies, using different methodologies and outcome measures, provided convergent support for the overarching thesis of the present paper, which is that the relation between planning and PA is moderated by the level of goal conflict students experience from the academic domain.

### Review and Integration of the Main Findings

The results of Study 1 and Study 2 dovetail nicely to reveal two key findings. First, it was found that academic goal conflict consistently moderated the influence of planning on desired PA outcomes. This result is in line with prior research showing the deleterious influence of goal conflict at both the between- (e.g., Bailis, Thacher, Aird, & Lipschitz, 2011; Gebhardt & Maes, 1998) and within-person levels (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Payne, Jones, & Harris, 2010). Relatedly, the second, and perhaps most striking, finding to arise from our studies was that AP and CP play *differential roles* in predicting PA outcomes when students are experiencing goal conflict. More precisely, our results showed that AP related to better PA outcomes at *lower* levels of academic goal conflict, whereas CP related to better PA outcomes at *higher* levels of academic goal conflict. These two self-regulatory strategies clearly play a different, yet complementary role in the goal pursuit process. Although AP and CP are highly interrelated (and both positively relate to desired PA outcomes), their differential function becomes apparent when examining their impact across varying levels of academic goal conflict.

On the one hand, it was found that the positive relation between AP and PA outcomes was stronger when students experienced *lower* levels of academic goal conflict over the course of the semester (Study 1) or on a given day (Study 2). Interventions fostering AP have traditionally been targeted at helping individuals articulate when, where, and how to pursue their PA goals without considering how such goals need to be conciliated with other important life strivings. Our findings could explain why such AP interventions sometimes fail to report strong effect sizes (e.g., Carraro & Gaudreau, 2013) insofar as several individuals might be struggling to avoid conflicts stemming from other important life goals. A second generation of

AP interventions could be devised to help individuals plan for multiple goals in such a way as to minimize the risk of their goals conflicting with one another.

On the other hand, it was found that the positive relation between CP and PA outcomes was generally stronger when students experienced *higher* levels of academic goal conflict over the course of the semester (Study 1), or a given day of the week (Study 2). Interventions including CP have typically involved asking individuals to proactively identify potential obstacles and problems that could eventually interfere with their goal striving (Sniehotta et al., 2005). Our findings could also explain why CP interventions sometimes fail to report strong effect sizes, because CP seems largely inconsequential when individuals are not experiencing conflict between competing goals. As shown in our studies, however, the importance of CP becomes more obvious when individuals start experiencing some conflict in the pursuit of their PA goals. These findings offer convincing empirical support for the notion that CP should be systematically included in planning interventions insofar as it can prevent goal striving from getting derailed “when the going get tough” — in this case, during times of higher conflict stemming from concurrent academic obligations. Differences in findings across the two studies are worth noting. In particular, the CP × Conflict interaction was only marginally significant in Study 1 was non-significant for the PA behaviour outcome in Study 2. One possible reason for this might be that participants did not perceive their academic goal to conflict with their physical activity pursuits. Another reason might simply be related to a lack of correspondence between how constructs were measured (i.e., retrospectively versus daily diary). Such considerations strengthen the argument for research to be performed at the within-person

level, to amass a larger body of evidence to be considered alongside traditional between-person research.

From a practical standpoint, as discussed above, interventionists might seek to optimize AP and CP by encouraging people to devise plans for getting started and coping with obstacles that specifically consider how concurrent goals might interfere with focal goal pursuit.

Notwithstanding, as illustrated in Figures 1 and 2, students still made greater overall PA gains when goal conflict was lower. This suggests that planning may not be the most appropriate “first line” strategy against goal conflict. An interesting line of future research would be to examine whether it may be more fruitful to intervene at the goal setting stage, by devising goals at the front end that take into account potential ways of minimizing conflict and even increasing facilitation. This could naturally reduce goal conflict to help maximize the effectiveness of AP interventions.

### **Limitations and Additional Future Directions**

Study limitations should be considered when examining our results, and may serve as a springboard for future research. First, we employed a *dual goal model*, which is one way of assessing interrelationships among goals. One limitation of this approach is that the two goals assessed were only a small subset of individuals’ broader goal structure. Other approaches have been used to study multiple goal pursuit. For example, Presseau and colleagues (2013) used *personal projects analysis* (Little, Salmela-Aro, & Phillips, 2007), which involves using a series of assessment modules to elicit, rate, and compare an average of 10 goals. Other researchers (e.g., Segerstrom & Nes, 2006) have used the *striving instrumentality matrix* (Emmons, 1986), which also involves more exhaustive goal matrices. Alternatively, industrial organizational

researchers have also focused on two life domains, such as work and family (Wiese & Salmela-Aro, 2008), but they included multiple goals within each domain, and examined the degree of conflict and facilitation between each of them. It would be interesting to examine whether the results obtained across our two studies can be replicated using these alternative methods, though this work would need to balance thoroughness in assessing idiosyncratic goal structures with the potential for participant burden, particularly in intensive longitudinal designs such as that employed in Study 2.

A second limitation concerns our use of university student samples, which limits the generalizability of our findings. From an applied perspective, it is fruitful to study this demographic group given the downward trajectory of PA behaviour beginning in university (Stone, et al., 1998). However, it would be important to study other populations (e.g., employees and new parents) and combinations of goals (e.g., work/family/friendship/romantic relationships) – particularly those combinations involving goals relating to primary social roles and leisure endeavours. Often, people strive to lead a more “balanced life” that includes both types of pursuits, but they live in environments (e.g., office, home) that favour their social role-related goals by priming reminders and cues that increase their salience within the goal system and interfere with alternative goals (e.g., Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001). In addition to contextual factors, it would be fruitful to examine motivational variables that could influence the observed relationships. For example, a recent study (Vogt, De Houwer, & Crombez, 2011) demonstrated that the motivational strength of a goal directly impacts attention allocation in a multiple goal context. More specifically, study participants were found to orient toward goals with higher value (Experiment 1) and expectancy of success (Experiment

2) when faced with competing goals. Relatedly, theories such as the *Self-Concordance Model* (Sheldon & Elliot, 1998) suggest that the type of motivation underlying goals may also matter. Goals can be considered "autonomous" if they are pursued for reasons related to personal interests and values, whereas they can be considered "controlled" if they are pursued for reasons relating to external or internal pressure. The model posits that goals that controlled goals are likely to generate a sense of conflict within the self, whereas autonomous goals are likely to promote the effective usage of effortful volitional strategies (Koestner, Otis, Powers, Pelletier, & Gagnon, 2008). Hence, it may be that autonomous goal motivation buffers the deleterious impact of goal conflict on AP, another interesting avenue for future research.

A third limitation concerns our use of self-report measures of PA, which are often critiqued for over-estimating absolute PA values due to such factors as social desirability and retrospective recall bias (Sallis & Saelens, 2000). Notably, a recent systematic review (Prince, et al., 2008) showed no clear overall trends regarding the degree of correspondence between self-report and direct measures of PA, but did highlight the strengths and weaknesses of each approach, and recommended selecting appropriate measures on the basis of study objectives. Given that the primary aim of our studies centred on the relationships between predictor and PA outcome variables, and less on absolute PA levels per se, the use of well-validated self-report PA measures was deemed appropriate. Nevertheless, it would be valuable for future work to include objective measures of goal conflict and/or PA outcomes, to safeguard against potential threats of shared method variance. Of note, regarding conflict and facilitation, both Penseau and colleagues (2013) and Reidiger and Freund (2004) showed that perceived goal facilitation and conflict were highly associated with behavioral indicators of goal conflict (i.e.,

amount of daily time spent engaging in alternative goal pursuits). Finally, a fourth limitation concerns our use of correlational designs in both Studies 1 and 2, which do not speak to potential causal pathways. Future work could use an experimental design by randomizing participants to higher or lower conflict groups, and testing for a potential interaction with action planning and coping planning.

### **Conclusion**

In sum, the two studies reported herein provided convergent support for the moderating role of academic goal conflict in the relation between AP and CP with PA at both the between- and within-person levels of analysis. The key finding to emerge was that AP and CP play *differential roles* in predicting PA outcomes, with AP showing greater associations with PA at lower levels of academic goal conflict and CP showing greater associations with PA at higher levels. Although the reported results require further replication and elaboration, they extend our current understanding of self-regulation in dual goal pursuit. Future research is encouraged that continues to chart the conditions under which AP and CP are respectively more or less helpful in helping people maximize desired outcomes in the real world.

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Table 1

*Study 1: Descriptive Statistics, Reliability Estimates, and Bivariate Correlations*

	Range	M	SD	1.	2.	3.	4.	5.
1. Time 1 AP	1 – 7	3.71	1.69	.93				
2. Time 1 CP	1 – 7	3.13	1.55	.77**	.95			
3. Time 2 academic goal conflict	1 – 5	3.58	0.99	-.03	-.02	.93		
4. Time 2 academic goal facilitation	1 – 5	2.60	0.91	.20**	.29**	-.29**	.91	
5. Time 2 PA goal progress	1 – 7	4.40	2.09	.21**	.22**	-.51**	.42**	.98

Note. Cronbach alphas are presented on the diagonal. \*\*  $p < .01$ .

Table 2

*Study 1: Results of Moderated Regression Analyses on Physical Activity Goal Progress*

	<i>Wald</i>	<i>R</i> <sup>2</sup>	$\beta$	<i>95% CI</i>
<i>Step 1</i>	145.120** <i>df</i> = 4	.331**		
AP			0.109 (0.111)	[-0.109, 0.327]
CP			0.094 (0.124)	[-0.149, 0.337]
Goal conflict			-0.871** (0.126)	[-1.118, -0.624]
Goal facilitation			0.578** (0.136)	[0.311, 0.845]
<i>Step 2</i>	178.294** <i>df</i> = 6	.346**		
AP			0.123 (0.108)	[-0.089, 0.335]
CP			0.070 (0.120)	[-0.165, 0.305]
Goal conflict			-0.876** (0.121)	[-1.113, -0.639]
Goal facilitation			0.558** (0.135)	[0.293, 0.823]
AP X Conflict			-0.215* (0.093)	[-0.397, -0.033]
CP X Conflict			0.187 (0.102) <sup>†</sup>	[-0.013, 0.387]

*Note.* *N* = 317. † *p* = .068. \* *p* < .05. \*\* *p* < .01. Difference in Wald statistic from step 2 to step

1 was significant,  $\Delta$  Wald = 33.094,  $\Delta$ df = 2, *p* < .01. All parameters are unstandardized.

Standard errors are reported in parentheses.

Table 3

*Study 2: Descriptive Statistics, Reliability Estimates, and Bivariate Correlations*

	Range	ICC	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.
1. Daily AP	1 – 7	.50	3.49	1.92	.91					
2. Daily CP	1 – 7	.59	2.95	1.68	.75**	.93				
3. Daily academic goal conflict	1 – 5	.48	2.38	1.42	-.15**	-.18**	.94			
4. Daily academic goal facilitation	1 – 5	.55	1.74	0.99	.12*	.21**	.05	.88		
5. Daily PA goal progress	1 – 7	.38	3.61	2.17	.65**	.56**	-.35**	.22**	.99	
6. Daily self-reported PA	0 - 3360	.45	412.29	428.90	.35**	.35**	-.31**	.15**	.49**	NA

Note. *N* = 378 daily reports from 97 participants. Cronbach alphas are presented on the diagonal. \*\*  $p < .01$ . \*  $p < .05$ .

Table 4

*Study 2: Results of Multilevel Model Predicting Daily Goal Progress*

Effects	Daily goal progress		
	Model 1	Model 2	Model 3
<b>Fixed effect</b>			
$\beta_{00}$ = Intercept	3.544** (0.162)	3.544** (0.160)	3.558** (0.161)
$\beta_{10}$ = Action plan (AP)		0.574** (0.106)	0.547** (0.104) [0.343, 0.751]
$\beta_{20}$ = Coping plan (CP)		0.284** (0.108)	0.300** (0.107) [0.090, 0.510]
$\beta_{30}$ = Academic conflict (AC)		-0.436** (0.074)	-0.443** (0.072) [-0.584, -0.302]
$\beta_{40}$ = Academic facilitation (AF)		0.390** (0.124)	0.361** (0.130) [0.106, 0.616]
$\beta_{50}$ = AP x AC			-0.172* (0.080) [-0.329, -0.015]
$\beta_{60}$ = CP x AC			0.221** (0.073) [0.078, 0.364]
<b>Random effect</b>			
	Variance	Variance	Variance
$\sigma^2$	2.878	1.234	1.219
$\tau_{00}$	1.728**	2.161**	2.148**
r1		0.256 $p = .096$	0.268 $p = .085$
r2		0.137 $p = .051$	0.162 $p = .046$
r3		0.041 $p > .500$	0.046 $p > .500$
r4		0.093 $p = .051$	0.122 $p = .037$
r5			Not estimated
r6			Not estimated

*Note.*  $p < .05$ . \*\*  $p < .01$ . Pseudo  $R^2 = 0.571$ . Pseudo  $R^2 = 0.013$ . r5 and r6 could not be simultaneously estimated. Models in which either r5 or r6 was estimated yielded non-significant variance component ( $ps > .35$ ). The two random effects were not included in the final model. Standard errors are reported in parentheses. 95% CI of model 3 are reported in brackets. All parameters are unstandardized.

Table 5

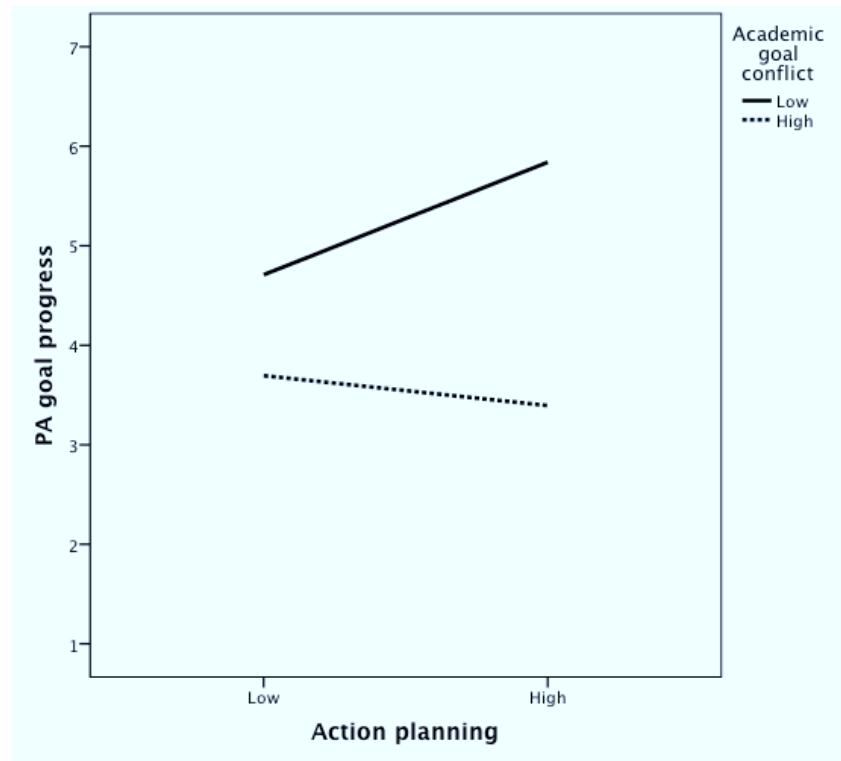
Study 2: Results of Multilevel Model Predicting Daily Self-Reported PA

Effects	Daily Self-Reported PA		
	Model 1	Model 2	Model 3
<b>Fixed effect</b>			
$\beta_{00}$ = Intercept	397.748** (33.184)	401.761** (34.233)	399.859** (34.052)
$\beta_{10}$ = Action plan (AP)		52.432** (17.683)	50.660** (17.313) [16.7, 84.6]
$\beta_{20}$ = Coping plan (CP)		18.624 (19.237)	23.454 (19.593) [-14.8, 61.7]
$\beta_{30}$ = Academic conflict (AC)		-78.901** (18.800)	-79.830** (18.338) [-115.8, -43.9]
$\beta_{40}$ = Academic facilitation (AF)		57.650 (37.120)	57.978 (37.501) [-15.5, 131.5]
$\beta_{50}$ = AP x AC			-33.128** (11.084) [-54.9, -11.4]
$\beta_{60}$ = CP x AC			11.384 (12.150) [-12.4, 35.2]
<b>Random effect</b>			
	Variance	Variance	Variance
$\sigma^2$	96864	46600	47616
$\tau_{00}$	80134**	101443**	100176**
r1		2662 p = .090	2337 p = .092
r2		2204 p = .023	3253 p = .024
r3		15353 p = .090	14250 p = .111
r4		41154**	39164**
r5			Not estimated
r6			Not estimated

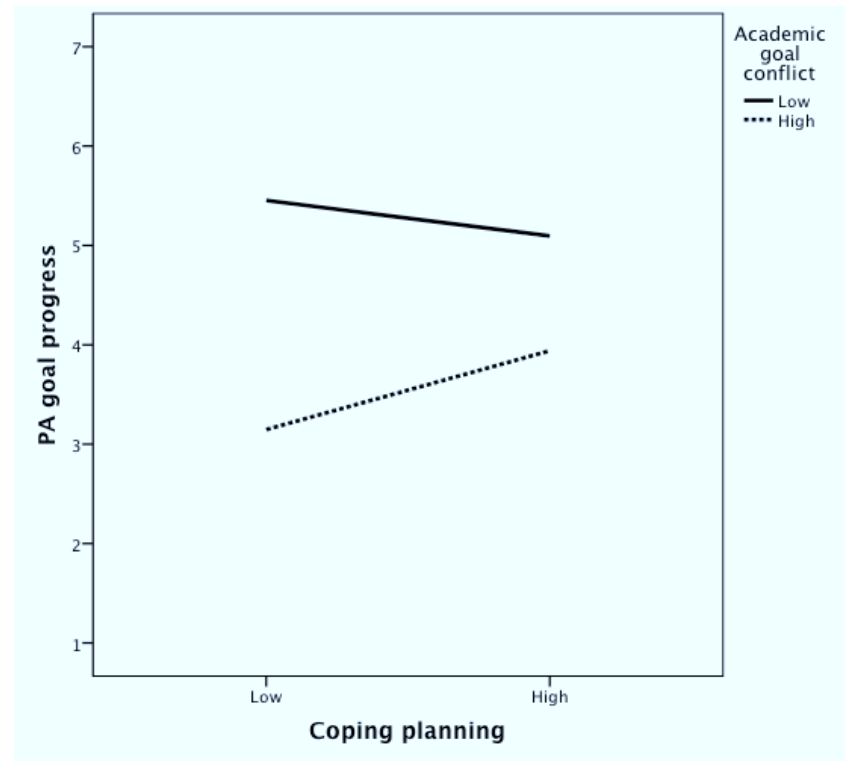
Note.  $p < .05$ . \*\*  $p < .01$ . Pseudo  $R^2 = 0.519$ . Pseudo  $R^2$  cannot be estimated. r5 and r6 could not be simultaneously estimated. Models in which either r5 or r6 was estimated yielded non-significant variance component ( $ps > .35$ ). The two random effects were not included in the final model. Standard errors are reported in parentheses. 95% CI of model 3 are reported in brackets. All parameters are unstandardized.

Figure 1

Study 1: Simple Slopes for AP × Conflict and CP × Conflict Interactions on PA Goal Progress



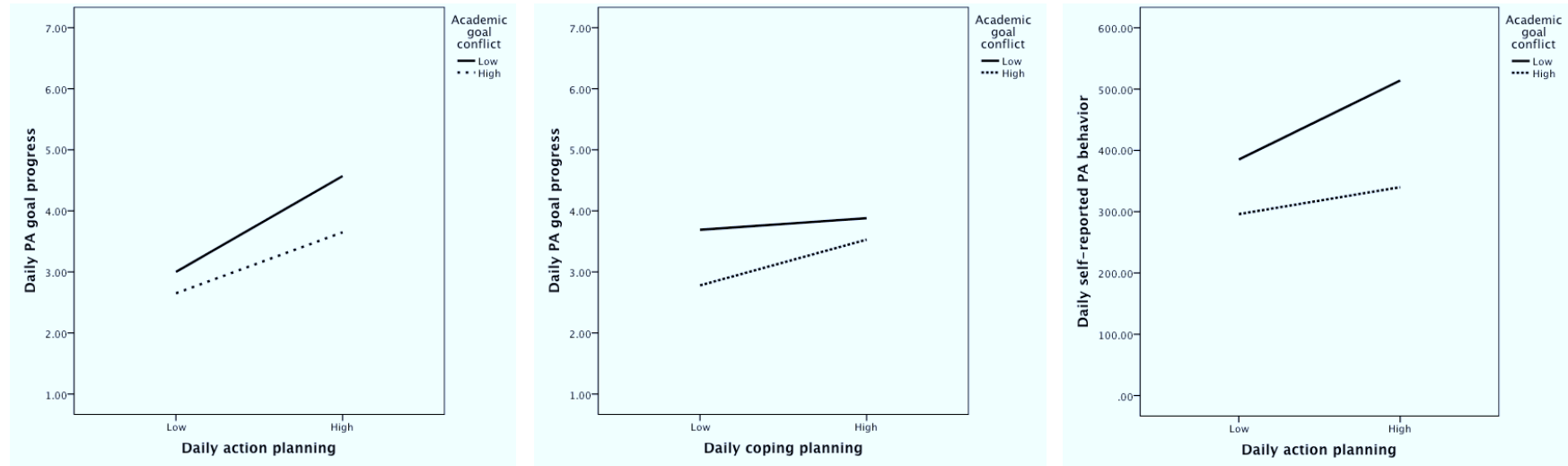
Panel A



Panel B

Figure 2

*Study 2: Simple Slopes for AP × Conflict and CP × Conflict Interactions on Daily PA Goal Progress and Daily Self-Reported PA Behavior*



Panel A

Panel B

Panel C

## CHAPTER 5: General Discussion

### Review of the Context and Aims of the Dissertation

With the advent of modern medicine, we have entered a phase in history in which the bases of premature morbidity and mortality are primarily behavioural (Bogg & Roberts, 2004). With physical activity holding so much promise as a means of supporting people's physical and mental health (Paluska & Schwenk, 2000; Warburton, et al., 2006), it is no wonder a preponderance of health behaviour research has been aimed at understanding the psychological factors that predict and promote physical activity. Several prominent health behaviour theories posit that one's intention to perform physical activity behaviour is the most important and proximal predictor of the actual enactment of this behaviour (see Head & Noar, 2014 for a helpful overview). Over time, an accumulation of research has challenged this premise by showing that most people who intend to perform a behaviour fail to do so, termed the *intention-behaviour gap* (Orbell, et al., 1997; Sheeran, 2002). Planning has played an important role in advancing this research, and it has been proposed as a significant bridge of this gap (Gollwitzer & Sheeran, 2006; Schwarzer, 2008). Notwithstanding the clear contribution of planning to our understanding of self-regulation for physical activity, planning itself is not the panacea for a sedentary lifestyle as the enthusiasm in the literature might sometimes seem to suggest (de Vet & Penseau, 2009). Indeed, planning, too, must be critically examined and scrutinized, because its own gaps (Schwarzer, 2014) and limits (e.g., Churchill & Jessop, 2010) remain to be fully fleshed out.

The overarching aim of this dissertation was twofold. The first aim, addressed in *Chapter 3*, was to "look back" on the planning for physical activity literature and summarize and

synthesize the extant empirical knowledge about action planning and coping planning for physical activity. This was achieved by way of a meta-analytic review with the goal of clarifying the overall effect of spontaneous and experimentally induced action planning and coping planning, respectively, on physical activity outcomes as well as examining theoretically driven mediators and moderators. The second aim, addressed in *Chapter 4*, was to use the information gleaned from the review to “move forward” by taking steps in novel research directions – in particular, by studying action planning and coping planning in relation to more than one goal at a time, while examining the relevant moderator of goal conflict at both the between-and within-person level of analysis. A summary of the specific aims, key findings, and implications of this dissertation are presented in Tables 1 and 2, and discussed in greater detail below.

Table 1. Summary of Chapter 3 Aims, Findings, Conclusions, and Implications

		Aims	Findings	Conclusions and Implications
Chapter 3	Correlational	<ul style="list-style-type: none"> <li>Estimate overall ES for spontaneous AP and CP for PA.</li> </ul>	<ul style="list-style-type: none"> <li>Overall ES                             <ul style="list-style-type: none"> <li>Medium-to-large ES found (<math>\phi = .41</math>) for AP (<math>\bar{X}</math> delay).</li> <li>Medium-to-large ES found (<math>\phi = .38</math>) for CP (<math>\bar{X}</math> delay).</li> <li>ES for AP and CP not significantly different from one another.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Medium-to-large ES found while correcting for sampling error and measurement bias.</li> <li>The ES for spontaneous AP and CP are similar and not significantly different; each form of planning is important for PA.</li> <li>There is marked heterogeneity in the measurement of spontaneous planning as well as the overall ES.</li> </ul>
		<ul style="list-style-type: none"> <li>Use the correlational ES to examine two meta-analytic path models: (a) a <i>dual mediation model</i> and (b) a <i>sequential mediation model</i>.</li> </ul>	<ul style="list-style-type: none"> <li>Dual model                             <ul style="list-style-type: none"> <li><i>Dual mediation path model</i>: Both AP and CP were found to be unique partial mediators in the intention to PA relation.</li> </ul> </li> <li>Sequential model                             <ul style="list-style-type: none"> <li><i>Sequential mediation path model</i>: The prospective sequence from AP to CP to PA was responsible for transmitting the impact of intention.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Spontaneous AP and CP can operate <i>both</i> uniquely (as suggested in the HAPA model) and sequentially as part of a self-regulatory chain that begins with intention and culminates in PA (as suggested by Sniehotta et al., 2005).</li> </ul>
		<ul style="list-style-type: none"> <li>Test moderators of AP composition, time lag, intention, age, and sample type.</li> </ul>	<ul style="list-style-type: none"> <li>AP composition                             <ul style="list-style-type: none"> <li>No significant differences emerged between studies measuring pure AP and those measuring combined AP and CP (<math>\bar{X}</math> delay).</li> <li>A weaker effect was reported in studies in which the AP measure contained 2 compared to 4 or 5 components (<math>\bar{X}</math> delay).</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>There is value in keeping the AP and CP constructs separate as we continue to accrue data in more consistent manner.</li> <li>Greater number of components yielded better PA results, perhaps by increasing the specificity of the plans.</li> </ul>
			<ul style="list-style-type: none"> <li>Time lag                             <ul style="list-style-type: none"> <li>Time lag significantly reduced the strength of the link between AP and PA (longest delay).</li> <li>Not a significant moderator in the relation between CP and PA using either the shortest or the longest time delays.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>May be a decay effect, or perhaps AP is more useful for getting started but then fades as becomes less important with increased goal engagement.</li> <li>May not moderate CP because barriers are consistently encountered across time.</li> </ul>
	<ul style="list-style-type: none"> <li>Intention                             <ul style="list-style-type: none"> <li>Intention was a significant moderator of the AP to PA relation, and was best modeled in quadratic terms (<math>\bar{X}</math> delay). AP <math>\rightarrow</math> PA was stronger for samples with lower levels of intention compared to samples with moderately high levels of intention; AP <math>\rightarrow</math> PA was stronger for samples with highest values of intention compared to those with moderately high values of intention.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>AP seems to work best when people have low or high intentions. Deciding to spontaneously create AP might circumvent some of the debilitating effects associated with lower levels of intention.</li> </ul>		

	Aims	Findings	Conclusions and Implications	
	<ul style="list-style-type: none"> <li>• Age</li> </ul>	<ul style="list-style-type: none"> <li>• Mean sample age had a significant attenuating influence on the AP to PA relation (shortest and longest delays).</li> <li>• For CP, age had a significant attenuating influence (longest delay).</li> </ul>	<ul style="list-style-type: none"> <li>• Attenuating influence perhaps reflects normative age-related cognitive decline.</li> </ul>	
	<ul style="list-style-type: none"> <li>• Sample type: rehabilitation status</li> </ul>	<ul style="list-style-type: none"> <li>• Magnitude of the ES between AP and PA was significantly greater in the normative as compared to the rehabilitation samples (<math>\bar{X}</math> delay).</li> <li>• CP to PA relation, no significant interaction.</li> </ul>	<ul style="list-style-type: none"> <li>• Stronger effects in the normative groups could be attributable to the fewer/less debilitating obstacles that they face compared to their rehabilitative counterparts.</li> </ul>	
Experimental	<ul style="list-style-type: none"> <li>• Estimate overall ES of experimental planning for PA.</li> </ul>	<ul style="list-style-type: none"> <li>• Overall ES</li> <li>• Small overall ES found (<math>\phi = .12</math>) when comparing <i>All Experimental vs. All Control</i> conditions (<math>\bar{X}</math> delay).</li> <li>• Small overall ES found (<math>\phi = .07</math>) when comparing <i>Pure Planning vs. Neutral Controls</i> (<math>\bar{X}</math> delay).</li> </ul>	<ul style="list-style-type: none"> <li>• SE of experimental planning are modest and highly heterogeneous, suggesting the presence of moderators.</li> <li>• Studies were of low/unclear quality, lowering the confidence in the results. High quality studies are needed.</li> <li>• There is variability in the measurement of planning. Clear operation definitions and consistency in measurement is called for.</li> </ul>	
	<ul style="list-style-type: none"> <li>• Test theoretically based moderators of AP composition, time lag, intention, age, sample type (x2), CP approach, outcome type, and publication status.</li> </ul>	<ul style="list-style-type: none"> <li>• AP composition</li> <li>• <i>All Experimental Conditions vs. All Control Conditions</i>: 4 AP components yielded significantly greater ES than 3 components, but not 2 components. AP with 2 components yielded significantly greater ES than 3 components.</li> <li>• No significant difference between interventions that included CP and those that did not.</li> <li>• <i>Purely Planning Conditions vs. Neutral Control Conditions</i>: AP with 4 components yielded significantly greater ES than those with 3 components. AP with 2 components yielded significantly greater ES than those with 3 or 4 components.</li> </ul>	<ul style="list-style-type: none"> <li>• Regarding number of components, it may be that more elaborated plans render them more personal and helpful, yet shorter plans are easier to recall.</li> <li>• No significant difference was found between AP and AP and CP combined. Future research comparing 'pure AP', 'pure CP', and 'combined AP/CP' will help elucidate the role of CP in planning interventions.</li> </ul>	
		<ul style="list-style-type: none"> <li>• Time lag</li> </ul>	<ul style="list-style-type: none"> <li>• <i>All Experimental Conditions vs. All Control Conditions</i>: no moderation found.</li> <li>• <i>Purely Planning Conditions vs. Neutral Control Conditions</i>: ES became stronger with increasing time lag (shortest delay).</li> </ul>	<ul style="list-style-type: none"> <li>• The effect of planning interventions appeared to hold up well over time. Longitudinal studies with longer follow up would increase confidence in this result.</li> </ul>
		<ul style="list-style-type: none"> <li>• Sample type: previous PA (<i>sedentary vs. active</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• <i>All Experimental Conditions vs. All Control Conditions and Purely Planning Conditions vs. Neutral Control Conditions</i>: Sedentary samples reported significantly greater ES than mixed samples.</li> </ul>	<ul style="list-style-type: none"> <li>• Consistent with previous findings that planning is especially beneficial for people with chronic difficulties in regulating their behaviour.</li> </ul>

Aims	Findings	Conclusions and Implications
<ul style="list-style-type: none"> <li>Mode of delivery of intervention (<i>self-administered</i> vs. interviewer-assisted)</li> </ul>	<ul style="list-style-type: none"> <li><i>All Experimental Conditions vs. All Control Conditions</i>: interventions that were assisted reported significantly greater ES than those that were solitary.</li> <li><i>Purely Planning Conditions vs. Neutral Control Conditions</i>: assisted interventions reported significantly greater ES than solitary interventions.</li> </ul>	<ul style="list-style-type: none"> <li>People do benefit from the assistance of another person when formulating their plans – perhaps emphasizes that planning is a skill that people may benefit from support in learning at first.</li> </ul>
<ul style="list-style-type: none"> <li>Publication status</li> </ul>	<ul style="list-style-type: none"> <li><i>All Experimental Conditions vs. All Control Conditions</i>: published studies reported significantly greater ES than unpublished studies</li> <li><i>Purely Planning Conditions vs. Neutral Control Conditions</i>: no significant difference between published and unpublished studies.</li> </ul>	<ul style="list-style-type: none"> <li>Suggests the possibility of publication bias, in which case it is important to consider the likelihood that the observed summary effects are overestimated.</li> </ul>

Table 2. Summary of Chapter 4 Aims, Hypotheses, Findings, Conclusions, and Implications

	Aims	Hypotheses	Findings	Conclusions and Implications
Chapter 4 Study 1	<ul style="list-style-type: none"> <li>To investigate, using a six-week prospective design, whether academic goal conflict moderates the AP and CP relationships with PA goal progress.</li> </ul>	<ul style="list-style-type: none"> <li>Time 1 AP → Time 2 goal progress should be stronger at <i>lower levels</i> of academic goal conflict (Hypothesis 1).</li> <li>Time 1 CP → Time 2 goal progress should be stronger at <i>higher levels</i> of academic goal conflict (Hypothesis 2).</li> </ul>	<ul style="list-style-type: none"> <li>Time 1 AP → Time 2 goal progress was only significant at <i>lower levels</i> of academic goal conflict (Hypothesis 1 supported).</li> <li>Time 1 CP → Time 2 goal progress was marginally significant at <i>higher levels</i> of academic goal conflict (Hypothesis 2 was partially supported).</li> </ul>	<ul style="list-style-type: none"> <li>There is a differential impact of academic goal conflict on the relations of AP and CP with PA goal progress and self-reported PA behaviour at the between- and within-person levels.</li> <li>Goal conflict in the real world is one possible explanation for why AP and CP are sometimes not as strongly associated with PA as expected.</li> </ul>
Study 2	<ul style="list-style-type: none"> <li>To test, using a one-week daily diary design, whether daily academic goal conflict moderate the relation between AP and CP with daily goal progress and PA?</li> </ul>	<ul style="list-style-type: none"> <li>The positive relationship of daily AP with daily PA goal progress (Hypothesis 1a) and daily self-reported PA behaviour (Hypothesis 1b) will be <i>weaker</i> on days when students experience <i>higher</i> academic goal conflict than their own average.</li> </ul>	<ul style="list-style-type: none"> <li>Daily AP → daily goal progress on days during which individuals experienced <i>lower</i> goal conflict from their academic goal. Daily AP → daily PA goal progress was significant, but substantially weaker on days during which individuals experienced <i>higher</i> goal conflict (Hypothesis 1a supported).</li> <li>Daily AP → daily self-reported PA behaviour on days during which individuals experienced <i>lower</i> goal conflict. Daily AP → daily self-reported PA behaviour was not significant on days during which individuals experienced <i>higher</i> goal conflict (Hypothesis 1b supported).</li> </ul>	<ul style="list-style-type: none"> <li>AP and CP may need to be created with multiple goals taken into account.</li> <li>Across all findings in Chapter 4, students made greater progress when goal conflict was lower – suggesting that the reduction of conflict rather than or in addition to, the modification of planning in multiple-goal context is perhaps a more fruitful first line strategy.</li> </ul>
		<ul style="list-style-type: none"> <li>The positive association of daily CP with daily PA goal progress (Hypothesis 2a) and daily self-reported PA behaviour (Hypothesis 2b) will be <i>stronger</i> on days during which students experienced <i>higher</i> academic goal conflict than their own average.</li> </ul>	<ul style="list-style-type: none"> <li>Daily CP → daily goal progress not significant on days during which individuals experienced <i>lower</i> goal conflict. Daily CP → daily progress was positive and significant on days during which individuals experienced <i>higher</i> goal conflict (Hypothesis 2a supported).</li> <li>CP x conflict interaction was not significant (Hypothesis 2b not supported).</li> </ul>	

## “Looking back”

### Overall Effect Sizes

The first aim of *Chapter 3* was to estimate the respective overall effect sizes for spontaneous and experimentally induced action planning and coping planning on physical activity. Among the correlational studies, a medium-to-large overall effect size was found for both spontaneous action planning ( $\phi = .41$ ) and coping planning ( $\phi = .38$ ). Among the experimental studies, the overall effect size was found to be small, whether it involved comparisons of mixed planning experimental groups (i.e., planning and other interventions; ( $\phi = .12$ ) versus mixed control groups, or purely planning experimental groups (i.e., action planning, coping planning, and/or both) versus neutral control groups ( $\phi = .07$ ). The overall effect sizes of the experimental studies are considered small from a statistical point of view (Cohen, 1988), but may nevertheless remain important from an applied point of view (Webb, Joseph, Yardley, & Michie, 2010). For example, studies in other health domains, such as smoking cessation, have shown that even small statistical effects of interventions can have substantial clinical significance (West, 2007).

**Comparing the effect sizes obtained with those of prior reviews on planning.** The overall effect size estimates uncovered in the meta-analysis of *Chapter 3* were largely consistent, if slightly smaller, with those reported in a prior meta-analysis of experimentally induced planning for physical activity (Bélanger-Gravel, Godin, & Amireault, 2011). In this meta-analysis small-to-medium effect sizes for experimentally induced planning were observed at post-intervention ( $d = .31$ ) and no contact follow up ( $d = .24$ ). Considering the no contact follow-up point is a strength of this work, by showing that planning effects were maintained

even without further intervention contact. Similarly, the meta-analysis of *Chapter 3* also included a temporal component by performing all analyses at the shortest, average, and longest time delays. It also went beyond the prior meta-analysis by distinguishing between mixed experimental and control conditions and 'pure' planning versus neutral control conditions, the aim of which was to increase the precision of the effect sizes obtained. This is important, as the nature of the control conditions used has been found to significantly moderate overall effect sizes in a past meta-analysis on planning for healthy eating (Adriaanse, et al., 2011).

In general, the effect sizes reported in the meta-analyses of planning for physical activity were smaller than the medium effect sizes reported in a previous seminal meta-analysis on implementation planning for various behaviours (Gollwitzer & Sheeran, 2006). One reason for the smaller effect sizes reported in *Chapter 3* as compared to the meta-analysis of Gollwitzer and Sheeran is that the former primarily included experimental studies generated from field studies whereas the latter primarily included experimental studies carried out in a laboratory. Smaller effects reported in field experiments on action planning and coping planning versus the laboratory experiments on implementation planning might be explained by the fact that changes in the environment outside the laboratory or even alternative goals might interfere with the link between the cue and associated action specified in the plans by providing alternative cues or courses of action, thereby impairing their effectiveness (Hagger & Luszczynska, 2014; Sniehotta, 2009). Another reason for the smaller overall effect sizes of *Chapter 3* may be that they reflect the complexity of physical activity as a target for behaviour change (Gebhardt & Maes, 1998). Such a notion is consistent with the findings of prior meta-

analyses in the area of health behaviour. For example, Adriaanse et al. (2011) conducted a meta-analysis of implementation planning for eating a healthy diet, which is also a complex health behaviour. These researchers reported a small effect size for reducing unhealthy eating ( $d = .29$ ), and a medium effect size for increasing healthy eating ( $d = .51$ ). Regarding the latter, the researchers cautioned that, “for some studies promoting healthy eating effect sizes may have been inflated due to less than optimal control conditions” (p. 183).

**Comparing the effect sizes obtained with those of prior reviews on interventions for health behaviour.** It is worth situating the effects of the meta-analysis within the context of other meta-analyses in the broader health literature, particularly those with an applied focus on health behaviour interventions. The experimental studies of *Chapter 3* yielded small overall effect sizes, with high amounts of heterogeneity. This is consistent with the meta-analysis of Michie, Abraham, Whittington, McAteer, and Gupta (2009), who found effect sizes of  $\beta = .32$  and  $.31$  in their meta-analysis of cognitive and behavioural interventions for physical activity and healthy eating, respectively. Similarly, in a recent meta-analysis of Internet-based interventions for health-behaviour, (Webb, et al., 2010) found a small, highly heterogeneous effect size of  $d_+ = .16$ . Moreover, the meta-analysis of *Chapter 3* showed that most planning interventions were included amongst multiple other intervention strategies. This was entirely consistent with prior reviews. Whereas Michie et al. did not find higher numbers of intervention techniques to yield greater effectiveness, Webb et al. did find this to be the case. In the meta-analysis of *Chapter 3*, no significant difference was found between planning interventions that included other techniques and interventions that only involved planning.

It seems important for future research to consider how particular combinations of

techniques might be especially effective in promoting physical activity behaviour change.

Michie et al. (2009) found that the technique of self-monitoring explained the greatest amount of variance in health behaviour outcomes. It may be that a combination of planning strategies coupled with self-monitoring could yield greater physical activity than either strategy alone. It would also be interesting to test whether such a combination would buffer against the negative impact of goal conflict, by bringing interference issues into sharper relief during the reflective practice of self-monitoring, while creating tailored plans – the effectiveness of which could be monitored and modified in a timely manner.

**Comparing correlational and experimental findings.** Larger effect sizes were observed in the correlational studies relative to the experimental studies. Sniehotta (2009) has noted that participants in real life behaviour-change studies are often found to have made prior plans. Hence, participants who have already formed plans pre-randomization might be less likely to benefit from planning interventions. Further, the levels of spontaneous planning in the control group would further reduce the potential effect size. The larger effect sizes observed in the correlational studies relative to the experimental studies is also consistent with other research examining the impact of socio-cognitive constructs such as behavioural intention on physical activity. In this work, medium-to-large linkages have been found among correlational studies (e.g., McEachan, Conner, Taylor, & Lawton, 2012), and smaller effects have been found in experimental studies (e.g., Rhodes & Dickau, 2012).

**Comparing action planning and coping planning.** In terms of comparing action planning and coping planning, regarding the correlational studies, the overall effect sizes for spontaneous action planning and coping planning were similar and not significantly different,

which suggests both forms of planning play a role in facilitating physical activity. Regarding the experimental studies, it was not possible to specifically isolate action planning and coping planning, because too few studies created explicit conditions for each. In fact, most studies included other potentially active components alongside planning interventions. However, coping planning was tested as a moderator and found not to significantly increase the effect of action planning on physical activity, a finding that was inconsistent with those of Bélanger-Gravel, et al. (2011) and a systematic review of coping planning for health behaviour (Kwasnicka, Preseu, White, & Sniehotta, 2013) who found that combined action planning and coping planning interventions yielded more efficacious results. These different findings likely reflected differences in how studies were coded and analyzed. Since the publication of the meta-analysis, a position paper on the state of the literature on implementation planning and action planning in the broader health context has been published (Hagger & Luszczynska, 2014). In this position paper, the authors noted that, overall, the evidence across different health contexts seems to suggest that a combination of action planning and coping planning is superior to action planning alone. However, they also noted that the mechanisms responsible remain unclear and further research is warranted prior to arriving at a more certain conclusion. Furthermore, as noted in the work of Kwasnicka et al (2013), very few studies on coping planning were designed in a way that would allow the evaluation of the efficacy of coping planning only, or the additional effect of adding coping planning to interventions containing multiple techniques. Undoubtedly, randomized trials disentangling various behaviour change techniques used in physical activity interventions are needed to develop our knowledge of the efficacy of individual techniques such as coping planning.

In summary, the effect sizes obtained were small and heterogeneous, which is consistent with prior reviews on planning and health behaviour more broadly (Adriaanse, et al., 2011; Bélanger-Gravel, et al., 2011). Notwithstanding, the findings were encouraging in that they showed that action planning and coping planning are useful strategies for facilitating physical activity behaviour. Significant variability in the operationalization and measurement of planning and the low to unclear quality of the studies was noted. This is in line with the findings of other researchers who have reviewed the status of the planning literature for health behaviour outcomes (Hagger & Luszczynska, 2014). Future studies could adopt factorial designs that explicitly compare implementation planning, ‘purely action planning’, ‘purely coping planning’, and ‘combined action planning/coping planning’ to help elucidate the role of coping planning in planning interventions.

### **Moderation**

The second aim of *Chapter 3* was to perform a series of moderation analyses in order to elucidate for whom and under what conditions action planning and coping planning are most beneficial in helping bring about physical activity behaviour. The overall effect size estimates for both the correlational and experimental studies were highly heterogeneous. As discussed, some of this heterogeneity may reflect differences in operationalization and measurement of planning and physical activity outcomes. Another reason for this heterogeneity is that it suggests the presence of relevant moderators. Rather than recapitulate the discussion of each of the moderating effects found (see Table 1 for an at-a-glance summary), selected moderators that yielded inconsistent or unexpected findings will be considered in greater depth here.

Among the correlational studies, a greater number of action planning components yielded stronger associations to physical activity outcomes, perhaps by rendering the action plans more specific, which prior work has found to be important (de Vet, Oenema, & Brug, 2011). In contrast, among the experimental studies, it was not a clear case of more action planning components yielding stronger effects. For example, interventions with four components yielded significantly greater effect sizes than those with three components, and interventions with two components also yielded significantly greater effect sizes than those with 3 components. One possible explanation for this difference is that, instead of, or in addition to the *number* of components included in the plans, the *format* of the plans themselves may be more crucial. For example, Chapman, et al. (2009) found the “if-then” plans to be superior than more global plans without such a contingency format. In addition to the number or format of *components*, the number of *plans* may also be important. Repeating the same action plan at a later point in time (Chapman & Armitage, 2010), or being permitted to revise/create a new action plan at multiple time points (Conner & Higgins, 2010) have been shown to yield better results in the areas of healthy eating and smoking cessation, respectively. Multiple plans or the revision of plans may help circumvent some of the issues identified through the moderating analyses in this dissertation, such as the link between spontaneous planning and physical activity decaying over time (as was found for action planning only), and across age groups (as was found for both action planning and coping planning).

Another unexpected finding was that, for the correlational studies, stronger associations were found between action planning and physical activity for people with low or high—as opposed to more moderate—levels of intention. No moderating effect of intention was found

for the experimental studies. Interestingly, prior experimental research has found stronger effects of implementation planning on health behaviour for people with particularly strong intentions (Norman & Conner, 2005; Sheeran, Milne, Webb, & Gollwitzer, 2005). Conversely, other research has found that action planning was only effective for people with low/unstable goal intentions to perform physical activity (Godin, et al., 2010). One possible reason for these opposing findings relates to the context (laboratory versus field) or the outcome (behavioural engagement versus goal attainment), and researchers have called for additional experimental research to tease apart these possibilities (Hagger & Luszczynska, 2014).

Interestingly, another possible reason for the unexpected findings regarding intention may relate to the level of analysis. As noted by Conroy, Elavsky, Hyde, and Doerksen (2011), “intentions will vary naturally within-people and embracing that variation will lead to more accurate behavioural predictions” (p. 810). Using an ecological momentary assessment design (number of steps [Level 1] nested in days [Level 2] nested in people [Level 3]) and accelerometer data, these researchers uncovered a three-way interaction. Specifically, for people with strong overall intentions across the four weeks, greater daily intention was positively related to daily step count on weekdays, but not on weekends. It may therefore also be valuable to conduct additional diary research that is sensitive to nuanced contextual factors (e.g., day of the week, season, exam period) that may influence within-person variability in physical activity behaviour, and the ability of planning to predict this variability under conditions of greater-than-average and lesser-than-average intention (Shoda, Cervone, & Downey, 2007).

The results from the correlational studies showed that the strength of the relation between planning and physical activity was greater in normative versus rehabilitation samples

for action planning but not coping planning. Among the experimental studies, no such moderating effect was found, which is consistent with the findings of Bélanger-Gravel, et al. (2011). Also, among the experimental studies, it was found that the effects of planning interventions were stronger among studies whose participants reported more sedentary lifestyles prior to the intervention. The results from the experimental studies are highly encouraging because they suggest that planning interventions work best for those who need them most, which is consistent with a prior review on implementation planning (Gollwitzer & Sheeran, 2006).

### **Mediation**

The third aim of *Chapter 3* was to explore theoretically-relevant postulates by testing mediation models using meta-analytical path analysis. Two models were tested: the *dual mediation model*, representing a small subsection of the HAPA model, and the *sequential mediation model* (Sniehotta, 2009; Sniehotta, Schwarzer, et al., 2005). Support for each model was observed, in that spontaneous action planning and coping were found to operate both uniquely (as suggested in the HAPA model) and sequentially as part of a self-regulatory chain from intention, to action planning, to coping planning that ultimately culminates in physical activity behaviour, as suggested by Sniehotta and his colleagues. These findings build on results found in correlational studies from the broader health behaviour literature showing various forms of planning as a mediator of the intention to behaviour relationship (Conner, Sandberg, & Norman, 2010; Scholz, Schüz, Ziegelmann, Lippke, & Schwarzer, 2008; Schwarzer, et al., 2007; Sniehotta, Scholz, & Schwarzer, 2005; Wiedemann, Schüz, Sniehotta, Scholz, & Schwarzer, 2009). They provide a useful complement to these results by leveraging the meta-analytic data

to examine two mediation models that include both forms of planning, which is not always the case in individual studies (Norman & Conner, 2005).

Future studies could extend this work by continuing to examine the mediating role of action planning and coping planning in increasingly refined ways. For example, in the HAPA model, it is proposed that the volitional phase of health behaviour change is subdivided into initiation and maintenance stages (Schwarzer, 2008). Previous studies (Scholz, Schüz, et al., 2008) have used past physical activity behaviour to represent different stage groups, such that “initiators” can be defined as people who were previously inactive and “maintainers” can be defined as people who were previously active. It would be interesting to test whether the observed mediation models hold in similar ways for initiators and maintainers, or whether action planning emerges as the more crucial mechanism for transmitting the impact of intention on behaviour for initiators, and coping planning emerges as the more crucial mechanism for transmitting the impact of intention on behaviour for maintainers. Such a finding would be in line with the theorizing of Sniehotta, Schwarzer, et al. (2005) who postulated that action plans are designed to promote action initiation, whereas coping plans are designed to promote behavioural maintenance.

Finally, these analyses considered the role of action planning and coping planning as mediators in the intention to physical activity relation. It would also be important for future work to test the role of potential mediators in the action planning and coping planning to physical activity relations, as their working mechanisms are less well understood (Sniehotta, 2009). It has been suggested that one of the ways in which action planning and coping planning differ from implementation intentions is that they have different mediating mechanisms

(Hagger & Luszczynska, 2014; Sniehotta, 2009). Implementation plans have been found to operate through *strategic automaticity* (i.e., the delegation of behavioral control to situational cues), which is largely non-conscious (Achtziger & Gollwitzer, 2008). Although the mediating mechanisms of action planning and coping planning are not as heavily studied or clearly elaborated, there is evidence to suggest that they operate through more conscious, effortful processes (Luszczynska, 2006). For example, one study found that the prospective relationship between planning and goal progress was mediated by the life management strategies of selection, optimization, and compensation (Dugas, Gaudreau, & Carraro, 2012). Another example concerns a particular form of self-efficacy. *Volitional self-efficacy* refers to optimistic beliefs regarding one's ability to cope with the experience of possible failure to attain one's goal and recovery from relapse to inactivity (Schwarzer, 2008). It may be that planning operates by generating optimistic beliefs about one's ability to cope with possible initial failure to enact action plans and coping plans, and to recover by generating new plans, modifying plans, or re-attempting plans (Koring, et al., 2012).

### **Summary of Chapter 3 Contributions**

In sum, the published meta-analysis of *Chapter 3* offers several important contributions. First, the meta-analysis complemented and extended prior meta-analytic reviews on planning by providing overall effect size estimates for *both* correlational and experimental studies on *both* action planning and coping planning for physical activity. To our knowledge, it was the first meta-analysis to examine action planning and coping planning separately. Second, overall effect sizes were generated in such a way as to minimize potential bias by coding and taking into consideration the time lags, outcomes, and experimental/control conditions of the individual

studies in the meta-analysis as recommended by Higgins and Altman (2008). Additionally, individual studies were corrected for measurement error to again achieve the most accurate estimates possible with the information available. Third, experimental study quality and the precise planning components were also coded and reported in order to help readers evaluate the potential risk of bias currently attached to the planning literature for physical activity. Fourth, the mediating role of action planning and coping planning as well as several relevant moderators were elucidated. Finally, overall conclusions on the state of the literature and recommendations for future research were provided. In particular, it was uncovered that planning is generally useful for helping bring about physical activity, though experimental effect sizes were modest. There is a clear need for future studies on planning to more consistently define and measure action planning and coping planning, and to report statistics completely and in a format that is amenable to future meta-analysis. Moreover, it was determined that higher quality experimental studies on planning will be immensely helpful in continuing to refine evidence-based interventions for physical activity.

### **“Moving Forward”**

The second overarching objective of this dissertation was to “move forward” in novel research directions that also addressed certain gaps in planning for physical activity research to date. In particular, the results of the meta-analytic review of *Chapter 3* pointed to marked heterogeneity in the overall effect size estimate for spontaneous action planning and coping planning, pointing to the need to test theoretically driven moderators that could help explain this heterogeneity. Furthermore, the meta-analysis confirmed that the overwhelming majority of planning for physical activity research only examined a single goal in isolation, despite data

showing that most people pursue multiple goals concurrently in their daily lives (Austin & Vancouver, 1996). As well, most studies were only at the between-person level of analysis. As is becoming increasingly apparent, however, an important amount of the variability in physical activity behaviour has been found to occur at the within-person level, and action planning has also been shown to vary within individuals (Conroy, Elavsky, Doerksen, & Maher, 2013; Conroy, et al., 2011; Hekler, et al., 2012). Studying daily fluctuations in action planning and coping planning may offer a complementary level of analysis to more fully understand why some people are more active than others (i.e., between-person differences), and why people are more active at certain times than others (i.e., within-person differences).

### **Overview of Key Findings**

In *Chapter 4*, two original studies examined the extent to which action planning and coping planning were associated with physical activity when university students experienced conflict between their academic and physical activity goals, both at the between- (Study 1) and within-person (Study 2) levels. The key finding to emerge from these two studies was that, in line with prior research showing the deleterious influence of goal conflict at both the between- (e.g., Bailis, Thacher, Aird, & Lipschitz, 2011; Gebhardt & Maes, 1998) and within-person levels (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008; Payne, Jones, & Harris, 2010), academic goal conflict moderated the influence of planning on physical activity outcomes. Interestingly, action planning and coping planning were found to play *differential roles* in predicting physical activity outcomes when students were experiencing goal conflict from the academic domain: action planning related to better physical activity outcomes at *lower* levels of academic goal conflict, whereas coping planning related to better physical activity outcomes at *higher* levels of

academic goal conflict. These results were mostly replicated at the between-person and the within-person levels of analysis in Study 1 and Study 2, respectively.

The take-home message from these findings is that action planning and coping planning play a different, yet complementary role in the goal pursuit process. This is a novel research finding that has, to our knowledge, never been found before. It is important to note that, although action planning and coping planning were found to be highly interrelated and both positively related to physical activity, their differential role became apparent when examining their impact across low versus high levels of academic goal conflict. This finding is also a possible clue as to why action planning interventions yielded more modest effect sizes than anticipated in *Chapter 3*, in that people might be struggling to avoid conflicts stemming from other important life goals in their daily lives. Conversely, this finding could also explain why coping planning interventions sometimes fail to report strong effect sizes, because coping planning seems largely inconsequential when individuals are not experiencing conflict between competing goals, but become more important when such conflicts arise. Future studies should continue to shed light on other possible differential impacts of action planning and coping planning. For example, one might expect action planning to be more helpful to those initiating a new goal or behaviour, and coping planning to be more helpful to those either maintaining their goal pursuit or improving an established behaviour (Schwarzer, 2008; Sniehotta, Schwarzer, et al., 2005).

### **Relation of Key Findings to Recommendations by Michie, et al. (2013)**

**Increasing context sensitivity.** Collectively, the results of *Chapter 4* strengthen the argument for enhancing the usefulness of health behaviour research by increasing its context

sensitivity (Michie, et al., 2013). The studies of *Chapter 4* achieved this by considering goal pursuit within its natural ecosystem – that is, within a multiple-goal context, in which more than one goal competed for students' finite personal resources. By expanding planning research in this way – that is, by considering more than one goal simultaneously – it became apparent that action planning and coping planning related to physical activity differently, according to the level of academic goal conflict experienced by study participants.

**Considering the dynamic nature of goal pursuit.** The results of *Chapter 4* captured the dynamic nature of goal pursuit, by tapping into the daily fluctuations in planning and physical activity outcomes. Although still relatively scarce, a small number of studies have emerged that examine planning at the within-person level. However, to our knowledge, none of these studies have examined the moderating role of daily events in the relation between action planning and coping planning and physical activity. The results of this dissertation have contributed to a sparse yet growing stream of research in which planning has, for the most part, been found to predict physical activity at the within-person level (Hekler, et al., 2012; Scholz, et al., 2009; Scholz, Nagy, et al., 2008).

### **Summary of *Chapter 4* Contributions**

The two studies presented in *Chapter 4* provide three main contributions. First, both studies answered an important call for social and health behaviour research to take into account the context in which health behaviour is pursued, by considering the larger goal context. Second, Study 2 took into account the dynamic nature of goal pursuit by considering the day-to-day fluctuations in action planning and coping planning and physical activity outcomes. Finally, the action planning and coping planning literature was advanced in a novel,

ecologically and statistically sound, and practically useful research direction, by discovering goal conflict as key moderator of planning on physical activity at the between- and within-person level. Overall, the two (sets of) studies in this dissertation covered much ground, looking back at the research landscape while shining a light on fruitful paths forward.

### **Limitations and Future Directions**

#### **Methodological Limitations**

It is important to highlight the limitations of this dissertation in order to provide a context for the results, as well as a springboard for future research.

**Sample.** In *Chapter 3*, as is appropriate in any meta-analytic review, attempts were made to secure as many studies and unpublished data sources as possible. Notwithstanding, the review contained a relatively small number of studies, which is not uncommon in the social sciences (Rothstein, Sutton, & Borenstein, 2005). Nevertheless, this decreased confidence in the overall effect size estimates and limited the number and types of comparisons that could be performed. However, detailed tables containing all coded information were provided, which should facilitate the execution of future meta-analyses as more studies become available. Future meta-analyses seem particularly desirable in light of another limitation. Namely, the meta-analysis of *Chapter 3* sought to examine the particular effect of action planning and coping planning. However, most studies conducted in the physical activity domain have intervened on planning in combination with other types of potentially active ingredients (e.g., motivational enhancements such as decisional balance, and self-regulatory strategies such as self-monitoring). Therefore, it remains uncertain whether the effects reported can solely be attributable to planning. It is clear that the field is ripe for additional primary correlational and

experimental research that clearly distinguishes between action planning and coping planning for physical activity, and that reports the results of statistical analyses in usable form for meta-analysis.

The studies comprising *Chapter 4* each relied on samples of university students. As discussed above, this is an important population to study because studies show that students' physical activity levels are vulnerable to decline during the transition to university, in part due to increased work demands (Gyurcsik, Bray, & Brittain, 2004). However, this transition period is a crucial time to develop and maintain healthy lifestyle habits (Bray & Born, 2004). As shown in correlational studies of *Chapter 3*, the relationship between action planning and physical activity was greater for studies using normative samples (such as university students) versus rehabilitation samples. No moderating influence of rehabilitation status was found for spontaneous coping planning or for experimentally induced planning. It would be important to study the relation between planning and physical activity in high-risk and under-researched populations as inconsistent results have also been observed in these groups, which may very well be explained by relevant moderators such as goal conflict. For example, some studies have shown planning to be helpful to obese and overweight individuals (Göhner, et al., 2012), whereas others have not (Parschau, 2013, Study 3). This is similar for retired older adults (Caudroit, Stephan, & Le Scanff, 2011), individuals with physical disabilities (Perrier, Sweet, Strachan, & Latimer-Cheung, 2012), or people expecting their first child (Rhodes, et al., 2014). It would seem particularly vital to study adults experiencing important life transitions such as entering the workforce after post-secondary studies or becoming a new parent, particularly if other risk factors are present (e.g., obesity or low income status; Chang, Nitzke, Guilford, Adair,

& Hazard, 2008). In sum, postsecondary researchers typically focus on school-related issues whereas health psychologists typically study psychological processes paving the way for the adoption of health behaviours. This dissertation created connections between these two streams of research by showing how the academic role conflict of emerging adults can jeopardize their capacity of make progress and to maintain a reasonable level of physical activity behaviour during the school year.

**Design.** Researchers have identified critical issues to be addressed in meta-analysis design, including the proper identification and selection of studies (Walker, Hernandez, & Kattan, 2008). Several steps were taken to carefully design the meta-analysis in *Chapter 3* to avoid potential biases. For example, both published and unpublished studies were included to minimize the risk of publication bias. In choosing the studies to be included, attempts were made to reduce selection bias by selecting as complete a set of search words as possible, and using relevant search engines, which were also identified in consultation with a librarian specialist. Looking back, other search terms might have been included, such as “HAPA” to identify even more studies containing planning. Further, similar to the double coding performed for the data-abstraction, perhaps another researcher could have searched for studies to be included as well as an additional safeguard. Although this was not carried out, criteria were clearly outlined and reported in a transparent fashion. Future meta-analyses might select studies via two researchers, with a final list chosen by consensus as an added precaution against selection bias (Ng, McGory, Ko, & Maggard, 2006). Relatedly, although a thorough double-coding procedure was used, in once instance, both coders erroneously pulled out a standard error instead of a standard deviation, due to a discrepancy between information

provided in the text and in a table in one of the primary studies included in the meta-analysis.

This had an impact on the summary effect and associated moderator analyses. Once discovered, all studies were checked again, the database was re-analysed, and a corrigendum was published to inform readers. The error in question was missed by both coders (due to convergence between their codes), co-authors, reviewers, and numerous readers.

Nevertheless, future meta-analysts may wish to have a third person code a random sub-set of the data abstracted, as an additional precaution against such incidents.

Given the prospective design of Study 1, *Chapter 4*, a certain amount of attrition was observed, which introduces the possibility of selection bias having influenced the results. That stated, attrition analyses revealed no significant differences on Time 1 variables. Also, the imputation procedure utilized in Study 1 permitted the optimization of the power of the analyses while minimizing the impact of attrition. Future work could seek to reduce attrition by rendering batteries of questionnaires even briefer to reduce participant burden, as well as emphasizing the rationale and importance of participants' continued engagement for the success of the study. Also, both Study 1 and Study 2 were correlational in nature and thus do not speak to potential causal pathways. Regarding Study 1, replication studies using a cross-lagged panel design would be helpful in estimating the strength of the causal relationships of each variable on the other. Regarding Study 2, increasing the number of days in the daily diary would be a fruitful research avenue. Following people across more than one week would allow for the examination of both daily and weekly effects, as well as the possibility of examining whether effects change as a function of whether it is a weekday or the weekend, as has been

found in within-person studies of behavioural intention for physical activity (e.g., Conroy, et al., 2011).

**Measurement.** The review in *Chapter 3* did not explicitly test methodological quality as a potential moderator of the effect sizes obtained for the experimental results, although study quality was coded and discussed. Nevertheless, study quality was taken into account in numerous ways, including separating correlational and experimental studies; coding each planning component; running analyses separately according to the time lag between assessment points; running analyses separately for the different experimental comparisons; and correcting for measurement error. Thus, study quality was considered at length and all the steps taken toward assuring this variable did not have undue influence on the results are clearly outlined in a comprehensive and transparent manner. In addition, some comparison groups contained a small number of studies, which limited their power and means that they should be interpreted with some measure of caution.

As the action planning and coping planning literature expands, it has been suggested that future meta-analysts should strive to include only high-quality studies into the summary analyses (Hagger & Luszczynska, 2014). While this is a noble endeavour, a reasonable compromise may be to continue to code study quality and examine it as a potential moderator. Although several important moderators were coded and analysed in *Chapter 3*, other potentially relevant moderators of planning were not included because it was not feasible or possible to include them all (e.g., insufficient number of studies). That stated, future systematic reviews, using a narrative approach, would be an appropriate means by which to generate a complete discussion of individual difference variables that are important but were not

considered directly in this review. For example, it has been shown that planning interventions are not likely to be of incremental benefit to highly conscientious individuals (Chatzisarantis & Hagger, 2007) or to those already generating action plans and coping plans spontaneously (Sniehotta, 2009). Individuals high on socially prescribed perfectionism, perhaps because of their over-regulation and self-criticism, have been found to respond negatively to planning (Powers, Koestner, & Topciu, 2005). Results of a recent study also showed that a planning intervention designed to increase fruit and vegetable consumption was least beneficial for those high on *urgency*, a form of impulsivity (Churchill & Jessop, 2011). There is much to learn about individual differences in spontaneous action plans and coping plans as they can inform the development of more tailored interventions.

Relatedly, most of the primary experimental studies included in the meta-analysis did not assess and test potential mediating mechanisms of intervention effects, which are important to elucidate. For example, a recent randomized control trial showed that a combined action and coping planning intervention increased fruit and vegetable consumption through changes in spontaneous action plans and coping plans across time (Wiedemann, Lippke, Reuter, Ziegelmann, & Schwarzer, 2011). Knowing whether theorized mechanisms of change are actually responsible for the transmission of successful interventions contributes to theoretical refinement, and ultimately, more powerful interventions (Michie & Abraham, 2004).

As mentioned, a *dual goal model* was employed in *Chapter 4*, which is one way of assessing interrelationships among goals. One benefit of this approach is that it is not very burdensome to the participant, yet yields much useful information. One drawback of this approach is that it only captures a small subset of participants' broader goal structure. More

elaborated approaches have been used to study multiple goal pursuit, including *personal projects analysis* (Little, Salmela-Aro, & Phillips, 2007) or the *striving instrumentality matrix* (Emmons, 1986), which involve more exhaustive goal matrices. Future studies could examine whether the results obtained in the second article of this dissertation are replicated when using these more comprehensive methods of assessing goal conflict. Relatedly, self-report measures of physical activity behaviour and goal progress were used, which are often critiqued for overestimating absolute physical activity due to concerns regarding social desirability and retrospective recall bias (Sallis & Saelens, 2000). Notably, a recent systematic review (Prince, et al., 2008) showed no clear overall trends regarding the degree of correspondence between self-report and direct measures of physical activity, but did highlight the strengths and weaknesses of each approach, and recommended selecting appropriate measures on the basis of study objectives. Given that the primary aim of our studies centred on the relationships between predictor and physical activity outcome variables, and less on absolute physical activity levels per se, the use of well-validated self-report physical activity measures was deemed appropriate. In addition, as discussed in *Chapter 4*, the examination of goal progress is a useful complement to measure of absolute physical activity behaviour and represented a strength of these studies. Nevertheless, it would be valuable for future work to include objective measures of goal conflict and/or physical activity outcomes, to safeguard against potential threats of shared method variance. Of note, regarding conflict and facilitation, both Presseau and colleagues (2013) and Reidiger and Freund (2004) showed that perceived goal facilitation and conflict were highly associated with behavioural indicators of goal conflict (i.e., amount of daily time spent engaging in alternative goal pursuits).

**Statistics.** In *Chapter 3*, path-analysis was used to test theoretically relevant, yet relatively simple path analyses. These analyses examined portions of theories but did not include all theorized constructs and pathways. Future meta-analyses could build on this work by testing the role of action planning and coping planning within fuller theoretical frameworks, such as the HAPA model or an extended TPB model, which would require coding a larger set of correlations. Also, it is important to note that, due to the small number of studies included in the meta-analysis, many subgroup analyses included only a small number of studies and therefore lacked statistical power (Walker, et al., 2008). These results must therefore be interpreted with caution. In addition, the small number of studies also prevented an examination of three-way interactions. For example, examining the effect of planning in rehabilitation samples with low intentions versus high intentions. Related to the primary studies themselves, the reliabilities of scales were often not reported, in which case predetermined conservative yet acceptable judgements of reliability were used. It would be helpful to future meta-analysts for studies to include reliability estimates for all measures used.

Study 2 of *Chapter 4* focused exclusively on the daily associations between planning and physical activity (Level 1). Future studies using daily diary methods could be carried out to explore research questions that address both levels of analysis simultaneously. For example, one could explore a potential cross-level interaction to understand how daily action planning and coping planning might relate to daily physical activity behaviour as a function of the average level of *physical activity identity* endorsed in a given timeframe. Based on prior work showing that physical activity identity is related to greater self-regulatory actions toward physical activity (Carraro & Gaudreau, 2010; Strachan, Fortier, Perras, & Lugg, 2013), one might

expect that the within-person relationships between action planning and physical activity and coping planning and physical activity would be stronger during times when participants report a greater sense of physical activity identity.

### **Theoretical Implications**

As discussed in *Chapter 2*, models such as the Model of Action Phases (MAP) and Health Action Process Approach (HAPA) seek to extend and address the limitations of socio-cognitive models of health-behaviour such as TPB that emphasize the motivational variable of intention as the most proximal predictor of physical activity. These models do so by suggesting that intention is a necessary but not sufficient condition for the enactment of a desired behaviour. More specifically, these models propose that post-intentional/volitional processes, such as planning, are needed for the enactment of the intended behaviour. The results of the meta-analytic path models of *Chapter 3* showed that action planning and coping planning operate either uniquely and in parallel, or as part of a chain, to bridge the intention-behaviour gap.

The studies in *Chapter 4* focused primarily on the volitional constructs of action planning and coping planning. Future studies could extend this work by also including motivational constructs derived from validated theories such as the Self-Concordance Model (SCM; Sheldon & Elliot, 1998). The SCM, grounded in Self-Determination Theory (SDT; Deci & Ryan, 1985), examines the reasons for which individuals strive toward their goals. The model proposes that goals are self-concordant to the extent that they are intrinsically desirable and perceived as important for purposes of personal development. In contrast, goals are said to be nonself-concordant to the extent that they are pursued because of introjected guilt or perceived external pressure. The SCM predicts that goals that are in line with personally held values and

interests are more likely to be attained than goals pursued for introjected or extrinsic reasons. Accordingly, numerous works have demonstrated that individuals are more likely to make successful progress when they select goals that are self-concordant (Gaudreau, Carraro, & Miranda, 2012; Koestner, et al., 2006; Koestner, et al., 2002).

Self-concordance may be related to the experience of goal conflict in meaningful ways. The SCM posits that nonself-concordant goals are likely to generate a sense of conflict within the self, whereas autonomous goals are likely to promote the effective usage of effortful volitional strategies (Koestner, Otis, Powers, Pelletier, & Gagnon, 2008). In line with this, studies have found non-self determined/concordant goals to be related to increased conflict (Williams, Guerin, & Fortier, 2014), whereas self-determined/concordant goals have been found to increase usage of volitional strategies, such as planning, which ultimately led to increased progress on personal goals (Carraro & Gaudreau, 2011). Related to *Chapter 4*, it would be interesting to examine whether greater goal self-concordance is associated to diminished goal conflict, and whether we would continue to find the differential effects of action planning and coping planning observed. Considering multiple goals, albeit more complex and sometimes less parsimonious, appears warranted to understand how physical activity goals unfold in the real lives of individuals struggling to initiate and remain physically active.

### **Methodological Implications**

One strength of the meta-analysis is that it provided a detailed breakdown of the planning components included in each of the individual studies. This breakdown showed that there is much variability in the way planning is operationalized and measured. Flowing from this was the recommendation to continue to distinguish between action planning and coping

planning so as to disentangle their respective roles in facilitating physical activity behaviour. In addition to distinguishing between each form of planning, it would also be helpful to remain consistent in our measurement of each form of planning. Clearly defined and comprehensive measures of action planning and coping planning have been validated which should be used (Sniehotta, Schwarzer, et al., 2005). In parallel, it would be helpful to refine our understanding of what people's spontaneous plans actually look like from a content and structure perspective. It would be useful to adopt a qualitative approach to uncover this information, as it has implications for likely mediating mechanisms and likelihood of behaviour change (Chapman, et al., 2009). Content analysis could be performed to ascertain the typical format and content of self-set plans. Such an approach falls in line with urgent calls to create standardized or shared understandings of constructs and behaviour change techniques, so as to facilitate replication across studies and isolate the "active ingredients" of behaviour change techniques (Abraham & Michie, 2008).

Among the experimental studies, as noted in *Chapter 3*, higher quality studies are needed, which adopt randomized-controlled designs with clearly identified protocols. Particularly among paper-and-pencil interventions not assisted by a researcher, there can be a lack of fidelity to planning protocols (Kwasnicka, et al., 2013), rendering them less efficacious (van Osch, Lechner, Reubsaet, & De Vries, 2010). Monitoring the extent to which participants form relevant plans may increase the efficacy of planning interventions and yield more accurate results. Asking participants about the extent to which they have formed plans, as is done in the correlational studies, is one way of assessing intervention fidelity.

Research utilizing daily diary designs with associated within-person analyses is a very exciting and interesting complement to traditional between-person work. Conventional health behaviour theories and the associated methods to study them are focused on explaining relations between a person's typical (i.e., aggregated) self-regulation and their typical (i.e., aggregated) behaviour. Typical self-regulation or behaviour over a period of time may or may not resemble self-regulation or behaviour at a given point in time (Conroy, et al., 2013). It would be useful to capture *both* the short-term fluctuations with the longer-term development. For instance, are individuals with more daily variability in self-regulation and behaviours more likely to abandon their physical activity behaviours over the longer term? Combining daily diaries nested within longitudinal studies (and perhaps even randomized control trials) could offer unique ways to examine both the short- and long-term effects of planning for physical activity behaviour – as well as their mediators and moderators.

### **Practical Implications**

Based on the results of this dissertation, suggestions can be made for how to more effectively plan for and protect physical activity goals. First, the results of *Chapter 3* generally suggest that more elaborated plans yield better results, as do those generated with the assistance of the researcher, as opposed to completing paper-and-pencil exercises. As mentioned, this builds on other research examining how to augment planning interventions, which showed that plans work best when they a) have an if-then format versus being more global (Chapman, et al., 2009), b) are repeated or revised (Chapman & Armitage, 2010), and c) are based on self-concordant (Koestner, et al., 2006; Koestner, et al., 2002) or personally relevant reasons for goal pursuit (Adriaanse, De Ridder, & De Wit, 2009). Continued research on

how to optimize plans, for example, through generating them collaboratively with a partner (Prestwich, et al., 2005), or supplementing them with reminders (Prestwich, Perugini, & Hurling, 2009) or self-monitoring (Michie, et al., 2009), will be very useful in helping to maximize the potential benefit of planning on physical activity behaviour.

The results of *Chapter 3* also showed that planning interventions seemed to work best for people with lower or higher levels of intention. Regarding the former, this result suggests that planning interventions work well for people who need it most, which is in line with results from the broader planning literature that have shown that planning interventions work best for people with difficulties regulating their behaviour (Gollwitzer & Sheeran, 2006). Regarding the latter, this result suggests that planning interventions work well for people with higher levels of intention. This has possible implications for enhancing planning interventions – in particular, by supporting the value of combining interventions to promote both intention and planning given that planning has a significantly stronger impact on physical activity when intentions are strong. Future work using full factorial experimental designs that distinguish between action planning and coping planning and manipulate both intentions and each for of planning with further clarify the robustness of this effect (Prestwich & Kellar, 2010).

The correlational studies reviewed in *Chapter 3* and the correlational nature of the data in *Chapter 4*, as well as the low to unclear quality of the experimental studies reviewed in *Chapter 3*, preclude firm recommendations for the results obtained to be translated into widely applied policies. To be sure, prudence is warranted before recommending the universal implementation of planning interventions to improve physical activity. Notwithstanding, the results of this dissertation can inform the development of future randomized controlled trials to

further investigate ideas found in the dissertation. For example, the *Chapter 4* studies demonstrated the differential effects of action planning and coping planning according to the level of academic goal conflict. This work can be used as a springboard to set research priorities for well-controlled experimental studies (Weinstein, 2007). One interesting idea would be to employ an experimental “matched-mismatched” randomized control design (Weinstein, Rothman, & Sutton, 1998), which has been used successfully to test stage models of behaviour change (Lippke, Schwarzer, Ziegelmann, Scholz, & Schuz, 2010). An action planning intervention would be matched to participants with lower goal conflict, and mismatched to participants high on goal conflict. Accordingly, a coping planning intervention would be matched to participants with higher goal conflict, and mismatched to participants low on goal conflict. We would expect that physical activity behaviour change would be more likely in participants receiving a planning intervention matched to their perceived level of goal conflict at the start of the study than those in either the control condition or the mismatched intervention condition.

Finally, *Chapter 4* demonstrated how fruitful it can be to take the multiple goal context into account. Indeed, if planning research is to be maximally useful, it will need to be adapted to take into account the larger goal structure in which it is embedded. Recent work by Dalton and Spiller (2012) showed that helping people reframe their pursuit of multiple goals as manageable (Study 3) reduced the perceived difficulty of multiple goal pursuit, thereby enabling them to enact their plans to a greater degree than people forming intentions alone. A complementary line of research could examine whether encouraging people to see the facilitative links between their goals could increase the benefits of planning by lowering perceptions of difficulty. Such findings would be in accordance with research showing that the

success of multiple goal pursuit is enhanced when people are encouraged to view their goals as working together to achieve a higher-order aim, versus disparate pursuits (Shah, Friedman, & Kruglanski, 2002). Relatedly, it would be interesting to know whether the use of planning strategies to increase facilitation among goals can ultimately lead to greater levels of physical activity through a reduction in goal conflict.

### **Conclusion**

Using theoretical perspectives on motivation and self-regulation, the present dissertation had as its aim to better understand the unique and differential roles of action planning and coping planning on physical activity behaviour. The main contributions of this dissertation are the following:

- (1) In *Chapter 3*, the roles of spontaneous and experimentally induced action planning and coping planning in the prediction of physical activity were confirmed and clarified. A medium-to-large link was found for the correlational studies, and small effect was found for experimental studies. It was uncovered that there is a clear need for future studies on planning to more consistently define and measure action planning and coping planning, and to report statistics completely and in a format that is amenable to future meta-analysis. Moreover, it was determined that higher quality experimental studies will be immensely helpful in testing theory-based interventions for physical activity.
- (2) In *Chapter 3*, support for the mediating role of action planning and coping planning in the relation between intention and physical activity was provided.
- (3) In *Chapters 3 and 4*, important moderators of the action planning and coping planning to physical activity relationship were tested, which provided useful information that has

the potential to contribute to more appropriately targeted intervention efforts and explanations for the marked heterogeneity of the planning to physical activity relation.

(4) In Chapter 4, action planning and coping planning research was advanced in novel, ecologically and statistically sound, and practically useful research directions, by unearthing goal conflict as key moderator of planning on physical activity at the between- and within-person levels.

(5) Finally, numerous ideas for future research were provided that take into account the results obtained across the multiple studies presented.

Although additional research is needed to further investigate the validity and generalizability of the present findings, these results provided the basis for future studies examining the role of action planning and coping planning in the physical activity domain and in a dual-goal context. Such research will be important not only to better understand self-regulation processes, but also how to ultimately help people focus their self-regulatory actions for physical activity more effectively, an important task both in terms of the greater public health and individual physical and emotional wellness.

**References (Background, General Introduction, and General Discussion)**

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**APPENDIX A**

**Chapter 3: Data Abstraction Coding Scheme**

### Information extracted from the studies included in the meta-analysis

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#### Study descriptors

For each study, the author name(s), year of publication, publication form (e.g., journal, dissertation, unpublished manuscript), and study language were noted.

#### Sample information

For each study, the following elements were coded:

1. Initial number of participants (i.e., number of participants recruited for the study)
2. Final number of participants (i.e., number of participants on which the analyses were based)
3. Type (e.g., university students, employees, rehabilitation patients, Internet)
4. Gender (% male)
5. Age (mean, standard deviation, range)
6. Ethnicity (Caucasian, African-American, Hispanic, Asian, Aboriginal, mixed but primarily Caucasian, mixed but primarily African-American, mixed but primarily Hispanic, mixed but primarily Asian, mixed but primarily Aboriginal, not specified)
7. Country in which the study was conducted

Additionally, for the experimental studies, the following group (i.e., study condition) information was coded:

1. Assignment (e.g., randomized, cluster randomized, non-random)
2. Available information (e.g., RCT, pre-post, RCT and pre-post)
3. Intervention components (for the experimental conditions)
4. Delivery of the intervention (e.g., interviewer-assisted, paper and pencil, support group)
5. Intervention part of hospital rehabilitation program?
6. "Neutral" components (for the control and other comparison conditions)

#### Outcome measures

Five antecedent and outcome variables were coded:

1. Past behavior
2. Behavioural intention
3. Action planning
4. Coping planning
5. PA behavior

#### Effect size and supporting information from the correlational studies

1. Outcome descriptives (mean, standard deviation, alpha)
  2. Concurrent bivariate correlations between outcomes
-

- 
3. Prospective bivariate correlations between outcomes
  4. Prospective time lag (in weeks)
  5. Shortest delay
  6. Longest delay
  7. Within-outcome bivariate correlations (e.g.,  $r$  between T1 intention and T2 intention)

Effect size and supporting information from the experimental studies

1. PA descriptives (mean, standard deviation, cell  $n$ )
  2. Computed effect sizes (all relevant  $t$ ,  $F$ , or  $\chi^2$  values with associated df,  $p$  value, and cell  $n$ )
  3. Number of follow-ups
  4. Prospective time lag (in weeks) between the intervention and each follow-up
  5. Shortest delay
  6. Longest delay
  7. Data distribution (e.g., adjusted means, log transformed)
-

**APPENDIX B**

**Chapter 3: Experimental Study Quality**

## Quality coding for the experimental studies

	<b>Adequate sequence generation?</b>	<b>Allocation concealment?</b>	<b>Blinding?</b>	<b>Incomplete outcome data addressed?</b>	<b>Free of selective outcome reporting?</b>
Araújo-Soares, et al. (2009b)	Unclear.  “randomly assigned” (p. 4) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 4	Unclear.  Not specified in Methods.  p. 4	Yes.  Attrition unrelated to intervention; ITT performed.  p. 9 & 10	Unclear.  Link to original research protocols or REB documents not available.  p. 11
Arbour & Ginis (2004)	Unclear.  “randomly assigned” (p. 177) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 177	Unclear.  Not specified in Methods.  p. 177	Unclear.  Reasons for missing data across groups not provided.  p. 181	Unclear.  Link to original research protocols or REB documents not available.  p. 181
Budden & Sagarin (2007)	Unclear.  “randomly assigned” (p. 393) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 393	Unclear.  Not specified in Methods.  p. 393	Unclear.  Reasons for missing data not provided.  p. 395	Unclear.  Link to original research protocols or REB documents not available.

					p. 396
Chatzisarantis, Hagger, & Thøgersen-Ntoumani (2008)	Unclear.  “pile of questionnaires with unknown number of intervention packets” might not constitute randomization.  p. 206	Unclear.  Not specified in Methods.  p. 203	Unclear.  Blind at point of administration but may not have been blind to outcome or analyses.  p. 203	Unclear.  Reasons for missing data not provided.  p. 206	Unclear.  Link to original research protocols or REB documents not available.  p. 207 & 208
Darker, French, Eves, and Sniehotta (2010)	Yes.  “randomized... using random number generator”  p. 6	Unclear.  Not specified in Methods.  p. 6	Unclear.  “Interviewer-assisted.” Interviewers may have also been outcomes assessors and/or data analysts.  p. 6	Yes.  Equal rates of attrition across groups.  p. 5	Unclear.  Link to original research protocols or REB documents not available.  p. 6
de Vries, Ket al. (2008)	Unclear.  “assigned at random” (p. 418) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 418	Unclear.  Not specified in Methods.  p. 418	Unclear.  Reasons for missing data across groups not provided.  p. 420	Unclear.  Link to original research protocols or REB documents not available.  p. 418
Hill, Abraham, & Wright (2007)	Yes.  “randomized...	Unclear.  Not specified	Unclear.  Not specified	Yes.  Reasons for	Unclear.  Link to

	using random number generator” p. 1051	in Methods. p. 1051	in Methods. p. 1051	attrition explained p. 1051	original research protocols or REB documents not available. p. 1054
Kwak, et al. (2007)	Unclear. “random allocation” (p. 254) is insufficient as per Higgins & Altman (p. 8.27).	Unclear. Not specified in Methods. p. 254	Yes. Outcomes assessed by someone blind to condition. p. 254	Yes. Reason for attrition explained and ITT performed. p. 254	Unclear. Link to original research protocols or REB documents not available. p. 254
Latimer, Ginis, & Arbour (2006)	Unclear. “Randomized” (p. 274) is insufficient as per Higgins & Altman (p. 8.27).	Unclear. Not specified in Methods. p. 275	No. “single-blind” p. 275	Yes. Comparable attrition across groups; reasons provided p. 277	Unclear. Link to original research protocols or REB documents not available. p. 277
Lippke, Ziegelmann, & Schwarzer (2004b)	Unclear. “Randomized” (p. 225) is insufficient as per Higgins & Altman (p. 8.27)	Unclear. Not specified in Methods. p. 226	Unclear. Interviewer blind to condition at point of assignment but not	Yes. Data imputation applied. LOCF procedure used to deal	Unclear. Link to original research protocols or REB documents

			specified whether blind at point of assessment of analysis of outcomes.  p. 226	with differential drop out rates.  p. 227	not available.  p. 232
Luszczynska (2006)	Unclear.  "Participants were randomly allocated" (p. 902) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 902	Unclear.  Not specified in Methods.  p. 902	Unclear.  Reasons for missing data across groups not provided  p. 902	Unclear.  Link to original research protocols or REB documents not available.  p. 904
Milne, Orbell, & Sheeran (2002)	Unclear.  "Participants were randomly allocated" (p. 168) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 168	Unclear.  Not specified in Methods.  p. 168	Unclear.  Reasons for missing data across groups not provided  p. 168	Unclear.  Link to original research protocols or REB documents not available.  p. 175
Prestwich, Lawton, & Conner (2003)	Unclear.  "Participants were randomly allocated" (p. 711) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 711	Unclear.  Not specified in Methods.  p. 711	Yes.  n.s. drop out across conditions  p. 711	Unclear.  Link to original research protocols or REB documents not available.

					p. 714
Prestwich, Perugini, & Hurling (2009)	Yes. “a computer-based random number generator was used to allocate participants to conditions” p. 680	Unclear. Not specified in Methods. p. 680	Unclear. Not specified in Methods. p. 680	Unclear. Reasons for missing data across groups not provided. p. 680	Unclear. Link to original research protocols or REB documents not available. p. 682
Ransom-Flint (2007)	Unclear. “the researcher randomized the assignment of participants” (p. 52) is insufficient as per Higgins & Altman (p. 8.27).	Unclear. Not specified in Methods. p. 54	Unclear “participants were asked to read their exercise aloud to the experimenter” Interviewers may have also been outcomes assessors and/or data analysts. p. 54	Yes. “participants who withdrew from the study were no more likely to have been assigned into one particular intervention condition than any other” p. 66	Unclear. Link to original research protocols or REB documents not available. p. 54
Rhodes & Matheson (unpublished)	Unclear. “the researcher randomized the assignment of participants” (p. 4) is insufficient as per Higgins &	Unclear. Not specified in Methods. p. 5	Unclear. Not specified in Methods. p. 5	Unclear. Reasons for missing data across groups not provided. p. 5	Unclear. Link to original research protocols or REB documents not

	Altman (p. 8.27).				available. p. 5
Scholz, et al. (2006)	Unclear.  “participants were randomly assigned” (p. 3111) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods. p. 3111	Unclear.  Interviewer-assisted. Interviewers may have also been outcomes assessors and/or data analysts.  p. 3111	Yes.  Multiple Imputation data imputation was used.  p. 3113	Unclear.  Link to original research protocols or REB documents not available.  p. 3113
Skår et al. (2011)	Yes.  “Participants were randomly assigned...using a computerized Perl script”  p.10	Yes.  Masked online random allocation procedure used.  p. 10	Yes.  “researchers were blinded to the condition that participants were being allocated to. Participants were unaware of the random allocation, and that they were taking part in an intervention”  p. 10	Yes.  Full ITT analysis used; drop out did not differ across groups.  p. 11	Unclear.  Link to original research protocols or REB documents not available.  p. 10
Sniehotta, Scholz, & Schwarzer (2006)	Unclear.  “participants were randomly assigned” (p. 27) is insufficient as	Unclear.  Not specified in Methods. p. 28	Unclear.  Interventions delivered by “trained consultants”. Consultants	Unclear.  Reasons for missing data across groups not provided.	Unclear.  Link to original research protocols or REB

	per qual doc p. 8.27”		may have also been outcomes assessors and/or data analysts.  p. 28	p. 29	documents not available.  p. 28
Sniehotta, Scholz, Schwarzer, et al. (2005)	Unclear.  “participants were randomly assigned” (p. 246) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 247	Unclear.  Interviewer-assisted. Interviewers may have also been outcomes assessors and/or data analysts.  p. 247	Unclear.  Reasons for missing data across groups not provided.  p. 248	Unclear.  Link to original research protocols or REB documents not available.  p. 247
Waters (2007)	Unclear.  “participants were randomized” (p. 27) is insufficient as per Higgins & Altman (p. 8.27).	Unclear.  Not specified in Methods.  p. 21	Unclear.  Outcomes assessed via telephone interview. Interviewers may have also been outcomes assessors and/or data analysts.  p. 21	Yes.  Reasons for exclusions provided. Equal attrition across groups.  p. 32	Unclear.  Link to original research protocols or REB documents not available.  p. 21

**APPENDIX C**

**Chapter 3: Planning Components**

## Planning Component Descriptives

Reference	Planning components							
	Action Planning					Coping planning		
	What		When	Where	With whom	How		
	Type? Yes	Type? No			How to carry out INT	Freq? Int? Dur?	Cope with barriers: Idiographic	Cope with barriers: Nomothetic
<b>Correlational</b>								
Araújo-Soares, et al. (2009a)			X	X	X	Y		X <sup>1</sup>
Blanchard (2008)		X	X	X	X	N		
Brickell, et al. (2006)			X2	X2	X	N		
Carraro and Gaudreau (2010)		X	X2	X	X	N		
Carraro and Gaudreau (2011)		X	X2	X	X	N		
Lippke, et al. (2009)			X	X	X	Y		
Lippke, Ziegelmann, & Schwarzer (2004a)	X		X	X	X	N		
Norman and Conner (2005)			X	X	X	Y		
Renner, et al. (2007)			X	X	X	Y		X <sup>2</sup>
Reuter, et al. (2010)			X	X		N		X <sup>3</sup>
Rhodes, et al. (2006)		X	X	X		N		
Rise, Thompson, and Verplanken (2003)	X		X	X		N		X <sup>3</sup>
Roberts, et al. (2010)			X	X	X	Y		
Scholz, Nagy, Schütz, & Ziegelmann (2008)			X	X	X	Y		X <sup>1</sup>
Scholz, et al. (2008)			X	X	X	Y		X <sup>1</sup>
Schwarzer, et al. (2007)	--	--	--	--	--	--	--	--
Sniehotta, et al. (2010)			X	X				
Sniehotta, et al. (2005)			X	X	X	Y		X <sup>1</sup>
Sniehotta, Scholz, and Schwarzer (2005)			X	X	X	Y		

Wiedemann, et al. (2009)		X	X		X	Y	
Ziegelmann & Lippke (2007) – Sample 1	X	X	X	X		N	X <sup>1</sup>
Ziegelmann & Lippke (2007) – Sample 2	X	X	X	X		N	X <sup>1</sup>
<b>Experimental</b>							
Araújo-Soares, et al. (2009b)		X	X		X	Y	X
Arbour & Ginis (2004)	X	X2	X				
Budden & Sagarin (2007)	X	X	X				
Chatzisarantis, Hagger, & Thøgersen-Ntoumani (2008)		X	X				
Darker, et al. (2010)		X	X	X	X	N	X
de Vries, Ket al. (2008)	X				X		
Hill, Abraham, & Wright (2007)	X	X			X	N	
Kwak, et al. (2007)		X	X				
Latimer, Ginis, & Arbour (2006)	X	X	X		X	Y	
Lippke, Ziegelmann, & Schwarzer (2004b)		X	X	X	X	Y	X
Luszczynska (2006)	X	X	X		X	N	
Milne, Orbell, & Sheeran (2002)		X2	X				
Prestwich, Lawton, & Conner (2003)	X	X	X				
Prestwich, Perugini, & Hurling (2009)	X	X	X				
Ransom-Flint (2007)	X	X2	X				
Rhodes & Matheson (unpublished)	X	X2	X				
Scholz, et al. (2006)	X	X2	X			N	X
Skår et al. (2011)	X	X	X				
Sniehotta, Scholz, & Schwarzer (2006)		X	X	X	X		
Sniehotta, Scholz, Schwarzer, et al. (2005)		X	X	X	X		
Waters (2007)		X2	X		X		X

*Note.* AP components = *What* (type yes = type of PA specified by the researcher, e.g., to what extent did you make specific plans regarding what to do to perform the exercises you learned in the rehabilitation program at least 3 times per week?; type no = no type of PA specified by the researcher e.g., to what extent did you make specific plans regarding what to do to be physically active over the last x weeks?), *when* (e.g., time of day and/or day of week), *where*, *with whom*, and *how* (how to carry out INT = how to carry out intention e.g., ...how to reach your goal of losing 3 lbs of fat by running bleachers. How Freq? Int? Dur? = the how

component includes mention of frequency, intensity, or duration of PA, e.g., ...how to perform moderate to vigorous PA (intensity) for at least 30 minutes (duration) 3 times per week (frequency); CP components = how to overcome barriers, obstacles, temptations, distractions identified either by the participants themselves (idiographic) or by the researchers (nomothetic) via a self-report questionnaire or during a one-on-one interview. X = the component was assessed; X<sup>2</sup> = the component was assessed via 2 items; Y = yes; N = no; X<sup>1</sup> = CP scale; X<sup>2</sup> = CP scale but aggregated with AP scale for analyses; X<sup>3</sup> = CP item imbedded in AP scale. NB: X<sup>2</sup> and X<sup>3</sup> were excluded from analyses comparing AP and CP so as to successfully isolate each planning type.

**APPENDIX D**

**Chapter 3: Prospective Effect Sizes**

*Prospective effect sizes between all constructs of interest*

	Intention	Action planning	Coping planning	Physical Activity
Intention	1.00	$\phi = .41$ $k = 8$ $n = 2818$	$\phi = .19$ $k = 5$ $n = 1522$	$\phi = .33$ $k = 18$ $n = 4711$
Action planning	$\phi = .41$ $k = 8$ $n = 2818$	1.00	$\phi = .67^*$ $k = 3$ $n = 791$	$\phi = .40$ $k = 16$ $n = 2948$
Coping planning	$\phi = .19$ $k = 5$ $n = 1522$	$\phi = .53$ $k = 3$ $n = 473$	1.00	$\phi = .35$ $k = 4$ $n = 818$
Physical Activity	$\phi = .33$ $k = 18$ $n = 4711$	$\phi = .40$ $k = 16$ $n = 2948$	$\phi = .35$ $k = 4$ $n = 818$	1.00

*Note.* Top of diagonal = dual mediation model. Bottom of diagonal = sequential mediation model. \* = concurrent.

Harmonic mean<sub>multiple mediation</sub> =  $1 / [(1 / 2818 + 1 / 1522 + 1 / 4711 + 1 / 791 + 1 / 2948 + 1 / 818) / 6]$

Harmonic mean<sub>multiple mediation</sub> = 1482

Harmonic mean<sub>sequential mediation</sub> =  $1 / [(1 / 2818 + 1 / 1522 + 1 / 4711 + 1 / 473 + 1 / 2948 + 1 / 818) / 6]$

Harmonic mean<sub>sequential mediation</sub> = 1316