INTEGRATING SOCIAL PSYCHOLOGICAL THEORIES OF MOTIVATION AND INTENTION TO EXPLAIN HEALTH AND SAFETY BEHAVIOURS

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To my Grandfather

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Abstract

The work within the thesis aimed to integrate concepts from three psychological frameworks, including self-determination theory (SDT), the theory of planned behaviour (TPB), and the hierarchical model of motivation (HMM), into a model to understand the processes that underpin motivation and intention toward health and safety behaviours. The first tenet of the model (derived from SDT and HMM), namely the trans-contextual effect of motivation, hypothesised that self-determined motivation for a given activity related to self-determined motivation for undertaking health-promoting behaviour associated with the activity. The second tenet of the model (derived from the strength, limitation, and theoretical assumptions of SDT and the TPB) speculates that the effects of self-determined motivation for health and safety behaviour on intention and behaviour were mediated by social cognitive variables. A total of eight studies were employed to test the two tenets of the integrated model across various health contexts (i.e., sport injury rehabilitation and prevention (Study 1 to 5), occupational injury rehabilitation and prevention (Study 6 and 7), and myopia prevention (Study 8), and these studies are presented in five related research chapters (Chapters 2 to 6) in this thesis. The results provided preliminary evidence in support of both tenets of the integrated model, in which motivation from a general life domain is transferred to motivation, and antecedent social cognitive variables, for behaviour in a health and safety domain.

The final chapter (Chapter 7) of the thesis summarises the findings of the eight studies and offers explanations and interpretations of the overall pattern of results. Conclusions were then drawn with respect to the theoretical and practical implications of the findings. Consideration was also given to the methodological limitations of the thesis and the scope for

further studies to improve the predictive power, utility, measurement reliability, and evidence base for the model.

List of Published Papers from this Thesis

Chan, D. K. C., & Hagger, M. S. (in press). Trans-contextual motivation in sport injury prevention among elite athletes. *Journal of Sport and Exercise Psychology*.

Chan, D. K. C., & Hagger, M. S. (2012). Autonomous motivations underpinning injury prevention and rehabilitation among police officers: An application of the trans-contextual model. *Motivation and Emotion, 36(3)*, 363-349.

Chan, D. K. C., & Hagger, M. S. (2012). Self-determined forms of motivation predict sport injury prevention and rehabilitation intentions. *Journal of Science and Medicine in Sport*, *15,* 398-406.

Chan, D. K. C., & Hagger, M. S. (2012). Theoretical integration and the psychology of sport injury prevention. *Sports Medicine, 42*(9), 725-732.

Chan, D. K. C., Hagger, M. S., & Spray, C. M. (2011). Treatment motivation for rehabilitation after a sport injury: Application of the trans-contextual model. *Psychology of Sport and Exercise, 12*, 83-92.

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Chapter 1

Introduction

This Chapter is a modified form of the following published article:

Chan, D. K. C., & Hagger, M. S. (2012). Theoretical integration and the psychology of sport injury prevention. *Sports Medicine, 42*(9), 725-732.

Background

Why do people at risk of health problems fail to complete a course of prescribed treatment or do not follow recommended changes to their behaviour that will aid recovery, or prevent of future disease, injury, or illness? What social, dispositional (e.g., personality), motivational, and decision-making factors are associated with individuals' beliefs in and compliance toward health and safety recommendations? Answers to these questions are important for health-care practitioners, researchers, and policy makers who deliver prescriptions for medication or behavioural recommendations aimed at reducing the incidence and severity of health problems.

The need to understand individuals' motivation and intention to undertake recommended advice on behavioural change and promote adherence to health and safety recommendations is paramount, as indicated by research that has highlighted the importance of environmental and personal factors in the prediction of health-related behaviours known to reduce disease, and injury, or deficiencies (Courtenay, 2000; Davies & McColl, 2002). Unfortunately, national statistics have frequently reported that a considerable proportion of individuals do not adhere to health and safety guidelines even though they aware of the health risk and negative consequences of non-compliance (Fischer et al., 2010; Health & Safety Executive, 2010; Vermeire, Hearnshaw, Van Royen, & Denekens, 2001). For example, the link between physical inactivity and incidence of chronic conditions such as obesity, heart disease, and diabetes has been well documented (Department of Health, 2004; Lee, Sesso, & Paffenbarger, 2000; Oguma, Sesso, Paffenbarger, & Lee, 2002), and has raised national awareness of the importance of the promotion of physical activity in the community (Department of Health, 2004; World Health Organization, 2004). Health practitioners are

encountering considerable challenges in their attempts to persuade inactive individuals to adopt behaviour-change recommendations and commit to an active lifestyle in the future (Biddle, Whitehead, O'Donovan, & Nevill, 2005; Van der Horst, Paw, Twisk, & Van Mechelen, 2007; Van Sluijs, Van Poppel, Twisk, Brug, & Van Mechelen, 2005). These difficulties also apply to community campaigns for the promotion of many health enhancing behaviours such as smoking cessation (Williams, McGregor, Sharp, Levesque, et al., 2006) and prevention of binge drinking (Hagger, Lonsdale, & Chatzisarantis, 2012), because notable proportions of participants in the health care interventions eventually dropout or lose their motivation to fully adhere to the health recommendations (Brewer, 1998; Fischer et al., 2010; Haynes, Ackloo, Sahota, McDonald, & Yao, 2008), resulting in an overall reduction in the effectiveness of behavioural interventions (Sokol, McGuigan, Verbrugge, & Epstein, 2005).

There is also growing amount of evidence regarding non-compliance to treatment and therapy in clinical contexts. A recent study has revealed notable rates of non-adherence to prescribed treatment (between 20% and 60%) in patients across a number of medical conditions (e.g., diabetic drugs, asthma medication, anti-depressants, neuropsychiatric drugs, and dermatological agents; Fischer et al., 2010). This poor adherence may lead to higher rates of mortality or other adverse outcomes among patients prescribed with long-term medication regimens to treat illnesses such as diabetes (Ho et al., 2006) and coronary heart disease (Ho et al., 2008). In addition, non-compliance with medical guidelines not only impairs patients' safety and medical service quality, but may also substantially reduce the cost-effectiveness of medical treatment. In a study on the total healthcare cost of four major chronic illnesses in the United States (diabetes, hypertension, hypercholesterolemia, and congestive heart failure), patients' medication adherence was strongly (and negatively) associated with the total healthcare cost (i.e., total cost for hospitalization, emergency room treatment, home-care service, and drugs claimed) and the rate of hospitalization (Sokol et al., 2005). On the other

hand, non-compliance with medical regimen has been estimated to increase the national healthcare cost by over $170 billion annually in the United States (Fischer et al., 2010; Vermeire et al., 2001).

The substantial incidence of non-compliance to health and safety guidelines and the growing concerns about the health and economic burdens associated with dropout from medical and health programs highlight the importance of studying the social, dispositional (e.g., personality), motivational, and decision-making factors associated with adherence toward health and safety behaviours.

The Main Aims of the Current Research

The maladaptive behavioural patterns evidenced in the literature on rehabilitation and prevention of medical conditions highlight the heavy dependence of the effectiveness of medical treatment or health promotion programs on human factors, particularly individuals' ability to self-regulate and adhere to the treatment regimen (Ryan, Patrick, Deci, & Williams, 2008; Williams et al., 2002). For example, it has been reported that some workers do not comply with occupational safety regulations designed to prevent injury because productivity is considered, within their workplace culture, to be more important than health and safety (Laurence, 2005; Rundmo & Hale, 2003; Runyan, Dal Santo, Schulman, Lipscomb, & Harris, 2006). Similarly, because some health professionals prescribe treatment without offering any rationale or support, outpatients eventually dropout from the home-based treatment because the treatments are not fully accepted or valued highly, and are perceived as obstacles to leading a normal life (Johnson, 2007; Williams et al., 2009).

These behavioural and motivational patterns in the context of health and safety highlight numerous social and personal factors that may plausibly undermine, or facilitate, the degree to which individuals follow behavioural recommendations from health professionals.

Researchers in health psychology and behavioural medicine have used a number of social psychological theories to model human behaviour in various health and safety settings (Lippke & Ziegelmann, 2008; Noar, Chabot, & Zimmerman, 2008). The most commonly used individual-level theories include the theory of reasoned action (TRA; Ajzen & Fishbein, 1980), the theory of planned behaviour (TPB; Ajzen, 1985, 1991), the health belief model (HBM; Rosenstock, 1974), social cognitive theory (Bandura, 1989, 1998), and the transtheoretical model (TTM; Prochaska & DiClemente, 1983). Self-determination theory (SDT; Deci & Ryan, 1985b), the information motivation behavioural skills model (IMB; Fisher, Fisher, Bryan, & Misovich, 2002), the precaution-adoption process model (PAPM; Weinstein & Sandman, 2002), and the health action process approach (HAPA; Schwarzer, 2008), are receiving growing amount of attention. While, each of the theories demonstrated unique power for explaining the process or mechanism of human health behaviour, theorists suggested that the total explained variance of health behaviour could be increased when combing the concepts of multiple theories (Hagger, 2010a; Lippke & Ziegelmann, 2008; Noar et al., 2008). However, due to the use of similar or common variables by different social psychological theories applied in health contexts, and the surface-level incompatibility of the premises and hypotheses of these theories, there has been lack of consensus about in what ways multiple health theories may work together to bring forth a better predictive power and a more complete understanding the health and safety actions (Chan & Hagger, 2012d; Hagger, 2010a; Lippke & Ziegelmann, 2008; Noar et al., 2008).

A recent trend in the literature on the application of social psychological theories to predict and explain health behaviour is the adoption of an evidence-based integrated approach that involves the integration of multiple theories that provide complementary explanations of behaviour (Hagger, 2009b; Hall, 2010; Kok, Schaalma, Ruiter, Van Empelen, & Brug, 2004; Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Michie, Rothman, & Sheeran, 2007).

Research adopting an evidence-based multi-theory approaches often leads to better prediction, in terms of variance explained, of health behaviour but, most importantly, demonstrates how one theory may assist in addressing the shortcomings of another and reveal a more effective and comprehensive explanation of the psychological processes that lead to health behaviour (Chan & Hagger, 2012d; Hagger & Chatzisarantis, 2009b). Nevertheless, an evidence-based theoretical integration must be performed systematically; researchers aiming to use theoretical integration need to pay keen attention to remaining true to the hypotheses of the component theories and to base their integration on evidence and logical derivation. Simply combining the concepts of from different theories presents an element of risk of including overlapping constructs or potential dissonance between the constructs from the component theories (Hagger, 2009b; Lippke & Ziegelmann, 2008; Noar & Zimmerman, 2005). It is important that researchers and practitioners fully articulate the theoretical assumptions and evidence for the integration of theories so that the integrated model offers a more precise and complete understanding of the motivational process of the health behaviour (Hagger, 2009b; Orbell, Hagger, Brown, & Tidy, 2006). This is one of the key prerequisites for successful theoretical integration (Hagger, 2009b, 2010a).

The present thesis is fundamentally based on a theoretical integration of SDT and the TPB, which has received strong support from published theoretical rationales and empirical evidence (Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, & Biddle, 2002a; Hagger, Chatzisarantis, & Harris, 2006). Adopting an organismic and dialectical perspective, SDT specifically recognises the innate human predisposition towards psychological growth, mastery of challenges, and the integration of intrapersonal and interpersonal experiences into a coherent sense of self (Deci & Ryan, 1985b, 2002), which is unique when compared to other health psychology theories (e.g., HBM, TTM). The TPB on the other hand, is a leading social cognitive theory of intentional behaviour that combines the strengths of its predecessor,

the theory of reasoned action (Ajzen & Fishbein, 1980), and the social cognitive theory (Bandura, 1998). The TPB has been thoroughly researched in numerous health domains (Armitage & Conner, 1999, 2001; Hagger, Chatzisarantis, & Biddle, 2002b; McEachan, Conner, Taylor, & Lawton, 2011), and is believed to be effective in identifying and modeling the proximal predictors of behaviour such as attitude, self-efficacy, and intention (Godin, Belanger-Gravel, Eccles, & Grimshaw, 2008; Noar et al., 2008), that are also highlighted in other social psychological theories adopted in health psychology (e.g., TTM, HAPA, IMB, HPB; Fisher et al., 2002; Prochaska & DiClemente, 1983; Rosenstock, 1974; Schwarzer, 2008).

The theoretical integration in the current thesis is derived from the concepts of these two prominent social psychology theories, namely, SDT (Deci & Ryan, 1985b, 2008) and the TPB (Ajzen, 1985, 1991) with a careful consideration of the strengths, limitations, and theoretical assumptions of both theories, in order to articulate a comprehensive motivational and social psychological model for the explanation of individuals' commitment and behaviour of health and safety. In the following sections, I will briefly outline the main concepts of SDT and the TPB and how the theoretical integration is derived. Alongside this I will identify the main aims of the research reported in the thesis.

Developing an Integrated Theoretical Model of Injury Behaviour. Self-determination theory (Deci & Ryan, 1985b) is recognized as a leading approach for the explanation of motivated behaviour in health-related contexts, including sport injury (Chan & Hagger, 2012d; Chan, Hagger, & Spray, 2011; Chan, Lonsdale, Ho, Yung, & Chan, 2009). In particular, SDT makes a broad distinction between autonomous and controlled motivations. Autonomous motivation is characterised by behavioural engagement for reasons of personal interest, satisfaction, enjoyment, self-initiated values, and fulfilling life goals, while controlled motivation is defined as participation in behaviour to meet external contingencies,

to avoid aversive outcomes such as shame and guilt, or to obtain conditional self-worth. According to SDT, behaviours driven by autonomous motivation are more likely to sustain than controlled motivation as autonomously motivated behaviours are perceived to be self-initiated and psychological need satisfying. Therefore, when the social environment supports the basic psychological needs of individuals within the behavioural context and provides opportunities for the individuals to develop personal endorsement and self-ownership to the behaviour, self-determined motivation (i.e., a motivational profile charactersed by high autonomous motivation and low controlled motivation) can be promoted (Standage, Gillison, Ntoumanis, & Treasure, 2012). Such social environment is known as autonomy support according to SDT, and is generally defined as the provision of choice, a meaningful rationale, and the consideration of one's opinions and feelings, whilst avoiding pressuring interpersonal communication styles (Deci, Eghrari, Patrick, & Leone, 1994; Hagger, Chatzisarantis, Hein, et al., 2007; McLachlan & Hagger, 2010). Hence, the theory has clearly demonstrated efficacy in identifying the motivational factors that underpin social behaviour and how social factors in the environment may give rise to these factors.

However, SDT has been proposed to be limited in two ways (Chan & Hagger, 2012d; Hagger et al., 2002a). First, the theory does not explicitly illustrate the proximal effect of some important belief-based social cognitive factors like the impressions, social norm, and controllability of the behaviour perceived by the individuals (Godin & Kok, 1996; Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a). Second, action plans and commitment play a major role on the actual execution of future behaviour (Gollwitzer & Brandstatter, 1997), but these processes have not been specifically addressed in SDT. Although the original outline of SDT made reference to social cognitive factors as mediators of the effects of self-determined motivation and support for self-determined motivation on intention and behaviour, these

specific processes have not been formally outlined within the theory nor have they been tested empirically within the framework of SDT.

The TPB, on the other hand is explicit in identifying and explaining the processes by which key belief-based social cognitive variables like attitudes, subjective norms, and perceptions of control, influence intentions to perform a given behaviour in the future and actual behaviour. In particular, according to the TPB (Ajzen, 1985, 1991), intention (the effort one plans to invest toward engaging in a particular behaviour in the future) is regarded as the most proximal predictor of future behaviour, but it is also proposed to be a function of three belief-based factors: attitudes (subjective evaluations of the behaviour), subjective norms (perceived social appropriateness of the behaviour), and perceived behavioural control (PBC; confidence and ability toward engaging in the behaviour). However, a limitation of the TPB highlighted in previous research (Hagger et al., 2002a) is that the origins (i.e., social and psychological antecedents) of attitude, subjective norm, and PBC are not clearly detailed within the TPB framework (Chatzisarantis, Hagger, Smith, & Phoenix, 2004).

Research applying the two theories has demonstrated that they are each effective in explaining unique variance in health behaviour, particularly physical activity (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Hagger et al., 2002b; McEachan et al., 2011), but each theory has limitations which hinder our full understanding of the psychological processes of health behaviour.

As a result, the first purpose of the current thesis is to integrate the constructs from SDT and the TPB in order to combine the strengths and compensate for the weaknesses of both theories in terms of the explanation of the intention and behaviour of health and safety compliance, such as the rehabilitation and prevention of injury. The structure of the integrated model of SDT and the TPB is based on the earlier work by Hagger and colleagues which hypothesised a nested hierarchical relationship between the SDT constructs and the TPB

variables (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a; Hagger et al., 2006). In particular, it was hypothesised in the integrated model that self-determined forms of motivation from SDT act as distal factors that exert their effects on behaviour through the mediation of the proximal factors from the TPB. In other words, the integration formalises the hypotheses of SDT with respect to the pathways by which self-determined motivation impacts beliefs regarding future behavioural engagement, and utilises the TPB to make the role of the social cognitive mediators explicit in the relationship between self-determined motivation and intentional behaviour. Such motivational consequences may improve the comprehensiveness and precision of the prediction by charting the exact pattern of effects involved in the relationships between variables from SDT and the TPB. However, the tests of this theoretical integration have primarily focused only on physical activity (Hagger & Chatzisarantis, 2009b), so there has been very little scientific evidence for the validity of the model in other health care contexts or clinical settings. Research is needed to explore the efficacy of the motivational and behavioural factors from the model to explain the salient outcomes in the prevention or recovery from illness or injury. As such, a major aim of the current research is to validate the utility of this proposed integrated model to explain behaviour in a specific health and safety context (e.g., injury prevention).

Extending the Integrated Model. In addition to the theoretical integration between SDT and TPB, the second goal of the present thesis is to utilise the hierarchical model of motivation (HMM; Vallerand, 1997; Vallerand, 2000) to address how the perceived social environment (e.g., autonomy support from coaches) and behavioural patterns (e.g., motivation in sport) in daily life are related to the motivational and social cognitive factors associated to health and safety actions (e.g., motivation for sport injury prevention). According to HMM, motivational orientations from SDT operate at three levels of generality: specific, contextual, and global) and are presumed to be inter-connected (Vallerand, 1997, 2000). The hierarchical

model of motivation may therefore, present a feasible theoretical explanation to the potential "trans-contextual effect" between the psychosocial and motivational pattern in a general behavioural context (e.g., work) and the corresponding pattern regarding health and safety action within the context (e.g., occupational injury prevention).

The key reason to take individuals' general motivational pattern (e.g., motivation at work and in other life domains) into account when studying the psychological antecedents of health behaviours is that many health risks are closely associated with individuals' lifestyles (Courtenay, 2000; Davies & McColl, 2002). For instance, in sport, there is a considerable amount of evidence regarding the inhibiting effect of an emphasis on winning and performance in the sporting culture on athletes' personal acceptance and values applied to safety, injury prevention and rehabilitation in sport (Curry & Strauss, 1994; Howe, 2004; Roberick & Waddington, 2000). Likewise, the occupational health literature also documents similar effects. For example, workers and managers in some outcome-oriented workplaces believe that occupational injury prevention is not as important as productivity (Laurence, 2005; Rundmo & Hale, 2003). Thus, the general motivational orientations in daily life or working environments and the motivational patterns for the health and safety action might be closely related. Nevertheless, most social psychological and behavioural research focus on single health-related contexts (e.g., Chatzisarantis et al., 2003; Hardeman et al., 2002), very few empirically have taken trans-contextual approach to test whether general motivational orientations in life domains (e.g., self-determined motivation for work) may direct the formation of the motivational and social cognitive patterns of health and safety.

Previous studies have indeed examined the trans-contextual effect of motivation in the promotion of physical activity among primary school students, and it has been consistently shown that students' motivational orientation in physical education is related to their motivational and behavioural patterns in leisure time physical activity (Hagger,

Chatzisarantis, et al., 2009). Applying such trans-contextual process of motivation in health and safety may infer that motivation in a general life or work domains may transfer into motivation for health and safety actions. As such, supporting adaptive motivational orientations (i.e., self-determined motivation) might not only predict behavioural outcomes (i.e., behavioural persistence) in a given context, but also contribute to individuals' motivation, beliefs, and behavioural patterns regarding health and safety (e.g., rehabilitation following an occupational related health issue). The second purpose of the thesis is to integrate the concepts of HMM into the integrated model of SDT and TPB, in order to examine if social environments (e.g., autonomy support from instructors) and motivational orientation (e.g., work motivation) in daily life are transferred into individuals' motivation and cognitions toward health and safety.

Furthermore, the trans-contextual model also features the integration between SDT and TPB and has been tested in the context of transferring self-determined motivation from a physical education context to a leisure-time physical activity context (Hagger, Chatzisarantis, et al., 2009). Therefore, the full hypothesised model in my thesis will begin with the trans-contextual effect of self-determined motivation from a general life domain to a specific domain, namely, self-determined motivation for health and safety (*tenet 1*). I will then focus on the effect of self-determined motivation for health and safety on behaviour and test the hypothesised mediation of this effect by the social cognitive variables from the TPB, namely, attitude, subjective norm, and PBC, as well as intentions, toward future health and safety actions (*tenet 2*). Figure 1.1 outlines the hypothesised model and the corresponding tenets in the thesis.

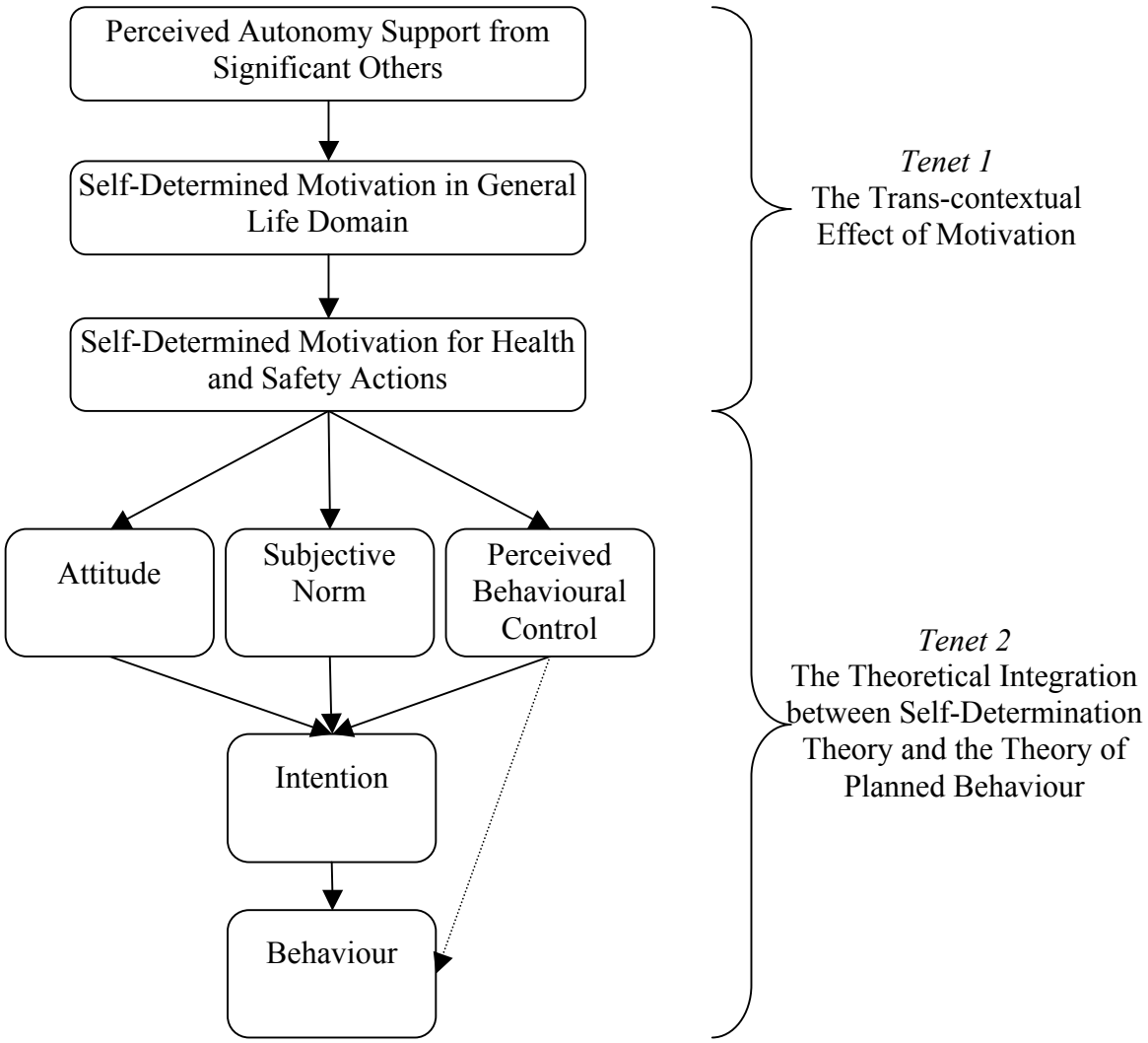

Figure 1.1 The hypothesised model in the thesis.

Research Plan

In this thesis, a total of eight studies were employed to test the two core tenets of the integrated model of SDT, TPB, and HMM across various health contexts, including sport injury, occupational injury, and myopia prevention, contexts in which there have been no previous applications of the model. These studies were presented as five related research chapters (Chapters 2 to 6) in the current thesis (see Table 1.1 for a summary).

The first chapter (Chapter 2) reports retrospective (Study 1) and cross-sectional (Study 2) studies examining the first tenet of the integrated model regarding the trans-contextual effect of motivation (derived from SDT and HMM) from a sport-related context (i.e., self-determined motivation in sport) to a sport injury rehabilitation context (i.e., self-determined motivation for sport injury rehabilitation). Apart from this core theoretical component, the chapter also introduces measures of motivational (i.e., perceived autonomy support from coach and physician) and personality (i.e., general causality orientation) factors according to SDT and HMM to test their relative roles in the trans-contextual model in Study 2. The sample of Study 1 was recreational level athletes, and that of Study 2 was elite athletes.

The second chapter (Chapter 3) presents two cross-sectional studies (Studies 3 and 4) that examined the second tenet of the thesis about the theoretical integration between SDT and TPB in two related health settings. The two studies were set to test the process by which self-determined motivation predicted intention of health and safety actions through the mediation of the TPB variables. Specifically, Study 3 tested the model regarding sport injury rehabilitation (Study 3) and Study 4 examined the model for sport injury prevention (Study 4). Participants in both studies were elite athletes, and they completed measures of self-determined motivation based on SDT and attitude, subjective norm, PBC, and intention based on the TPB.

The third chapter (Chapter 4) documents a cross-sectional study (Study 5) that replicated the test of the first tenet of the model (i.e., the trans-contextual effect of motivation) in an injury prevention context of elite sport with the inclusion of behavioural adherence and safety beliefs as outcome variables. The study also provided a preliminary examination of basic need satisfaction (derived from SDT) in the trans-contextual effect of motivation. In particular, I examined whether basic need satisfaction in sport would exert a positive effect on self-determined motivation of sport injury prevention through the mediation of self-determined motivation in sport. The sample was identical to that of Study 4 but used unanalysed data to test the proposed hypotheses.

The fourth chapter (Chapter 5) describes cross-sectional (Study 6) and retrospective (Study 7) studies to further test the first and second premises of the model within an occupational injury setting. In particular, the aim of the study was to examine whether autonomous motivation for work (i.e., high self-determined motivation for work) was associated with autonomous motivation for occupational injury prevention (Study 6) and rehabilitation (Study 7). Study 6 examined both tenets of the thesis among police officers. Study 7 utilised the first premise of the model (i.e., the trans-contextual effect of motivation) to predict the treatment adherence and recovery length of occupational injury, among a subset of the police officers from Study 6 who had reported recent occupational injuries.

The fifth chapter reports a prospective study (Study 8) that aimed to apply the second tenet of the integrated model to predict future engagement of a health behaviour (i.e., 'near work' indicated by reading distance) when controlling for its associated clinical function (i.e., visual acuity) within the context of myopia prevention. The primary objective of this final study was to not only to test the second tenet of the model in a new health context, but also to overcome the limitations of Studies 1 to 7 for their cross-sectional designs and the use of self-reported method in the measurement of behaviours. Undergraduate students with heavy

demand of near work (i.e., working in close proximity to reading material such as paperwork or computer displays) in their daily life completed reading distance and visual acuity tests in the laboratory one month after their completion of the psychometric measures of the integrated model of SDT and TPB regarding myopia prevention.

Table 1.1 Overview of all studies in the thesis

Overview of all studies in the thesis

	Study	Tenet(s) Tested	Health Domain	Theoretical Component(s) in Additional to the Tenet(s) Involved	Dependent Variable(s)
Chapter 2	1	1	Sport injury rehabilitation	None	Motivation for sport injury rehabilitation
	2	1	Sport injury rehabilitation	Perceived autonomy support from physiotherapist General causality orientation	Intention for sport injury rehabilitation
Chapter 3	3	2	Sport injury rehabilitation	None	Intention for sport injury rehabilitation
	4	2	Sport injury prevention	None	Intention for sport injury prevention
Chapter 4	5	1	Sport injury prevention	Basic psychological need satisfaction	Adherence and beliefs of sport injury prevention
Chapter 5	6	1, 2	Occupational injury prevention	Perceived autonomy support from supervisor	Intention of occupational injury prevention
	7	1	Occupational injury rehabilitation		Adherence of occupational injury rehabilitation
Chapter 6	8	2	Myopia prevention	Perceived autonomy support from significant others Visual acuity (clinical function of behaviour)	Reading distance

Chapter 2

Treatment Motivation for Rehabilitation after a Sport Injury: Application of the Trans-Contextual Model

(Studies 1 and 2)

A version of this Chapter is published as:

Chan, D. K. C., Hagger, M. S., & Spray, C. M. (2011). Treatment motivation for rehabilitation after a sport injury: Application of the trans-contextual model. *Psychology of Sport and Exercise, 12*, 83-92.

Overview of Chapter 2

In order to test the first premise of the thesis (i.e., the trans-contextual effect of motivation; *tenet 1*), the two studies reported in this chapter (see Chan, Hagger, & Spray, 2011) employed the trans-contextual model (TCM; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003) to understand the relationships between sport motivation, treatment motivation, and autonomy support. Study 1 tested TCM among recreational athletes, while Study 2 examined the effects of causality orientations and autonomy support from coaches in the TCM among professional athletes.

In Study 1, recreational athletes (N = 115) with ruptured anterior cruciate ligaments completed questionnaires measuring sport motivation, autonomy support from physiotherapists, and treatment motivation for injury rehabilitation. In Study 2, professional athletes (N = 206) with experiences of moderate to severe sport injury completed questionnaires assessing sport motivation, general causality orientation, autonomy support from coaches and physiotherapists, and treatment motivation and treatment intention based on a hypothetical injury scenario.

The results generally supported the first premise of the thesis. In Study 1, autonomous sport motivation (high self-determined motivation) and controlled sport motivation (low self-determined motivation) formed positive associations with autonomous and controlled treatment motivation, when controlling for the effect of autonomy support from physiotherapists. In Study 2, the relationship between sport motivation and treatment motivation corroborated findings of Study 1. In addition, autonomy orientation formed positive associations with autonomous sport and treatment motivation and autonomy support from coaches and physiotherapists. Controlled orientation positively predicted controlled

sport and treatment motivation. Autonomy support from physiotherapists, instead of that from coaches, positively predicted autonomous treatment motivation.

Hence, the trans-contextual transfer of motivation is supported in the motivational patterns between sport and treatment contexts. Athletes with higher autonomous motivation in sport may be more likely to be autonomously motivated in their rehabilitation when injured. This chapter fits in with the global aim of the overall thesis by providing initial support for a key hypothesis within the model of motivation adopted to test the trans-contextual effect of motivation on health and safety behaviours (*tenet 1*; see Figure 1.1). In particular, it demonstrates that motivation in one context (i.e., sport) transfers to a related but distinct context (i.e., treatment) and paves the way to investigate a more complete model adopting multiple social-cognitive and motivational theories to explain motivation toward health and safety behaviours. This is important as it provides evidence for an overall integrated process model for the motivational factors that influence health and safety behaviours.

Introduction

Sport injury (e.g., musculoskeletal and soft tissue injuries) appears to be a fact of life that frequently occurs in sport participants of all levels of expertise (Conn, Annest, & Gilchrist, 2003; Schneider, Seither, Tonges, & Schmitt, 2006). Such injuries not only lead to time-out from sport but also increase the likelihood of re-injury (Knowles et al., 2006). Proper rehabilitation therefore is essential to enhance recovery and prevent further injury. However, not all sport participants with injuries completely adhere to prescribed treatment by rehabilitation specialists such as physiotherapists and sport injury experts. Poor treatment adherence and dropout from treatment protocols among sports participants who require clinic-based or home-based physical therapy have often been reported (Bassett & Prapavessis, 2007; Sluijs, Kok, & van der Zee, 1993). While an increasing amount of evidence suggests that motivation to undertake rehabilitation is a critical factor to determine the treatment adherence of outpatients (Chan et al., 2009; Hagger, Chatzisarantis, Griffin, & Thatcher, 2005; Ryan et al., 2008; Williams, 2002), very few studies have examined the motivational factors in the context in which the injury has taken place. Therefore, the current study aims to apply a theory-based integrated model of motivation, the trans-contextual model (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005), to examine the relationships between sport motivation, treatment motivation, and treatment adherence.

The Trans-Contextual Model

The trans-contextual model (TCM) is an integrated social cognitive and motivational theory that explains the transfer of motivation from one context (e.g., physical education (PE) context) to another (related) context (e.g., leisure time physical activity; Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). It is fundamentally based on a contemporary theory of

motivation, *self determination theory* (SDT; Deci & Ryan, 1985b), which posits that human behaviour is governed by the reasons individuals assign to actions. These reasons are known as motives, or *behavioural regulations*. When an action is executed because it is felt as self-initiated, personally important, and coherent with one's deeply-rooted values, according to SDT, the action is regulated by self-determined or *autonomous* motivation. In contrast, SDT also identifies non-self-determined or *controlling* forms of motivation which are generally characterized by performing behaviours for reasons perceived as external to the individual. Individuals who cite these kinds of reasons for acting feel coerced or pressured by interpersonal or intrapsychic forces to act. Autonomous motivation is important because it is linked to optimal self-regulation of behaviour (Hagger, 2010c, in press; Hall, 2010). Individuals with high autonomous motivation toward a particular behaviour or activity are more likely to evidence adaptive behavioural responses (e.g., persistence) and psychological well-being as it is coherent with humans' active nature and the tendency towards growth and development (Deci & Ryan, 1985b; Ryan & Connell, 1989). This is very important for those interested in promoting individuals to persist with behaviour and supportingself-regulation in the absence of persuasion or external contingencies (e.g., Chatzisarantis et al., 2004; Hagger, Wood, Stiff, & Chatzisarantis, 2009, 2010; Orbell, 2004; Orbell & Hagger, 2006), such as coaches and physiotherapists trying to get their athletes to adhere to treatment and promote their return to sport.

The primary hypothesis of TCM is that the perceived autonomy support from a significant social agent (e.g., a PE teacher) exerts an influence on an individual's autonomous motivation in one context, but also indirectly on the autonomous motivation in another related context (Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2003). This trans-contextual influence of perceived autonomy support is established by the association between autonomous motivation toward two closely-

related actions, or a single behaviour, in the two contexts. The TCM received initial support in research among high school PE students in the UK (Hagger, Chatzisarantis, et al., 2003), confirming the associations between autonomy support from the PE teacher, students' autonomous motivation in PE and autonomous motivation in leisure-time physical activity. Recently, further evidence in PE from Singapore, Estonia, Hungary, Finland, and Greece supports the robustness of the TCM across different countries from diverse cultures (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009). The model has been replicated in sport and physical education contexts (Barkoukis & Hagger, 2009; Barkoukis, Hagger, Lambropoulos, & Tsorbatzoudis, 2010; Pihu, Hein, Koka, & Hagger, 2008; Wallhead, Hagger, & Smith, 2010), including laboratories independent of the original researchers (Mata et al., 2009; Shen, McCaughtry, & Martin, 2007, 2008). The cross-cultural validity of the TCM and other strong supporting evidence leads us to speculate that the principles of TCM apply in other related areas. We speculate that the TCM may also be applicable in explaining the relationship between sport motivation and treatment motivation for sport injury.

Operationalization of the TCM

The TCM is not applicable only to PE and leisure-time physical activity contexts, but also to others such as rehabilitation of sport injury, and the reasons can be revealed by understanding the mechanism behind the model. According to Hagger and colleagues (2003), the trans-contextual process of motivation is derived from the *hierarchical model of motivation* proposed by Vallerand (1997, 2000). Vallerand's model proposed that motivational dynamics are represented within individuals at three inter-connected levels of generality: global, contextual, and situational. The connections between these three levels

provide explanations for the mechanisms underlying the transfer of motivation between two contexts (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2003).

Motivation at the situational level refers to the motivation toward a specific behaviour in a given context and time. For instance, if an individual exercises for the enjoyment of physical activity, it is quite likely that the exercise behaviour of this individual is driven by autonomous motivation from time to time (i.e., when physically injured). However, exercise, to him/her, may be decomposed into many sub-components, such as warm-up, strength training, and recovery, in which the motivation for these sub-components is also likely to be autonomous. In that sense, if effective rehabilitation after sport injury is considered as a way to continue doing sport in the future, the association of motivational constructs between sport and rehabilitation may be established because treatment behaviour is considered a sub-component of physical activity, and so the motivational constructs in both contexts are likely account for the formation of treatment intention in the TCM.

Motivation at the contextual level refers to how people regulate behaviour in a given context, so it is heavily influenced by perceptions of autonomy support in that context. Thus, the transfer of motivation could be instigated by significant others who exert consistent autonomy support in both contexts in the TCM. In other words, if a sport participant perceives significant social agents in the sport environment (e.g., coaches, trainers) are autonomy supportive, not only are they likely to have high levels of autonomous motivation toward their sport, but they are also likely to have high autonomous motivation in a related context such as rehabilitation from injury. This is clearly adaptive as autonomous motivation in a rehabilitation context will likely assist injury recovery and prevention and facilitate continued participation in sport, a context in which the athlete gains satisfaction and enjoyment. This effect would be independent of the effect of autonomy support from significant others in the

rehabilitation context. Apart from these possibilities, the link between motivation in sport and rehabilitation contexts can also derive from motivation at the global level.

The apex of Vallerand's hierarchical model represents the *global level* of motivational determinants, which reflects individuals' generalized disposition to behave or perceive actions and environments as autonomous across a number of contexts (Hagger, 2009a; Hagger, Biddle, Chow, Stambulova, & Kavussanu, 2003). Motivation at this global level is consistent with the generalized trait characteristic proposed by SDT (Deci & Ryan, 1985a) known as *general causality orientation*s. According to Deci and Ryan (1991), individuals who rate autonomy orientation highly have a tendency to adopt self-determined reasons for action and behave according to their personal goals and interests. Individuals who rate controlled orientation highly are prone to adopting non-self-determined reasons for action and tend to behave because they feel obliged to or due to external demands (e.g., salary, deadlines). As a result, these orientations exert dispositional and distal influences on self-determined motivation in different contexts. Such motivational orientations affect motivation at the contextual level for a number of different behaviours. As suggested in the previous section, causality orientation may also influence people's autonomous motivation (Deci & Ryan, 1991). Therefore, an autonomous causality-oriented athlete who perceives his/her coach to be autonomy supportive, may also be likely to perceive his/her physiotherapist to be autonomy supportive when injured, resulting in the adoption of similar self-determined motivation in sport and rehabilitation contexts.

Research on Treatment Motivation

Research findings in previous studies are consistent with the TCM in the view that autonomy support and autonomous motivation are strongly linked to treatment adherence in a number of health care contexts, such as smoking cessation programs (Williams, McGregor,

Sharp, Levesque, et al., 2006), treatment of chest pain (Williams, Gagné, Mushlin, & Deci, 2005), drug-addiction (Zeldman, Ryan, & Fiscella, 2004), weight management (Williams, Grow, Freedman, Ryan, & Deci, 1996), rehabilitation for cancer survivors (Milne, Wallman, Guilfoyle, Gordon, & Courneya, 2008), and exercise programs for heart disease patients (D'Angelo, Reid, & Pelletier, 2007). A recent study by Chan, Lonsdale, Ho, Yung, and Chan (2009) also yielded consistent findings in the context of home-based physiotherapy treatment among sport-injured patients. The results suggested that when patients perceived their physiotherapists to be autonomy supportive they were autonomously motivated with respect to their rehabilitation and were more likely to adhere to their treatment. However, these studies only investigated the influence of autonomy support and motivation within a single context. No attempt has been made to test the influence of autonomy support and motivation from another context related to treatment adherence.

Nevertheless, a few studies have examined the influence of patient's causality orientation on treatment motivation. Autonomy orientation has been positively linked to autonomous treatment motivation of overweight patients (Williams et al., 1996), and completion of treatment among chest pain patients (Williams, Gagné, et al., 2005). However, these studies did not formally examine the nested relationships between causality orientation, perception of autonomy support, and treatment motivation.

The Present Study

In summary, the current literature on rehabilitation from sport injury has not tended to provide a comprehensive account of the mechanisms by which motivation between contexts and levels of generality are inter-connected in the context of treatment and rehabilitation from sport injuries. The present investigation aims to apply the TCM to understand the motivational dynamics of rehabilitation for physical injury among people who had been

injured in sport for various reasons. In the two studies presented here, we recruited samples of participants involved in recreational and professional sport whose reasons and motives for doing sport were likely to be substantially different. For example, we expected the professional sports performers to exhibit more extrinsic motives due to the heightened extrinsic rewards system and external pressures that are present in professional sport (Hagger & Chatzisarantis, 2005). We contend that the TCM for treatment motivation would hold regardless of individual differences in sport expertise and participation level and background.

In Study 1, we examined the effect of sport motivation on treatment motivation (i.e., the trans-contextual process) among recreational sport participants who ruptured their ligaments in sport. This initial study was carried out as an attempt to explore the relationship between sport motivation and treatment motivation while controlling for the effect of autonomy support from physiotherapists. It was hypothesised that autonomous sport motivation would form a positive association with autonomous treatment motivation with an equal or higher magnitude of that of autonomy support from physiotherapist, whereas sport controlled motivation was expected to form a positive association with controlled treatment motivation.

In Study 2, we tested the effects of causality orientation and autonomy support from significant others on the trans-contextual transfer of motivation among professional sport participants who had experienced a variety of sport injuries. It was hypothesised that autonomy orientation would form positive relationships with autonomous sport motivation, autonomous treatment motivation, and autonomy support from significant others (physiotherapist and coach). In contrast, controlled orientation was expected to be positively associated with controlled sport motivation and controlled treatment motivation, and negatively related to, or have a non-significant relationship with, autonomy support from significant others (physiotherapist and coach). We also proposed another hypothesis based on the proposition that autonomy support from coach would form positive relationships with

autonomous sport motivation and treatment motivation. In addition, we further tested the effects of treatment motivation on treatment intention using a hypothetical injury scenario related to professional athletes. Based on the findings of Chan et al. (2009), it was hypothesised that intentions to engage in treatment for injury would be positively predicted by autonomous treatment motivation and negatively predicted by controlled treatment motivation.

Study 1

Method

Participants. A total of 115 recreational-level athletes who ruptured their anterior cruciate ligaments (ACL) in sport were recruited from an orthopaedic clinic of a local hospital in Hong Kong. The sample consisted of 94 males (mean age = 27.05, *SD* = 3.99) and 21 females (mean age = 23.38, *SD* = 4.01). They completed ACL reconstruction and were subsequently undergoing rehabilitation for more than six months (range = 0.50 to 3.00 years; mean interval = 1.77, *SD* = 0.80 years). Before their ACL injuries, athletes participated in a variety of sports such as association football (54.40%), basketball (28.10%), volleyball (4.30%), and athletics (4.40%), for an average of 8.48 years (*SD* = 6.91), and they experienced ACL ruptures during training or competition. They only had ACL reconstruction once and did not receive any follow-up or subsequent surgical treatment on their knees.

Procedures. Ethical approval was obtained from The Chinese University of Hong Kong's Research Ethics Committee (REC) prior to data collection. Participants were fully informed of the procedures of the study and their rights (i.e., voluntary nature of participation, confidentiality of data, and freedom of withdrawal). They signed the consent form to indicate they understood these points before completing a 15-minute long questionnaire concerning their sport motivation, treatment motivation, and the perceived autonomy support from their

physiotherapists. The items and instructions of the questionnaires were translated in to Chinese under the guidelines developed by the International Test Commission (Hambleton, 2005).

Measures

Sport motivation. The Behavioural Regulation in Sport Questionnaire (BRSQ; Lonsdale, Hodge, & Rose, 2008) was used to assess participants' sport motivation. BRSQ is a 24-item questionnaire comprising three dimensions for autonomous motivation (intrinsic motivation, integration, identification) and three dimensions for controlled motivation (introjection, external motivation, amotivation)[1]. Participants were asked to reflect on how the items corresponded to their reasons for doing sport and give their responses on seven-point Likert-scales with anchors ranging from 7 (very true) to 1 (not true at all). The Cronbach's alphas of the six dimensions ranged from .74 to .90, and the alphas for the aggregate autonomous (α = .93) and controlled sport motivation (α = .89) scales were high, supporting the internal reliability of BRSQ (see Appendix A for example items for each dimension of BRSQ).

Autonomy support from physiotherapist and treatment motivation. To assess autonomy support from physiotherapists, we used the Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) . The HCCQ is a unidimensional questionnaire that measures the degree to which patients perceive their specific medical care providers are autonomy supportive (Williams et al., 1996). The full version (15 items) HCCQ (α = .93) was used in this initial study. The Treatment Self Regulation Questionnaire (TSRQ; Williams et al., 1996) measures self-determined motivation to start or continue health promoting behaviours (Williams, Gagné, et al., 2005; Williams et al., 1996; Williams, McGregor, Sharp, Levesque, et al., 2006). In this study, we adopted the version used by Williams et al. (1996) to measure the motivation to follow a long term rehabilitation program. The questionnaire measures two

[1]Following Ryan and Connell's suggestion that behavioural regulations could be categorized into two styles of

dimensions: autonomous regulation (α = .73; 5 items) and controlled regulation (α = .81; 8 items). Both scales showed adequate internal reliability in this study, as they did in previous studies (see Appendix A for example items from the TSRQ and the physiotherapy-version HCCQ).

Data analysis. In order to test the hypothesised relationships between sport motivation and treatment motivation, structural equation modeling (SEM) was conducted using the EQS 6.1 computer program (Bentler, 2004). Two incremental fit indices, the comparative fit index (CFI) and Tucker-Lewis index (TLI, also known as non-normed fit index), and two absolute fit indices, the root-mean square error of approximation (RMSEA) and standardized root-mean square residual (SRMR), were adopted to evaluate the goodness-of-fit of the proposed model to the data. Values greater than .90 for the CFI and TLI are usually considered acceptable (Bentler, 1990), but Hu and Bentler (1999) proposed a more stringent .95 criterion, so we considered this value as an indicator of good fit. Values of .08 or less for the RMSEA and SRMR indicate adequate fit (Hu & Bentler, 1999). SEM analysis typically requires a relatively large sample size to yield acceptable statistical power (.80), so we estimated the statistical power for all of the SEM models (MacCallum, Browne, & Sugawara, 1996). For this initial study, the hypothesised model is depicted in Figure 1. In the model, autonomous treatment motivation and controlled treatment motivation were the two endogenous latent factors predicted by the (exogenous) latent factors of autonomous sport motivation, controlled sport motivation, and autonomy support from physiotherapists. Additionally, we freely estimated the correlations between the disturbances of the two endogenous variables and between the three exogenous variables.

Results

Mardia's normalized kurtosis coefficient, an indicator of multivariate non-normality was 6.23, higher than the criterion figure recommended by Byrne (1994). Therefore we used a robust maximum likelihood estimation method for our SEM analysis to protect the model from any violations of the assumption of multivariate normality (Satorra & Bentler, 1988). Goodness-of-fit indices revealed that the proposed model fit the data well (Satorra-Bentler χ^2 = 80.418, df = 55; CFI = .960; TLI = .944; RMSEA = .086; SRMR =.062) and obtained very good statistical power of .95.

In line with our hypotheses, autonomous sport motivation (β = .46, p < .01) and controlled sport motivation (β = .48, p < .01) formed positive associations with autonomous treatment motivation (R^2 = .45) and controlled treatment motivation (R^2 = .26), respectively, after controlling the effects of perceived autonomy support from physiotherapists. Moreover, perceived autonomy support from physiotherapists predicted autonomous treatment motivation positively (β = .19, p < .05), with a magnitude lower than sport autonomous motivation, but did not predict controlled treatment motivation. In contrast with predictions, the effect of controlled sport motivation on autonomous treatment motivation (β = .28, p < .01) was significant, although the magnitude was smaller than that of autonomous sport motivation (see Figure 2.1).

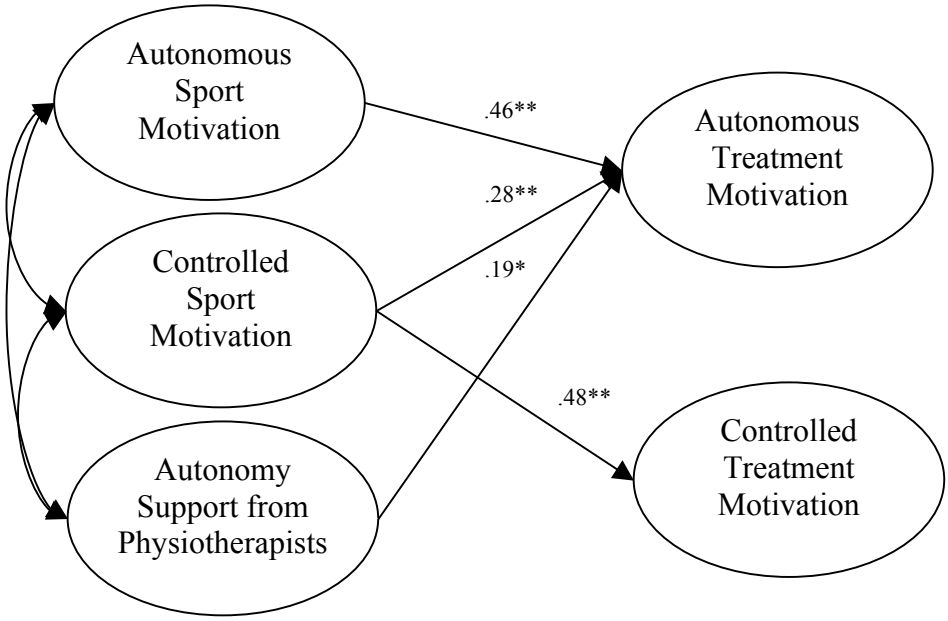

Figure 2.1 Path estimates in the model from Study 1.

Non-significant paths, indicators and disturbances (D) of the latent variables, and the correlations between Ds are not shown in this figure. The omitted paths, autonomous sport motivation → controlled treatment motivation (β = .03), autonomy support from physiotherapists → controlled treatment motivation (β = -.06), were not significant $p > .05$ for a one-tailed test.

* $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test.

Discussion

Consistent with our hypothesis, results revealed that sport motivation was closely related to treatment motivation after the occurrence of a severe sport injury. Individuals who reported more autonomous reasons for doing sport were more likely to undergo treatment for sport injury because they personally viewed treatment as important, beneficial to recovery, and a challenge they would like to accomplish. In contrast, those who reported more controlled reasons in sport were more likely to undertake treatment of physical injuries because they felt that the treatment was compulsory and *must* be done. The positive association between controlled sport motivation and autonomous treatment motivation may be because sport participants who regulate their sporting behaviour for controlled reasons are also highly motivated to participate in sport, so they are therefore more likely to consider the treatment of sport injury as important and meaningful in order for them to return to their sport.

Study 2

Method

Participants. Full time athletes (N = 298) from Sichuan province of China voluntarily participated in this study. As the study was concerned with personal rehabilitation experiences of moderate to severe sport injuries, data from the athletes who had experienced sport injuries with less than two weeks of recovery were excluded from the study. The final sample comprised 206 elite athletes (males, n = 98; females, n = 108; mean age = 24.75, *SD* = 4.13) from a wide range of sports including athletics (32%), football (19.4%), basketball (9.2%), volleyball (8.3%), swimming (7.3%), canoeing (5.3%), and others (18.5%; e.g., cycling, gymnastics). Athletes were regional-level (31.1%), national-level (61.6%), or international-level (3.9%) performers who received professional training for an average of 6.88 (*SD* = 3.97) years. Regarding their personal experience of the most severe sport injury, they reported

having a history of either muscular injury (19.4%), skeletal injury (29.1%), ligament injury (30.6%), and other types of injuries (14.7%) from sports with recovery periods ranging from 3 weeks to 25 months (mean = 2.71 months, *SD* = 3.82). Injured athletes consulted regularly with a personal physiotherapist (mean years spent with the athlete = 3.24, *SD* = 2.88) responsible for providing them with physiotherapy treatment. We followed identical REC approval, informed consent, and translation procedures to those implemented in Study 1.

Procedures and measures. Six months preceding the National Games of China, participants were asked to complete a questionnaire which consisted of BRSQ (sport motivation) used in Study 1, and a battery of psychological measures.

Personality. The General Causality Orientation Scale (GCOS; Deci & Ryan, 1985a) was used to assess the autonomy orientation and controlled orientation of individuals. The original scale has three subscales (autonomy, controlled, and impersonal orientations) and consists of 12 vignettes and 36 items. Participants rated the degree to which they felt the three responses in the hypothetical social situation of each vignette, corresponding to the three types of motivational orientations, were typical for them, on seven-point Likert scales with "very unlikely" (1) and "very likely" (7) as anchors. This scale yielded satisfactory internal reliability and test-retest reliability in the original validation study of Deci and Ryan (1985a). The psychometric properties of the Chinese version of GCOS were also supported in a study among Taiwan Chinese athletes (Wu & Hwang, 2000). In the present study, we only included the items of autonomy orientation ($\alpha = .73$) and controlled orientation ($\alpha = .69$), and their internal reliabilities were both satisfactory (see Appendix A for example items of the GCOS used in Study 2).

Autonomy support and treatment motivation. The TSRQ and the short version of HCCQ (6 items) used in Study 1 were used to measure participants' treatment motivation and perceived autonomy support from their coach and physiotherapist respectively. The items for

autonomy support from the coach had the same stem as the HCCQ for physiotherapists, but the subject of each item was replaced by 'coach'. Previous studies adopting the HCCQ to measure autonomy support in the contexts of exercise have reported good internal reliability (Hagger, Chatzisarantis, et al., 2003). The internal reliability for the HCCQ for the coach (α = .90) and physiotherapist (α = .85) was also satisfactory (see Appendix A for example items of the coach-version HCCQ).

Treatment intention. Two items were developed based on a previous study of rehabilitation adherence after sport injury (Chan et al., 2009) to measure the degree to which participants intended or planned to follow the prescribed rehabilitation recommendation in the forthcoming month according to the hypothetical sport injury scenario. The item construction followed Ajzen's (1985, 2002) guidelines for the measurement of behavioural intention from the Theory of Planned Behaviour. The participants responded to the following items: "I intend to carry out the rehabilitation exercises recommended by my physiotherapist over the forthcoming month" and "I will try to exert effort in doing the rehabilitation exercises recommended by my physiotherapist over the forthcoming month" using seven-point Likert scales with anchors ranged from "strongly agree" (7) to "strongly disagree" (1). The inter-item correlation was .82 supporting the internal reliability of the scale.

Injury scenario. Participants first completed the HCCQ and GCOS, and were then asked to respond to the TSRQ and treatment intention items based on a hypothetical sport injury situation. The athlete (in the scenario) was injured in a training session one month before an important competition and experienced an increasing sensation of pain due to the injury over time (see Appendix B for the script). The athlete was recommended by his/her physiotherapist to suspend all training and begin treatment and rehabilitation. The scenario was carefully designed to tap participants' experiences based on typical sport injury narratives which commonly occur in elite athletes.

Analysis. Consistent with Study 1, SEM using a robust maximum likelihood method was employed to examine the fit of the proposed model and generate path estimates among the variables in Study 2. Based on the findings of Chan et al. (2009) and our first study, we built our hypothesised model as follows (see Figure 2.2)[2]. First, treatment intention was predicted by autonomous and controlled treatment motivation. Second, the two-treatment motivational constructs were predicted by autonomous and controlled sport motivation, and autonomy support from physiotherapists. Third, the two sport motivational constructs were predicted by autonomy support from coaches. Finally, autonomous and controlled orientation predicted autonomy support from physiotherapist and coach, sport motivation, and treatment motivation. We freely-estimated correlations among the disturbances of autonomy support from physiotherapists, autonomous sport motivation and controlled sport motivation, and between the latent factors of autonomous and controlled orientation. Furthermore, we performed a series of mediation analyses (Baron & Kenny, 1986) to test if mediation effects were present in our hypothesised relationships between causality orientations, autonomy support, sport motivation, treatment motivation, and treatment intention[3].

[2]Please refer to introduction section under the subheading "The Present Study" for the direction (i.e., positive and negative) of the hypothesised effects in the model.

[3]According to Baron and Kenny (1986), full mediation is shown if (i) the direct effects of the independent variable (IV) and the mediator on the dependent variable (DV) are significant, and (ii) the strength of the relationship between the IV and DV becomes non-significant after controlling for the effect of the mediator. Partial mediation is shown if the reduced relationship between the IV and DV remains significant. Therefore, we tested the mediation effects by adding the paths which showed direct effects of IV→DV or fixing the paths of mediator→DV to zero in the structural model.

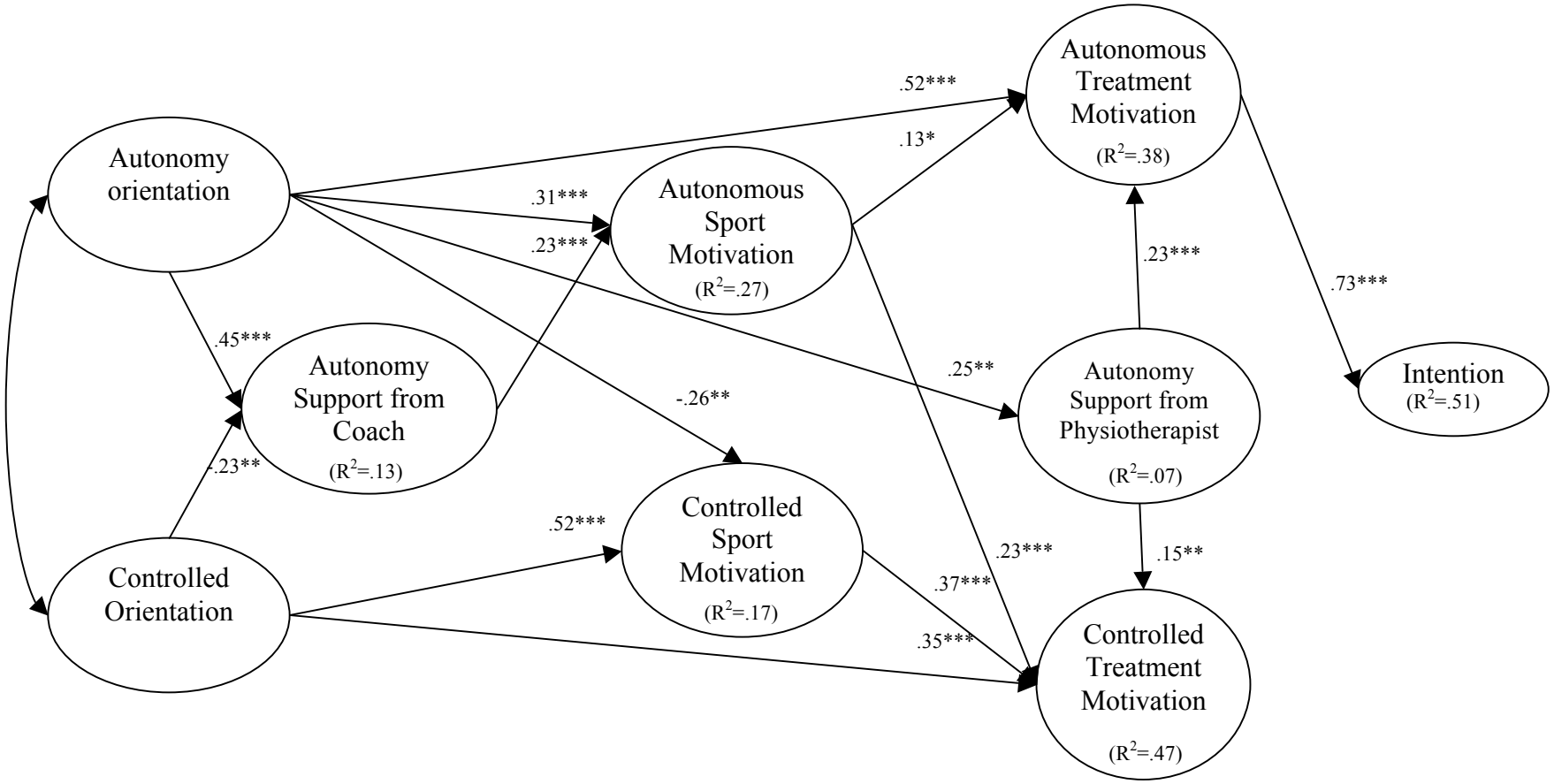

Figure 2.2 Paths estimates in the model from Study 2. Non-significant paths, indicators and disturbances (D) of the latent variables, and the correlations between Ds are not shown. The omitted paths, autonomy orientation → controlled treatment motivation (β = -.12), controlled orientation → autonomous sport motivation (β = .14)/ autonomous treatment motivation (β = -.15)/ autonomy support from physiotherapist (β = .02), autonomy support from coach → controlled sport motivation (β = -.05), controlled sport motivation → autonomous treatment motivation (β = .01), controlled treatment motivation → treatment intention (β = -.04), were not significant p > .05 for a one-tailed test. * $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test, *** $p < .001$ for a two-tailed test.

Results

The proposed SEM yielded acceptable indices of fit (Satorra-Bentler χ^2 = 562.633, df = 350; CFI = .934; TLI = .924; RMSEA = .057; SRMR =.046). Despite its complexity, the model obtained a statistical power of .81, which indicated the sample size was statistically acceptable to limit the possibility of type-II errors. The path estimates generally supported the findings of Study 1. Autonomous treatment motivation was positively predicted by autonomous sport motivation (β = .13, $p < .05$), autonomy support from physiotherapists (β = .23, $p < .01$), and autonomy orientation (β = .52, $p < .01$). On the other hand, controlled treatment motivation was predicted positively by controlled sport motivation (β = .37, $p < .01$) and controlled orientation (β = .35, $p < .01$) as expected, but it was also predicted positively by both autonomous sport motivation (β = .23, $p < .01$) and autonomy support from physiotherapists (β = .15, $p < .05$) (see Figure 2).

In line with our hypotheses, autonomy orientation was positively associated with autonomy support from the coach (β = .45, $p < .05$), autonomy support from physiotherapists (β = .25, $p < .05$), autonomous sport motivation (β = .31, $p < .05$), and autonomous treatment motivation (β = .52, $p < .05$). In addition, it was negatively related to controlled sport motivation. Similarly, controlled orientation formed positive relationships with controlled sport motivation (β = .52, $p < .05$) and controlled treatment motivation (β = .35, $p < .05$), and showed a negative relationship with autonomy support from the coach (β = -.23, $p < .05$), but its relationship with autonomy support from physiotherapists was not significant.

Autonomy support from the coach formed a positive association with autonomous sport motivation (β = .23, $p < .05$) as expected, but, inconsistent with our hypothesis, the expected relationship between coaches' autonomy support and autonomous treatment motivation was not significant. Regarding our last hypothesis, treatment intention was positively predicted by

autonomous treatment motivation ($\beta = .73$, $p < .05$) as expected, but its proposed negative relationship with controlled treatment motivation was not significant. Therefore, this hypothesis was partially supported.

Results from the mediation analyses are reported in Table 2.1 which gives the direct and combined effects of all the independent variables in the study. The effect of autonomy orientation on autonomous treatment motivation was partially mediated by autonomous sport motivation and autonomy support from physiotherapists. Further, the effect of controlled orientation on controlled treatment motivation was partially mediated by controlled sport motivation. The effect of autonomy orientation on treatment intention was fully mediated by the motivational sequence proposed in the model. In addition, autonomous treatment motivation fully mediated the effects of autonomous sport motivation and autonomy support from coaches and physiotherapists on treatment intention.

Table 2.1 Results from the mediation analyses of Study 2

Results from the mediation analyses of Study 2

Paths	Mediator(s)	Direct Effect	Combined Effects	Mediation Type
AS-Co→ATx	ASM	0.00	-0.02	None
AO→ATx	AS-Phy, ASM, CSM[a]	.78**	.52**	Partial
CO→CTx	AS-Phy[b], ASM[b], CSM	.62**	.35**	Partial
AO→Inten	ATx, CTx[a, b]	.54**	0.03	Full
CO→Inten	ATx, CTx	-.06	-.02	None
AS-Phy→Inten	ATx, CTx[a]	.31*	-0.02	Full
AS-Co→Inten	ASM, CSM[b], ATx, CTx[a]	.20*	-0.03	Full
ASM→Inten	ATx, CTx	.26*	-0.08	Full
CSM→Inten	ATx, CTx	-0.07	-0.06	None

Note: AO = Autonomy Orientation; CO = Controlled Orientation; ASM = Autonomous Sport Motivation; CSM =Controlled Sport Motivation; AS = Autonomy Support; Co = Coach; Phy = Physiotherapist; ATx = Autonomous Treatment Motivation; CTx = Controlled Treatment motivation; Inten = Intention.

* $p < .05$ at 2-tailed, ** $p < .01$ at 2-tailed

[a]This variable was not a significant mediator because it did not significantly predict the dependent variable.

[b]This variable was not a significant mediator because it was not significantly predicted by the independent variable.

Discussion

In Study 2, we provided initial evidence to support the effect of causality orientation on the TCM. Not only does causality orientation influence how people perceive the autonomy support of significant others, but it also has strong effects on the level of self-determination of behaviours in both sport and treatment contexts. It is, therefore, an important component of the trans-contextual effect. However, autonomy support from coaches was only related to sport motivation and not treatment motivation. This suggests that the trans-contextual effects of motivation were unlikely to be due to coaches providing autonomy support in both contexts.

General Discussion

In order to utilize the trans-contextual model to understand the relationship between motivation in sport and rehabilitation contexts (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2003), we carried out two independent studies in groups of sport participants with different backgrounds and level of expertise and experience. Study 1 tested the TCM in accordance with a recent ACL rupture experience among recreational-level sport participants, while Study 2 tested the TCM in a sample of professional athletes who placed higher occupational demands on sport than the recreational sport participants. Results from both studies supported the trans-contextual processes of motivation between sport and rehabilitation of sport injury and were in line with previous studies of the TCM (Barkoukis & Hagger, 2009; Barkoukis et al., 2010; Hagger & Chatzisarantis, 2009b; Pihu et al., 2008; Wallhead et al., 2010). Moreover, the results were consistent with previous findings (i.e., Chan et al., 2009; Williams et al., 1996) and SDT (Deci & Ryan, 1985b) with respect to the adaptive role of autonomous treatment motivation and autonomy support.

The Transfer of Motivation

Unlike previous studies adopting the TCM which used a single composite score (the relative autonomy index) to represent the overall autonomous and controlled sport motivation of participants (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009), we intended to test the precise trans-contextual processes of motivation by making a clear distinction between the two opposing forms of motivation. Although highly consistent results were revealed in both studies in the current research regarding the associations between sport and treatment motivation, our investigation still presented some contradictory findings which are worthy of discussion. In Study 1, controlled sport motivation unexpectedly formed a positive association with autonomous treatment motivation, but interestingly, we did not find the same pattern in Study 2.

According to SDT, humans have an active nature and a tendency towards development, both of which enable individuals to gradually internalize their controlling behaviours into more autonomously-motivated actions (Deci & Ryan, 1985b). Compared with the most severe sport injuries reported by the participants in Study 2, the reported injury (ACL rupture) of participants in Study 1 was generally more serious and required more time for recovery. Participants in Study 1 may therefore have had more time to internalize their controlled treatment motivation into autonomous treatment motivation. The participants in Study 2 responded according to a hypothetical sport injury scenario rather than actual current experience with a real injury, so their response patterns may not have necessarily revealed the effects of internalization. In addition, recent SDT research in sport suggests that the maladaptive effects of controlled sport motivation can be compensated by autonomous sport motivation (Gillet, Vallerand, & Rosnet, 2009). The recreational sport participants in Study 1 had apparently fewer external demands and more volitional participation in sport (Hagger & Chatzisarantis, 2005). In that sense, their potentially heightened autonomous sport motivation

may be able to protect them against the negative influence of controlled sport motivation, leading to greater autonomous treatment motivation for a sport injury.

The Role of Causality Orientation

As expected, causality orientations not only influenced perceptions regarding the autonomy support from coaches and physiotherapists, but also athletes' behavioural regulations in both sport and treatment contexts. This pattern indicated that the causality orientation of athletes could make a substantial contribution to the trans-contextual process of motivation. Although causality orientations have a very important influence on treatment motivation and intention, it is important to include the mediators of these relationships such as sport motivation and autonomy support from physiotherapists.

These mediators fully or partially mediated the effects of causality orientations on treatment motivation and intention in Study 2. We hypothesised that the independent variables (i.e., causality orientation) and the mediators (i.e., sport motivation and autonomy support from physiotherapists) would both exert direct influences on the dependent variable. In other words, a highly autonomously-oriented athlete is likely to have high autonomous treatment motivation when injured. However, when physiotherapists do not adequately support the needs of the athlete or provide appropriate treatment options and proper explanations regarding rehabilitation, the resulting treatment motivation of the athletes may still be impaired. In contrast, athletes who have high-controlled orientation may have a predisposition toward highly-controlling treatment motivation perceptions, a style of treatment motivation that was found to be maladaptive with respect to treatment adherence for sport injury (Chan et al., 2009). Importantly, however, autonomy support from physiotherapists may foster their autonomous treatment motivation for sport injury, which would further lead to enhanced intention to continue the treatment in the future.

The Role of Significant Others

Autonomy support from coaches predicted autonomous sport motivation, but did not have any significant association with autonomous treatment motivation. Instead, both studies demonstrated that autonomy support from physiotherapists had a significant effect on treatment motivation, thus revealing that physiotherapists maybe more important than coaches in fostering an adaptive psychosocial environment for injured athletes to recover. It is important to discuss why coaches' autonomy support was only influential on sport motivation and not treatment motivation. A possible reason could be that athletes do not identify coaches as medical figures or experts in injury rehabilitation when they get injured. In comparison to coaches, physiotherapists are likely perceived as more clinically based and proficient in handling sport injuries. Nevertheless, during the recovery process, it is important for injured sport participants to be autonomously motivated to return to their sport, as this autonomous sport motivation was suggested to be related to optimistic perspectives regarding future sport participation after sport injury (Podlog & Eklund, 2007). Thus, autonomy support from coaches is essential to help injured athletes prepare psychologically to return to their sport.

Limitations and Future Directions

In spite of the theoretical and pragmatic insights obtained from this study, a number of limitations should be addressed and future research directions should be discussed to advance the understanding of the TCM. First, the data of the study relied exclusively on self-report measures that tend to be more vulnerable to contamination from common method variance and social desirability. Future studies should attempt to assess other-reported autonomy support and treatment adherence and use alternative behavioural measures such as rehabilitation attendance to obtain more objective and reliable behavioural data on the motivational dynamics of injured athletes. Second, the correlational design of the study precludes definitive conclusions regarding the causal and temporal relationships between

autonomy support, sport motivation, and treatment motivation. Stronger evidence could be provided by studies with intervention designs such as randomized control trials and reciprocal effect models with longitudinal designs (Hagger & Chatzisarantis, 2009a; Marsh & Perry, 2005). Finally, although the samples of the two studies involved athletes with a variety of sport levels and sport injury experience, we cannot conclude that the TCM would consistently hold for athletes for all sport-related injuries. In addition, similar injuries to those experienced by the athletes in the present investigation also occur among employees in the working environment who would also require proper treatment for recovery. Further studies should examine the framework of the TCM among patients who sustain injuries in occupational settings.

Conclusion

The TCM may be a useful framework to explain the processes by which sport motivation is transferred into treatment motivation for sport injury. Injured athletes, who enjoy sport, and consider it a meaningful and important aspect of their lives, in contrast to those who experience pressure or coercion to engage in their sport, are more likely to be autonomously-motivated toward their rehabilitation from injury. From a practical perspective, it seems that the onus is on coaches and physiotherapists to promote self-determined or autonomous forms of motivation in their athletes. In particular, autonomous motivation in sport will transfer to autonomous motivation to seek and adhere to rehabilitation should athletes get injured. In this case, the coach can provide an optimal social environment that fosters increased self-regulation among athletes when it comes to performing behaviours alone and in the absence of external contingencies. Numerous techniques to foster autonomous motivation have been well cited in the sport and exercise psychology literature, and include providing rationale, giving choice, promoting self-referenced goals, acknowledging conflict, and providing

experiences of competence and mastery in practice and training (Chatzisarantis & Hagger, 2009; Gagne, Ryan, & Bargmann, 2003; I. M. Taylor, Ntoumanis, & Standage, 2008).

Implications of Chapter 2

The two studies in Chapter 2 provided preliminary support for the first tenet of the hypothesised integrated model in the thesis, namely, the trans-contextual effect of motivation from a sport context to a sport injury rehabilitation context. This transfer of motivation demonstrated that individuals who endorsed self-determined motivation for their given activity (e.g., sport) were more likely to have self-determined motivation for undertaking health-promoting behaviours associated with the activity (e.g., rehabilitation for sport injury). Perceptions that significant-others fostered self-determined motivation by facilitating an autonomy-supportive climate were not only be associated with corresponding behavioural outcomes, but also to motivation and intention for health and safety behaviours in that behavioural context. These findings were important to the global aim of the study as it showed that support for self-determined motivation in a context that was not directly related to health and safety promotes self-determined motivation in a health and safety context. With supportive evidence for first tenet of the thesis, the present thesis moved on by testing the second tenet of the thesis (i.e., the theoretical integration of SDT and the TPB) in the contexts of sport injury rehabilitation and prevention. The corresponding research paper is presented in the next chapter (Chapter 3).

Chapter 3

Self-Determined Forms of Motivation Predict Sport Injury Prevention and Rehabilitation Intentions

(Study 3 and 4)

A version of this Chapter is published as:

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Overview of Chapter 3

In order to test the second premise of the thesis (i.e., the theoretical integration between SDT and TPB; *tenet 2*), two cross-sectional studies reported in this chapter examined how motivational regulations from SDT influenced athletes' intentions towards sport-injury rehabilitation (Study 3) and prevention behaviours (Study 4) using the TPB as a framework.

Participants of both studies were elite athletes (Study 3: $N = 214$; Study 4: $N = 533$). They completed the Treatment Self-Regulation Questionnaire and psychometric measures of constructs from the TPB, with respect to their rehabilitation from sport injury in a hypothetical scenario (Study 3), or their injury prevention experiences (Study 4).

Partial least squares path analytic models indicated acceptable fit of the hypothesised model in all samples, and consistently found in both studies that autonomous motivation from SDT was positively associated with attitudes, subjective norms and perceived behavioural control from the TPB, and these three TPB variables positively-predicted intentions for injury rehabilitation and prevention. Controlled motivation from SDT was, unexpectedly, positively-linked to intentions, but the effect was smaller than that for autonomous motivation.

In conclusion, motivational regulations from SDT might serve as sources of information that influence athletes' intentions through their impact on the attitude, perceived social norm and controllability of injury rehabilitation and prevention. The studies in Chapter 3 are in line with the global research question of the thesis, and the results are generally consistent with the second tenet of the thesis with respect to the theoretical integration between SDT and TPB. Specifically, the results demonstrate that self-determined motivation from SDT is related to the formation of behavioural intention through the mediation of the social cognitive variables from the TPB. Such evidence extends the application of the hypothesised model of the overall thesis from the rehabilitation of sport injury to the prevention of sport injury that

pave the way to examine the global model of the thesis within various health and safety contexts in Chapters 4 to 6.

Introduction

Although breakthroughs in technology have been shown to reduce the likelihood and severity of sport injury in clinical contexts, their effectiveness in the field depends greatly upon human factors (e.g., adherence to rehabilitation; Chan, Hagger, et al., 2011; Chan et al., 2009). Social psychological theories of motivated behaviour are considered important in this regard because they identify the malleable factors related to individual self-regulation of behaviour (Hagger, 2010b; Hagger, Wood, et al., 2009). The present investigation aims to integrate self-determination theory(Deci & Ryan, 1985b) and the theory of planned behaviour (Ajzen, 1985) to explain the psychological processes of sport injury rehabilitation and prevention.

Self-determination theory (SDT; Deci & Ryan, 1985b) has been applied to explain athletes' motivation towards rehabilitation after experiencing sport injuries (Chan, Hagger, et al., 2011; Chan et al., 2009). A key prediction of SDT is that the quality of motivation, reflected in the reasons individuals engage in a particular activity, will predict behavioural commitment and persistence. Behaviours driven by intrinsic motivation (i.e. for interest, fun, and excitement), integrated regulation (i.e. to engage in behaviours that are consistent with psychological needs and a coherent sense of self), and identified regulation (i.e. to attain personally-valued goals) are considered to be regulated by autonomous forms of motivation.

In contrast, behaviours driven by external motivation (i.e. compliance to external demands, avoidance of punishment, and social pressure) and introjected regulation (i.e. to attain contingent self-worth and avoid internal guilt and shame) are considered to be regulated by controlled forms of motivation. The fundamental distinction is that autonomous motivation emanates from one's sense of volition, self-satisfaction or intrinsic values, and controlled motivation emerges from the experience of pressure, external demands, or defense of one's

self-esteem and ego. Tests of SDT in sport injury contexts have demonstrated that these two forms of motivation explain substantial variance in athletes' intention to follow the prescribed treatment protocols (Chan, Hagger, et al., 2011) and their actual adherence to treatment (Chan et al., 2009). Autonomous motivation has been shown to be a positive predictor, and controlled motivation a negative (Chan et al., 2009) or non-significant predictor (Chan, Hagger, et al., 2011), of these outcome variables.

The theory of planned behaviour (TPB; Ajzen, 1985) on the other hand, posits that people's engagement in a given volitional behaviour is a function of three belief-based factors: attitudes (subjective evaluations on the behaviour), subjective norms (perceived social appropriateness of the behaviour) and perceived behavioural control (PBC; ones' perceived confidence in his/her ability to engage in the behaviour). These three constructs are proposed to predict individuals' intention to perform the behaviour in the future. Behavioural intention reflects the direction and intensity individuals plan to invest effort in engaging in a given behaviour. Intention is viewed as the most proximal predictor of behaviour and is assumed to fully mediate the effects of attitude, subjective norm and PBC on behaviour. The TPB has received considerable support in a variety of health contexts (TPB; Ajzen, 1985), including safety (Hagger & Chatzisarantis, 2009b; McEachan et al., 2011) and rehabilitation (Lajunen & Resänän, 2004; Quine, Rutter, & Arnold, 1998; Quine, Rutter, & Arnold, 2001; White et al., 2012). However, there has been a relative dearth of research applying the TPB into the sport injury prevention and rehabilitation of elite athletes (Gardner & Hausenblas, 2004; Horne & Weinman, 1999), even though this group of individuals typically experiences higher risk of sport injury (White et al., 2012).

Although evidence has so far supported the utility of SDT and TPB in predicting injury-related behaviour, Hagger and colleagues (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a) argued that both theories have shortcomings. First, SDT does not explicitly outline

how proximal factors like beliefs, perceptions of control, planning and commitment influence the actual execution of behaviours (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002b; Hagger et al., 2006). Second, in the TPB, there is a lack of detail regarding the origins of attitude, subjective norm and PBC. It is also unclear about how sources of information (such as general motives and global goal orientations) may influence intentions via the mediation of the more proximal variables from the TPB.

An integrated model of SDT and TPB may, therefore, resolve the limitations of both theoretical frameworks and provide a more comprehensive analysis of the motivational and cognitive processes that influence intention formation, and subsequently behaviour. Based on the findings of Hagger and coworkers (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a), autonomous and controlled forms of motivation are considered distal predictors of behaviour in the integrated model, while attitude, subjective norm, and PBC are viewed as proximal predictors. The reason for this proposed pattern of effects is that, in terms of both theoretical conceptualization and measurement aspects, constructs from SDT are operationalised as generalised motivational orientations towards acting in a specific context (e.g. injury prevention), while social cognitive variables from the TPB focus on a specific action (e.g. engaging in rehabilitation exercises provided by a physiotherapist).

The SDT constructs should, therefore, be considered more generalised and trait-like in their conceptualisation and have general influences on many specific behaviours, and the psychological antecedents thereof, in a given context. Taking this pattern of effects, the full motivational sequence of the integrated model of TPB and SDT is outlined as follows: The distal predictors (i.e. motivational orientations from SDT) exert effects (positive for autonomous forms of motivation and negative for controlled forms of motivation) on the situation-specific, proximal predictors of intentions (i.e. attitude, subjective norm, and PBC in

TPB), and the proximal predictors are positively related to intention and behaviour as proposed in the TPB (Hagger, Chatzisarantis, & Biddle, 2001).

Sudies of the integration between SDT and TPB employed so far have been applied to only a limited set of health behaviours such as physical activity, dieting, breast feeding and condom use, with a strong emphasis on physical activity, as shown in the meta-analysis of Hagger and colleagues (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002b; Hagger et al., 2006). It remains unclear whether or not this model could be applicable to the rehabilitation and prevention of sport injury. On the other hand, a recent study has applied SDT and TPB into the prediction of injury preventive behaviours among police officers. It was found that the positive effect of autonomous motivation on the intention of occupational injury prevention significant, and was fully mediated by attitude and subjective norm (Hagger & Chatzisarantis, 2009b). While the injury is as well regarded as one of the key factors contributing to the risk of participation and premature retirement (Chan & Hagger, 2012a) as it is in some of the high-risk occupations, the motivational and social cognitive factors associated with injury in the workplaces might plausibly be relevant to the rehabilitation and prevention of injury in elite sport. There is, therefore, a need for further replications of this integrated model. Such replications have value as they will not only serve to diversify the behaviours to which the model applies, but also serve to demonstrate whether the pattern of effects holds in a behavioural context that is removed from the behaviours in which the model has, thus far, been tested (Schneider et al., 2006). This will provide evidence for the effects of key motivational factors from two prominent social psychology theories on athletes' commitment to injury rehabilitation and prevention.

In this article, we report two quantitative studies conducted with elite athletes. In Study 3, we aimed to predict athletes' intentions to engage in injury *rehabilitation behaviours* and in Study 4, we focused on predicting athletes' intentions for injury *preventive behaviours*.

Based on the integrated model of SDT and TPB, we proposed the following hypotheses: autonomous motivation and controlled motivation would form positive and negative relationships, respectively, with intention for sport injury rehabilitation (Study 3) and prevention (Study 4). We also predicted that the effects of these motivational orientations on intentions would be mediated by attitude, subjective norm and PBC.

Method

The study received prior approval from the Research Ethics Committee of the University of Nottingham (Ref: VC/HCF/260110). Questionnaire data were collected from 214 elite athletes (Mean age [19.3± 4.0 yr], 43.0% male) for Study 3 and another group of 533 elite athletes (Mean age [16.8 ± 2.8], 50.3% male) for Study 4. They were international, national or regional level athletes from 13 different sports (e.g. athletics, canoeing, cycling, soccer and swimming), and received elite training for more than 1 year (Study 3 [6.3 ± 3.8 yr], Study 4 [3.2 ± 2.2 yr]) in the Sichuan province of China. Approximately half of the participants in both studies (52.3% for Study 3, 47.1% for Study 4) had experience of moderate-to-severe forms of sport injury (i.e. required two weeks of medical attention or more) in the last two years. Prior to completing the 15-min questionnaire, participants and their parents or guardian signed the consent forms to indicate that they understood the procedures of the study and their rights (i.e. voluntary nature of participation, confidentiality of data and freedom to withdraw from the study at any time without prejudice).

The questionnaire comprised psychological measures of motivation from SDT and standardised measures of attitude, subjective norm, PBC and intention from the TPB (Orbell et al., 2006) with respect to injury rehabilitation (Study 3) and injury prevention (Study 4). In Study 3, participants responded the items that made reference to a hypothetical scenario developed in a previous study that was specifically designed to tap a typical sport injury

experience for elite athletes (Chan, Hagger, et al., 2011). In the scenario, the participant was depicted as having become injured during a training session one month before an important competition and described as having experienced increased pain from the injury over time. In Study 4, participants responded to the items according to their present experience of sport injury prevention. The questionnaires in both studies were in Chinese, the first language of the participants. Items and instructions were either translated from their original English versions using the back-translation procedures described by Hambleton (2005) or adapted from their Chinese versions developed in previous studies (Chan et al., 2009).

In Study 3, the sport rehabilitation (Chinese) version of Treatment Self-Regulation Questionnaire (TSRQ; Chan et al., 2009), which measured autonomous and controlled motivation for sport injury rehabilitation, was used. For Study 4, we adapted the items for autonomous and controlled motivation from the smoking-cessation version of TSRQ (Williams, Cox, Kouides, & Deci, 1999) by following the protocol used in a previous study to adapt items to measure motivation towards occupational injury prevention (Chan & Hagger, 2012a). For both studies, items assessing the TPB variables, including attitude, subjective norm and PBC, were developed according to Ajzen's (2002) guidelines. Example items and anchors of each scale are displayed in Table 3.1.

Table 3.1 Instruments Information (Study 3 and 4)

Instruments Information

Variable	Dimension	Example item	Anchors
		Study 3	
Motivation for injury rehabilitation	Autonomous motivation	I have been following the procedures of the rehabilitation because it is important to me that my efforts succeed	1 = not at all true, 7 = very true
	Controlled motivation	I have remained in treatment and carry out rehabilitation exercise because others would have been angry at me if I didn't	1 = not at all true, 7 = very true
TPB Variables	Attitude	Following the prescribed treatment protocols or guidelines for my rehabilitation in the forthcoming month is …	1 = valuable/ beneficial/ pleasant/ enjoyable/ good/ virtuous, 7 = worthless/ harmful/ unpleasant/ unenjoyable/ bad/ not virtuous
	Subjective Norm	The people in my life whose opinions I value would approve of my following the prescribed treatment protocols or guidelines for rehabilitation in the forthcoming month	1 = strongly disagree, 7 = strongly agree
	Perceived Behavioural Control	I have complete control over following the prescribed treatment protocols or guidelines for my rehabilitation in the forthcoming month	1 = strongly disagree, 7 = strongly agree
	Intention	I plan to engage in all the activities that are recommended by my physicians in the forthcoming month	1 = strongly disagree, 7 = strongly agree
		Study 4	
Motivation for injury prevention	Autonomous motivation	I want to prevent or avoid sport injury because I personally believe it is the best thing for my health	1 = not at all true, 7 = very true
	Controlled motivation	I want to prevent or avoid sport injury because I would feel guilty or ashamed of myself if did not	1 = not at all true, 7 = very true
TPB Variables	Attitude	Following all required safety procedures to reduce the likelihood or severity of injury	1 = valuable/ beneficial/ pleasant/ enjoyable/ good/ virtuous, 7 = worthless/ harmful/ unpleasant/ unenjoyable/ bad/ not virtuous
	Subjective Norm	The people in my life whose opinions I value would approve of approve me to follow all required safety procedures to reduce the likelihood or severity of injury in the forthcoming month	1 = strongly disagree, 7 = strongly agree
	Perceived Behavioural Control	I have complete control over how to follow all required safety procedures to reduce the likelihood or severity of injury in the forthcoming month	1 = strongly disagree, 7 = strongly agree
	Intention	I plan to follow all required safety procedures to reduce the likelihood or severity of injury in the forthcoming month	1 = strongly disagree, 7 = strongly agree

Data Analysis

Variance-based structural equation modelling (VB-SEM; also known as partial least squares path analysis) using the SmartPLS 2.0 statistical software (Ringle, Wende, & Will, 2005) was used to examine the path estimates and the "fit" of the hypothesised model with the data. We evaluated model fit using a number of indices focusing on the convergent and discriminant validity of the measurement model. Convergent validity is typically considered acceptable when the Cronbach's alpha and the composite reliability of each dimension are higher than 0.70 (Barclay, Thompson, & Higgins, 1995), the average variance extracted (AVE) for each factor is higher than 0.50 (Chin, 1998), and the factor loading of each items on its corresponding factor is higher than 0.70 (Komiak & Benbasat, 2006). Discriminant validity is adequate when the loading of an item on its own construct is higher than its loadings on the other constructs (Komiak & Benbasat, 2006) and the square root of the AVE of any construct is higher than its correlation with other constructs (Chin, 1998). In addition, a bootstrapping resampling technique with 5000 replications was used to reveal the significance level of the path estimates. Mediation analysis was conducted to reveal whether the TPB variables (i.e. attitude, PBC and subjective norm) mediated the relationship between motivation and intention. Mediation was supported when motivation exerted a significant direct and indirect effect (computed by the bootstrapping algorithm of Preacher and Hayes (2008)) on intention, and the direct effect was not significant (indication of full mediation) or reduced to comparatively lower value (indication of partial mediation) when the three antecedents of intention were taken into account (Preacher & Hayes, 2008; Zhao, Lynch, & Chen, 2010).

Results

The variable distributions, zero-order correlation matrix and specific fit indices of the variables for both studies are shown in Table 3.2. The convergent validity indices for both studies generally met the criteria for acceptable score reliability in VB-SEM. For the variables in Study 3, Cronbach's alphas ranged from 0.67 to 0.81, composite reliability scores were between 0.82 and 0.89, AVE values were between .58 and .80, and factor loadings ranged from 0.76 to 0.89. For the variables in Study 4, Cronbach's alphas ranged from 0.68 to 0.86, composite reliability scores were between 0.81 and 0.90, AVE values were between 0.59 and 0.71, and factor loadings ranged from 0.71 to 0.84. The Cronbach's alphas of three constructs (controlled motivation in Study 3 and subjective norm in both studies) were slightly lower than 0.70, but they all met the published criteria for internal consistency (i.e., 0.60; Cronbach, 1951), and thus deemed acceptable. Similarly, the results also supported the discriminant validity of the scale dimensions in both studies. The factor loadings were higher than their cross loadings on the other factors by a average difference of 0.56 in Study 3 and 0.44 in Study 4. The square root of the AVE of each construct was larger than the construct correlation with other factors by an average difference of 0.48 in Study 3 and 0.26 in Study 4.

Table 3.2 Correlation Matrix and Fit Indices for Study 3 and Study 4

Correlations and Fit Indices among Measured Variables for Study 3 and Study 4

		Autonomous motivation	Controlled motivation	Attitude	Subjective norm	PBC	Intention
				Study 4			
Autonomous motivation	**Study 3**	1	0.63**	0.87**	0.53**	0.43**	0.64**
Controlled motivation		0.44**	1	0.59**	0.37**	0.39**	0.46**
Attitude		0.27**	0.02	1	0.42**	0.42**	0.51**
Subjective norm		0.53**	0.27**	0.23**	1	0.23**	0.59**
PBC		0.34**	0.33**	0.02	0.64**	1	0.43**
Intention		0.46**	0.15*	0.22**	0.46**	0.34**	1
	M	5.16	3.87	5.66	4.92	4.85	5.19
	SD	1.07	1.14	1.03	1.12	1.08	1.24
	α	0.73	0.68	0.81	0.67	0.71	0.75
Study 3	CR	0.85	0.88	0.89	0.82	0.83	0.89
	AVE	0.65	0.58	0.72	0.60	0.63	0.80
	FL	0.89	0.78	0.85	0.76	0.81	0.79
	CL	0.25	0.33	0.12	0.22	0.32	0.27
	M	4.86	3.73	5.32	4.78	4.68	4.64
	SD	1.34	1.3	1.46	1.41	1.32	1.32
	α	0.79	0.74	0.86	0.68	0.78	0.80
Study 4	CR	0.85	0.81	0.90	0.83	0.85	0.88
	AVE	0.59	0.65	0.59	0.61	0.63	0.71
	FL	0.74	0.71	0.77	0.78	0.73	0.84
	CL	0.28	0.31	0.29	0.35	0.33	0.27

Note: The correlation coefficients for Study 3 are presented below the principal diagonal and the correlation coefficients for Study 4 are presented above the principal diagonal. CR = composite reliability; FL = factor loading; CL = cross-loading.

* $p<0.05$ for a two-tailed test, ** $p<0.01$ for a two-tailed test.

A consistent pattern of path estimates (in keeping with the hypotheses) was obtained in both studies. Despite controlled treatment motivation positively predicting PBC in Study 3, and subjective norm and PBC in Study 4, the path estimates from the model of sport injury rehabilitation and the model of sport injury prevention were in line with our hypotheses: (a) autonomous motivation was significantly and positively related to attitude, subjective norm and PBC (i.e. the three TPB variables) in both studies; (b) the relationship between controlled motivation and the other TPB variables (attitude and subjective norm in Study 3; attitude in Study 4) was non-significant; and (c) the three TPB variables were significantly and positively related to intention in both studies. The pattern of relationships among the study variables for both studies is illustrated in Figure 3.1.

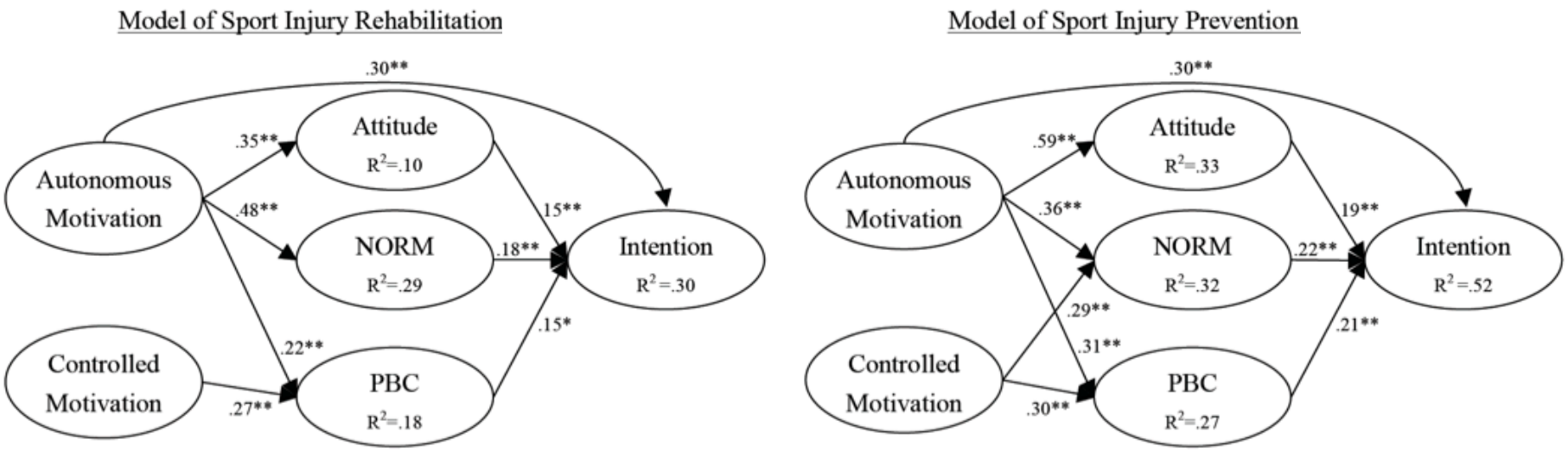

Figure 3.1 Path estimates in the model of sport injury rehabilitation from Study 3 (left) and prevention from Study 4 (right).

NORM = subjective norm; PBC = perceived behavioural control. Non-significant paths were omitted from the diagram. * $p<0.05$ for a two-tailed test, ** $p<0.01$ for a two-tailed test.

In terms of the mediation analyses, the direct effect of autonomous motivation on intention relationship was significant and positive, and was partially mediated by the TPB variables (attitude, subjective norm and PBC) in Study 3 (total indirect effect = 0.21, $p<0.001$; direct effect without mediators = 0.47, $p<0.01$; direct effect when controlling for mediators = 0.30, $p<0.01$) and Study 4 (total indirect effect = 0.47, $p<0.001$; direct effect without mediators = 0.61, $p<0.01$; direct effect when controlling for mediators = 0.30, $p< 001$) as expected. The direct relationship between controlled motivation and intention was also fully mediated by the TPB variables (PBC in Study 3; subjective norm in Study 4) in Study 3 (total indirect effect = 0.15, $p<0.01$; direct effect without mediators = 0.19, $p<0.01$; direct effect when controlling for mediators = 0.03, $p>0.05$) and Study 4 (total indirect effect = 0.42, $p<0.001$; direct effect without mediators = 0.43, $p<0.01$; direct effect when controlling for mediators = 0.12, $p>0.05$), but the effects were, surprisingly, positively valenced when they were expected to be negatively valenced.

Discussion

The present research extended the integrated model of SDT (Deci & Ryan, 1985b, 2008) and TPB (Ajzen, 1985) in the area of sport injury rehabilitation and prevention. Results from both studies revealed a consistent pattern of relationships among the key theoretical constructs from SDT and TPB, congruent with the hypothesised model. In both studies, autonomous motivation was positively associated with intention via the mediation of attitude, subjective norm and PBC, and these three TPB variables positively predicted intention. However, the pattern of effects for controlled motivation was not in line with our hypotheses. Controlled motivation for injury rehabilitation exerted a positive effect on intention through

the mediation of PBC in Study 3, whereas controlled motivation for injury prevention had a positive effect on intention through the mediation of subjective norm in Study 4. Overall the data supported 64.71% (14/22) of the hypothesised paths and 66.67% (8/12) of the hypothesised mediation effects due to the contrasting patterns of results from autonomous motivation and controlled motivation. Overall, the motivational sequence shown in both studies was generally consistent with previous meta-analytic findings for the theoretical integration of SDT and TPB (Hagger & Chatzisarantis, 2009b).

Motivation

In keeping with the results of previous research (Chan & Hagger, 2012a; Chan, Hagger, et al., 2011; Chan et al., 2009; Hagger & Chatzisarantis, 2009b), the current studies yielded theoretically-consistent findings for the effects of autonomous motivation on intentions in injury rehabilitation and prevention contexts. Autonomous motivation was a significant and direct predictor of attitude, subjective norm and PBC in both contexts. There was also a significant and positive indirect effect of autonomous motivation on intention mediated by the three TPB variables. In other words, the more the athlete was motivated to engage in sport injury rehabilitation and prevention for autonomous reasons, the more likely they would positively evaluate the behaviour (attitudes), regard such actions as consonant with social norms (subjective norms), endorse a belief that the behaviour is under their personal control (PBC), and commit to engaging in the behaviour in future (intentions). Accordingly, these adaptive response patterns due to autonomous motivation are in line with the predictions of SDT (Deci & Ryan, 1985b, 2008): autonomous forms of motivation, (e.g. intrinsic motivation and two internalised forms of extrinsic motivation, namely, identified motivation and integrated motivation) were expected to be associated with adaptive outcomes, such as enhanced psychological wellbeing (Adie, Duda, & Ntoumanis, 2008), lower risk of

burnout (Lonsdale, Hodge, & Rose, 2009) and higher persistence (Edmunds, Ntoumanis, & Duda, 2007) in sporting contexts. Our study findings indicate that these positive correlates of autonomous motivation could also be applied in sport injury rehabilitation and prevention contexts.

In contrast, our findings in regard to controlled motivation were not consistent with our hypotheses and the tenets of SDT (Deci & Ryan, 1985b, 2008). Controlled motivation was significantly correlated with PBC and intention for sport injury rehabilitation (Study 3) and with subjective norm, PBC and intention for sport injury prevention (Study 4). The relations were also in a positive direction instead the expected negative pattern according to our hypotheses. However, the strength of the effect of autonomous motivation on the TPB variables was substantially greater than the effect of controlled motivation. In addition, controlled motivation did not significantly predict attitude and subjective norm in Study 3, and attitude in Study 4. Overall, our findings seemed to indicate that autonomous motivation had the strongest effects on intentions and on its antecedent variables relative to controlled motivation, and were consistent with previous research (Chan, Hagger, et al., 2011; Chan et al., 2009; Halvari, Halvari, Bjornebekk, & Deci, 2010). These findings are consistent with the central theoretical assumption of SDT which suggests that humans naturally seek out behaviours consistent with their basic psychological needs, particularly the need for autonomy, and this motivational orientation is more likely to result in behavioural perseverance and optimal functioning in comparison to controlled motivation (Deci & Ryan, 1985b).

It is, however, important to discuss why controlled motivation predicted TPB variables in a direction that countered our predictions. Controlled motivation for sport injury rehabilitation was not a significant predictor of treatment intention in the study of Chan and

colleagues (2011), and it was even found to be negatively associated with the treatment adherence among athletes who had received anterior cruciate ligament reconstruction (Chan et al., 2009). Our results were in contrast to these previous findings and this could be owing to three reasons.

First, in the self-determination continuum proposed Ryan and Connell (1989), the forms of motivation that make up controlled motivation do not fall into the most extrinsic category of extrinsic motivation. Controlled motivation comprises introjection, which is considered a less controlling form of extrinsic motivation than external regulation, the type of motivation located at the most extrinsic pole of the continuum and the stereotypical form of extrinsic motivation. Unlike external regulation, introjected regulation is not directly driven by external contingency for actions. Rather, it is proposed to emanate from the perceived internal pressure to attain contingent self-esteem. Ryan and Connell (1989) suggested that behavioural regulations (i.e. motivation) along the self-determination continuum were inter-correlated with different magnitudes and directions. Those adjacent to each other (i.e. introjected and identified regulation) would correlate more strongly and with positive valence than those farther apart (i.e. external regulation and intrinsic motivation). Consequently, it would be plausible that athletes with high introjected regulation might also carry identified and integrated regulation (i.e. autonomous motivation) to some extent, and the combined effects of all the behavioural regulations could be adaptive and result in an overall positive intention to engage in injury rehabilitation and prevention behaviours. This phenomenon might concur with the findings of Hagger and colleagues (2002a) who reported significant effects of external regulation and introjected regulation on the TPB variables, but these effects were weakened by the inclusion of intrinsic motivation.

Another possibility was that the intention measure used in this study did not differentiate between forced and volitional forms (Chatzisarantis, Frederick, Biddle, Hagger, & Smith, 2007). Controlled motivation might well establish a positive relationship with forced intention in which the behaviour and the formation of intention were likely considered by the individual as a "must-do". While autonomous motivation would still have a positive effect on volitional intention where individuals were truly willing to make the decision to undertake the behaviour itself, both types of motivation could bring together a positive effect on intention. This could, of course, be resolved by including separate measures of volitional and forced intentions in future research.

Last, the effect of controlled motivation might not necessarily be negative, and it could depend on the health context, length of the health program, and the background of the respondents (e.g., age, personality, and culture; Chan, Hagger, et al., 2011; Hagger & Chatzisarantis, 2009b). A previous study on coronary heart disease patients' rehabilitation also reported a positive association between controlled motivation and adherence to dieting (Williams, Gagné, et al., 2005). Similarly, in a recent qualitative study on motivational interviewing for weight management, patients who perceived their counselors to be controlling and unsupportive to their psychological needs, still adhered to the program of physical activity and dieting, provided that adequate amount of social support was given to them (Hardcastle & Hagger, 2011). Hence, further studies may look at the effects of controlled motivation when taking these potential moderators into account, and see how its effects on the behaviours in different health contexts might interact with that of autonomous motivation.

Theory of Planned Behaviour Variables

Our findings with respect to the relationships among the TPB constructs, and with the SDT constructs, were in line with our hypotheses. Although autonomous motivation was positively related to intention, the effect was partially mediated by attitude, subjective norm and PBC. This indicates that athletes with autonomous reasons for sport injury rehabilitation and prevention would tend to form positive attitudes, perceived controllability and subjective norms for performing the behaviour in future.

The positive associations of these three TPB variables on intention were congruent with previous findings for the TPB (Ajzen, 1985; Hagger et al., 2002b; McEachan et al., 2011) and previous studies applying the TPB in the context of rehabilitation (Gardner & Hausenblas, 2004; Horne & Weinman, 1999) and injury prevention (Deroche, Stephan, Castanier, Brewer, & Le Scanff, 2009; Lajunen & Resänän, 2004; Quine et al., 1998; Quine et al., 2001; White et al., 2012). However, it is notable that the amount of variance in intention explained by these variables was apparently smaller in Study 3 in comparison to Study 4. Such findings could, arguably, imply that attitude, subjective norm, and PBC had more predictive power on intentions for sport injury prevention than they did on the intentions for sport injury rehabilitation. The smaller amount of variance explained for intention in Study 3 could be due to the fact that participants' responses were drawn upon a hypothetical situation rather than the actual experience. Although the injury scenario was tailored to match the experience of most athletes (Chan, Hagger, et al., 2011) and, more importantly, the severity or recovery of the injury was standardized in the presented scenario, the degree to which participants 'bought in to', and identified with, the scenario may have varied between individuals. This could plausibly heighten the error variances of the variables in Study 3 and lead to reduced predictive power for the TPB variables. Therefore, it would be important to direct further

investigation among injured athletes and test the integrated model against different injury types, recovery length and treatment effectiveness.

Limitations

In addition to the potential influence of the moderator or confounding variables mentioned above, we must also recognise a number of other limitations. First, even though the proposed pattern of relationships was supported in both contexts, the cross-sectional design limited our capacity to draw definite conclusions about the causal and temporal effects within the models. Moreover, intention typically explains a substantial amount of variance in behaviour (Hagger et al., 2002b; McEachan et al., 2011) and is often regarded as the most proximal indicator of future behaviour (Ajzen, 1985), but we could not make assumptions regarding the effects of intentions on behaviour in the current study. Indeed, research has suggested that the effect of intentions on behaviour can be relatively modest (Hagger et al., 2002b; McEachan et al., 2011), and interventions targeting changes in intentions do not lead to strong effects on behaviour (Webb & Sheeran, 2006). Thus, it would be important to include objective measures of behaviour in the future research, and examine whether intention (together with the other TPB variables) mediated the relationship between motivation from self-determination theory and behaviour in a sport injury context. Furthermore, research will be further advanced by introducing reliable measures of injury outcomes, and so we can examine the nested model by which motivation from the SDT and the TPB variables predict the incidence and recovery length of sport injury (Chan & Hagger, 2012a). Additionally, it is important to note that our responses obtained from self-report measures could be subjected to social desirability, memory bias, and general response tendency (due to no reversed scored items in the inventories we used), and also the adapted version of the TSRQ may not warrant complete compatibility with the context of sport injury prevention even though the

psychometric property of the scale was supported. Thereby, we shall interpret our findings with caution and instigate further testing and development of the measures of the psychological variables in our model. Finally, we did not investigate the social antecedents (e.g. autonomy support, controlling behaviour, and need thwarting) of the motivational and the TPB variables. Further studies with improved designs (e.g. experimental or longitudinal designs) should attempt to incorporate these factors into our integrated model within sport injury contexts.

Conclusion

Findings of the present investigation provide preliminary validation of an integrated model of SDT and TPB in the context of sport injury rehabilitation and prevention. The results generally supported the hypothesised motivational sequence in the model, suggesting that athletes' volitional orientations were closely related to intentions to engage in sport injury rehabilitation and prevention. Therefore, practitioners in sport science and medicine (e.g. coaches, support teams, physiotherapists) might be able to modify athletes' attitudes, perceived social norms, perceived controllability and subsequent intentions by fostering athletes' autonomous motivation towards injury rehabilitation and prevention.

Implications of Chapter 3

The studies reported in Chapter 3 (Study 3 and 4) addressed a second tenet of the hypothesised integrated model about the mediating role of TPB variables on the relationship between self-determined motivation and intentions for health and safety behaviour. This was important because it provided a clear link between forms of motivation from one component theory (SDT) were related to factors associated with future behavioural engagement of another component theory (TPB) in a health and safety context. The results of Study 3 in this

chapter, together with that of Study 1 and 2 (in Chapter 2), have offered preliminary evidence about the full integrated model of the thesis (both tenet 1 and 2) within the context of sport injury rehabilitation. In addition, Study 4 from this chapter extended the scope of the thesis to sport injury prevention, but the results were limited to the second tenet of the model, so the study reported in the next chapter (Chapter 4) intended to test the first tenet in the context of sport injury prevention.

Chapter 4

Trans-contextual Development of Motivation in Sport Injury Prevention among Elite Athletes

(Study 5)

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Overview of Chapter 4

The study (Study 5) presented in this Chapter investigates the first premise of the thesis, the trans-contextual process of motivation, and is thus a replication of the sport injury rehabilitation studies (Studies 1 and 2) reported in Chapter 2 within a sport injury prevention setting. In particular, Study 5 examined whether general causality orientation, perceived autonomy support from coaches, self-determined motivation and basic need satisfaction in a sport context predicted beliefs, self-determined motivation, and adherence with respect to sport injury prevention. Thus, on top of testing whether self-determined motivation in sport is transferred into self-determined motivation for sport injury prevention, Study 5 also provided a preliminarily test of the trans-contextual effect of basic need satisfaction in sport on self-determined motivation of sport injury prevention, and whether the effect was mediated by self-determined motivation in sport.

The sample was identical to that of Study 4 (in Chapter 3), but unanalysed data was used to test the hypothesised trans-contextual effect of motivation. Hence the predictors (i.e., general causality orientation, perceived autonomy support from coaches, self-determined motivation and basic need satisfaction in a sport context) and dependent variables (i.e., beliefs, self-determined motivation, and adherence with respect to sport injury prevention) in the hypothesised model were measured on two separate occasions approximately 1 week apart.

Variance-based structural equation modeling supported the hypothesis regarding the trans-contextual process of motivation: Self-determined motivation in a sport context was significantly predicted by autonomy support and basic need satisfaction and was positively associated with self determined motivation for sport injury prevention when controlling for general causality orientation. However, the effect of basic need satisfaction on self-determined motivation of sport injury prevention was not significant and not mediated by

self-determined motivation in sport. Autonomy orientation formed positive relationships with autonomy support, basic need satisfaction, and self-determined motivation in sport, but the corresponding relationships for controlled orientation were not significant. Self-determined motivation for sport injury prevention was a significant predictor of adherence to injury prevention behaviours and beliefs regarding safety in sport.

In conclusion, the trans-contextual mechanism of motivation may explain the process by which distal motivational factors in sport direct the formation of proximal motivation, beliefs, and behaviours with respect to sport injury prevention, but basic need satisfaction is unlikely to be a key element that contributes to the trans-contextual process of motivation. Study 5, thus, fits in with the global direction of the thesis by showing that motivation in a general life or work domain (e.g., sport motivation) may be transferred into motivation for health and safety actions. This means that the psychosocial and personality factors associated with one's motivational orientation in a general life domain might be indirectly related to motivation, beliefs, and behavioural patterns regarding health and safety.

Introduction

Recent advances in sport medicine to enhance the effectiveness of sport injury prevention notwithstanding, sport injury has increased in the past 15 to 20 years, and still remains a major reason for premature retirement in elite athletes (Knowles et al., 2006). Many intervention strategies such as safety education, physical conditioning or neuromuscular training, and the assessment and reduction of environmental risk have been shown to work reasonably well in ameliorating sport injury incidence in the clinical settings (Bahr & Engebretsen, 2009; Emery & Tyreman, 2009), but their long-term benefits in the field will be largely dependent on whether the athletes and sport practitioners (e.g., coaches, physiotherapists) adopt and adhere to the necessary injury-preventive behaviours. Furthermore, research has shown that adherence is a serious problem when it comes to injury-preventive behaviour (Chan & Hagger, 2012a; Verhagen, van Stralen, & van Mechelen, 2010). However, in sport, research has been very limited in using psychological theories to investigate individuals' safety or injury-preventive behaviour. A recent systematic review by McGlashan and Finch (2010) shows that only 11% of studies on sport injury prevention considered social or behavioural science theories. It is, therefore, imperative that researchers seek to identify the motivational and psychosocial factors that influence the uptake and adherence to injury-preventive behaviours. The purpose of the present study is to utilize self-determination theory (SDT; Deci & Ryan, 1985b) and the hierarchical model of motivation (Vallerand, 2000) to explain the trans-contextual motivational processes underpinning athletes' adherence and beliefs of injury prevention. The present study is original and unique because it is the first empirical investigation of sport injury-preventive behaviour grounded in SDT and the hierarchical model of motivation.

Autonomy Support, Basic Need Satisfaction, and Motivation

According to *self-determination theory* (Deci & Ryan, 1985b), humans have psychological needs for autonomy (feelings of volition, freedom, and choice when acting), competence (perceiving oneself to be an effective agent in the environment), and relatedness (feelings of belongingness, connection and care from others). The extent to which these needs are satisfied will determine whether an individual functions optimally and experiences concomitant adaptive outcomes. The behaviours that are considered need-satisfying are experienced as driven by a*utonomous motivation*. Autonomous motivation is an internal drive toward engaging in a particular behaviour initiated from an individuals' sense of volition, and can be classified into various forms, including intrinsic motivation (i.e., for fun, excitement and interest), integration (i.e., acting to satisfy psychological needs that are consistent with a true sense of self), and identification (i.e., acting to achieve personally-valued targets). Individuals that are autonomously motivated experience a sense of personal agency and choice over their behaviour and are more likely to persist with behaviours relative to individuals who are not autonomously motivated (Deci & Ryan, 1985b). Nevertheless, behaviours may not always be need-satisfying as individuals could be driven by forces or pressures external to the sense of self. These drives from the external locus of causality are known as *controlled motivation* (Deci & Ryan, 1985b). Controlled motivation may involve introjection (i.e., acting to attain contingent self-worth, or to avoid of internally-felt contingencies like guilt and shame) and external regulation (i.e., acting to meet external demands, avoidance of punishment, and social pressure).

The distinction between autonomous and controlled motivation, and their proposed antecedents according to SDT, the psychological needs, provides a plausible explanatory system for the motivational processes that underlie human behaviour. A substantial literature exists reporting significant links between these constructs (i.e., psychological needs

satisfaction → motivation → behaviour), and the adaptive nature of basic need satisfaction and self-determined motivation (i.e., the relative autonomy level of the behavioral regulation in the locus of causality based on ones' endorsement of autonomous motivation as opposed to controlled motivation; Ryan & Connell, 1989) toward behavioural outcomes in sport, exercise, and health domains (Fortier, Sweet, O'Sullivan, & Williams, 2007; Lonsdale et al., 2009; Ng, Lonsdale, & Hodge, 2011; Williams et al., 1996). In addition, perceptions that significant others (e.g., coaches, sport leaders, PE teachers) provide self-initiated opportunity, meaningful rationale for advised actions, and respect for opinions and feelings may satisfy these needs. These perceptions, known as *autonomy-support*, have been shown to be the antecedent of basic need satisfaction and self-determined motivation among athletes and PE students (Adie et al., 2008; Barkoukis et al., 2010; Reinboth, Duda, & Ntoumanis, 2004).

Likewise, in the sport injury context, studies have provided preliminary support for the relationship between perceived autonomy-support provided by a sports team's physician and athletes' self-determined motivation and adherence to sport injury rehabilitation (i.e., a pivotal element for the prevention of re-injury in sport; Chan et al., 2009). There is also support for the association between self-determined motivation, intentions, adaptive social cognitive beliefs with respect to injury-preventive behaviour in sport (Chan & Hagger, 2012b) and occupational settings (Chan & Hagger, 2012a). However, no previous study has simultaneously tested the links between perceived autonomy-support from the coach and self-determined motivation in sport and injury prevention contexts among elite athletes.

The Trans-Contextual Process

Another important gap in the research is that coaches are often perceived to be less relevant to injury issues in comparison to medical professionals (Chan, Hagger, et al., 2011), but they are nevertheless important because they are the professionals with whom athletes

spend most of their time in a sport context. Previous qualitative research has highlighted that the external pressure from coaches may encourage athletes' acceptance of injury-risk or safety violation (Howe, 2004; Roberick & Waddington, 2000). Furthermore, a growing body of research has supported the view that the self-determined motivation reinforced by perceived autonomy-support is a strong predictor of individuals' attitude, normative beliefs, and perception of control toward health behaviours (Hagger & Chatzisarantis, 2009b), such as injury-preventive actions (Chan & Hagger, 2012a, 2012d). In an injury context these beliefs may include safety commitment, prioritization of injury prevention, attitude toward safety violation, and the personal beliefs that injury is inevitable, worth talking about, and not terrifying (Rundmo & Hale, 2003). These phenomena may highlight the central theoretical tenet in our study, namely "the trans-contextual effect", in which motivation from one behavioural context (i.e., sport) affects the motivational and belief patterns in another related context (i.e., sport injury prevention).

A key premise of this trans-contextual effect is that the transfer of motivation is generalizable across related behaviours. This is consistent with many social psychological theories that explain the generalizability of psychological constructs (e.g., self-concept, and enjoyment) across contexts at different levels of generality (Goetz, Hall, Frenzel, & Pekrun, 2006; Marsh & Yeung, 1998). Similarly, empirical research based on the SDT has also revealed that the global motivational orientation (i.e., the motivation applies to all life domains) and the specific learning motivation of students are reciprocally transferrable (Guay, Mageau, & Vallerand, 2003). A central tenet of which is that the motivational processes that lead to behavioural engagement are applicable to multiple behavioural contexts at the same level of hierarchy. For instance, athletes engaged in sport performance training and competitions in a sport context, and the behaviours relevant to this context, would be different to those in the context of sport injury prevention where athletes undertake injury-preventive

behaviours such as stretching, attending massage or physiotherapy sessions, and neuromuscular training – all behaviours that are not directly relevant to training or preparation for sport performance. However, according to the trans-contextual effect of motivation, behaviour in these two contexts might be compatible in terms of the type and quality of motivation experienced and the organismic goals they service (e.g., satisfaction of psychological needs and to feel autonomous in thought and action). This is because motivation at the lower levels is likely to be governed by higher-order motivational orientations, but also, most importantly, because of motivational transfer at the contextual level.

The premise that motivation is transferrable across contexts is in accordance with the *hierarchical model of motivation* (Vallerand, 2000). According to the model, motivational orientations from SDT operate at three levels of generality (i.e., situational, contextual, and global) and are presumed to be inter-connected. Motivation at *contextual level* (i.e., the overall motivational level of all the tasks submerged in a given context) is regarded as the bridge between motivation at situational level (motivation at the lowest level of the hierarchy that is highly dependent on time and task) and *global level* (motivation at the highest level of the model that is generalized and global in orientation, synonymous with general causality orientation; Deci & Ryan, 1985a; Vallerand, 2000). This hierarchical model may help explain the transferability of motivation between sport and injury prevention.

In particular, at the global level, the two types of general causality orientations, namely autonomy orientation and controlled orientation (Deci & Ryan, 1985a), may serve as catalysts of the trans-contextual motivational effect. Autonomy orientation refers to a relatively stable tendency of being motivated by autonomous reasons such as personal goals and interest, or to perceive events and people as autonomy-supportive (i.e., provision of choice, respect of opinions, and support for competence). Whereas, controlled orientation

refers to the tendency to be motivated by controlled reasons such as external contingency or internal feelings of obligation, or to perceive others as controlling. These causality orientations are important dispositional determinants of self-determined motivation because autonomy orientation is more likely to lead to the satisfaction of psychological needs in comparison to controlled orientation (Vallerand, 2000).

For that reason, these two types of trait-like motivational orientation not only influence motivation at the situational level directly, but also indirectly through their impact on the social environmental (e.g., perceived autonomy-support, a proposed social antecedent of motivation according to SDT) and motivational factors at contextual level (Deci & Ryan, 1985a; Vallerand, 2000). Such tenets may imply that an athlete who holds high autonomy and low controlled orientation is more likely to perceive his or her coach as autonomy-supportive, and such perceptions would further elevate levels of self-determined motivation in sport, and also in other performance-optimizing activities related to sport, such as injury prevention and rehabilitation. Thus, we speculate that causality orientation may help establish the relationship between motivation in sport and motivation for sport injury prevention.

Furthermore, the trans-contextual effect could be instigated by perceptions that significant others (i.e., coach) provide autonomy-support to athletes for sport-related behaviours (e.g., training attendance, specific skills practice) and for behaviours related to sport injury management (e.g., warming up, stretching, strengthening exercises; Chan, Hagger, et al., 2011). This is because athletes' perceptions of autonomy-support from coaches may not only influence self-determined motivation toward sport, but may also affect motivation for behaviours in another related context, such as sport injury rehabilitation (Chan, Hagger, et al., 2011) and, plausibly, in sport injury prevention. Therefore, perceived autonomy-support from the coach might not only be predictive to athletes' motivation in sport, but it could also explain athletes' motivational and belief patterns of sport injury prevention.

In addition, feeling self-determined toward sport means that the athlete possesses high inherent interest and attaches personally-relevant value to sport, which are means to satisfy psychological needs (Vallerand, 2000). Therefore, when an injury arises, or when faced with the prospect of future injury, athletes with high self-determined motivation are more likely to engage in injury-preventive behaviours or rehabilitation for autonomous reasons because they truly want to be able to continue to pursue their valued behaviour in sport, and injury or re-injury (i.e., by rehabilitation) is a key barrier to achieving this goal (Chan & Hagger, 2012a; Chan, Hagger, et al., 2011). Therefore, the trans-contextual transfer of motivation across sport and sport injury contexts occurs because they both service the same autonomous goal, namely, to continue to pursue engagement in an activity that satisfies psychological needs, namely, sport. We plan to empirically test this trans-contextual effect across both contexts by measuring motivation in sport and sport injury-prevention contexts.

Empirical tests of the trans-contextual process of motivation have primarily focused on physical education (PE), and it was consistently found that students' self-determined motivation to be active in a PE context is transferred to the motivation toward physical activities outside school (Hagger, Chatzisarantis, et al., 2009). A recent study also incorporated the concepts of basic psychological need satisfaction into the model, wherein the satisfaction for autonomy and competence were found to be significant mediators of the relationship between PE perceived autonomy-support from teachers' and students' motivation in PE (Barkoukis et al., 2010).

Recent evidence has confirmed the trans-contextual process of motivation in health-related and safety behaviour contexts. For example, a series of recent studies has supported the transfer of motivation across contexts in athletes' rehabilitation from sports injuries (i.e., motivation transferred from the sport context; Chan, Hagger, et al., 2011), and the prevention

and rehabilitation of injuries in occupational settings (i.e., motivation transferred from the work context; Chan & Hagger, 2012a).

The Present Study

In summary, research has supported the hypothesis that self-determined forms of motivation can be transferred between related contexts, particularly for the transfer of motivation of exercise behaviour from educational to leisure-time contexts. Given the prevalence of injuries in sport (Knowles et al., 2006) and the growing amount of research showing that psychological factors like motivation play a key role in athletes' compliance to medical advice to help recover from injury (Chan, Hagger, et al., 2011; Chan et al., 2009), it is important to investigate whether psychosocial factors from the sport context may explain athletes' motivation of injury-preventive behaviours. The overall aim of the present study is to examine a trans-contextual model in which general causality orientation, and perceived autonomy-support, basic need satisfaction, and self-determined motivation in sport predict motivation, beliefs, and behaviour regarding sport injury prevention. The study will make an original contribution to the literature not only by bringing forth a preliminary test of SDT for sport injury prevention among elite athletes, but also by testing the trans-contextual mechanism of injury-preventive motivation with the inclusion of basic need satisfaction, which is unique to the existing literature concerning health and safety (Chan & Hagger, 2012a).

In this study, we tested a number of key premises derived from SDT and the hierarchical model of motivation in a sport injury prevention context. Based on the previous literature (Chan & Hagger, 2012a; Chan et al., 2009; Vallerand, 2000), we present the following hypotheses with respect to the motivational influences on injury prevention in elite sport. First, we hypothesise that the key paths in the motivational sequence of trans-contextual

motivation from perceived autonomy-support to motivation for sport injury prevention will be significant and positive. Specifically, we expect the following motivational sequence to be confirmed: *perceived autonomy-support from the coach→ basic need satisfaction in sport (mediator 1) →self-determined motivation in sport (mediator 2)→self-determined motivation for sport injury prevention*. As such, basic need satisfaction in sport and self-determined motivation in sport are hypothesised mediators within the proposed motivational sequence. Second, the constructs within the proposed motivational sequence are hypothesised to be significantly and positively predicted by autonomy orientation and negatively predicted by controlled orientation. Third, we hypothesise that self-determined motivation for sport injury prevention (mediator 3) would be predictive of injury-related outcomes (forms significant positive associations with adherence to injury prevention, safety commitment, and injury priority, and negative associations with fatalism concerning injury prevention, attitude toward safety violation, barriers to safety communication, and injury worry), and would mediate the relationships between self-determined motivation in sport and these outcome variables.

Methods

Participants

Participants were 533 elite athletes (Mean age = 16.79, *SD* = 2.80; 50.30% male) recruited from 8 elite-sport training centers within the Sichuan Province of China. They were either regional level (15.00%), national level (70.70%), or international level (11.6%) athletes from 13 different sports (16.32% swimming, 15.38% athletics, 15.01% soccer, 9.94% gymnastics, 6.94% cycling, 6.75% badminton, 5.81% volleyball, 5.25% canoeing, 4.88% diving, 4.32% tennis, 4.13% basketball, 3.56% rowing, and 1.69% windsurfing). Athletes had received elite training in their sport for more than 1 year (Mean training years = 3.23, *SD* = 2.15). Participants on average experienced 2.49 injuries (*SD* = 5.11; range from 1 to 80) of in

the previous 6 months, a number of them (15.80%) reported injury that currently affected their training or sport performance, and a large proportion (47.10%) reported prior experience with a sport injury that required at least two weeks of medical attention in the previous two years. Participants and their parent or guardian signed the consent forms to acknowledge that they fully understood the procedures of the study and their participation rights (i.e., voluntary nature of participation, confidentiality of data, and freedom to withdraw from the study at any time without prejudice). Participation was completely voluntary and no inducement was given to participants. The study was approved by the Research Ethics Committee of the University of Nottingham, and supported by the Sichuan Sport Bureau and the coaches and managers of sport teams involved in the study.

Measures

To reduce the effect of common method variance (Doty & Glick, 1998) and the response burden to the participants, psychological measures of the study were distributed across two questionnaires administered by a research assistant to the participants after they had finished their training sessions. The consent forms and the completed questionnaires were collected within 2 days of the questionnaire administration. The first and second questionnaires were administered on two separate occasions, with at least one week apart. The first questionnaire comprised scales measuring demographic variables (i.e., gender, age, years in sport), general causality orientation, basic need satisfaction in sport, sport motivation, and perceived autonomy-support from coaches. The second questionnaire included items to measure self-determined motivation, personal beliefs, and adherence with respect to injury prevention.[4] The research assistant delivered the second questionnaire to the participants

[4]The second questionnaire also comprised measures of the theory of planned behaviour (TPB; Ajzen, 1985) variables for another study (Chan & Hagger, 2012b) concerning about the theoretical integration between SDT and TPB. The study utilized a different theoretical framework, and was setup to test hypotheses related to

across the whole week to enhance the response-rate for this 1-week follow-up, and all the participants managed to complete both questionnaires. The questionnaires were presented in Chinese, the native language of the participants and took 10 to 15 minutes to complete. Items and instructions were either translated using back-translation procedures from their original English versions or, where available, adapted from Chinese versions developed in previous studies. Details of the measures we used are described below, and their example English items and Likert-scale anchors are given in Appendix C.

Autonomy Support, Basic Need Satisfaction in Sport, and Sport Motivation. Perceived autonomy-support from the coach was measured using an adapted version of the Health Care Climate Questionnaire (HCCQ; Williams & Deci, 1996). HCCQ is a single-dimension scale that has frequently been adopted to assess the perceived autonomy-support in health contexts (Adie et al., 2008; Reinboth et al., 2004), and we adopted the six-item-Chinese version developed in a previous study (Chan, Hagger, et al., 2011).

We used the 21-item Chinese version of the Basic Need Satisfaction in Sport Scale (Ng et al., 2011) to assess the three basic psychological needs of athletes, including autonomy, relatedness, and competence (Deci & Ryan, 1985b).We developed an overall basic need satisfaction factor[5] indicated by the means of the autonomy (10 items), competence (5 items), and relatedness (6 items) items.

We used the Chinese version (Chan, Hagger, et al., 2011) of the Behavioural Regulation in Sport Questionnaire (BRSQ; Lonsdale et al., 2008) to measure autonomous and controlled forms of motivation from SDT. We computed a single index[5] of self-determined

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research questions independent of the present investigation. Self-determined motivation for sport injury prevention was the only variable in this study included in our analysis.

[5]Alternative models with autonomy (*r* with competence = .77), competence (*r* with relatedness = .62), and relatedness (*r* with autonomy = .73) as three separate basic need satisfaction latent factors were employed in our analyses. Although the factors demonstrated acceptable level of discriminant validity, the paths and mediation analysis results were highly consistent across the three factors. In order to reduce the complexity of the model, we derived a single score representing the total basic psychological need satisfaction from these three factors.

sport motivation by summing the weighted scores of autonomous and controlled forms of motivation along the SDT continuum (Lonsdale et al., 2009).

Motivation for Injury Prevention. The Treatment Self Regulation Questionnaire (TSRQ; Williams et al., 1996) was used to measure participants' overall autonomous motivation to engage in recommended health-enhancing behaviours. The TSRQ has been adapted for use in different health contexts, such as prescribed weight control or exercise programs (Levesque et al., 2007), and received strong evidence for its score reliability and validity. In this study, we used the sport injury prevention version of TSRQ (Chan & Hagger, 2012b) to measure autonomous (6 items) and controlled motivation (6 items) for sport injury prevention. The relative autonomy index for sport injury prevention was the sum of the weighted scores of autonomous (weight = +1) and controlled (weight = -1) items (Fortier et al., 2007).

Adherence. Following previous research examining injury prevention and rehabilitation motivation in occupational settings (Chan & Hagger, 2012a), we developed nine items to measure the self-reported adherence of sport injury prevention. Participants reported how frequently (5 items) and how much effort (4 items) they invested in engaging in injury-preventive behaviours (e.g., achieving safety objectives, improving physical or mental conditions, caring for an old injury, seeking advice from others; Bahr & Engebretsen, 2009; Emery & Tyreman, 2009).

Injury Beliefs. We adapted 21 items from the Manager Safety Attitude Questionnaire (MSAQ; Rundmo & Hale, 2003) to assess salient injury and safety related beliefs shared by athletes, including safety commitment (3 items; the degree of commitment toward safety guidelines in sport), injury priority (2 items; the extent to which injury prevention is more important than other aspects in sport), fatalism concerning injury prevention (5 items; the belief about the inevitable nature of sport injury), attitudes toward safety violation (5 items;

acceptance toward the violation of safety regulation in sport), barriers to safety communication (2 items; the perceived difficulty of talking to others about sport injury prevention), and injury worry (4 items; the degree of worry toward sport injury). The adaptation was done by firstly screening the dimensions of MSAQ applicable to elite sport, secondly replacing the terms "job", "work", and "career", by "sport" in the items, and thirdly re-examining their comprehensiveness and face validity.

General Causality Orientation. The General Causality Orientation Scale (GCOS; Deci & Ryan, 1985a) was adopted to assess the dispositional autonomy (12 items) and controlled (12 items) orientations of individuals. This study adopted the Chinese version of GCOS developed in a previous study among Taiwanese athletes (Wu & Hwang, 2000).

Analysis

Variance-based structural equation modeling (VB-SEM) was employed to test the hypothesised model using the SmartPLS 2.0 statistical software (Ringle et al., 2005). To estimate latent factor scores and correlations, VB-SEM adopts a partial least-squares algorithm, which is supposed to be distribution-free (i.e., the estimation is not affected by the complexity of the model, small sample size, or non-normality of the data). Therefore, it was unlike the typical covariance-based SEMs which perform model estimation by using an ordinary least-squares algorithm (Reinartz, Haenlein, & Henseler, 2009). We evaluated the fit of the model using a number of indices of convergent and discriminant validity from the measurement model. Convergent validity was considered acceptable when the Cronbach's alpha and the composite score reliability of each dimension were higher than .70, the average variance extracted (AVE) for each factor was higher than 0.50, and the factor loading of each item on its corresponding factor was higher than .70 (Barclay et al., 1995). Discriminant validity was supported when the factor loadings of an item on its own construct was higher

than its cross-loadings on the other constructs and the square-root of the AVE of any construct was higher than its correlation with other constructs (Chin, 1998). Moreover, a bootstrapping resampling technique with 5000 replications was utilized to reveal reliable averaged path estimates and associated significance levels.

We also conducted a mediation analysis (Zhao et al., 2010) to examine whether the proposed mediation effects[6] were present in our hypothesised motivational sequence among the study constructs. Mediation was supported when the independent variable (IV) exerted a significant direct and indirect effect computed by the Aroian test (Aroian, 1947) on the dependent variable (DV), and the direct effect of the IV on the DV was not significant (indication of full mediation) or significantly reduced (indication of partial mediation) when controlling for the effect of the mediator. The ratio between indirect and total effect was computed to indicate the proportion of the total effect explained by the mediator in the IV→DV path.

Results

Preliminary Analyses

The convergent and discriminant validity indices generally met the criteria for acceptable score reliability of VB-SEM (see the Analysis section for the criteria). Regarding convergent validity, composite reliability scores ranged from .72 to .93, AVE values ranged from .55 to .74, and factor loadings ranged from .63 to .91. Cronbach's alpha coefficients ranged from .70 to .92, apart from that for the injury priority (α = .65), barriers to safety communication (α = .66), and injury worry (α = .68) scales. Yet, all the alpha coefficients were above the published criteria of internal consistency (i.e., .60; Cronbach, 1951). For

[6]Four proposed mediation effects (as shown by the number of mediators) are presented in the hypothesised motivational sequence: Perceived autonomy-support →basic need satisfaction (proposed mediator 1)→self-determined motivation in sport (proposed mediator 2)→self-determined motivation for sport injury prevention (proposed mediator 3)→ outcome variables, with the two causality orientations as covariates.

discriminant validity, items had factor loadings higher than .70 (median factor loading = .79), and the factor loadings were higher than their cross-loadings on the other factors by an average difference of .37. The square-root of the AVE for each construct was larger than the construct correlation with other factors by an average difference of .33. Table 4.1 displays the correlation matrix, distributions (mean and *SD*), and internal score reliability statistics (Cronbach's alpha, composite score reliability) of the variables.

Table 4.1 Descriptive Statistics for Study 5

Correlation matrix and distribution of the variables

	GCOS-Auto	GCOS-Cont	A-Support	Needs	SDI-Sport	SDI-Injury	Adher	Commit	Priority	Fatalism	Violation	C-Barrier	Worry
GCOS-	1.00												
GCOS-	.45**	1.00											
A-	.49**	.16**	1.00										
Needs	.64**	.24**	.64**	1.00									
SDI-	.48**	-.04	.48**	.56**	1.00								
SDI-	.24**	-.09	.29**	.21**	.38**	1.00							
Adher	.32**	.21**	.36**	.36**	.26**	.10*	1.00						
Commit	.30**	.18**	.39**	.38**	.30**	.21**	.60**	1.00					
Priority	.30**	.04	.38**	.32**	.29**	.40**	.36**	.41**	1.00				
Fatalism	.06	.33**	.00	.07	-	-.26**	.28**	.21**	.08	1.00			
Violation	.09*	.35**	-.01	.09*	-	-.41**	.20**	.13**	-.11*	.64**	1.00		
C-Barrier	.01	.33**	-.04	-.02	-	-.35**	.08	.04	-.14**	.55**	.56**	1.00	
Worry	.07	.27**	-.06	.07	-	-.22**	.23**	.18**	.07	.51**	.54**	.52**	1.00
Mean	5.02	4.32	4.98	5.10	8.41	1.13	4.26	5.29	3.69	3.48	3.11	3.73	5.02
SD	1.11	1.21	1.68	1.14	5.67	1.42	1.22	1.68	1.40	1.45	1.79	1.45	1.11
A	.85	.86	.92	.87	-	-	.80	.70	.65	.73	.77	.66	.68
r_r	.88	.78	.94	.92	-	-	.74	.78	.85	.72	.82	.85	.73

Note. GCOS-Auto = autonomy orientation; GCOS-Cont = controlled orientation; A-Support = perceived autonomy-supportive coaching climate; Needs = basic psychological needs satisfaction; SDI-Sport = self-determination index in sport; SDI-Injury = self-determination index for sport injury prevention; Adher = adherence; Commit = safety commitment; Priority = injury priority; Fatalism = fatalism concerning injury prevention; Violation = attitude toward safety violation; C-Barrier = barriers to safety communication; Worry = injury worry; r_r= composite score reliability (Raykov, 1997).

* $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test.

Path Estimates

The mean estimates generated from the bootstrapped re-sampling method fully supported our hypothesised motivational sequence (see Figure 4.1). The paths included in our sequence: perceived autonomy-support→basic need satisfaction (Path 1)→self-determined motivation in sport (Path 2)→self-determined motivation (Path 3) for sport injury prevention were all positive and significant as predicted. With regards to the independent variables at global level, while there were positive effects for autonomy orientation on perceived autonomy-support, basic need satisfaction, self-determined motivation in sport, and self-determined motivation for sport injury prevention as expected, the corresponding effects of controlled orientation were not significant. Self-determined motivation for sport injury prevention formed significant positive associations with adherence, safety commitment, and injury priority, and negative relationships with fatalism concerning injury prevention, attitude toward safety violation, barriers to safety communication, and injury worry.

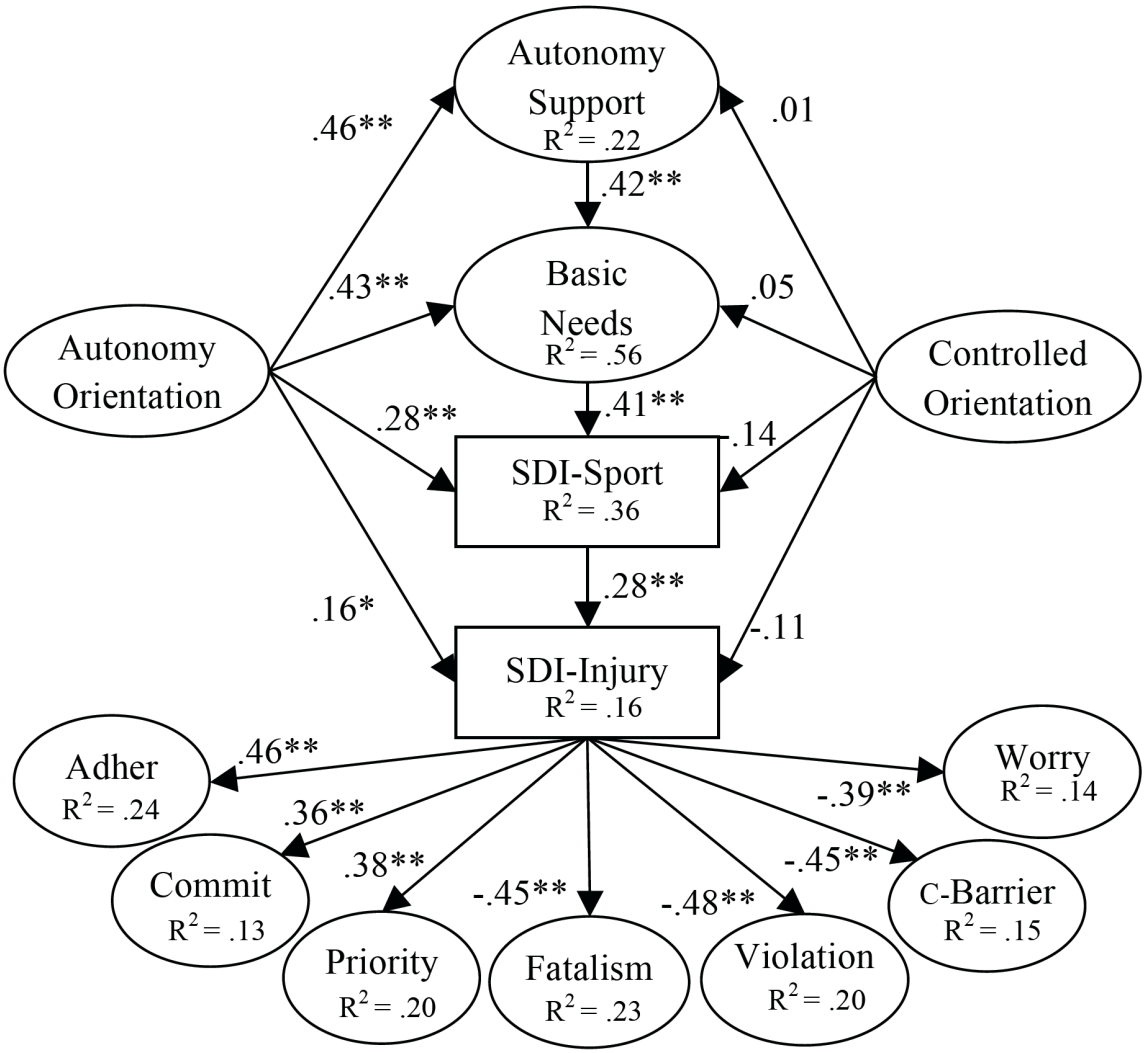

Figure 4.1 Path estimates for the Trans-Contextual Motivation of sport injury prevention (Study 5).

Note. Autonomy support = perceived autonomy-support; SDI-Sport = self-determination index in sport; SDI-Injury = self-determination index for sport injury prevention; Commit = safety commitment; Priority = injury priority; Fatalism = fatalism concerning injury prevention; Violation = attitude toward safety violation; C-Barrier = barriers to safety communication; Worry = injury worry.

* $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test.

Mediation Analysis

Mediation analyses supported the effects for two of our hypothesised mediators. Basic need satisfaction (mediator 1) partially mediated the relationship between perceived autonomy-support and self-determined motivation in sport. Self-determined motivation for sport injury prevention (mediator 3) was shown to be a significant (partial) mediator of the effects of self-determined motivation in sport on all the outcome variables (i.e., adherence, safety commitment, and injury priority, fatalism concerning injury prevention, attitude toward safety violation, barriers to safety communication, and injury worry). However, self-determined motivation in sport (mediator 2) did not mediate the relationship between basic need satisfaction and self-determined motivation for sport injury prevention as hypothesised, but its mediating effect was significant in the relationship between perceived autonomy-support and self-determined motivation for sport injury prevention (see Table 4.2 for details).

Table 4.2 Mediation analysis results (Study 5)

Mediation analysis results

Path	Direct Effect	Combined Effects	Total Effect	Indirect Effect	Indirect/ Total	Mediation Type
A-Support→ Needs→SDI-Sport	.29**	.15**	.29**	.13**	.46	Partial
A-Support →SDI-Sport→SDI-Injury	.14**	.09	.14**	.06**	.41	Partial
Needs→ SDI-Sport→SDI-Injury	.09	-.03	.07	.12**	1.79	None
SDI-Sport→SDI-Injury→Adherence	.40**	.32**	.39**	.07**	.19	Partial
SDI-Sport→SDI-Injury→Commit	.35**	.28**	0.34**	.06**	.18	Partial
SDI-Sport→SDI-Injury→Priority	.29**	.17**	0.26**	.09**	.34	Partial
SDI-Sport→SDI-Injury→Fatalism	-.38**	-.21**	-0.33**	-.10**	.31	Partial
SDI-Sport→SDI-Injury→Violation	-.31**	-.09**	-0.23**	-.11**	.49	Partial
SDI-Sport→SDI-Injury→Talk	-.30**	-.11**	-0.22**	-.12**	.56	Partial
SDI-Sport→SDI-Injury→Worry	-.28**	-.12**	-0.22**	-.10**	.43	Partial

Note. A-Support = perceived autonomy-supportive coaching climate; Needs = basic psychological needs satisfaction; SDI-Sport = self-determination index in sport; SDI-Injury = self-determination index for sport injury prevention; Commit = safety commitment; Priority = injury priority; Fatalism = fatalism concerning injury prevention; Violation = attitude toward safety violation; C-Barrier = barriers to safety communication; Worry = injury worry. * $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test.

Discussion

The present study is the first to examine the trans-contextual process of motivation within a competitive sport context, where sport motivation "transfers" into an injury-preventive motivation. To summarize, our findings supported our three key hypothesised sets of relations among the study variables: (1) the trans-contextual process of motivation between the sport and sport injury prevention context, (2) the effects of general causality orientations on the trans-contextual effect, and (3) the prediction of self-determined motivation for sport injury prevention on the behavioural and belief outcomes. Overall, the present research provided additional supporting evidence for the proposed trans-contextual effects of motivation derived from SDT and the hierarchical model of motivation.

The Trans-Contextual Effect

Unlike the previous studies of Chan and Hagger (2012a), we controlled the effect of global-level-motivation (i.e., the general causality orientation) on the relationship between motivations in two related contexts. However, we obtained a pattern of results consistent with their findings (Chan & Hagger, 2012a), indicating that athletes' motivation in sport is related to the quality and magnitude of their motivation for injury prevention within sport. In addition, self-determined motivation in sport predicted self-determined motivation for sport injury prevention in a higher magnitude than the two forms of general causality orientation did, thus it might depict that the trans-contextual mechanism was not merely driven by individuals' personality trait of motivation, but it was also be channeled by the transfer of motivation between related contexts under the same hierarchy according to our speculation.

This implies that athletes with autonomous motivational orientations in sport are more likely to be motivated to prevent sport injury for autonomous reasons such as finding injury prevention optimally challenging and highly relevant to achieve life goals, as opposed to

controlled reasons such as to avoid upsetting others (e.g., coach, physiotherapist). This finding is particularly important for the promotion of injury prevention within the current competitive environment in sport where performance and winning usually override actions or decisions that aim to reduce the likelihood or severity of injury (Roberick & Waddington, 2000).

Similarly, controlled motivation in sport may heighten the likelihood of endorsing controlled motivation for sport injury prevention. Thus, the external focus among those with controlling motivational orientations in sport (e.g., "I am training hard because I don't want to disappoint my coach"), according our results, may give rise to the endorsement of controlling motives for sport injury prevention (e.g., "I wear a cycling helmet only because it is the rule"), which is likely to further reduce athletes' initiative and sense of ownership over injury-preventive actions. In other words, the more the competitive environment emphasizes extrinsic reasons such as winning and external contingencies associated with the game (i.e., the promotion of controlled motives in sport), the less the players might regard the prevention of injury or re-injury as being a meaningful and personally-fulfilling experience. This may explain the social process that leads to the consolidation of the 'playing-hurt' or risk-averse culture in sport (Roberick & Waddington, 2000) and provide a plausible reason why the increasing professionalism in sport could be associated with higher incidence of sport injury (Howe, 2004). Indeed, research using approaches from sport policy and sociology should be conducted to further examine these arguments alongside the current evidence.

Likewise, the amount of variance explained in the self-determined motivation for injury prevention was comparable to a previous study in an occupational context (Chan & Hagger, 2012a). The size of the effect was small, and this is probably because the current study computed a single composite score (i.e., the relative autonomy index) to represent overall self-determined motivation instead of making a distinction between autonomous and

controlled forms of motivation. This approach though reduced the complexity of the model, making the results more interpretable, the power of prediction could have been weakened because the measurement errors of self-determined motivation in both contexts was heightened cumulatively whilst the independent predictive validity of different behavioural regulations did not accumulate to produce stronger predictive power. This could explain why a higher amount of variance in self-determined motivation for sport injury rehabilitation was explained by autonomous motivation and controlled motivation in sport (Chan, Hagger, et al., 2011). Another explanation could be the presence of an injury-tolerance culture in a sport injury prevention context (Howe, 2004; Roberick & Waddington, 2000) as noted previously. Such a maladaptive culture might plausibly lead some athletes to accept sport injury and the risk of injury as "part of the game" (Howe, 2004; Roberick & Waddington, 2000), and in this case, self-determined motivation in sport might ironically become an antecedent of self-determined motivation for risk-taking behaviours, rather than for the behaviours of injury prevention and safety. This possibility is an interesting avenue for future research, and it also raises the importance of safety education in elite sport.

Perceived Autonomy Support and Basic Need Satisfaction

Consistent with SDT (Deci & Ryan, 1985b) and previous research (Adie et al., 2008; Reinboth et al., 2004; Vallerand, 2000), perceived autonomy-support from the coach was shown to be a positive predictor of basic need satisfaction which further associated with the facilitation of self-determined motivation in sport. However, it is noteworthy that sport motivation was only significant in mediating the direct path between autonomy-support and motivation for sport-injury prevention, but not the path between basic need satisfaction and motivation for sport-injury prevention. This is inconsistent with our hypothesis that basic

need satisfaction would be a more proximal predictor of self-determined motivation than perceived autonomy-support.

Nevertheless, athletes' basic need satisfaction in sport is not equivalent to the corresponding perception in the injury prevention context, so injury-preventive motivation would potentially be dependent on whether the athletes' basic psychological needs were also fulfilled in the injury prevention context (Keats, Emery, & Finch, 2012). Bearing in mind that perceived autonomy-support is a contextual-level determinant of motivation according to Vallerand's (2000) hierarchy which may carry its impact down to the situational level of generality. Thus, an autonomy-supportive coaching climate might also involve the provision of support for psychological needs regarding players' injury-preventive behaviours, and it could carry a more salient effect on motivation for sport injury prevention. Future research should scrutinize the role of significant others' (e.g., coaches and team physicians) actual support for the basic psychological needs of athletes with regard to injury prevention.

Motivation for Sport Injury Prevention

In this study, we measured a series of outcomes associated with the self-determined motivation for sport injury prevention, and our findings were consistent with previous studies that have applied SDT to explain injured athletes' intentions to follow, and actual adherence to, medical guidelines (Chan, Hagger, et al., 2011; Chan et al., 2009). Self-determined motivation was not only associated with athletes' adherence to injury prevention, it was also shown to be a strong predictor of a number of beliefs concerning safety and injury prevention, which were consistent with the findings of previous studies that predicted individuals' social cognitive beliefs by self-determined motivation for injury prevention in sport (Chan & Hagger, 2012b) and occupational contexts (Chan & Hagger, 2012a).

These studies examined beliefs from the theory of planned behaviour (Ajzen, 1985). In contrast, the current study used the MSAQ to measure a set of attitude-based beliefs that were more generalized in measurement and conceptualization. These measures had some commonalities with the beliefs outlined in the theory of planned behaviour and other attitude theories in that they serve as antecedents of intentional behaviour (Rundmo & Hale, 2003). The hypothesised prediction of these attitude-based beliefs by the motivational variables in the current study is consistent with Deci and Ryan's (1985b) original contention that people form attitudes and beliefs consistent with motivational orientations from SDT. According to SDT, these beliefs drive future behavioural engagement because they inform the formation of intentions to do the behaviour in the future in accordance with many attitude or belief-based social cognitive theories like the TPB. Of course these are not the only types of beliefs people might hold with respect to sport injury. There may be beliefs incompatible with SDT motives. For example, a cyclist might think that downhill racing without wearing a helmet can be dangerous (a positive belief of sport injury prevention), but the primary reason to wear a helmet in a competition could be that it is the rule (a controlled motive). This is why the relationships between beliefs and SDT constructs, although strong, are not perfect leaving some variance in the beliefs unexplained (Chan & Hagger, 2012b; Hagger & Chatzisarantis, 2009b). Therefore, the current data are consistent with previous research that has shown beliefs from social cognitive theories like the theory of planned behaviour mediate the effects of motivational orientations from SDT on intention and behaviour (Chan & Hagger, 2012b; Hagger & Chatzisarantis, 2009b), and these reflect the process by which SDT motives affect variables implicated in decisions to engage in the behaviour in future through intentions. This is consistent with SDT (Deci & Ryan, 1985b) which suggests that motives drive the formation of beliefs that serve to perpetuate experiences of autonomy and competence. Even though we did not examine the mediating role of belief-based variables on the motivation-behaviour

pathway as has been done previously in models integrating SDT and attitude theories like the theory of planned behaviour (Chan & Hagger, 2012b; Hagger & Chatzisarantis, 2009b), our findings may inform future tests of the effects of generalized motives from SDT on injury prevention mediated by proximal social-cognitive variables like beliefs.

General Causality Orientations

As expected, autonomy orientation formed positive associations with perceived autonomy-support, basic need satisfaction, and self-determined motivation in both contexts (i.e., sport, and injury prevention), but the proposed negative predictions by controlled orientation were not evident. Therefore, these findings suggest that autonomy orientation is more effective than controlled orientation for establishing connections between motivation at different contexts and levels of generality. It supports the premises from SDT (Deci & Ryan, 1985b) and the "top-down effect" of Vallerand's (2000) model that generalized orientations act as distal influences on motivational orientations in a number of contexts. The reason for the non-significant effects for controlled orientation is that a controlling and need thwarting environment is not synonymous with the absence of perceived autonomy-support and basic need satisfaction (Bartholomew, Ntoumanis, Ryan, & Thogersen-Ntoumani, 2011). With these considerations in mind, the development of reliable measures for constructs like need thwarting and controlling behaviours is crucial for future research to uncover the darker side of social and motivational patterns within an injury-prevention context (Ryan & Deci, 2000a).

Limitations and Further Directions

Apart from the commendations above, there are some limitations of this study that need to be addressed and we hope that these will stimulate future research in this area. With a cross-sectional design, we were unable to draw definite conclusions about the causal and temporal order of the variables within the model, and a lack of follow-up assessments and

control for past behaviour also hindered our understanding of how changes in injury-preventive behaviour initiated by motivation and perceived autonomy-support are related to the change of sport injury incidence over time. However, the evidence from the present study could form the basis of an experimental or intervention study in which the constructs from the integrated model of trans-contextual motivation are independently manipulated, providing a robust test of the differential effects on the various components, and the evidence regarding the discriminant validity, and the causal and meditational processes of the model. Despite of real challenges in terms of data attrition in the longitudinal design, the difficulty in manipulating the motivational variables while holding other variables constant, and the effects of error artifacts (e.g., non-compliance, treatment fidelity, mere-measurement), such methods will be an avenue for future research into the psychosocial aspects of sport injury prevention.

Moreover, the implementation of a number of adapted measures and the comprehensiveness of the items for the youth participants in this study might undermine the precision of measurement. Some of the adapted dimensions of the MSAQ constructs (e.g., injury priority, barriers to safety communication) measured by small number of items might have restricted coverage of the entire construct. Also, a few reliability scores (i.e., coefficient alphas) of these constructs were lower than the cutoff criterion for VB-SEM. These scores are often regarded as the lower-boundary of score reliability and could have been affected by item-per-dimension and the total number of factors within the scale (Cortina, 1993; Raykov, 1997). On this basis we should interpret our findings with caution due to these measurement limitations. Further studies should examine the face validity and test-retest reliability of the scales within the samples of different age groups, and should continue developing and refining the scales by multi-method (e.g., qualitative-quantitative) and cross-cultural approaches (Hagger & Chatzisarantis, 2009a). Finally, using self-report assessment of

adherence might embrace problems associated with social desirability and memory-bias. Even though these factors would likely inflate the measurement error and attenuate the path estimates in the model than increase the potential for type-I error (Williams et al., 1996), future studies should develop objective ways to measure adherence to injury-preventive behaviours and behaviours related to safety-violation in sport.

Conclusions

In conclusion, our study presented a preliminary test of the dispositional, psychosocial, and motivational processes associated with sport injury prevention. Results revealed that general causality orientation predicts the psychological components of the proposed trans-contextual transfer of motivation, and athletes' self-determined motivation in sport is related to the endorsement for motivation in a different, but related, sport context. Thus, the associations between motivational factors at the global, contextual, and situational levels of generality convey important information for sport policy, team management, and coaching strategies to build up an injury-free environment for athletes.

Implications of Chapter 4

Study 5 reported in this chapter extended the evidence regarding the trans-contextual effect of motivation to the preventive behaviours and beliefs about safety in sport, and it also illustrated that basic need satisfaction was not associated with the trans-contextual effect of motivation in the model. The promising findings of the model in Study 5, together with those of Studies 1 to 4, indicated that the model might not only be applicable to explaining health and safety behaviours in sport, so the following studies in the thesis (reported in Chapter 5 and Chapter 6) were set out to extend the model to other health-risk contexts (i.e., occupational injury, and myopia).

Chapter 5

Autonomous Forms of Motivation Underpinning Injury Prevention and Rehabilitation among Police Officers: An Application of the Trans-Contextual Model

(Study 6 and 7)

A version of this Chapter is published as:

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Overview of Chapter 5

Chapter 5 presents two studies (Studies 6 and 7) that aim to test the first (i.e., the trans-contextual process of motivation) and second (the theoretical integration between SDT and the TPB) tenets of the thesis within an occupational injury setting. Study 6 tested both of the tenets for the prevention of occupational injury, so it was a replication of Study 4 (Chapter 3) and Study 5 (Chapter 4) in a work domain, and the sample was full-time police officers (N = 207; *M* age=37.24, *SD*=9.93). Likewise, Study 7 examined the first tenet of the thesis for the rehabilitation of occupational injury, but unlike Studies 1 and 2 (Chapter 2) it included a retrospective measure of the length of recovery as the dependent variable, and the sample was recruited from the full-time police officers (N = 87; *M* age = 38.27, *SD* = 9.94) in Study 6 who reported a recent occupational injury that required medical attention. However, Studies 6 and 7 were brief investigations because only autonomous forms of motivation were measured.

The results of Study 6 revealed that the positive effect of perceived autonomy support from supervisor on autonomous motivation for injury prevention (M-injury) was fully mediated by autonomous work motivation (M-work), and the positive effect of M-injury on intention was fully mediated by attitude and subjective norm. On the other hand, the results of Study 7 showed that the positive effect of perceived autonomy support from supervisor on autonomous treatment motivation (M-treatment) was partially mediated by M-work, and the positive effect of perceived autonomy support from physician on treatment adherence was fully mediated by M-treatment. Yet, there was no effect of treatment adherence on recovery length.

In conclusion, Studies 6 and 7 presented in this chapter extended the generalisability of the two tenets (*tenets 1 and 2; see Figure 1.1*) of the model proposed in the current thesis from sport injury settings (reported in Chapters 2 to 4) to a more general health and safety

domain (i.e., injury prevention and rehabilitation in an occupational setting). Findings of both studies again supported the motivational sequence of the trans-contextual process of motivation (*tenet 1*) and the theoretical integration of SDT and the TPB (*tenet 2*). Therefore, the model defined by the two tenets of the thesis appears to be useful not only for the prediction of the intention or the behaviour of sport injury prevention and rehabilitation, but also for explaining the motivational, social cognitive, and behavioural patterns of public health and safety behaviours. These promising findings once more address the importance of promoting an autonomy supportive environment. When significant others, such as coaches and supervisors, provide support for personally-valued outcomes, present tasks in an autonomy-supportive manner (e.g., acknowledging commitment, providing a clear rationale, and providing choice), and foster competence for any advisory actions, individuals are more likely to experience increased personal engagement and sense of ownership over their behaviour. Such experiences are relevant to the motivational and social cognitive factors that affect health and safety actions in many life domains (e.g., sport and work).

Introduction

Physical injuries resulting from overuse, accidents, and environmental hazards frequently occur in the workplace (Health & Safety Executive, 2010). The increasing evidence that loss in life years and quality of life resulting from injury are comparable to that of cancer, stroke, and heart disease has resulted in injury prevention and rehabilitation receiving increased attention in national public health departments in recent years (British Medical Association, 2001; PRC Standing Committee of the National People's Congress, 2002). Although the public health sectors have put forward substantial financial resources and legislation to reduce the environmental risk factors for injury and improve the quality of medical services to treat injury (Corso, Finkelstein, Miller, Fiebelkorn, & Zaloshnja, 2006), workers' non compliance to safety guidelines (Laurence, 2005; Runyan et al., 2006) and musculoskeletal injured patients' poor adherence to prescribed treatment (Bassett & Prapavessis, 2007) are still frequently reported. These non-compliant behaviours may eventually lead to higher risk of injury, re-injury, and impaired/extended recovery. These social phenomena may imply that enhancing medical or injury preventive resources, or setting up legislation for occupational safety, might not be sufficient to ensure workers' full compliance to safety and medical recommendations, because injury prevention and rehabilitation behaviours are relatively volitional actions that often require great deal of self-discipline, compliance, and personal awareness to maintain (Burstyn, Jonasi, & Wild, 2010; Chan et al., 2009). As such, it is important for researchers to investigate the psychological factors that contribute to individuals' compliance to health and safety guidelines with respect to injury (Gielen & Sleet, 2003).

Motivation is regarded as one of the crucial psychological factors impacting behavioural engagement, compliance, and persistence for volitional behaviours in health and

medical contexts (Chan et al., 2009; Rundmo & Hale, 2003; Williams, Lynch, & Glasgow, 2007) and this factor has been central to many social psychological models adopted to explain behaviour in these contexts (Conner & Norman, 2005; Orbell, 2007). The present study applied the trans-contextual model (TCM; Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, et al., 2009) to understand the motivational dynamics and psychosocial factors (e.g., perceived autonomy support) that influence police officers' intentions for injury prevention and rehabilitation adherence of occupational injury.

The Trans-Contextual Model

The central premise of the TCM is that motivation in one context (e.g., physical education) can be transferred to motivation in another related context (e.g., leisure time physical activity; Hagger & Chatzisarantis, 2009; Hagger, et al., 2005). The model was developed through the integration of two prominent theories in social psychology: self-determination theory (SDT; Deci & Ryan, 1985, 2008) and the theory of planned behaviour (TPB; Ajzen, 1985, 1991). The component theories and the bases for the integration within the TCM will be presented in the next sections.

Self-determination theory. SDT is an organismic theory derived from humanistic traditions that aims to explain human behaviours by motivation, trait characteristics, psychological needs, and goal contents (Deci & Ryan, 1985b, 2008). The TCM was derived from a core premise of one of the sub-theories of SDT, the organismic integration theory, which concerns the taxonomic organization of different human motives according to their level of self-determination (Deci & Ryan, 2008). According to the theory, motivation is determined by the reasons individuals perform behaviours. These motives are regarded as *behavioural regulations* and their relative importance (i.e., strength) may determine the extent to which people are motivated to pursue and persist with behaviours. Central to organismic

integration theory is the distinction between two forms of human motivation: autonomous and controlled. *Autonomous motivation*[7] refers to engagement in behaviour for internally-referenced reasons that emanate from the self, whereas *controlled motivation*[8] refers to the engagement in behaviour for externally-referenced reasons and to attain goals based on contingencies perceived as emanating from outside the individual (Deci & Ryan, 1985b, 2008). Individuals citing autonomous reasons for engaging in behaviour are likely to perceive the behaviour as volitional, enjoyable, exciting, optimally challenging, and meaningful to their life values, as opposed to those acting for controlling reasons who view their actions as determined by external demands from social agents or to avoid externally-referenced outcomes such as guilt and shame.

Autonomous motivation is often referred as self-determined motivation because actions are perceived to be self-initiated. According to Deci and Ryan (1985b, 2000) it is more adaptive than controlled motivation in facilitating behavioural compliance, long-term commitment, and other positive motivational outcomes (e.g., general well-being) because this self-determined form of motivation is more compatible with the human active nature of growth, integration, and development. Thus, it is important to address the antecedents of autonomous motivation. In this respect, it is proposed in SDT that if individuals perceive social agents (e.g., supervisors) in their environment to be autonomy supportive, they are more likely to endorse autonomous forms of motivation. In particular, *autonomy support* is

[7]There are three different forms of autonomous motivation in SDT (Deci & Ryan, 2000): (1) Intrinsic motivation, the most self-determined form of motivation, implies behavioural engagement for the inherent pleasure in the activity; (2) Integrated motivation, a less self-determined form of autonomous motivation than intrinsic motivation, is adopted when actions are coherent with life values or other structures within the self; (3) Identified motivation, the least self-determined form of autonomous motivation, represents performing acts for personally important values, which indeed are not fully emanated from the sense of self.

[8]There are two forms of controlled motivation in SDT (Deci & Ryan, 2000, 2008): (1) External motivation, the least self-determined form of controlled motivation, refers to behaviours executed merely for attainment of externally references rewards (e.g., money and promotion) or avoidance of negative consequences (e.g., punishment, fines); and (2) Introjected motivation, a controlled form of motivation which is somewhat more self-determined than external motivation, is adopted when we act for satisfying social obligations in order to avoid being guilty, shameful, or under-pressure.

characterized by social agents' encouragement of choice and opportunity, consideration of feelings and opinions, and emphasis of communication regarding the rationale behind the advisory behaviours (Deci et al., 1994; Hagger, Chatzisarantis, Hein, et al., 2007).

The concept of autonomy support and its relationship with autonomous motivation and behaviour might be somewhat in agreement with the literature suggesting that various forms of social support (e.g., emotional and instrumental support) from significant agents (e.g., medical providers) play an important role on individuals' treatment adherence (Rundmo & Hale, 2003) and compliance to safety guidelines (Burstyn et al., 2010; Gielen & Sleet, 2003). In addition, the commitment to, and perceived importance of, occupational safety actions have been found to be important factors related to intentions to engage in safety behaviour and actual compliance (Rundmo & Hale, 2003). Research findings support the proposition, derived from SDT, that when autonomously motivated workers who recognize injury preventive behaviour as something personally meaningful and worthy to enact, they would be more committed to safety regulations. A study by Burstyn, Jonasi, and Wild (2010) among occupational safety inspectors explored the potential effect of autonomy support on occupational safety. Results suggested that autonomy-supportive inspectors tended to issue fewer severe safety compliance orders, and were more efficient in resolving problems with safety compliance in the workplace. However, Burstyn and colleagues (2010) did not investigate the impact of autonomy support on the motivational consequences proposed by the SDT. With regards to rehabilitation compliance, Chan, Lonsdale, Ho, Yung, and Chan (2009) conducted a preliminarily investigation of the role of autonomy support from physiotherapists on patients' motivation toward, and adherence to, home-based physiotherapy exercise. Results were consistent with SDT such that autonomy support from physiotherapists was positively associated with autonomous treatment motivation and adherence. Moreover, it was found that the positive association between autonomy support and treatment adherence was

fully mediated by autonomous treatment motivation. Hence, the tenets of SDT appear useful in identifying the motivational antecedents of rehabilitative behaviours and may potentially help explain actions involving injury prevention.

Theory of planned behaviour. The aim of the TPB is to explain the psychosocial factors affecting human behaviour, but focuses on the decision-making processes that lead to behavioural engagement from a social cognitive perspective (Ajzen, 1985). A concept central to TPB is *intention*, which represents the willingness and effort individuals plan to exert toward engaging in a target behaviour in the foreseeable future (Ajzen, 1985). Intention is proposed to be the most proximal predictor of behaviour and, according to TPB (Ajzen, 1985, 1991), is a function of three social cognitive and belief-based constructs, namely, attitude, subjective norm, and perceived behavioural control (PBC). *Attitude* reflects individuals' positive or negative evaluation of a target behaviour (Ajzen, 1985). *Subjective norm* refers to the perceived appropriateness or acceptability of the target behaviour under the social environment encompassed by all the significant agents of the individuals (Ajzen, 1985). *PBC* represents how confident or difficult individuals feel with regards their participation in the target behaviour (Ajzen, 1991). PBC is often regarded as synonymous to self-efficacy or confidence toward engaging in a behaviour (Bandura, 1998), but it has been argued that PBC may also represent perceived control over external barriers (Rhodes & Courneya, 2003). Importantly, intention is proposed as a mediator of the effects of attitudes, subjective norms, and PBC on behaviour, reflecting the reasoned, planned processes by which these factors influence action (Ajzen, 1991). According to TPB (Ajzen, 1991), however, PBC can also predict behaviour directly independent of intentions should it adequately reflect real barriers or limits to control over the behaviour.

TPB has been recognized as one of the important theories that practitioners should consider when implementing behaviour change interventions for injury prevention (Gielen &

Sleet, 2003; Hardeman et al., 2002). However it has only been tested in a few studies in the areas of occupational safety and students' injury preventive behaviour. For example, in a prospective study of fire safety training among university staff, participants who reported higher attitude, subjective norm, and PBC were more likely to have higher intentions to attend a fire training course and heightened intentions predicted course attendance over a three-month period (Sheeran & Silverman, 2003). In addition, Lajunen and Resänän (2004) applied the TPB to predict teenagers' intentions for the use of bicycle helmet. They found that the intention to use a helmet was positively predicted by attitude and subjective norm. Such findings highlight the utility of the TPB in explaining variance in behaviour in safety and injury prevention contexts.

Trans-contextual model. The key theoretical concepts from SDT and TPB are integrated in the TCM. Such theoretical integration between SDT and TPB was consolidated in the TCM to provide a more comprehensive understanding about motivated behaviours (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009). SDT is an organismic theory of motivation and provides detail on the origins of constructs from the social cognitive theories (e.g., the TPB; Deci & Ryan, 1985). However, the belief systems and decision-making processes involving human behaviour are not explicitly outlined in the theory. In contrast, the processes by which behavioural, normative, and control beliefs are related to behaviour are outlined in the TPB (Ajzen, 1985, 1991), but the fundamental motives behind these beliefs are not explained in the model. For instance, a behaviour initiated by either one's true sense of self (i.e., autonomous reason), as opposed to a feeling of obligation (controlled reason), could lead to a very different set of beliefs, which would further impact on the implementation of the behaviour. Incorporating the two theories could therefore offer a reasonable framework for these motivational consequences. As a result, it

was proposed in the TCM that autonomous motivation is a distal and formative factor that influences the proximal belief-oriented factors of behaviours from the TPB.

In particular, the social-environmental and motivational predictors of behaviours based on SDT are included in the TCM. In the model it is explicitly proposed that autonomy support and autonomous motivation are related to behaviour positively and in a motivational sequence: autonomy support → autonomous motivation → behaviour. However, the proximal decisional processes leading to behaviour are further specified in the TCM through the introduction of the four variables as mediators of the relationship between motivation and engagement in future behaviour. Particularly, it is proposed that the attitude, subjective norm, and PBC (i.e., constructs from the TPB) mediate the relationship between autonomous motivation and intention, and the effects of these three variables on behaviour are, in turn, mediated by intention. This means that motives to engage in behaviour are important in the development of belief-based factors that lead to future behaviour.

Furthermore, hypotheses from the hierarchical model of motivation (Vallerand, 1997) are incorporated in the TCM such that the endorsement of motivational regulations are governed by the three inter-connected levels of generality (Hagger, Chatzisarantis, et al., 2009), including the global level (personality or trait-like variables), contextual level (event or social environment-related variables), and situational level (time-specific variables). According to Vallerand (1997), the endorsement of motivation in a given situation is dependent not only on global-level motivation, but also on the motivation from other related contexts. As such, the TCM hypothesises that motivation in one context can be transferred onto motivation of another related context (Hagger, Chatzisarantis, et al., 2009). Such hypothesis was initially proposed in regards to school pupils' exercise motivation (Hagger, Chatzisarantis, et al., 2003).

Specifically, according to the premises of the TCM (Hagger, Chatzisarantis, et al., 2003), autonomy support from teachers of physical education (PE), a social environmental factor that influence autonomous forms of motivation toward physical activity among school children in PE at the contextual level, can influence autonomous motivation toward exercise in another context (i.e., leisure time). Furthermore, autonomous motivation toward leisure-time physical activity at the contextual level is proposed to influence intentions to engage in physical activity in the future, which reflects situational motivation toward physical activity. Tests of the TCM support these key hypotheses. In an initial test of the model, students' autonomous motivation in PE was found to positively predict autonomous motivation for physical activity in leisure-time (Hagger, Chatzisarantis, et al., 2003). Furthermore, the effect of perceived autonomy support from PE teachers on students' autonomous motivation in leisure-time was fully mediated by students' autonomous motivation in PE (Hagger, Chatzisarantis, et al., 2003). The main premises for the TCM were further supported in samples from Singapore, Estonia, Hungary, Finland, and Greece (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009). These data provide a robust support for the validity of TCM, and have initiated an attempt to test the basic tenets of the model in other contexts (e.g., injury rehabilitation; Chan, Hagger, & Spray, 2011).

Application of TCM in an Injury Context

Chan, Hagger, and Spray (2011) reported two studies investigating the relationships between autonomous sport motivation and autonomous treatment motivation among sport players of different levels of ability who had experienced a variety of moderate to severe physical injuries in sport. Findings for both recreation-level and professional players consistently showed that sport participants who endorsed higher autonomous motivation in sport, in contrast to controlled motivation, were more likely to be autonomously motivated to

undergo treatment for their sport injuries. In addition, the authors reported that autonomous treatment motivation was a strong positive predictor of intentions for adhering to the prescribed treatment of sport injury in the future. With this promising finding in the sport context, Chan and colleagues (2011) proposed that TCM may potentially be applied to explain individuals' motivation and behaviour in other injury-related contexts such as occupational injury. Indeed, no studies have tested whether autonomous motivation at work can be transferred into motivation to prevent or rehabilitate from occupational injury.

In addition, Chan and colleagues (2011) did not examine whether the attitude, subjective norm, and PBC from the TPB were mediators of the relationships between autonomous treatment motivation and treatment intention as stipulated by the TCM. Such mediators are essential constructs of the TCM because behaviours or intention predicted by self-determined motivation alone does not take into account of individuals' proximal processing (i.e., belief systems, decision-making, intention formation) regarding the target action (Chatzisarantis, Hagger, Smith, & Sage, 2006; Hagger & Chatzisarantis, 2009b). A recent meta-analysis by Hagger and Chatzisarantis (2009b) summarized the findings of the relationships between SDT and TPB variables in previous studies (36 studies) on health behaviour (e.g., exercise, dieting, breast feeding, and condom use). The results showed that autonomous motivation exerted a significant medium-sized effect on intentions for the health behaviour (r = .52), but the effect was fully mediated by attitude, subjective norm, and PBC. No previous study has applied an integrated model adopting SDT and TPB to understand individuals' engagement in injury prevention. When attitude, subjective norm, and PBC are proposed to be the antecedents of individuals' intentions for injury prevention (Lajunen & Resänän, 2004; Sheeran & Silverman, 2003), it is important to investigate whether they mediate the effect of self-determined motivation on intention to engage in injury-preventive

behaviours in order to provide a comprehensive picture about the social cognitive processes underpinning safety actions.

The Present Study

The present study applied the TCM in a workplace context to explain the psychological and motivational factors influencing prevention of, and rehabilitation from, occupational injury. The purpose of the study was two-fold. First, we examined the relationship between the autonomous motivation for work and injury prevention, and investigated whether attitudes, subjective norms, and PBC mediate the relationship between autonomous motivation and intentions for injury prevention. Second, we examined the predictive validity of autonomous work motivation in explaining variance in autonomous treatment motivation, treatment adherence, and recovery length of a recent occupational injury. Police officers were chosen as our target population because the training and field work of police officers usually involves intensive physical activity, handling of dangerous or heavy equipment (i.e., weapons, protective gear), and long duration or night-shift working hours, where occupational injuries are more likely and prevalent in comparison to that of typical white-collar workers (Violanti, Vena, & Marshall, 1996). Also, from a theoretical perspective, police officers are more suitable than typical blue collar workers (e.g., workers in factories or mines) because under the support of the government, inadequate resources for injury prevention (e.g., education, training, protective kits) and rehabilitation are unlikely to be the reason affecting their injury preventive intention and rehabilitation behaviours. As a consequence, we were able to test the effect of the psychological variables in the TCM on the outcome variables while minimizing the potentially confounding impact of instrumental resources, which could be highly inconsistent in commercial industries.

Based on the findings of previous studies on the TCM, SDT, and TPB (Chan, Hagger, et al., 2011; Chan et al., 2009; Hagger & Chatzisarantis, 2009b), we drew the following hypotheses for the TCM applied to injury prevention and injury rehabilitation (Figure 5.1 depicts the two hypothesised models). In the TCM for injury prevention, we hypothesised that the direct effect of autonomy support from supervisors on autonomous motivation for injury prevention would be positive and mediated by autonomous work motivation, and the relationship between autonomous motivation for injury prevention and injury preventive intention would be positive and mediated by attitude, subjective norm, and PBC. In the TCM for injury rehabilitation, we speculated that the direct effect of autonomy support from supervisors on autonomous treatment motivation would be positive and mediated by autonomous work motivation, the effect of the autonomy support from physicians on treatment adherence would be positive and mediated by autonomous treatment motivation, and the effect of autonomous treatment motivation on length of recovery would be negative and mediated by treatment adherence. The TPB components of the TCM, namely attitude, subjective norm, and PBC, were not tested in the rehabilitation model due to the cross-sectional and retrospective nature of the study. Lastly, as perceived severity of health problems was found to facilitate the internalization of treatment among alcohol-addicted patients (i.e., greater autonomous motivation; Ryan, et al., 1995), perceived injury severity served as a control variable in the prediction of autonomous treatment motivation, treatment adherence, and length of recovery.

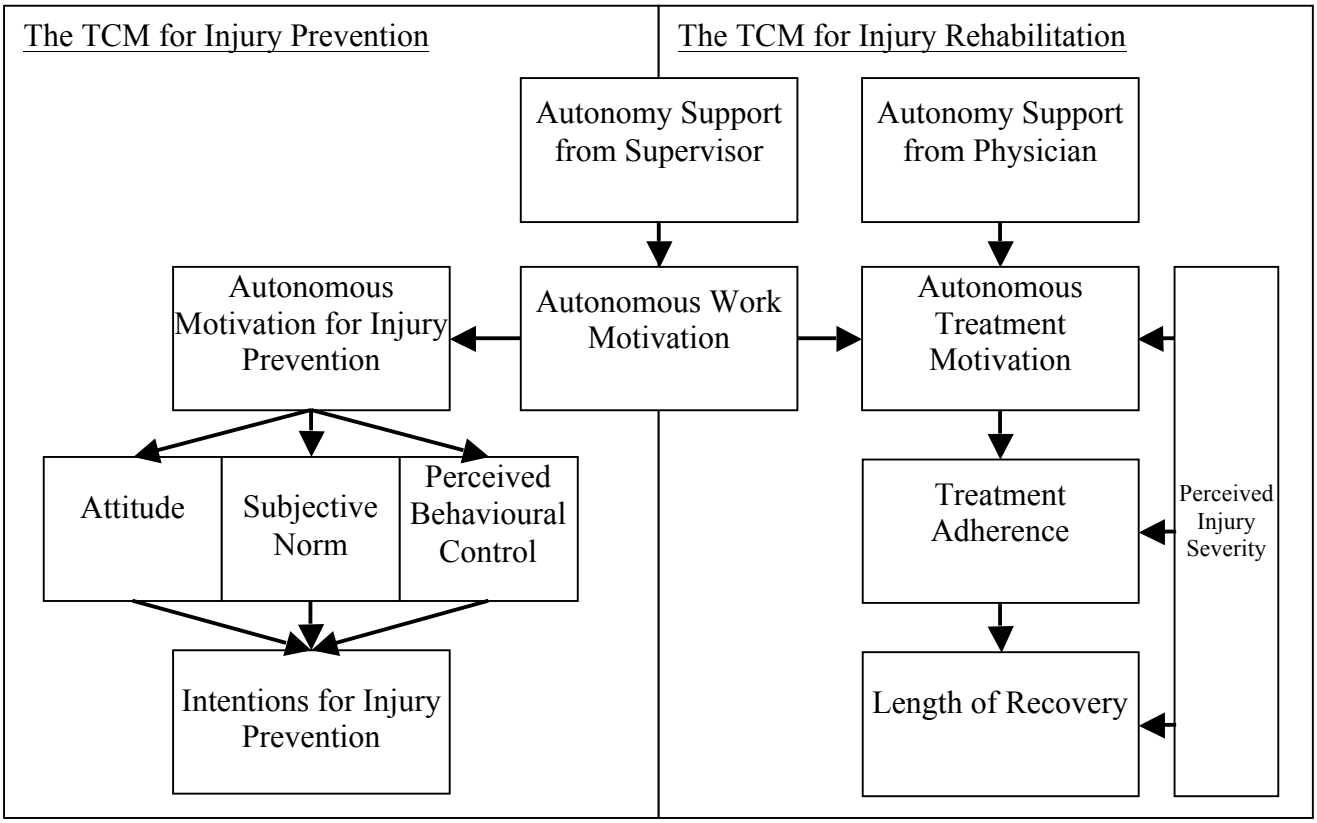

Figure 5.1 The hypothesised models of TCM in the present study (Study 6 and 7).
The relationship between treatment adherence and length of recovery was expected to be negative, while all other paths were proposed to be positive.

Method

Participants and Procedures

Participants were full-time police officers recruited from three police stations in the Sichuan province of China. Ethical approval for study protocol and measures was obtained from the Institutional Review Board of the University of Nottingham. Two-hundred and thirty nine participants returned and signed informed consent forms after being supplied with preliminary information regarding the study and agreed to participate. In order to reduce the length of questionnaire and avoid the problem of common method variance (Doty & Glick, 1998), participants were instructed to complete two sets of questionnaires on two consecutive occasions, one week apart. The first questionnaire included scales measuring demographic variables (gender, age, work years, injury history), autonomous work motivation, and perceived autonomy support from supervisors. The second questionnaire comprised items to measure motivation and TPB variables with respect to injury prevention. Those who reported experiencing an occupational injury that required medical attention were directed to an additional section comprising measures of treatment motivation, treatment adherence, and perceived autonomy support from physicians at the time of injury. Responses to this section were used to test the TCM for injury rehabilitation.

After omitting the data from 32 participants who either did not complete the second questionnaire or had more than 80% missing data, our final sample comprised 207 police officers (82.80% male; *M* age = 37.24, *SD* = 9.93; *M* years in police force = 14.56, *SD* = 16.12) Over half of the respondents (66.4%) reported experiencing an occupational injury. Six months prior to the first data collection, participants experienced an average of 0.56 (*SD* = 1.32) occupational injuries, and reported an average of 3.07 (*SD* = 11.50) days absence, an average of 9.69 (*SD* = 30.06) days of impaired work performance, and an average of 6.36 (*SD* = 22.58) days when they were required to modify their normal working routine as a

consequence of their injury. Eighty-seven (42.03%) participants reported having occupational injuries with an average lag of 1.45 years (*SD* = 1.79), including skeletal fracture (20.00%), swelling or contusion (16.40%), joint sprain or dislocation (10.90%), tear or rupture of ligament or tendon (10.90%), and others (30.90%; e.g., gun wounds, head injury), where physicians were involved in the treatment process. These participants were therefore eligible to, and completed, the second questionnaire containing additional questions regarding the treatment experiences of their injuries. Data from these participants (89.7% male; *M* age = 38.27, *SD* = 9.94; *M* years in police force = 14.82, *SD* = 10.06) were therefore used to test the TCM for injury rehabilitation.

Measures

Perceived autonomy support. The Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996) was used to measure perceived autonomy support from participants' physician and supervisor. HCCQ is a single dimension scale that has been frequently used to measure the perceived autonomy support from significant others such as physicians (Chan, Lonsdale, Ho, Yung, & Chan, 2008), physiotherapists (Chan, Hagger, et al., 2011), supervisors (Baard, Deci, & Ryan, 2004), and teachers (Hagger, Chatzisarantis, et al., 2003). The scores of the 6-item version of HCCQ used in this study for the assessment of autonomy support from both physician (e.g., "I feel that my physician has provided me choices and options") and supervisor (e.g., "I feel understood by my supervisor") had reliability coefficients (Cronbach, 1951) of .91 and .92 respectively.

Autonomous motivation for treatment and injury prevention. Participants' autonomous motivation for injury prevention and treatment was assessed by the Treatment Self Regulation Questionnaire (TSRQ; Williams et al., 1996). The TSRQ has been previously adapted for measuring patients' motivation in physiotherapy treatment (Chan et al., 2009) and

was found to be reliable across different behavioural contexts including smoking cessation, dieting, and exercise (D'Angelo et al., 2007; Williams et al., 1999; Williams et al., 1996). In order to measure autonomous treatment motivation, we used the five items (e.g., "I remained in treatment and carry out rehabilitation exercise because I felt like it's the best way to help myself") from the physiotherapy-version of TSRQ (Chan et al., 2009). In order to assess autonomous motivation for injury prevention, we adapted six items (e.g., "I want to prevent or avoid injury because it is an important choice I really want to make") from the autonomous treatment motivation subscale of the smoking cessation version of TSRQ (Williams et al., 1999). The Cronbach alphas of the scores of autonomous motivation for injury prevention and treatment were .76 and .77 respectively.

Autonomous work motivation. Autonomous work motivation was assessed using 12 items from an adapted version of the autonomous motivation sub-dimensions of the Behavioural Regulation in Sport Questionnaire (BRSQ; Lonsdale, Hodge, & Rose, 2008) . We adapted items from the BRSQ, a sport domain questionnaire, rather than the typical measure of self-determined motivation in the work domain (i.e., the Blais Inventory of Motivation; Blais, Briere, Lachance, Riddle, & Vallerand, 1993) for a number of reasons. First, the nature of police officers' job is unlike that of typical workers, and a major portion of their job duty involves the execution or training of physical tasks in the field, so the core content of the BRSQ appeared to better fit the job description of our target sample. Second, the BRSQ was developed to measure the full complement of behavioural regulations, so its items covered all the sub-dimensions of autonomous motivation of the self-determination continuum, including intrinsic motivation, integration, and identification (Lonsdale, et al., 2008). Third, the BRSQ has demonstrated equal or superior internal reliability and predictive validity than other psychological instruments (e.g., the Sport Motivation Scale; Pelletier, et al., 1995) for measuring behavioural regulations from SDT (Lonsdale et al., 2008), and, more

importantly, its Chinese version has been shown to be reliable among participants from mainland China (Chan, Hagger, et al., 2011).

In order to fit with the police force context, the terms "sport" or "participate in sport" in the BRSQ were replaced by "work", "job", or "work in the police force". The measure included four items for each of the intrinsic regulation (e.g., "I work for the police force because I enjoy it"), integrated regulation (e.g., "I work for the police force because it's a part of who I am."), and identified regulation (e.g., "I work for the police force because I value the benefits of my job") subscales. For analyses, four indicators of an autonomous work motivation scale were formed by taking the average of each of the intrinsic, integrated, and identified regulation items. Responses for all the above scales were made on seven-point Likert scales with anchors ranging from "very true" (7) to "not at all true" (1). The internal consistency coefficient (Cronbach, 1951) for the scores of the autonomous work motivation scale was .87.

TPB variables. Items assessing the TPB variables were developed according to Ajzen's (2002) recommendations. Items measuring attitude toward safety procedures was preceded by the common stem, "Following all the required safety procedures to reduce the likelihood or severity of injury in the forthcoming month is…" and participants' responses were made on six seven-point semantic differential scales with the following bi-polar adjectives: "valuable - worthless", "beneficial - harmful", "pleasant - unpleasant", "enjoyable-unenjoyable", "good - bad", and "virtuous - not virtuous". Measures of subjective norm (three items; e.g., "The people in my life whose opinions I value would approve of me following all the required safety procedures to reduce the likelihood or severity of injury in the forthcoming month"), PBC (five items; e.g., "I have complete control over following all the required safety procedures to reduce the likelihood or severity of injury in the forthcoming month"), and intention (three items; e.g., "I intend to carry out all the required safety procedures to reduce

the likelihood or severity of injury in the forthcoming month") were rated on seven-point Likert-type scales ranging from "strongly agree" (7) to "strong disagree" (1). The scores of attitude, subjective norm, PBC, and intention obtained reliability coefficients (Cronbach, 1951) of .91, .79, .87, and .87 respectively.[9]

Treatment adherence. We derived six items to measure self-reported treatment adherence based on a measure from a previous study on treatment adherence for home-based physiotherapy treatment (Chan et al., 2009). Chan and colleagues (2009) developed two items, one for assessing the *completion* of treatment and one for measuring the *effort* patients invest in their rehabilitation. In order to enhance the internal reliability of the test scores and coverage of the scale, we developed two further items for each of the completion (e.g., "I took the treatment prescribed by physicians") and effort (e.g., "I invested effort in following the recommendations offered by my physician") scales. The items for completion and effort were assessed on seven-point scales with scale endpoints ranging from "complete all" (7) to "complete none" (1) and "maximum effort" (7) to "minimum effort" (1) respectively. The test scores of the resulting six-item scale had a Cronbach's alpha of .86.

Length of recovery. Participants receiving medical treatment for their injury were required to recall the length of their recovery by indicating the number of days it took to recover completely from the injury.

Injury severity. We assessed perceived severity of the injury by adapting five items (e.g., "I feared that this injury would affect my long-term career") from the severity subscale of the Sports Injury Rehabilitation Beliefs Survey (SIRBS; Taylor & May, 1996) . Responses were made on seven-point Likert-type scales ranging from "strongly agree" (7) to "strongly disagree" (1). One reversed-scaled item (i.e., "I would think that the injury was a minor

[9]Full details for the psychometric properties of the TPB measure of injury prevention can be obtained from the first author.

interruption to my work") was omitted from the scale because it had low inter-item correlations and the scores of the remaining scale exhibited an internal consistency coefficient (i.e., α) of .79.

Translation. All questionnaires were translated from English to Chinese (the first language of the participants) apart from the physiotherapy-version of TSRQ which was originally developed in Chinese (Chan et al., 2009). The translation was conducted by three English-Chinese bilinguals based on the back-translation procedures of Hambleton (2005).

Analysis

We employed covariance-based structural equation modeling (CB-SEM)[10] using the EQS 6.1 statistical software (Bentler, 2004) to test the hypothesised relationships of the TCM for injury prevention in the full sample (N = 207). To protect the model against any violation of CB-SEM's assumption on normality, we used robust maximum likelihood estimation method (Satorra & Bentler, 1988). In addition, CB-SEM analysis is heavily dependent on sample size to ensure adequate statistical power (i.e., .80 or higher), so we also computed the statistical power of the model (MacCallum et al., 1996).

A sample size of 100 is usually the lowest boundary for CB-SEM analysis and some recent research recommended a minimum sample size of 200 to protect the robustness of the model against non-convergence and estimation biases (Boomsma & Hoogland, 2001). Since only 87 participants were categorized as having a previous work-related injury, we employed variance-based structural equation modeling to test the premises of the TCM for injury rehabilitation in this subsample (VB-SEM; also named partial least squares path analysis)

[10]Model goodness of fit for the CB-SEM analyses was evaluated using multiple criteria including the Tucker-Lewis index (TLI), comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardised root-mean square residual (SRMR). Values for the TLI and CFI greater than .90 were considered indicative of acceptable fit Bentler, P. M. (1990). Comparative fit index in structural models. *Psychological Bulletin, 107*, 238-246., with values greater than .95 preferable Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structural analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.. RMSEA and SRMR's values less than or equal to .06 were considered indicative of very good fit ibid., and values of .08 or less traditionally considered acceptable.

using the SmartPLS 2.0 statistical software (Ringle et al., 2005). Similar to CB-SEM, VB-SEM can also force measurement error to zero by forming latent variables (Henseler, Ringle, & Sinkovics, 2009). However, to estimate the latent factor scores and the relationships between the factors, VB-SEM relies on a partial least squares algorithm, which is theoretically distribution-free (Henseler et al., 2009). A number of simulation studies revealed that VB-SEM analysis displayed superior consistency, robustness, and accuracy than CB-SEM analysis for studies with small sample size (e.g., N = 20) and non-normal data (Reinartz et al., 2009; Ringle, Wilson, & Götz, 2007).

The "model fit" of VB-SEM analysis can be revealed by a number of indices about the convergent validity and discriminant validity of the measurement model. Convergent validity is typically regarded as acceptable when the Cronbach's alpha and the composite reliability of each dimension are higher than .70 (Barclay et al., 1995), the average variance extracted (AVE) for each factor is higher than 0.50 (Chin, 1998), and the factor loading of each items on its corresponding factor is higher than .70 (Komiak & Benbasat, 2006). Discriminant validity is generally considered adequate when the loading of an item on its own construct is higher than its loadings on the other constructs (Komiak & Benbasat, 2006) and the square-root of the AVE of any construct is higher than its correlation with other constructs (Chin, 1998). Furthermore, we utilized bootstrapping resample technique with 1000 replications to reveal the significance level of the path estimates.

For both the CB-SEM and VB-SEM analyses, we conducted a mediation analysis according to Baron and Kenny's (1986) and Zhao, Lynch, and Chen's (2010) criteria[11] to test

[11]According to Baron and Kenny (1986), mediation is confirmed if the mediator has significant associations with both the independent variable (IV) and dependent variable (DV), the IV predicts the DV independently (i.e., the direct effect model), and this path becomes non-significant when the DV is also predicted by the mediator (i.e., the combined effects model). Partial mediation is present when the strength of IV→DV is significantly reduced in the combined effects model and the indirect effect is significant but the direct effect remains significant. On the other hand, Zhao, Lych, and Chen (2010) proposed mediation should be evidenced by significant direct and indirect effects of the IV on the DV.

the hypothesised mediation relationships in the TCM. Detailed structures of the models analysed by CB-SEM (i.e., the TCM of injury prevention) and VB-SEM (i.e., the TCM of injury rehabilitation) are summarized in Figures 5.2 and 5.3 respectively.

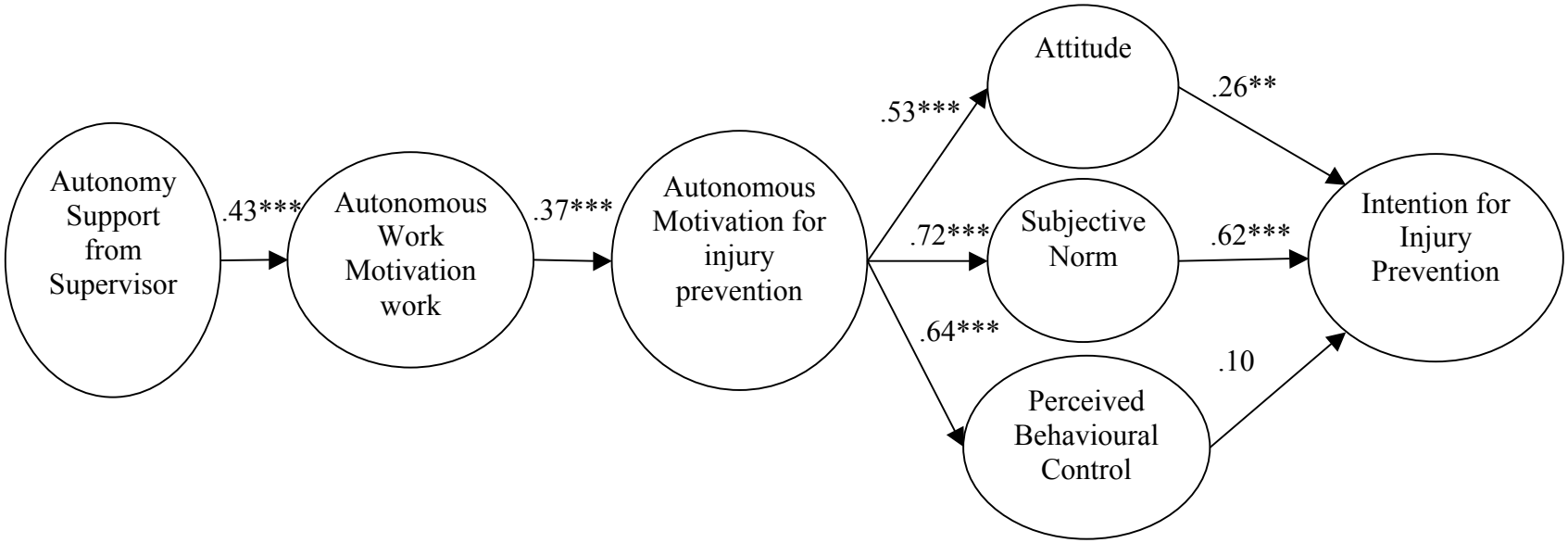

Figure 5.2 Path estimates for the TCM for injury prevention (Study 6).

Correlations between the disturbances of latent factors (attitude, subjective norm, and perceived behavioural control) are omitted from this figure.

***p <.01 2-tailed, **p <.05 2-tailed, *p<.05 1-tailed.

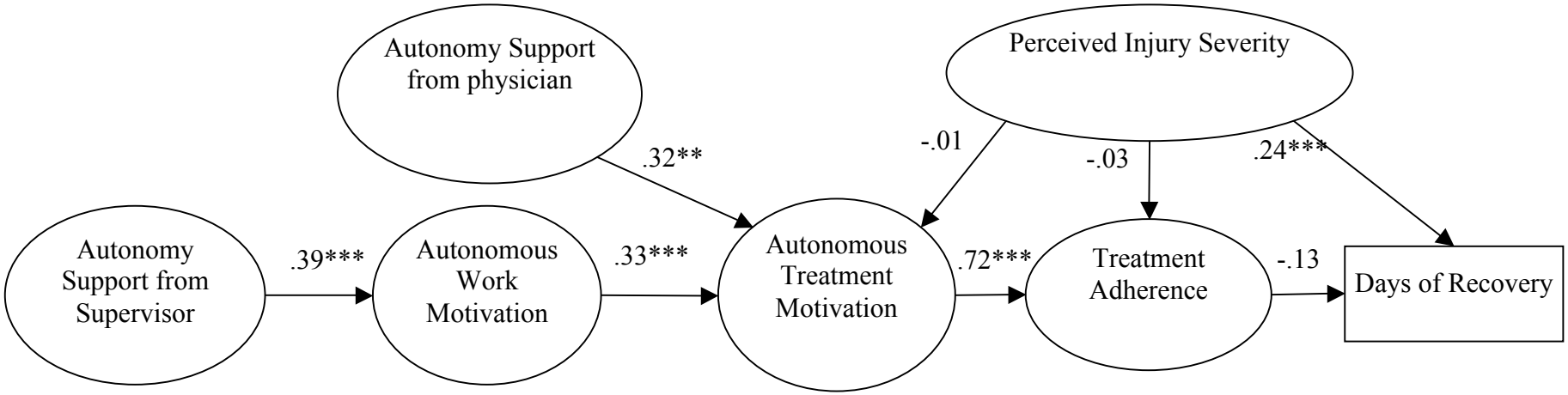

Figure 5.3 Path estimates for the TCM for injury rehabilitation (Study 7).
***p < .01 2-tailed, **p .05 2-tailed, *p< .05 1-tailed.

Results

TCM for Injury Prevention

CB-SEM revealed that the TCM for injury prevention yielded acceptable fit with the data (*df* = 187; Satorra-Bentler χ^2 = 375.02; TLI = .903; CFI = .917; RMSEA = .070; SRMR = .075) and obtained very good statistical power of .957. The descriptive statistics of the variables and the standardized path coefficients in the model are displayed in Table 5.1 and Figure 5.2 respectively. In line with our hypotheses, autonomous work motivation was positively predicted by autonomy support from supervisors (R^2 = .18) and was a positive predictor of autonomous motivation for injury prevention (R^2 = .14). Autonomous motivation for injury prevention was positively associated with attitude (R^2 = .29), subjective norm (R^2 = .52), and PBC (R^2 = .40). Intention (R^2 = .65) for injury prevention was predicted positively by attitude and subjective norm as hypothesised, but its expected relationship with PBC was not significant.

Table 5.1 Descriptive Statistics for Study 6 and 7.

Cronbach's Alphas, Correlations, Means and Standard Deviations of the TCM for Injury Prevention (N = 207; Study 6) and the TCM for Injury Rehabilitation (N = 87; Study 7) Variables.

TCM for injury prevention variables	1	2	3	4	5	6	7
1. AS from supervisor	1	-	-	-	-	-	-
2. Auto work Mtv	.37**	1	-	-	-	-	-
3. Auto Mtv for injury prevention	.21**	.30**	1	-	-	-	-
4. Attitude	.22**	.17*	.44**	1	-	-	-
5. Subjective norm	.15*	.28**	.49**	.33**	1	-	-
6. Perceived behavioural control	.11	.31**	.41**	.37**	.67**	1	-
7. Intention	.15*	.23**	.45**	.47**	.72**	.56**	1
Cronbach's alpha	.96	.87	.76	.91	.79	.87	.87
Mean	4.37	3.86	4.74	5.34	4.29	4.39	4.21
Standard deviation	1.38	1.14	1.24	1.43	1.37	1.28	1.49
TCM for injury rehabilitation variables	8	9	10	11	12	13	14
8. AS from supervisor	1	-	-	-	-	-	-
9. AS from physician	.49**	1	-	-	-	-	-
10. Auto work Mtv	.37**	.18	1	-	-	-	-
11. Auto treatment Mtv	.33**	.50**	.37**	1	-	-	-
12. Perceived injury severity	-.18	.21	.05	.17	1	-	-
13. Treatment Adherence	.34**	.43**	.31**	.67**	.23*	1	-
14. Days of recovery	-.05	.17	-.03	.08	.14	-.04	1
Cronbach's alpha	.92	.91	.87	.77	.79	.86	-
Mean	4.31	4.18	3.89	4.04	3.42	4.18	40.033
Standard deviation	1.45	1.50	1.14	1.31	1.45	1.46	94.84

Note. AS = perceived autonomy support; Auto = autonomous; Mtv = motivation.

** $p < .01$ 2-tailed, * $p < .05$ 2-tailed.

Mediation analysis demonstrated that work motivation fully mediated the relationship between autonomy support from supervisors and autonomous motivation for injury prevention, which is in line with our hypothesis. In a similar vein, the effect of autonomous motivation for injury prevention on intention was fully mediated by attitude and subjective norm, but not by PBC because its relationship with intention was not significant. Details of the mediation analyses are shown in Table 5.2.

Table 5.2 Results from the Mediation Analyses for Study 6

Results from the Mediation Analyses for the TCM for Injury Prevention

Paths	Mediator(s)	Direct effect (z-score)	Combined effects (z-score)	Indirect effect (z-score)	Total effect (t-value)	Indirect / Total effect	Type of mediation
AS → M-injury	M-work	.25*** (2.96)	.10 (1.11)	.08*** (3.27)	.14*** (2.75)	57.13%	Full
M-work → Attitude	M-injury	.19*** (2.52)	-.10 (-.37)	.18*** (3.83)	.20** (2.12)	92.63%	Full
M-work → Norm	M-injury	.31*** (3.91)	.02 (.30)	.16*** (4.03)	.27*** (3.82)	58.96%	Full
M-work → PBC	M-injury	.37*** (3.92)	.00 (.06)	.14*** (3.79)	.32*** (4.29)	44.68%	Full
M-injury → intention	Attitude, Norm, PBC	.81*** (5.78)	.02 (.26)	.58***[a] (7.97)	.68*** (8.01)	85.86%	Full

Note. AS = autonomy support from supervisors; M-injury = autonomous motivation for injury prevention; M-work = autonomous motivation at work; Norm = subjective norm; PBC = perceived behavioural control. The indirect and total effects were computed by the resampling algorithm (replication = 5000) of Preacher and Hayes (2008). [a]This indirect effect index represent the total indirect effect brought by the three mediators. The specific indirect effect by attitude (0.14, $p < .01$) subjective norm (0.40, $p < .01$), and perceived behavioural control (0.04, $p > .05$) Thus, perceived behavioural control was not a significant mediator.

***$p < .01$ 2-tailed, ** $p < .05$ 2-tailed, *$p < .05$ 1-tailed.

TCM for Injury Rehabilitation

The VB-SEM analysis for the TCM for injury rehabilitation revealed satisfactory goodness-of-fit indicators, which supported the convergent and discriminant validity of the model. First, acceptable Cronbach alphas (range = .769 to .926), composite reliability scores (range = .843 to .942), AVEs (range = .521 to .754), and mean item-to-corresponding-factor loadings (range = .717 to.867) were found for all latent factors. Second, the item-to-corresponding-factor loadings were higher than the item-to-other-factor loadings for all items with a mean difference of .646 (range = .519 to .826), and the $\sqrt{\text{AVE}}$ of each construct was higher than the construct's correlations with other latent factors (mean ($\sqrt{\text{AVE}}$ - highest factor correlation) = .332, range = .003 to .627). Table 1 also presents the descriptive statistics of the variables in this model.

Standardized path coefficients for the VB-SEM of the TCM for injury rehabilitation are depicted in Figure 3. Similar to the results of the CB-SEM analysis of the TCM for injury prevention, autonomous work motivation was positively predicted by autonomy support from supervisor (R^2 = .16). As expected, autonomous treatment motivation (R^2 = .25) was positively associated with autonomous work motivation and autonomy support from physicians after controlling for the effect of perceived injury severity. Congruent with our hypothesis, autonomous treatment motivation was a strong positive predictor of treatment adherence (β = .72, p < .01; R^2 = .51). However, treatment adherence was not significantly associated with length of recovery (R^2 = .08) when controlling for the effect of perceived injury severity.

Mediation analyses confirmed the hypothesised mediation effects in the TCM for injury rehabilitation. The only exception was the mediation of the relationship between autonomous treatment motivation and length of recovery by treatment adherence, which was

not supported. The effect of autonomy support from supervisor on treatment motivation was partially mediated by autonomous work motivation. The relationship between autonomy support from physicians and treatment adherence was fully mediated by treatment motivation. Details of the mediation analyses are shown in Table 5.3.

Table 5.3 Results from the Mediation Analyses for Study 7

Results from the Mediation Analyses for the TCM for Injury Rehabilitation

Paths	Mediator(s)	Direct effect (t-value)	Combined effects (t-value)	Indirect effect (z-score)	Total effect (t-value)	Indirect / Total effect	Type of mediation
AS-supervisor → M-treatment	M-work	.40*** (3.16)	.28* (1.68)	.10** (2.19)	.29** (3.14)	32.84%	Partial
M-work → Adherence	M-treatment	.33*** (3.94)	.05 (0.59)	.32*** (3.39)	.40*** (2.98)	79.69%	Full
AS-physician → Adherence	M-treatment	.25** (2.08)	-0.04 (.62)	.32*** (4.14)	.42*** (4.17)	75.41%	Full
M-treatment → Recovery	Adherence	.13 (1.12)	.46 ***[a] (2.61)	-.03 (-.96)	.02 (.54)	164.85%	None

Note. AS-supervisor = perceived autonomy support from supervisor; AS-physician = autonomy support from physician; M-treatment = autonomous treatment motivation; M-work = autonomous motivation at work; Recovery = length of recovery. The indirect and total effects were computed by the resampling algorithm (replication = 5000) of Preacher and Hayes (2008). [a]Both the significant combined effects of the IV on the DV was caused by suppression effect (MacKinnon, Krull, & Lockwood, 2000). Therefore, no mediation was presented in this path.

*** $p < .01$ 2-tailed, ** $p < .05$ 2-tailed, * $p < .05$ 1-tailed.

Discussion

The present study applied the trans-contextual model (Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009) to understand motivational factors associated with workers' compliance to safety and rehabilitation guidelines. We tested the predictive validity of the model in workers' intentions for injury prevention and treatment adherence for occupational injury. Indeed, the hypothesised pattern of effects in the TCM was generally supported in data from a sample of police officers, including those who had experienced a recent occupational injury.

Effects of Autonomous Work Motivation

In agreement with our hypotheses, autonomous work motivation was positively associated not only with workers' autonomous motivation for injury prevention, but also with the autonomous treatment motivation of workers who had experienced an occupational injury. This is consistent with previous research (Chan, Hagger, et al., 2011) and the hypotheses of the TCM (Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, Barkoukis, et al., 2005; Pihu et al., 2008).

This pattern of effects addresses an important issue in behavioural regulation research in the workplace. The endorsement of autonomous work motivation has been a frequently-cited reason for workers' work intention, perseverance, job satisfaction, job performance, and psychological well-being in the work place (Grant, 2008; Millette & Gagné, 2008; Otis & Pelletier, 2005), as this form of motivation is incorporated within human nature for growth and optimal functioning and well-being (Deci & Ryan, 1985b). However, our findings suggest that the predictive power of autonomous work motivation is not limited to performance-related behaviours and adaptive well-being within the work context, but it may also extend to the prevention and rehabilitation of occupational injury. Thus, autonomous

work motivation might be an extremely important factor indirectly related to the intentions for injury prevention among police officers and other workers with dangerous working conditions and duties (e.g., construction workers, coal-mine workers, and soldiers). Enhancing workers' enjoyment at work, increasing their sense of belonging to work, making work consistent with their life, values, and goals, and supporting their psychological needs (i.e., competence, relatedness, and autonomy; Deci & Ryan, 1985), were suggested to be feasible means to facilitate workers' autonomous motivation at work (Lynch, Plant, & Ryan, 2005). Further research should test whether these strategies may also enhance workers' autonomous motivation for injury prevention and rehabilitation. Some recent research suggests that non-compliant behaviour could be the result of the depletion of behavioural energy (i.e., ego energy), but such depletion could plausibly be slowed down by autonomous motivation (Hagger, 2010b; Hagger, Wood, et al., 2009; Hagger et al., 2010), so it might be interesting to investigate the effects of ego-energy depletion on injury preventive and rehabilitation behaviour, and how autonomous motivation in the associated aspects can moderate such effects.

Autonomous Motivation for Injury Prevention and the TPB

Consistent with our hypothesis, autonomous motivation for injury prevention was a positive predictor of attitude, subjective norm, and PBC, and the percentage of variance explained for each variable was comparable to the corresponding effect sizes from Hagger and Chatzisarantis' (2009b) meta-analysis. In other words, the more autonomous reasons (i.e., pleasure, values, life goals, and personal achievement) the workers endorse for engaging in preventive behaviour, the more likely the injury preventive behaviour is highly valued, perceived to be highly recommended by their significant others (e.g., family, friends, and colleagues), and perceived to be achievable regardless of difficulties. According to TPB, these

personal beliefs may further lead to increased intention to engage in corresponding preventive and rehabilitative behaviours in the future (Ajzen, 1985, 1991).

Nevertheless, our expected positive predictions of intention were only observed for attitude and subjective norm, which was in line with previous studies that have applied the TPB to explain safety behaviours (Lajunen & Resänän, 2004; Sheeran & Silverman, 2003). No such prediction was found for PBC. However, it is important to note that the prediction of PBC on intention to perform safety actions has been inconsistent across studies. Quine, Rutter, and Arnold (1998) found a significant positive relationship between PBC and intentions for the use of cycling helmets among school-aged children (aged 11 to 15 years). In contrast, Lajunen and Resänän (2004) found a negative relationship between PBC and intentions for the use of cycling helmets among adolescent cyclists (aged 12 to 19 years) who owned cycling helmets. This discrepancy might be due to a number of situational factors. The difficulty of performing safety action may vary across different situations. For instance the situational factors affecting the wearing of cycling helmets among school-aged cyclists (e.g., Quine, et al., 1998; Lajunen & Resänän, 2004) versus wearing bullet-proof vests by police officers are likely to be fundamentally different. In addition, the age/experience, education/ training background, and socioeconomic status, and availability of other safety supporting resources may plausibly affect how individuals' form intentions for the injury prevention behaviours that they felt were under their control. Thus, it is important to investigate these factors as moderators of the PBC-intention relationship in future studies.

On the other hand, it is noteworthy that subjective norm was the strongest predictor of intention, which also accounted for most of the indirect effect of autonomous motivation for injury prevention on intention. This pattern was not in line with typical findings in TPB (Hardeman et al., 2002) and its theoretical integration with SDT (Hagger, 2009b; Hagger & Chatzisarantis, 2009b), which have indicated that PBC and attitude should be more important.

However, research has indicated that individual differences in the value attached to normative factors may affect the extent to which intentions are based on subjective norms relative to attitudes and PBC. For example, Trafimow and Finlay (1996) found that the predictive power of subjective norm on intention would be inflated for some normative-based behaviours and individuals. Similarly, research has found that control-orientated individuals, who tended to act for external contingencies (e.g., money, deadlines), are more likely to adopt a normative identity style; a style characterized by being more influenced by beliefs and values shared by significant others (Soenens, Berzcnsky, Vansteenkiste, Beyers, & Goossens, 2005). This is likely to mean that intentions are formed on the basis of normative rather than personal beliefs. Also, in the police force, injury prevention is likely to be a behaviour which is predominantly influenced by normative beliefs because behavioural and control beliefs of injury prevention might be less important for police officers who are supposed to have sufficient training, education, and instrumental support for injury prevention. Alternatively, a salient collective self (i.e., thoughts and the perception of self derived from social membership), which is commonly endorsed by people from collectivistic countries like China (the population from which the current samples were drawn) has been suggested as a trait which could strengthen the association between subjective norm and intention (Hagger, Chatzisarantis, Hein, et al., 2007; Trafimow & Finlay, 1996). Therefore, although our findings for the subjective norms variable supported the view that normative factors might be more strongly related to intentions for safety maintenance than personal factors (e.g., attitudes, PBC), individual difference factors like personality traits (e.g., normative-based individuals, control causality orientation) and cultural differences (e.g., collectivist norms) should be considered in the future studies of injury prevention.

Autonomous Treatment Motivation, Treatment Adherence, and Recovery Length

In line with Chan and colleagues' (2009) study, autonomous treatment was a positive predictor of treatment adherence and explained substantial amount of its variance. A number of studies have reported a positive relationship between autonomous motivation and treatment adherence (e.g., D'Angelo, et al., 2007; Milne, et al, 2008), but most of these studies focused on the beneficial effect of autonomous treatment motivation in the treatment of various health problems (e.g., heart disease, cancer). To our knowledge, the present study is the first attempt to test the relationship between autonomous treatment motivation and adherence to treatment in the context of occupational injury. The findings indicate that workers with occupational injury are more likely to invest effort and fully comply with prescribed treatment when autonomously motivated toward their rehabilitation.

However, treatment adherence was not significantly related to the length of recovery after controlling for perceived injury severity, which is in contrast to our hypothesis. Although the effect of treatment adherence on recovery length could potentially be masked by the effects of other external factors (e.g., effectiveness of treatment, body capacity to recover, and type of injury) and attenuated by the social desirability of self-report measures and memory loss, the effect appeared to be negative, which was in line with our prediction. This implied that better adherence may be associated with the speed of recovery to some extent. Further studies with intervention designs such as randomized controlled trials or longitudinal designs like reciprocal effects models may help to test whether the reduction of recovery length is caused by heightened autonomous treatment motivation (Chan, Hagger, et al., 2011; Chan et al., 2009; Williams et al., 2007).

Autonomy Support from Supervisor and Physician

Realizing the adaptive role of autonomous motivation in work and rehabilitation, it is important to highlight their antecedents. Consistent with our hypothesis and the tenets of SDT

(Deci & Ryan, 1985b, 2008), autonomy support from supervisors and physicians was positively related to autonomous work motivation and autonomous treatment motivation respectively. These patterns were consistent with studies that have applied SDT in occupational (Burstyn et al., 2010; Lynch et al., 2005; Otis & Pelletier, 2005) and health settings (Chan, Hagger, et al., 2011; Chan et al., 2009; Milne et al., 2008). Therefore, autonomy-supportive actions such as the provision of choice, providing a rationale for safety advice, and taking individuals' feelings and opinions into consideration with minimal pressure could have a profound effect on facilitating workers' autonomous motivation in injury prevention and autonomous treatment motivation for those who suffered from occupational injury (c.f., Chatzisarantis, Hagger, & Brickell, 2008; Chatzisarantis, Hagger, & Smith, 2007; McLachlan & Hagger, 2010).

Limitations and Future Directions

We must acknowledge a number of limitations of the present study. The cross-sectional design of the injury prevention model precludes evidence for the predictive validity of TCM with regard to future injury-preventive behaviour. Our injury rehabilitation model included a behavioural measure, but the retrospective design prohibited the inclusion of the TPB variables, which are hypothesised as predictors of future behaviour. As a result, the full TCM model could not be scrutinized in a single analysis. Further studies should test the prediction of all the TCM variables among injured workers who are currently undertaking treatment and use longitudinal or diary methods (Bolger, Davis, & Rafaeli, 2003) to assess their rehabilitation or injury preventive behaviour over an extended period of time (i.e., greater than one month). Also, the effect of controlling environment and controlled motivation on individuals' health behaviours has received more attention in recent years (Bartholomew, Ntoumanis, & Thogersen-Ntoumani, 2010; Halvari et al., 2010), and these

constructs might plausibly represent the motivational consequences triggered by legislation and coercion (e.g., fines or other penalties) for safety in the workplace, so it is worthwhile for future studies to develop corresponding measures and investigate their impact on injury prevention relative to that of autonomy support and autonomous motivation.

In addition, the use of self-report measures and retrospective recall methods may be subject to social desirability and memory bias. Yet, these factors are unlikely to increase type-I error because the magnified error variance and restricted true variance may attenuate rather than inflate the path estimates in the models (Chan et al., 2009; Williams et al., 1996). Likewise, this initial study made use of a number of adapted instruments (e.g., TSRQ) which were not originally designed to measure the psychological constructs in the context of occupational safety. Although these adapted instruments displayed good convergent and predictive validity in this study, we should stress the importance of further development and examination of these measures for face validity and test-retest reliability within the context of occupational injury. This is because some environmental features and cultures within injury prevention or rehabilitation contexts could be unique and vary from one occupation to another. These factors might influence the operationalization of the psychological constructs, and also plausibly affect their relationships with behaviours. For instance, we had a majority of male police officers in our sample. Although this reflected the typical gender distribution within this this occupational context in China, it could be a potential confounding factor that impaired the generalizability of our findings across both genders. Future studies with samples from various occupations and cultural backgrounds, and with a more even gender distribution, may control for these confounding variables, including objective measures of injury risk, injury severity, and the effectiveness of safety facility and medical resources.

Lastly, the correlational design did not permit the inference of causal and temporal order effects of the hypothesised predictors. Successful interventions based on TPB

(Chatzisarantis & Hagger, 2005; Chatzisarantis et al., 2004) and SDT (Chatzisarantis & Hagger, 2009; Williams et al., 1999; Williams et al., 2007) to enhance individuals' engagement in health related behaviours, including occupational safety (Sheeran & Silverman, 2003), have been reported. Further studies should apply the principles of both theories to implement an intervention and use the TCM to predict behaviours regarding injury prevention and rehabilitation.

Conclusion

The present study extended the application of the trans-contextual model to an occupational injury prevention and rehabilitation context. The results supported the model and illustrated the importance of autonomous work motivation and autonomy support from supervisors and health and safety professionals in workers' engagement of safety and rehabilitation behaviours.

Implications of Chapter 5

Study 6 and 7 preliminarily examined the hypothesised integrated model in an occupational context. Although controlled motivation was not examined, the resulting pattern of effects corresponded with those reported in Studies 1 to 5 which tested the model in sport, further indicating that the more self-determined one's motivation toward the behaviour in a given behavioural context, the more self-determined one's motivation toward health and safety actions associated. In addition, the social-cognitive variables from the TPB were likely to mediate of the relationship between self-determined motivation and intention for health enhancing behaviours. However, all the studies (Study 1 to 7) up to this chapter only examined the hypothesised model for the prediction of cross-sectionally or retrospectively measured injury-related behaviour or intention, and the application of the model in predicting the future engagement of the prevention behaviours, and the behaviours of other health

deficiencies (e.g., myopia), was unknown. Hence, the final study (Study 8) presented in the next chapter (Chapter 6) attempted to apply the second tenet of the integrated model to predict future engagement in a health behaviour (i.e., 'near work' indicated by reading distance) when controlling for its associated clinical function (i.e., visual acuity) within the context of myopia prevention.

Chapter 6

Myopia Prevention, Near Work, and Visual Acuity of College Students: Integrating the Theory of Planned Behaviour and Self-Determination Theory

(Study 8)

Overview of Chapter 6

Chapter 6 documents the final study (Study 8) of the thesis that aims to address the limitations of Study 3, 4, and 6 in testing the second tenet of the thesis (i.e., the integration of SDT and the TPB). These studies were unable to reveal the relationship between intention and future behaviour due to their cross-sectional design. Study 8, therefore, attempted to test the second tenet of thesis using a prospective measure of a health behaviour (i.e., reading at an optimal distance) which was theoretically linked to clinical measure of functional capacity (i.e., visual acuity). In particular, Study 8 examined the theoretical integration between SDT and the TPB in the context of myopia prevention, and the behaviour, *near work* (an acknowledged primary risk factor associated with myopia) was measured objectively during a novel reading task.

The sample consisted of 107 undergraduate students who had heavy demand in terms of near work in their daily life. They were asked to complete a first questionnaire comprising items of perceived autonomy support from significant others who provided them vision care or advice, autonomous motivation, controlled motivation, and amotivation for myopia prevention based on self-determination theory in week 1, and a second questionnaire that included measure of the theory of planned behaviour variables (attitude, subjective norm, perceived behavioural control, and intention) regarding the maintenance of an optimal reading distance in week 2, before our measurement of their reading distance (assessed by an ultra-sound distance sensor during a novel reading task) and visual acuity (distance and near acuity assessed by ETDRS charts) in a laboratory setting in week 6. Data were analysed using variance-based structural equation modeling.

The results generally supported the second tenet of the thesis about the theoretical integration between SDT and the TPB. Perceived autonomy support and autonomous motivation from SDT significantly predicted attitude, subjective norm, and perceived behavioural control from the TPB. These social cognitive factors were significantly associated with intention and intention significantly predicted reading distance. Though controlled motivation was predicted by perceived autonomy support positively, this form of motivation, together with amotivation, were not significantly related to any of the TPB variables. The relationships in the integrated model of SDT and the TPB held when controlling for visual acuity.

In conclusion, the findings supported second tenet of the integrated model of SDT and the TPB in myopia prevention behaviours. Therefore, Study 8 extended application of the integrated model in a new health context (i.e., myopia prevention), showing that the utility of the second tenet of the model was not limited in injury prevention and rehabilitation, but may also applied to a very different health-care behaviour. More importantly, this final study fitted in with the overall goal of the thesis by establishing links between intention and a prospectively and objectively measured health behaviour, which addressed the gaps in all previous studies in the thesis in which behaviour was either not assessed (Studies 1, 2, 3, 4, and 6) or measured cross-sectionally by self-reported methods (Studies 5 and 7). The current data set provides support for the second tenet of the thesis and for the integrated model that means to explain how self-determined motivation from SDT affects the social cognitive factors from the TPB and injury preventive behaviour.

Introduction

More than a hundred million people suffer from visual impairment caused by some form of uncorrected refractive error (Resnikoff, Pascolinia, Mariott, & Pokharel, 2008). Myopia is one of the most common types of visual impairment and reduces the clarity of individuals' distance vision (other types include as hyperopia and astigmatism; Morgan, 2003). The prevalence of myopia has been increasing over the last few decades (Fredrick, 2002; Matsumura & Hirai, 1999; Saw, Katz, Schein, Chew, & Chan, 1996), and near work (i.e., working in close proximity to a visual target such as reading a book too closely), has been widely accepted and shown in epidemiological studies to be the antecedent of the onset and progression of myopia (Hepsen, Evereklioglu, & Bayramlar, 2001; Ip et al., 2008; Rosenfield & Gilmartin, 1998; Saw, 2003; Saw et al., 1996). While the educational system and increased use of computers in everyday working life have dramatically heightened the frequency of near work, modifying the distance between the eye and the visual target during near work might be a feasible solution in the prevention of myopia. From this perspective, near work should be viewed as a self-regulatory behaviour that is dependent on human factors, such as motivation and social-cognitive beliefs. To empirically test this premise, the present study aims to apply a psychosocial model integrating the theory of planned behaviour (Ajzen, 1985) and self-determination theory (Deci & Ryan, 1985b) to explain motivation and intention to maintain an appropriate reading distance when engaged in near work.

The theory of planned behaviour is a prominent social cognitive model that has been frequently applied in behavioural medicine to explain the proximal social cognitive, decision-making, and action planning processes that underpin peoples' health-related behaviour (Ajzen, 1985, 1991). It posits that engagement in future behaviour is governed by one's intention. Intention reflects the behavioural orientation and commitment towards a future action, and is proposed to be predicted by three belief-oriented social-cognitive variables (i.e.,

attitude, subjective norm, and perceived behavioural control (PBC)). Attitude reflects an individual's personal evaluation of performing a target behaviour in the future and subjective norm represents the perceived social appropriateness of the behaviour. PBC reflects an individual's perceived capacity to engage in the behaviour. According to the theory, the effect of these variables on behaviour is proposed to be mediated by intention, with the exception of PBC which is also proposed to influence behaviour directly. Even though a substantial amount of research in health behaviour has led to support for the predictive validity (McEachan et al., 2011) and application (Hardeman et al., 2002) of the theory of planned behaviour for numerous health behaviours, three shortcomings have been frequently identified in the literature which potentially reduce the predictive power and utility of the theory (Bagozzi, 1982). First, the theory does not identify the more superordinate and global cognitive variables that can explain the origin of its constituent variables. Second, the model does not account for how general motives serve as sources of information to direct the social cognitive processes. Third, the social and environmental factors associated with the formation of the theory of planned behaviour variables are not explicitly outlined. Thus, a growing amount of research has attempted to overcome these problems by integrating self-determination theory into the theory of planned behaviour. (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a; Hagger et al., 2006)

A central premise of self-determination theory is the distinction between three different forms of motivation: autonomous motivation, controlled motivation, and amotivation (Deci & Ryan, 1985b; Ryan & Deci, 2000b). Autonomous motivation reflects motivation to engage in a behaviour consistent with a sense of volition, choice, and personal agency over action. In contrast, controlled motivation reflects motivation to act determined primarily by external contingencies such as demands, rewards, or social pressure, or to avoid compromising outcomes that threaten contingent self-esteem leading to shame and guilt. On

the other hand, amotivation indicates a lack of purpose or reason for behaving. Such differentiation of motivation is important because autonomous motivation is an adaptive form of motivation relative to controlled motivation and amotivation. Research has consistently revealed significant links between autonomous motivation and behavioural perseverance in various health contexts (e.g., physical activity, smoking cessation, diabetic control, and dental care; Halvari et al., 2010; Silva et al., 2010; Williams et al., 2007; Williams, McGregor, Sharp, Kouides, et al., 2006). According to self-determination theory, autonomous motivation can be fostered through autonomy-supportive behaviours offered by significant others in the social environment. A perception of autonomy-supportive behaviours (i.e., perceived autonomy support) from significant others, such as the provision of choice and a personal rationale for doing a behaviour, acknowledging the perspective of the individual, and providing competence-related feedback, have all been shown to promote autonomous motivation (Reeve & Jang, 2006). Autonomy support has received considerable amount of supporting evidence in the health care contexts for the promotion of autonomous motivation (Halvari et al., 2010; Silva et al., 2010; Williams et al., 2007; Williams, McGregor, Sharp, Kouides, et al., 2006).

The integration of the theory of planned behaviour and self-determination theory stipulates that the motivational variables from self-determination theory are distal factors that exert effects on the proximal social-cognitive variables from the theory of planned behaviour. (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a; Hagger et al., 2006). This tenet has been examined in a number of health-related contexts such as the prevention of injury (Chan & Hagger, 2012a, 2012b) and binge drinking (Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Hein, et al., 2012), and the promotion of adherence in maintaining regular physical activity (Hagger et al., 2002a; Hagger et al., 2006), and weight management/ health dieting habit (Hagger et al., 2002a; Hagger et al., 2006). A recent meta-analysis (Hagger &

Chatzisarantis, 2009b) also confirmed the premises in the integrated model across a number of studies, that the effect of perceived autonomy support on attitude, subjective norm, and PBC was fully mediated by the motivational constructs from self-determination theory, and that the three theory of planned behaviour variables mediated the effect of the motivational variables from self-determination theory on intention and health behaviour. Yet, no previous study has tested the motivational sequence proposed in this the model in myopia prevention, regardless of the growing prevalence of myopia (Fredrick, 2002; Matsumura & Hirai, 1999; Saw et al., 1996) and how severely this visual deficiency negatively impacts on quality of life (Resnikoff et al., 2008; Saw, 2003).

Present Study

Our study is the first investigation that integrates the theory of planned behaviour and self-determination theory into a unified model to explain myopia preventive behaviours (i.e., near work). It is also a preliminary investigation of the model that prospectively examines individual's natural behavioural pattern with an objective measure of behaviour specifically designed for the current study to measure reading distance during near work (c.f., Hagger & Chatzisarantis, 2009b). We tested the model in China where the nation has one of the highest incidences of myopia in the world (Keeffe, Konyama, & Taylor, 2002; Saw, 2003) and the government has regarded vision care a primary issue in the community healthcare development since the 1990's (Lai, 2002). More importantly, it is widely accepted among parents, schools, and healthcare professionals in China that maintaining a healthy reading habits (e.g., reading in an optimal distance with adequate lighting) is a way to preserve vision (Sang et al., 2007; Zhang, Yan, Huang, Zhang, & Huang, 2011). Based on the theory of planned behaviour, self-determination theory, and previous research on the integration of the two theories, we propose a motivational sequence in which (1) perceived autonomy support exerts positive effects on attitude, subjective norm, and PBC (belief-based social cognitive

variables) through the mediation of autonomous motivation, (2) effects of perceived autonomy support on controlled motivation and amotivation are either negative or non-significant, (3) the positive effect of autonomous motivation on intention is mediated fully by the three belief-based social cognitive variables, (4) effects of controlled motivation and amotivation on intention are either negative or non-significant, and (5) the three belief-oriented social cognitive variables are positively related to reading distance through the mediation of intention (full mediation for attitude and subjective norm, and partial mediation for PBC). Visual acuity serves as a control variable in our model because the causal link between visual acuity and reading distance are theoretically reciprocal. Specifically, years of near work may impair visual acuity (Matsumura & Hirai, 1999; Morgan, 2003), but visual acuity directly determines the maximum viewing distance for a clear vision (Ferris & Bailey, 1996; Ricci, Cedrone, & Cerulli, 1998), and visual acuity is a clinical function that might exert its effects on the psychological variables associated with near work. See Figure 6.1 for the hypothesised model.

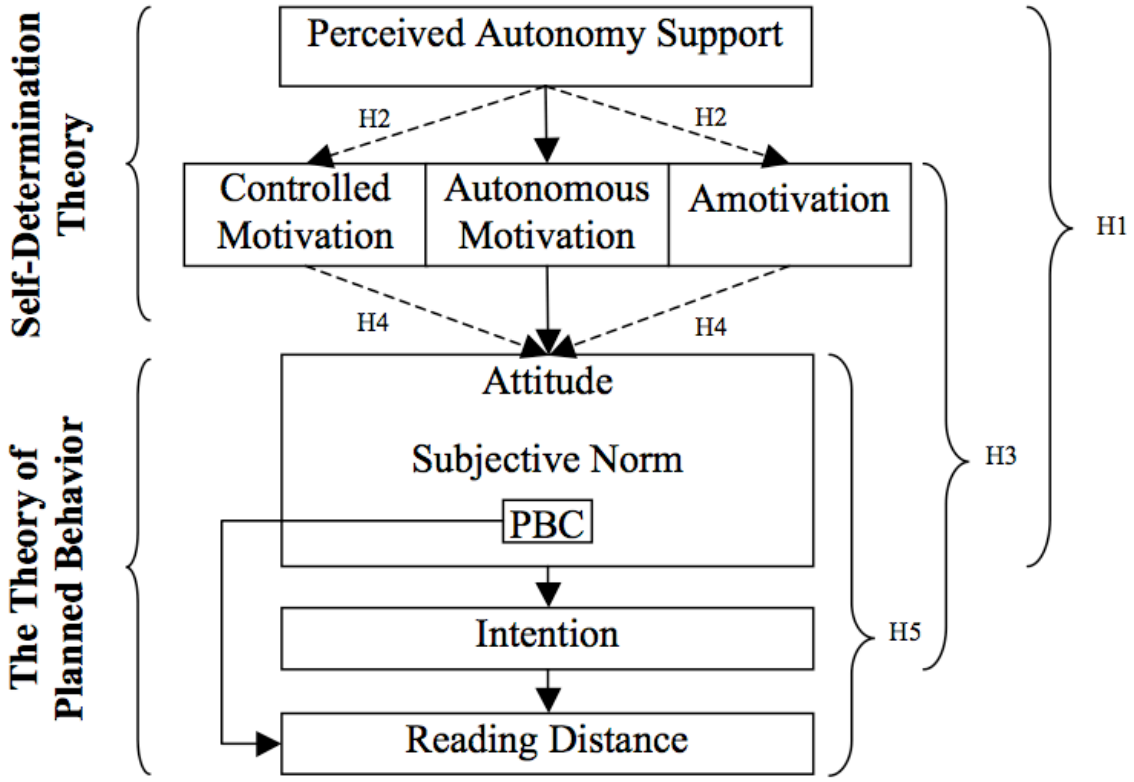

Figure 6.1 The hypothesised model (Study 8).

Note. H1 to H5 indicate the paths or mediation pathways of hypothesis 1 to 5. The normal vectors are hypothesised to be positive and significant, and the dotted vectors are hypothesised to be negative or non-significant. Distance visual acuity and near visual acuity are hypothesised control variables and set to predict all of factors in the model.

Method

Participants and Procedures

Subsequent to the approval of the study by the Research Ethics Committee of the first author's institution, invitations to participate in the study were sent to 120 undergraduate students who attended a *Sport Psychology* course at the Chengdu Sport University in China. They received information about the general purpose and procedures of the study and their participation rights (i.e., voluntary nature, right to withdraw, confidentiality). One hundred and seven respondents (response rate 89.2%; *M* age = 21.1, SD = 3.0 years; age range, 18–22 years; 79.4% male) agreed to participate and signed consent forms. Participants spent a considerable amount of time on near work during the week, such as revision of lecture notes (*M* = 6.3 hours/week, SD = 7.6), homework (*M* = 4.7 hours/week, SD = 6.0), reading textbooks (*M* = 6.8 hours/week, SD = 7.7), working on a computer (*M* = 24.7 hours/week, SD = 20.4), and playing video games (*M* = 10.1 hours/week, SD = 14.7). They did not have any major visual disability, but a number of them wore prescribed spectacles for myopia (32.7%), hyperopia (10.3%), or/and astigmatism (0.9%). All the participants either regarded maximizing reading distance (90.1%) and/or avoiding close-up reading (i.e., reading too closely from the source reading material; 86.4%) as important ways to prevent myopia. To reduce response burden and common method variance (Doty & Glick, 1998), respondents were asked to complete a questionnaire measuring self-determination theory variables and demographic items at baseline, and another questionnaire measuring the theory of planned behaviour variables in the following week. Adopting a prospective design, we assessed the reading distance and visual acuity of participants in a laboratory one month after their completion of both questionnaires. The native language of the participants was Chinese, so the questionnaires, scale instructions, and study information were either translated from their

original English versions into Chinese using standardized back-translation procedures (Hambleton, 2005) or adapted from the Chinese versions developed in a previous study (Williams et al., 1996).

Measures

Psychological Variables. The Health Care Climate Questionnaire (HCCQ; Williams et al., 1996) was used to assess the perceived autonomy support for eye protection and care. The HCCQ has been frequently used to assess the perceived psychosocial environment conceptualized by the self-determination theory in clinical (e.g., physiotherapy (Chan et al., 2009) and diabetes care (Williams et al., 2007)) and non-clinical (e.g., physical activity and weight control) (Silva et al., 2010) health care contexts. This study adopted the six-item Chinese version of the HCCQ validated in previous studies (Chan & Hagger, 2012a; Chan, Hagger, et al., 2011). The items were modified for use in the context of vision care (e.g., "I feel that he/she provides me choices and options about how to protect my eyes"), and participants responded to the items with reference to the most important person (66.4% parents; 28.0% optometrists; 5.6% physicians) who had talked to them about eye protection on seven-point Likert-type scales ranging from 1 ("strongly disagree") to 7 ("strongly agree"). A one-way ANOVA did not reveal any significant difference between the scores corresponding to parents, optometrists, and physicians ($F(2, 88) = 0.57$, $p = .57$, $\eta_p^2 = .01$), so we did not conduct separate analyses for each type of social agent.

The Treatment Self-Regulation Questionnaire (TSRQ) was used to measure participants' motivation for myopia prevention. The TSRQ has been adapted for use in different health contexts, such as prescribed weight control or smoking cessation programs (Levesque et al., 2007), and received support for its reliability and validity. In this study, we developed the myopia prevention version of the TSRQ based on a Chinese version of TSRQ

validated in an injury preventive context (Chan & Hagger, 2012b). The three dimensions, namely, autonomous motivation (6 items; e.g., "I want to prevent myopia because I personally believe it is the best thing for my eyes"), controlled motivation (6 items; e.g., "I want to prevent myopia because I would feel guilty or ashamed of myself if I became (more) short-sighted"), and amotivation (3 items; e.g., "I really don't think about preventing myopia") for myopia prevention, were rated on a 7-point Likert-scale ranging from 1 ("not at all true") to 7 ("very true").

The theory of planned behaviour variables, including attitude, subjective norm, and PBC of the target behaviour (i.e., reading at optimal distance), were developed according to Ajzen's guidelines (Ajzen, 2002). Items measuring attitude were preceded by the common stem, "Reading at an optimal distance from the reading material in the forthcoming month is …" and participants' responses were made on six seven-point semantic differential scales with the following bi-polar adjectives: "valuable - worthless", "beneficial - harmful", "pleasant - unpleasant", "enjoyable- unenjoyable", "good - bad", and "virtuous - not virtuous". Measures of subjective norm (three items; e.g., "Most people who are important to me think that I should read at an optimal distance from the reading material in the forthcoming month"), PBC (five items; e.g., "It is possible for me to read at an optimal distance from the reading material in the forthcoming month"), and intention (three items; e.g., "I intend to read at an optimal distance from the reading material in the forthcoming month") were rated on seven-point Likert-type scales ranging from 1 ("strongly disagree") to 7 ("strong agree").

Reading Distance. Our primary dependent variable was reading distance measured objectively during a novel reading task in laboratory conditions. The task was to read out 18 upper-case alphabetical letters (i.e., the reading material) as fast and accurate as possible. The letters were printed in *Sloan* font (the letters used in standard visual acuity tests with

consistent proportion and visibility; Pelli, Robson, & Wilkins, 1988) on non-reflective photo-papers with a resolution of 300dpi (see Figure 6.2). The reading distance test was preceded by a "practice trial" of the task, where participants could feely adjust the reading distance in the range between 40mm to 1340mm (by rolling the pulley) until they felt that it was their optimal reading distance. The reading distance was then recorded when the participants were reading out the letters in the "test trial" in which the reading distance was not allowed be changed.

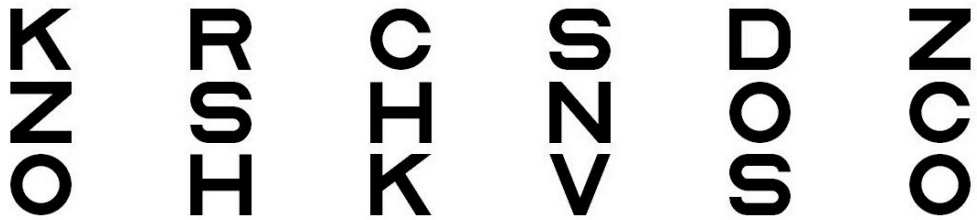

Figure 6.2 Example reading material for the reading distance test (Study 8).

We used a purpose-built apparatus constructed by a biomechanical engineer to measure participants' natural reading distance in a highly-controlled laboratory setting (see Figure 6.3). Reading distance was assessed by an ultra-sound distance sensor (Keyence UD-300; range = 20mm to 1300mm) attached at the bottom of the apparatus which simultaneously detected the distance between participants' eye and the reading material. The laboratory was insulated from external lights, such that the LED light on the apparatus provided a consistent luminance (158 to 166 cd/m^2 measured at 4 corners) to the reading material regardless of reading distance. The reading distance measured by our apparatus was calibrated using the measurement taken from video motion capturing system (VICON, UK).

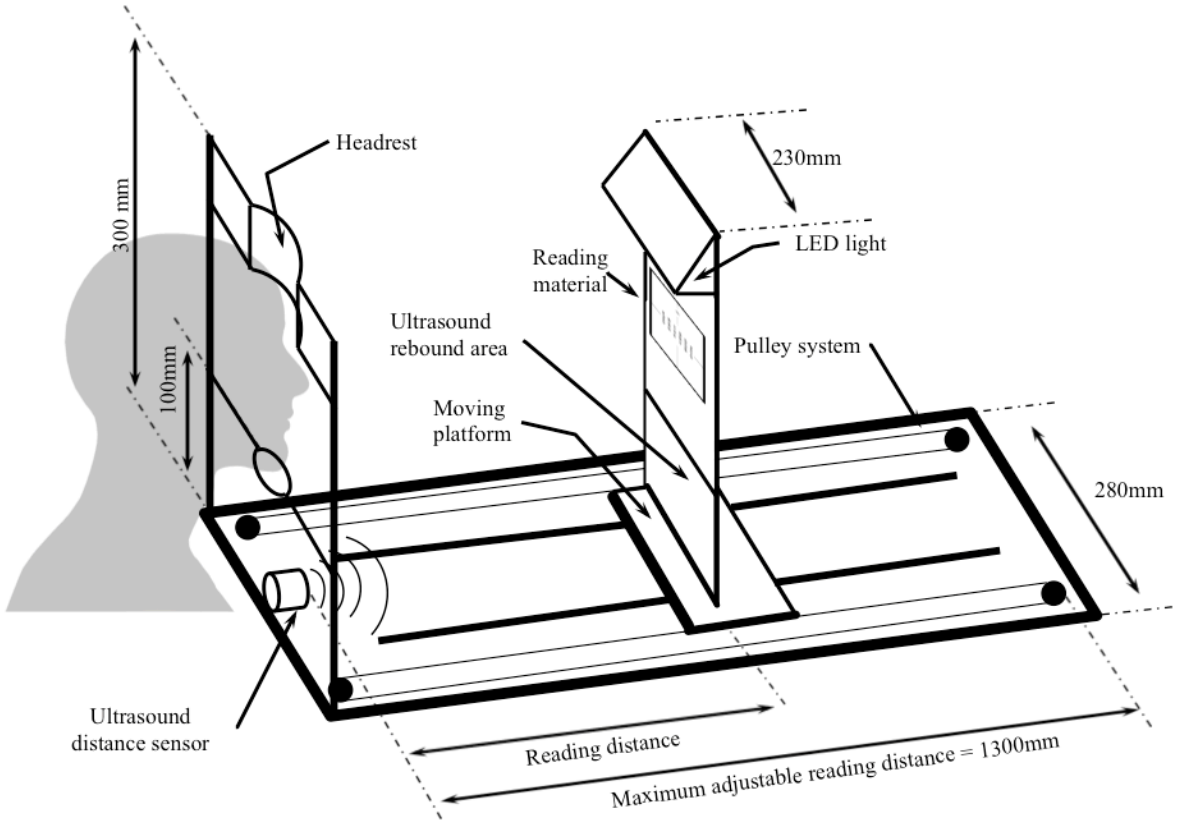

Figure 6.3 The apparatus for measuring reading distance (Study 8).

Note. The height of the reading material was adjusted to match participants' eye level so that the visual angle (horizontal) was standardised.

We examined the reading distance for five different font sizes (M0.25, M0.5, M1, M1.5, and M2; equivalent to font sizes of 2, 4, 8, 12, and 16 points respectively), and each font size was tested twice. To minimize practice effect, the letter combination for each trial was unique and participants were asked to close their eyes between the trials. The order of the font sizes was also counter-balanced to control for order effects. We then took the standardised reading distance measured at each trial as an indicator of the overall reading distance in the analysis. Participants were allowed to perform the test with their own prescribed spectacles (a total of 21 participants did; 19.6% of the sample), but we did not

statistically control for this variable because we did not find a significant difference of the reading distance between the participants who completed the test with or without spectacles ($t(105) = 0.30$; $p = 0.92$, $d = .06$).

Visual Acuity. Two types of vision acuity (distance acuity and near acuity; Ricci et al., 1998) were assessed in a laboratory with standard lighting. Distance visual acuity was examined using the two logMAR ETDRS-revised charts (chart 1 for right eyes and chart 2 for left eyes; Cat No. 212, Sussex Vision Ltd., UK) at a viewing distance of 4.0m. Near visual acuity was measured using logMAR ETDRS double-sided near-vision card (side-1 for right eyes and side-2 for left eyes; Cat No. 210-6, Sussex Vision Ltd., UK) at a viewing distance of 40.0 cm. The luminance at the centers and the four corners of the charts ranged from 162 to 180 cd/m^2 and was thus considered acceptable for standard measurement of visual acuity (Ferris & Bailey, 1996). Participants read the charts from the top to bottom until 2 or more letters were misread on a line, and a logMAR score was recorded from the lowest line on the chart at which participants could correctly identify three of the five letters (Ferris & Bailey, 1996; Ricci et al., 1998). For statistical analysis, we transformed the logarithmic progressive logMAR score into a linear visual acuity score by subtracting 10^{logMAR} (i.e., MAR (Ricci et al., 1998)) from 101, so that normal vision (i.e., denoted as 20/20 in Snellen chart or 0.0 logMAR) and near blindness (i.e., 20/2000 in Snellen chart or 2.0 logMAR) were indicated by a visual acuity score of 100 and 0 respectively.

Deception

In order to reduce response bias in our assessment of the psychological and behavioural variables, participants were informed that we were primarily interested in students' learning motivation and reading speed. As part of the cover story, the self-determination theory, theory of planned behaviour, and demographic items relating to myopia

prevention in the questionnaires and the visual acuity test were described as measures of control variables, and the two questionnaires also embraced items of learning based on both theories. The reading distance test was framed as a test of reading speed and the ultra-sound device was described as a sound recorder for recognizing the speed and accuracy of participants' speech. All the participants were formally debriefed about the true purpose of the study at the end of the experiment and were provided opportunity to withdraw their data. None of the participants expressed a wish to do so.

Analysis

The data were analysed by variance-based structural equation modeling (VB-SEM) using the SmartPLS 2.0 statistical software (Ringle et al., 2005). VB-SEM is able to force measurement error to zero by constructing latent factors, and its model estimation based on a partial least-squares algorithm (as opposed to the typical ordinary least-squares algorithm used in multiple regression) is supposed to be distribution-free (i.e., the estimation is not affected by the complexity of the model, small sample size, or non-normality of the data) making it ideal for use with the current data set (Reinartz et al., 2009). In addition, the convergent and discriminant validity of the hypothesised factors could be evaluated using a number of indices (i.e., factor loadings, cross-loadings, average variance extracted (AVE), composite score reliability, and Cronbach's alpha) taken at the measurement level of the model. To verify the robustness of model, a bootstrapping resampling technique with 5000 replications was utilized to estimate reliable averaged path estimates and associated significance levels.

Mediation analysis was conducted to test the proposed mediation effects in the hypothesised model. A significant mediation effect was evidenced by significant direct and total indirect effects (Aroian, 1947) of the independent variable (IV) in question on the

dependent variable (DV) (Zhao et al., 2010). The type of mediation was determined by whether the direct effect of the IV on the DV was not significant (indication of full mediation) or significantly reduced (indication of partial mediation) when controlling for the effect of the mediator (Zhao et al., 2010). Furthermore, we examined the partial indirect effects of each mediator by Preacher and Hayes' (2008) resampling strategies when two or more mediators were involved in the mediation pathways.

Results

The fit indices of the VB-SEM fully supported the convergent and discriminant validity of the proposed model in the current data. The Cronbach's alpha (range = 0.70 to 0.99), composite score reliability (range = 0.78 to 0.99), AVE (range = 0.50 to 0.85), and factor loadings (range = 0.61 to 0.95) of each factor met published criteria for acceptable convergent validity. Similarly, the fit indices revealed acceptable level of discriminant validity. The loadings for the items on each factor were higher than the cross-loadings by an average of 0.65 (range = 0.44 to 0.93), and the square-root of the AVE of any construct was higher than its correlation with other constructs by an average of 0.64 (range = 0.42 to 0.90). Table 6.1 displays the zero-order correlation matrix, descriptive statistics, and details of the fit indices for each factor.

Table 6.1 Descriptive statistics, and fit indices of the model (Study 8)

Correlational matrix, descriptive statistics, and fit indices of the model

	A-Support	Auto-Mtv	Cont-Mtv	Amotv	Attitude	Norm	PBC	Intention	Distance	VA-Dis	VA-Near
A-Support	—										
Auto-Mtv	0.43**	—									
Cont-Mtv	0.40**	0.48**	—								
Amotv	-0.10	-0.21*	0.29**	—							
Attitude	0.20*	0.45**	0.13	-0.28**	—						
Norm	0.18*	0.37**	0.21*	-0.17	0.42**	—					
PBC	0.22*	0.35**	0.17	-0.06	0.44**	0.37**	—				
Intention	0.25*	0.42**	0.28**	-0.04	0.55**	0.60**	0.50**	—			
Distance	0.13	0.18	0.11	-0.05	0.23*	0.16	0.31**	0.38**	—		
VA-Dis	0.08	-0.01	-0.09	-0.04	0.03	-0.01	-0.11	0.18	0.23*	—	
VA-Near	0.01	0.02	0.06	-0.05	0.11	0.13	0.34**	0.12	0.11	0.50**	—
Mean	4.88	5.41	4.18	3.14	5.61	5.48	4.83	4.92	0.00	92.67	99.29
SD	1.37	1.10	1.22	1.61	1.10	1.06	1.39	1.72	0.95	2.90	1.96
α	0.79	0.77	0.73	0.70	0.82	0.72	0.76	0.91	0.99	0.80	0.78
CR	0.84	0.84	0.78	0.80	0.87	0.82	0.83	0.94	0.99	0.85	0.90
AVE	0.61	0.61	0.51	0.58	0.53	0.60	0.50	0.85	0.90	0.81	0.72
F-loading	0.68	0.68	0.61	0.75	0.72	0.77	0.71	0.92	0.95	0.75	0.81
C-loading	0.16	0.20	0.18	-0.06	0.20	0.19	0.23	0.27	0.13	0.05	0.03

Note. A-Support = perceived autonomy-support; Auto-Mtv = autonomous motivation; Cont-Mtv = controlled motivation; Amotv = amotivation; Norm = subjective norm; PBC = perceived behavioural control; Distance = standardised reading distance; VA-Dis = distance vision acuity (4m); VA-Near = near visual acuity (40cm); CR = composite reliability; F-loading = mean factor loadings; C-loading = mean cross loadings.

*$p < .05$ for a two-tailed test, **$p < .01$ for a two-tailed test.

The bootstrapped estimates and significance levels of the paths in our hypothesised model are presented in Figure 6.4. Perceived autonomy support formed significant positive associations with autonomous motivation and controlled motivation, but its relationship with amotivation was not significant. Attitude, subjective norm, and PBC were significantly and positively predicted by autonomous motivation, and these variables had significant positive relationships with intention, but their associations with controlled motivation and amotivation were not significant. Intention was a significant positive predictor of reading distance. All variables in the model were set to be predicted by the visual acuity variables and only the effect of distance visual acuity on reading distance, and that of near visual acuity on subjective norm, was significant.

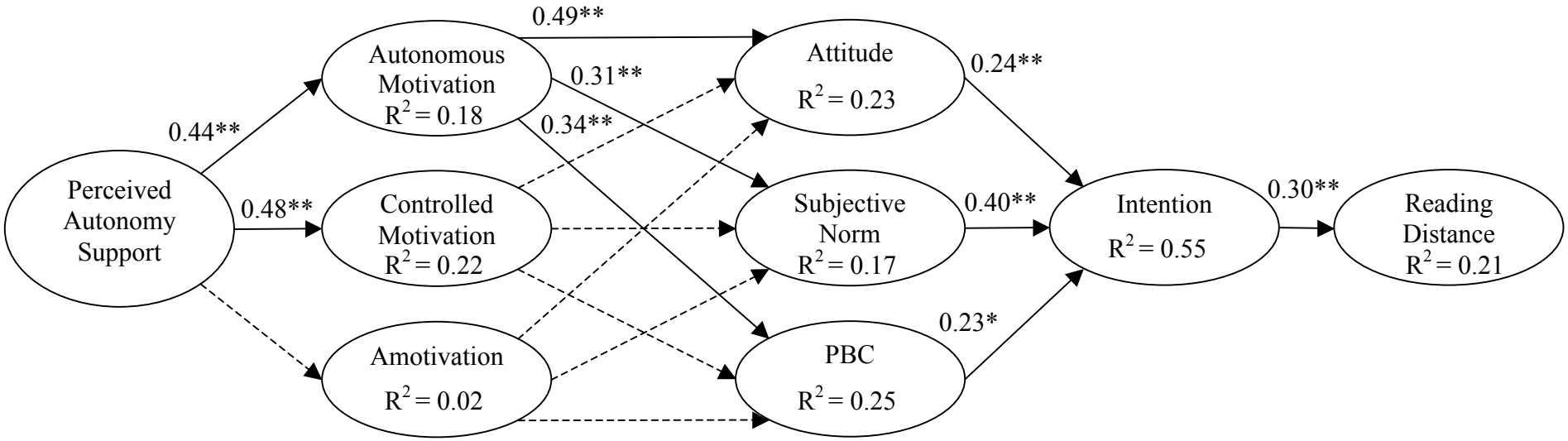

Figure 6.4 Path estimates in the integrated model of self-determination theory and theory of planned behaviour (Study 8).
Non-significant paths ($p > .05$) are represented by dotted vectors. * $p < .05$ for a two-tailed test, ** $p < .01$ for a two-tailed test. Distance visual acuity and near visual acuity were control variables and set to predict all of factors in the model. These paths are omitted for clarity. None of the effects were significant apart from the effect of distance visual acuity on reading distance ($\beta = 0.31$**) and the effect of near visual acuity on subjective norm ($\beta = 0.17$*).

Mediation analyses revealed that the positive effects of perceived autonomy support on attitude, subjective norm, and PBC were fully mediated by autonomous motivation, but not by controlled motivation and amotivation. Autonomous motivation, instead of controlled motivation, positively predicted intention via the complete mediation of attitude, subjective norm, and PBC. Intention fully mediated the positive effects of attitude and PBC on reading distance, but did not mediate on the corresponding effect for subjective norm. A summary of the results of the mediation analysis is presented in Table 6.2.

Table 6.2 Mediation analysis results (Study 8)

Mediation analysis results

Path	Mediators[a]	Direct Effect	Combined Effects	Total Effect	Indirect Effect	Mediation Type
A-Support → Attitude	Auto-Mtv*, Cont-Mtv, Amotv	.22*	.01	.21*	.15*	Full
A-Support → Norm	Auto-Mtv*, Cont-Mtv, Amotv	.17*	-.03	.21*	.14*	Full
A-Support → PBC	Auto-Mtv*, Cont-Mtv, Amotv	.22*	.04	.16	.09*	Full
Auto-Mtv → Intention	Attitude*, Norm*, PBC*	.43**	.12	.37**	.53*	Full
Cont-Mtv → Intention	Attitude, Norm*, PBC*	.31*	.12	.14	.21*	None[b]
Amotv → Intention	Attitude, Norm, PBC	-.04	.08	.05	-.19	None
Attitude → Distance	Intention*	.24**	.03	.20**	.17*	Full
Norm → Distance	Intention*	.18	-.12	.10	.18*	None
PBC → Distance	Intention*	.33**	.16	.27**	.14*	Full

Note. A-Support = perceived autonomy-support; Auto-Mtv = autonomous motivation; Cont-Mtv = controlled motivation; Amotv = amotivation; Norm = subjective norm; PBC = perceived behavioural control; Distance = standardised reading distance.

*$p < .05$ for a two-tailed test, **$p < .01$ for a two-tailed test.

[a]Significant partial indirect effects (lower bound of 95% confidence interval > 0) were marked by *.

[b]Mediation was not significant because the direct effects of controlled motivation on the mediators were not significant.

Discussion

The objective of the present study was to apply an integrated model based on the theory of planned behaviour and self-determination theory to understand the motivational and social cognitive process involving myopia preventive behaviour (reading distance). We hypothesised a motivational sequence in which perceived autonomy support and motivation (autonomous motivation, controlled motivation, and amotivation) from self-determination theory had direct and indirect links to the social cognitive variables (attitude, subjective norm, and PBC) and intention from the theory of planned behaviour. In addition, intentions were proposed to predict future preventive behaviour regarding near work and mediate the effects of the other variables in the sequence on behaviour. In the following sections we deal with the current findings for each component part of the proposed motivational sequence and how these findings are relevant to the understanding myopia preventive behaviour.

Self-Determination Theory Components

Apart from the significant positive association between perceived autonomy support and controlled motivation, all the paths associated with autonomous motivation were significant and positive as predicted, and the paths that linked to controlled motivation and amotivation were non-significant in accordance with our hypotheses. This pattern is consistent with self-determination theory (Deci & Ryan, 1985b; Ryan & Deci, 2000b), and suggests that applying an autonomy-supportive style in the delivery of vision-care messages could enhance the likelihood that people will endorse autonomous motivates for myopia prevention, the key motivational factor of intentions to engage in myopia-preventive behaviours. We did, however, find relationships that were contrary to hypotheses such as the link between perceived autonomy support and controlled motivation. A possible explanation for this anomalous effect could be that a majority of the significant autonomy support

providers were parents. In a Chinese culture listening to the advice of parents is a moral obligation because parents are typically regarded as authoritative figures (Fuligni, 1998). In some cases an autonomy-supportive style is likely to foster autonomous motivation in the theoretically-predicted pattern. However, in this particular culture, even though significant others may be perceived to display autonomy-supportive behaviours, these may, nevertheless, be interpreted as part of the moral obligation brought about by the cultural environment. Such obligations are experienced as reinforcing and other-referenced rather than self-referenced even if the significant others are perceived to provide autonomy support (Kim et al., 2000; Schouten & Meeuwesen, 2006).

Controlled motivation, together with amotivation, was not predictive of the social cognitive and behavioural variables in the model, which is consistent with the tenets of self-determination theory with respect to the importance of autonomous motivation in motivating initiative and persistence in behaviour (Deci & Ryan, 1985b; Ryan & Deci, 2000b). Amotivation, on the other hand, represents a deficiency of behavioural motives according to self-determination theory. Although the analysis did not reveal any significant links between amotivation and the social cognitive or behavioural variables in the model, the significant negative correlation of this variable with autonomous motivation and its positive correlation with controlled motivation suggests that individuals who are motivated to prevent myopia for the value and meaning associated with the action were less likely to amotivated than those motivated to prevent myopia merely for meeting external demands or for ego-protective reasons. This pattern again highlights the importance of ameliorating the sense of personal agency with regard to health behaviours among individuals who are encountering risk of health problems, and explains why autonomous motivation is advantageous to behavioural persistence in managing long-term illness or the maintenance of new health habits (Chan,

Hagger, et al., 2011; Chan et al., 2009; Halvari et al., 2010; Williams et al., 1996; Williams et al., 2007; Williams, McGregor, Sharp, Kouides, et al., 2006).

The Theory of Planned Behaviour Components

Autonomous motivation was an important predictor of intentions to engage in myopia preventive action, yet its effect was fully mediated by the three belief-based social cognitive variables from the TPB as hypothesised in the integrated model (Chan & Hagger, 2012a; Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a; Hagger et al., 2006). This result pattern explains why autonomous motivation is adaptive according to self-determination theory (Deci & Ryan, 1985b; Ryan & Deci, 2000b) because autonomously-motivated individuals are more likely to regard the action (i.e., reading in an optimal distance) as something worthwhile (attitude), socially appropriate (subjective norm), and manageable (PBC) given that these positive beliefs are strong correlates of the intention, the most proximate predictor of future behavioural engagement (Ajzen, 1985, 1991).

All the three belief-based social cognitive variables significantly predicted more than half of the variance in intentions to engage in myopia preventive behaviour, which was comparable to previous studies in other preventive contexts (Chan & Hagger, 2012a, 2012b; Hagger et al., 2002a; Hagger et al., 2006) and the meta-analysis of studies applying the theoretical integration between the theory of planned behaviour and the self-determination theory (Hagger & Chatzisarantis, 2009b). However, even though subjective norm was shown to be the strongest predictor of intention among the three belief-based social cognitive variables, only the effects of attitude and PBC on behaviour (i.e., reading distance) were supported and mediated by intention according to our hypotheses. These patterns might infer that subjective norm is as influential in the prediction of intention as attitude and PBC, but its indirect effect on behaviour is smaller by comparison. Moreover, intention fully mediated the

effect of PBC on behaviour, which was inconsistent to our hypothesis of a partial mediation of this pathway. This was likely because the measure of PBC in the current study reflected perceived rather than actual barriers and control beliefs relating to the behaviour (Chan & Hagger, 2012a). Ajzen (1991) suggests that to the extent that PBC reflects actual control over behaviour, PBC will predict behaviour directly. But if it reflects only perceived aspects of control, then it should be fully mediated by intention because the effects are motivational rather than directly inhibitive of behavioural engagement.

The importance of subjective norm in predicting intention is consistent with the cross-cultural research adopting the theory of planned behaviour. The research revealed that the effect of subjective norms on intentions in Chinese (Abrams, Ando, & Hinkle, 1998), or people from collectivistic countries (Hagger, Chatzisarantis, Barkoukis, et al., 2007), was higher in magnitude than those in Western or individualistic countries. Indeed, the indirect effect of subjective norm on behaviour was not significant. This was not in line with our hypothesis and findings from previous studies (Hardeman et al., 2002; McEachan et al., 2011). This may have been because people who perceived the behaviour as socially appropriate (i.e., those who rate subjective norm highly) were more likely to over-evaluate their behaviour (Budd & Spencer, 1986). Our assessment of behaviour was supposed to be unaffected by response bias, general response tendency, and self-fulfilling hypothesis because the participants were blinded from the true purpose of the study, thus such methodology could be as a solution for revealing the true relationships between the theory of planned behaviour variables and behaviour by minimizing confounding effects in the measurement of behaviour.

Reading Distance and Visual Acuity

In the current study, behaviour was measured by participants' reading distance, and it was significantly predicted by intention when controlling for the effect of visual acuity,

corroborating the tenets of individual (Hagger, Chatzisarantis, Barkoukis, et al., 2007; Hagger, Lonsdale, Hein, et al., 2012) and meta-analytic (Hagger & Chatzisarantis, 2009b; Hardeman et al., 2002; McEachan et al., 2011) tests of the theory of planned behaviour. In addition, this may imply that maintaining an optimal reading distance for near work is indeed a volitional or habitual behaviour and is not merely a function of visual acuity, but it also closely related to intention and other psychological variables in our integrated model. However, it is important to point out that reading distance is only one aspect of near work. We selected this dependent variable because other potential behavioural indicators such as the total volume of near work, the time of continuous close-up reading, and the frequency of rest periods between bouts of near work have been shown to produce inconsistent results (Ip et al., 2008) and assessments relying on self-reported near work are subject to memory bias and social desirability. Therefore, future studies should continue to adopt comprehensive and reliable assessments of near work to objectively quantify how working close to reading materials contributes to the impairment of visual acuity over time.

On the other hand, we regarded visual acuity as a control variable in the model rather than specifying its causal effect on reading distance even though reading distance was significantly correlated with distance visual acuity. It is because a significant reduction in visual acuity due to the progression of myopia was not likely to be detected during the course of our study as the degeneration is long term, and so the significant correlation is more likely to be attributable to the possibility that individuals with an impaired distance visual acuity tend to perform near work at a shorter viewing distance, but our one-month prospective design was unable to offer strong evidence to support this argument (see the Limitations section). Moreover, other uncorrected refractive errors may also contribute to the impairment of visual acuity, so future studies should use refractive error measured in diopter (the standard optometric scale; Fredrick, 2002; Morgan, 2003) to assess myopic symptoms. Finally, the

significant positive effect of near visual acuity on subjective norm raises a plausible possibility about the relationship between perceived social appropriateness of myopia preventive behaviours and individuals' clarity of vision for near objects, and testing their causal link may be an interesting avenue for further research.

Limitations

In addition to the previously-cited limitations, we also acknowledge a few more limitations of the present investigation that may stimulate future research. First of all, although the variables from the theory of planned behaviour, self-determination theory, and the hypothesised outcome (i.e., reading distance) were measured on separate occasions, the follow-up measures were short-term in nature and limited our ability to draw conclusions about the temporal and causal nature of the relationships in the model. For instance, myopia is likely to take several years to develop (Fredrick, 2002; Matsumura & Hirai, 1999) and so the effect of psychosocial factors and preventive behaviours on ameliorating the progression of myopia could hardly be revealed over such a short period. A cohort design with longitudinal assessments would be more effective in testing this hypothesis. However, our model and assessment tools may serve as a basis for the design, implementation, and evaluation of a community-based psychosocial intervention (Hagger, Lonsdale, & Chatzisarantis, 2012; Hagger, Lonsdale, Hein, et al., 2012) for enhancing the motivational, social cognitive, and behavioural factors associated with myopia prevention. Secondly, even though our study applied deception and the dependent variables were assessed objectively, the confounding effects of response bias were still not completely eliminated because the psychological variables in the model were measured by self-report. This is a typical weakness in survey-based research, and underscores the need for the development of implicit measures of motivation (Keatley, Clarke, & Hagger, 2011) and belief-based measures of attitudes

(Karpinski & Steinman, 2006) in future tests of the model for myopia prevention and other health contexts. Last, but not least, the sample was obtained from a homogenous population, that identified parents as the significant others primarily concerned with vision care, so future studies should examine the generalizability of the model in diverse populations including samples from different age groups, occupations, educational levels, and cultural backgrounds.

Conclusions

The present investigation provided preliminary support for the application of an integrated theoretical model comprising the theory of planned behaviour and self-determination theory to myopia prevention. Results corroborated evidence from previous social psychology research with respect to the importance of autonomous motivation and social-cognitive beliefs in predicting behavioural compliance toward health and safety recommendations. The study may provide important information for health practitioners and policy makers about the potential benefits of reinforcing autonomy-supportive health-care environments regarding health-promoting behaviours.

Implications of Chapter 6

Given the previous studies in this thesis were employed in injury-related contexts, Study 8 extended the application of the hypothesised integrated model to a general health-care context, and the results were consistent with the findings in Studies 3, 4, and 6 with respect to the role of social cognitive processes in motivated behaviour for health and safety. The findings were encouraging because the application of the integrated model was not limited to the rehabilitation and prevention of injury, and it was deemed applicable to explain motivation and intention toward behaviours in other health and safety contexts. Additionally, the prospectively and objectively measured behaviour (i.e., reading distance) in Study 8 addressed the limitations of all previous studies in thesis (Study 1 to 7) where behaviour was

either not measured or being assessed cross-sectionally. The next chapter (Chapter 7), hence, focuses on discussing the interpretations, theoretical and methodological contributions, and limitations and for the eight studies. Conclusions are then drawn with respect to the theoretical and practical implications, and future directions for the psychological research of health and safety behaviours.

Chapter 7

General Discussion

This Chapter is a modified form of the following published article:

Chan, D. K. C., & Hagger, M. S. (2012). Theoretical integration and the psychology of sport injury prevention. *Sports Medicine, 42*(9), 725-732.

Overview of Thesis

The aim of the research presented in this thesis was to integrate concepts from three psychological frameworks, including self-determination theory (SDT; Deci & Ryan, 1985b), the theory of planned behaviour (TPB; Ajzen, 1985), and the hierarchical model of motivation (HMM; Vallerand, 1997), into a model for understanding the processes underpinning motivation and intention toward health and safety behaviours. Specifically, the hypothesised model embraced two tenets derived from SDT, the TPB, and HMM, including the trans-contextual effect of motivation (*tenet 1*; derived from SDT and HMM) and the theoretical integration between SDT and the TPB (*tenet 2*), and various components of the model were respectively tested across a number of health and safety domains in the eight studies presented in Chapter 2 to 6 of this thesis. Overall, the findings from Chapter 2 to Chapter 7 were generally congruent with the global model of the thesis comprising two theoretical tenets derived from the framework of SDT, HMM, and the TPB.

Evidence for Tenet 1

The first tenet of the thesis hypothesised that self-determined motivation would transferred from a general life domain to a specific domain, namely, self-determined motivation for health and safety. As such, promoting self-determined motivation within a general life domain through the provision of autonomy support (a key theoretical premise of SDT) might carry over to self-determined motivation for health and safety through a trans-contextual process. In the current thesis, the first tenet of the model was examined in four different health and safety domains, including sport injury rehabilitation (Studies 1 and 2 in Chapter 2), sport injury prevention (Study 5 in Chapter 4), occupational injury prevention (Study 6 in Chapter 5), and occupational injury rehabilitation (Study 7 in Chapter 5).

The evidence for the first tenet of the thesis was consistent across all the health and safety domains investigated in the present thesis, revealing a robust motivational pattern where self-determined motivation in a general life domain may transfer into self-determined motivation for undertaking health and safety behaviour. Self-determined motivation did not only transfer in terms of volume, the trans-contextual mechanism of motivation also directed the transfer of motivation in terms of its quality. It appeared that autonomous motivation and controlled motivation for the behaviour in a given life domain such as sport, were associated with the endorsement of the corresponding types of motivation in the same magnitude and direction with respected to the continuum of self-determination according to SDT (Ryan & Connell, 1989). The personality trait-like motivational orientation at the global level according to HMM (Vallerand, 1997), the general causality orientation, was shown to be partly responsible for the trans-contextual effect of motivation by establishing significant relationships with the contextual motivations at both the general life domain (i.e., sport) and the context of health and safety, but the relationship between motivation in two related contexts (e.g., sport and sport injury rehabilitation) was significant after controlling for general causality orientation (Study 2 and 5), showing that the trans-contextual mechanism of motivation operates independently beyond the influence of dispositional motivational orientations. This pattern of results concurred with the propositions of the HMM regarding the inter-play of motivations across different contexts at contextual level (Vallerand, 1997, 2000), and were consistent with previous research that examined the trans-contextual effect of motivation across the contexts of PE and physical activity (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2003; Hagger, Chatzisarantis, et al., 2009).

This trans-contextual effect of motivation may provide explanations about why the social environment and motivational patterns evolving individuals' lifestyle are closely related to health and safety behaviours (Courtenay, 2000; Davies & McColl, 2002).

Individuals who are autonomously motivated in a given life domain are more likely to perform health and safety behaviours in the domain for autonomous reasons, and these reasons, according to the global model of the thesis and the additional evidence about the motivational outcomes (Chan et al., 2009; Hagger et al., 2002b; Williams et al., 2002), are key motives that further link to enhanced behavioural adherence and intention, and adaptive beliefs toward health and safety.

The provision of autonomy support, hence, is meaningful not only for one's endorsement of self-determined motivation in a given life domain, but it is also an important predictor of self-determined motivation for health and safety behaviour. However, it is important to point out that the effect of autonomy support might be dependent on the relative importance of each social agent to the individual in the behavioural context. In the context of sport injury rehabilitation, the role of physiotherapists or team physicians might be more important than that of coach (Chan, Hagger, et al., 2011). However, perceived autonomy support from coaches in sport injury prevention context, and that from supervisors in occupational injury prevention context (Chan & Hagger, 2012a), seem to be modest predictors of self-determined motivation for health and safety actions. Yet, in the context of myopia prevention among college students, parents tend to be more important than physicians and optometrists for vision care. Current findings concerning the effects of perceived autonomy support from different social agents, such as coaches, physicians, physiotherapists, optometrists, and supervisors, on self-determined motivation of health and safety behaviours, may provide some insights regarding the impact of significant others on health and safety promotion. Future research should employ more stringent approaches (e.g., multi-group structural equation modeling; Chan, Lonsdale, & Fung, 2011) to formally compare the relative role of these social agents across various health domains.

The promising findings supporting *tenet 1* from a number of health and safety contexts in this thesis also demonstrated a generalisability of trans-contextual process of motivation. Such evidence may pave the way for further replications of the model in other areas. For instance, research has begun to replicate the model into the explanation of students' motivation in learn. A multi-study paper involving cross-sectional and prospective datasets from both UK and China, revealed that university students' learning motivation in school was related to motivation of self-learning behaviour (e.g., revision) after-school (Chan & Hagger, 2012c). Given, the generalisability of the trans-contextual effect of motivation, the potential utility of the model might not only be limited to the areas that have been tested so far (i.e., health and safety, physical activity, and learning). Clearly there are a lot of other avenues that are worthy of investigation. For example, research on juveniles suggests that sport training is an effective medium to build young offenders' morality, positive attitudes, and values for the prevention of delinquency (Purdy & Richard, 1983; Sugden & Yiannakis, 1982). Does the transfer of motivation occur between sport and delinquency prevention? Research of anti-doping in sport support the view that sport motivation is associated with athletes' intention, beliefs and values of using banned performance-enhancing substances (Barkoukis, Lazuras, Tsorbatzoudis, & Rodafinos, 2011; Stewart & Smith, 2008). Could motivation to take or avoid banned performance-enhancing substance mediate the effect of sport motivation on the intention, beliefs, and values associated with doping in sport? These interesting research questions regarding the trans-contextual effect of motivation are left opened for future studies to answer.

Evidence for Tenet 2

The second tenet of the thesis focused on variables within the health and safety context, and it was hypothesised that self-determined motivation predicted behaviour

regarding health and safety through the mediation of the social cognitive mechanism of the TPB, where attitude, subjective norm, and perceived behavioural control (PBC) were linked positively to intention. The second tenet of the model was examined in four different health and safety domains, including sport injury rehabilitation (Study 3 in Chapter 3) and prevention (Study 4 in Chapter 3), occupational injury prevention (Study 6 in Chapter 5), and myopia prevention (Study 8 in Chapter 6).

Evidence for the second tenet of the thesis across all health and safety contexts examined (i.e., sport injury rehabilitation and prevention, occupational injury prevention, and myopia prevention) provides compelling support for the relationship between autonomous motivation and the three social cognitive variables from the TPB (i.e., attitude, subjective norm, and PBC). This clearly supports the propositions of my thesis about how self-determined motivation from SDT may inform social cognitive variables based on the TPB. However, there were contrasting results in Study 3 and 4 in relation to controlled motivation. Controlled motivation was suggested to be less adaptive to behavioural adherence according to SDT (Deci & Ryan, 1985b) and was found to be a negative predictor of treatment adherence in sport injury rehabilitation (Chan et al., 2009), and more importantly it did not significantly predict all the social cognitive variables in Study 6 and 8, but it surprisingly formed positive relationships with PBC of sport injury rehabilitation in Study 3, and with subjective norm and PBC of sport injury prevention in Study 4.

This unique pattern of effects for controlled motivation raises interesting questions about the way human behaviours being driven by externally-oriented motives. Behaviours driven by controlled motivation, according to SDT, are not need-satisfying, and are thus less likely to be sustained over time because basic psychological needs are essential for optimal functioning and psychological well-being (Deci & Ryan, 1985a, 2000, 2008). Nevertheless, there have been a few exceptions in previous research showing that controlled motivation

might not be as effective as autonomous motivation in predicting behavioural persitence, but it could also be adaptive to individuals' motivational and behavioural patterns to some extent (Chan & Hagger, 2012b; Chan, Hagger, et al., 2011; Hardcastle & Hagger, 2011; Williams, Gagné, et al., 2005). Is controlled motivation adaptive only in a particular health context or culture, and for individuals with certain occupational demands or health risks? Is controlled motivation maladaptive only to long-term behavioural compliance? Can autonomy support or controlled motivation compensate or counter-balance the negative effects of controlled motivation? These questions remained unanswered given the study designs (e.g., cross-sectional, retrospective, hypothetical) and analytical strategies (i.e., variable-centered approach) adopted in this thesis, but the interesting pattern of effects warrants future research employing longitudinal designs, personal-centered analytical approaches (e.g., latent class analysis; Collins, Fidler, Wugalter, & Long, 1993), and multi-sample or cross-cultural comparisons.

On a different note, the predictive validity of attitude, subjective norm, and PBC on behavioural intention has indeed shown to be consistent, but the relative contribution of the variables in relation to each other was observed to vary across contexts. All the thee social cognitive variables exerted small to moderate effects on intention in the domains of sport injury rehabilitation (Study 3), sport injury prevention (Study 4), and myopia prevention (Study 8), but their corresponding effects in the domain of occupational injury prevention were slightly different. In occupational injury prevention domain (Study 6), the effect of subjective norm on intention was large and that of PBC was not significant when controlling for other social cognitive variables. One possible explanation is that some social environment, culture, lifestyle, or behavioural characteristics within a life domain may heighten or suppress the impacts of particular social cognitive beliefs of health and safety (Abrams et al., 1998; Chol & Green, 1991). For instance, the participants in Study 6 were police officers who were

trained, educated, equipped professionally to prevent occupational injury, so their intention of preventing occupational injury could be less dependent on their injury prevention capacity, resources, or foreseeable obstacles, but rather it was a matter of their personal and perceived social values applied to health and safety (Chan & Hagger, 2012a). In this situation, PBC might appear as a less salient factor on the prediction of behavioural intention in relation to attitude and subjective norm. In a similar vein, subjective norm in Study 8 was not a significant predictor of reading behaviour, and this might also be attributed to the specific health and safety characteristics for myopia prevention. Perhaps reading distance (i.e., the behaviour) is typically a private behaviour where the approval of significant others for this personal preference is not usual. The inconsistent result patterns again raise the necessity to carry out meta-analysis for the integrated model of SDT and the TPB in all health and safety domains (cf. Hagger & Chatzisarantis, 2009b), including rehabilitation, physical activity, prevention of disease and deficiency, and safety in work and sport.

Contributions of the Thesis

Theoretical Contribution

The present thesis contributed to knowledge of the social psychological and motivational factors affecting social behaviour in a number of ways. Using an evidence-based theoretical integration approach (Chan & Hagger, 2012d; Hagger, 2009b, 2010a; Lippke & Ziegelmann, 2008), the current research not only extended the application of the trans-contextual effect of motivation and the theoretical integration between SDT and the TPB to various health and safety domains, but it also preliminary tested a number of key variables from SDT and the TPB associated with the rehabilitation and prevention of injury or deficiency. Much of the research in the thesis was conducted in mainland China in which the theoretical evidence of the SDT and TPB constructs could supplement the findings from

previous research that mostly conducted in the western countries (Hagger & Chatzisarantis, 2009b; Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2009). The theoretical evidence generated from the thesis is important to theorists and cross-cultural psychology researchers as it provides useful information on the psychological processes leading to motivated behaviour in various health contexts (Hagger, 2010a; Michie et al., 2008; Michie et al., 2007).

Methodological Contribution

Methodologically, the thesis also brought a few advances to the literature. The sport injury scenario constructed in Study 2 (Chapter 2) offered an example of developing hypothetical stories to elicit individuals' motivational and behavioural responses toward health-emergency situations. Despite its potential limitation in terms of external validity (see Chapter 2), this method is useful for researchers to collect cross-sectional or even longitudinal data on self-determined motivation and intention of health behaviours within highly controlled and standardised hypothetical settings. Research about rehabilitation experience (e.g., sport injury rehabilitation) has always been very challenging because the type and severity level of injury or illness vary across individuals, and the recovery progress may change from time to time, so it is very difficult to study patients' rehabilitation experience when controlling or standardising these external factors. A hypothetical injury scenario or other emergency health problems might provide a potential solution for certain experimental designs (e.g., randomised controlled trial with cross-over design) and methods for controlling the external factors associated with rehabilitation or treatment.

In addition to the hypothetical scenario, the present thesis implemented a number of measures for the assessment of core variables from both SDT and the TPB in various health and safety domains. Measures of perceived autonomy support and self-determined motivation

from SDT, and attitude, subjective norm, PBC, and intention from the TPB were developed for the contexts of sport injury prevention, occupational injury prevention and rehabilitation, and myopia prevention. Although these measures were mostly adapted from the existing scales (see the section below for its associated limitations), they provided assessment tools for SDT and TPB constructs in health and safety domains, and, more importantly, provided foundations for future research to develop new scales in related areas and improve the validity and reliability in the present measures.

In addition to the assessment of psychological variables, the thesis also introduced an innovative method to measure a health behavioural indicator (i.e., reading distance) objectively in a highly controlled laboratory setting (Study 8). In particular, the behavioural indicator was measured inattentively by a biomechanically-built apparatus during a novel reading task. This method presented a new behavioural assessment alternative to traditional survey-based self-report methods used to measure behaviour. It is important to note that previous research into the mechanisms of the trans-contextual effect of motivation (Hagger, Chatzisarantis, Barkoukis, et al., 2005; Hagger, Chatzisarantis, et al., 2003; Hagger, Chatzisarantis, et al., 2009) and the theoretical integration between SDT and the TPB (Hagger & Chatzisarantis, 2009b; Hagger et al., 2002a; Hagger et al., 2006) heavily relied on self-reported behavioural measures, and the responses could be subject to social desirability general response bias, and inaccuracies due to recall and memory, but the new measure of behaviour introduced in Study 8 was not subject to these problems. Even though the novel task and the purpose-built apparatus in Study 8 were designed specifically for measuring reading distance and they might not be applicable to the assessment of other health behaviours, the behavioural assessment protocol presented a good example of how the knowledge of other disciplines such as biomechanics could offer solutions to the research methods in health psychology research.

Practical Contributions

Practically, the findings of the current thesis are meaningful to sport practitioners particularly to inform the promotion of compliance to health and safety behaviours in sport (Finch, 2006; McGlashan & Finch, 2010) and other health settings (Kok et al., 2004; Michie et al., 2008). For instance, the integrated model could be very useful in informing coaching practice through the development of intervention strategies to foster athletes' adaptive motivation and beliefs with respect to injury prevention, and, in turn, affect behavioural adherence. An evidence-based integrated model may inform the development of interventions, through the application of intervention mapping (Dombrowski et al., 2011; Kok et al., 2004; Michie et al., 2008), to promote safety and prevent dropout from prescribed treatment. The mapping process aims to systematically identify the determinants of health behaviours and the associated techniques that will change these determinants from multiple theories to produce interventions that are most effective on changing behaviour (Michie & Johnston, 2012).

In particular, integrated models are advantageous in helping the development of more effective interventions by providing numerous pathways and strategies that are likely to have effects on intentions and behaviour (Chatzisarantis & Hagger, 2007; Hagger, Lonsdale, Koka, et al., 2012; Hagger, Lonsdale, & Chatzisarantis, 2011a, 2011b). In the integrated model proposed in the current thesis, interventions that target change in the constructs from the theories that have been shown in empirical research to have significant direct or indirect effects on intentions to engage in health and safety behaviours could be more likely to be met with success. Clearly, the cross-sectional research in the thesis has identified pervasive effects of self-determined forms of motivation from SDT, and attitudes and perceived behavioural control from TPB, on intentions and health behaviour (Chan & Hagger, 2012a, 2012b; Collins et al., 1993). This means that hybrid interventions with strategies that promote autonomous

motivation (e.g., autonomy supportive behaviours by the coach, physiotherapist, or significant others associated with the health behaviour), attitudes (e.g., promoting the advantages of doing the behaviour relevant to the sample), and perceived behavioural control (e.g., providing experiences of success with the target behaviour and helping overcome barriers) in a single intervention might be associated with changes in all of the variables linked to intention. In accordance with the integrated model, changes in these variables as a result of the interventions might have a knock-on effect in increasing intentions to engage in health and safety behaviours in the future and, as a consequence, a concomitant change in the target behaviour.

A 'hybrid' intervention would include components targeting constructs from both component theories (SDT and TPB) which would serve to influence behaviour through the differing motivational processes. Furthermore, the techniques to change the variables from each component theory are quite different. SDT intervention techniques to promote autonomous motivation usually involve the style of presentation and language chosen by social agents involved in helping individuals prevent injury or disease. Such agents (e.g., supervisor, physicians) would use techniques such as avoiding controlling language (words like 'should' or 'must') when describing preventive techniques (e.g., safe landing), offering individuals with opportunities for choice and to ask questions, providing a clear and unambiguous rationale related to personally-held values, and providing competence-related feedback (McLachlan & Hagger, 2010). In contrast, TPB interventions usually involve the provision of content that targets salient personal (attitudes) and control-related (perceive behavioural control) beliefs about the behaviours and actions surrounding the health behaviour. This would involve information targeting the advantages of performing the behaviour (e.g., not get injured, recover quicker) and how it can be done effectively (e.g., demonstrating technique, dispelling barriers). The techniques can be integrated in a single

intervention by presenting the belief-related information in conjunction with the SDT techniques like choice and rationale. This has been successfully achieved in previous interventions in a physical activity context (Chatzisarantis & Hagger, 2009). However, it is important that such hybrid interventions are implemented in health and safety contexts using fully-factorial, randomized controlled designs so that the efficacy of the intervention arm using the hybrid approach is found to be effective in changing behaviour than the effects of the intervention arms using techniques from each component theory alone (Hagger, 2010a; Michie et al., 2008; Weinstein, 2007).

Limitation and Future Directions

A word of caution should be offered when applying the integrated model to inform practice because a majority of the studies or data in the thesis, and the extant literature, are correlational (with the except of Study 8) and the findings limit researchers' ability to draw definite conclusions with respect to the causal effects and temporal sequence of the variables within the integrated model {Hagger, 2011 #1045;Collins, 1993 #116;Weinstein, 2007 #1031;Hagger, 2009 #1008}. Adopting longitudinal designs (e.g., a cross-lagged panel design or a cohort study), and experimental designs (e.g., randomized controlled trials) manipulating each of the variables within the integrated model are possible solutions for testing these causal and temporal effects, but they present real challenges for the future research (Hagger, Lonsdale, Koka, et al., 2012). Longitudinal research is challenging because of the need to collect data at multiple time points from the same participants without a prohibitively large attrition rate. Experimental research is difficult given the need to carefully manipulate the target variables while holding other variables constant and collecting data from sufficient control groups while bearing in mind potential artifacts of error such as non-compliance (Hagger, 2010a), intervention fidelity (Hardeman et al., 2008), mere-measurement effects

(Godin, Belanger-Gravel, Amireault, Vohl, & Perusse, 2011), and the effects of a number of potential confounding including personal (e.g., injury history, sensation seeking, and personality) and external (e.g., injury risk, safety resources, and the effectiveness of intervention delivery) factors.

From a theoretical point of view, the size of the integrated model, and associated constraints regarding the sample size, statistical power, and research design, means that no single study in the current thesis tested the complete model comprising all hypothesised tenets. As a result, the trans-contextual effect of motivation (*tenet* 1) and the theoretical integration between SDT and the TPB (*tenet 2*) were tested independently, and the full motivational and social cognitive mechanism in the full model has still not been examined simultaneously. Study 6 (Chapter 5) was the only exception in that it tested the motivational sequence of the integrated model from self-determined motivation in a general life domain to social cognitive variables of health and safety, but the link between intention and behaviour was not examined due to the cross-sectional design of the study. This limitation also applies to Studies 3 and 4 that provided cross-sectional tests of the relationship between self-determined motivation in sport and self-determined motivation for sport injury rehabilitation and prevention. Study 8 was the only study in the thesis that included a prospective design and was able to test the relationship between intention and behaviour. Nevertheless, the findings in the myopia prevention context need further testing to support the generalisability of the proposed effects across health and safety domains, such as sport and occupational injury prevention and rehabilitation.

Another notable limitation was that the findings about the effect of behaviour on health or clinical outcomes such as recovery length or the incidence of injury were quite limited. Only two of the eight studies included measures of health or clinical variables associated with behaviour. In addition, the designs of these two studies (Studies 7 and 8) were

correlational, meaning that causal inferences for the effects of compliance with health and safety recommendation on health status or reduced likelihood of injury or disease could not be made. Given the retrospective nature of Study 7, the findings for the positive relationship between treatment adherence and recovery length might be attributable to the possibility that participants who recovered quicker tended to report higher treatment adherence. Similarly, the behavioural dependent variable (i.e., reading distance) in Study 8 were measured concurrent with the associated clinical function (i.e., visual acuity) meaning that the relationship between behaviour and clinical function was more likely to be explained by the possibility that visual acuity enhanced the ability to read further, rather than shorter reading distance reducing visual acuity. Also, the predictive power of behavioural adherence on the health and clinical outcome could be smaller when controlling for the considerable number of potentially confounding external factors such as health and safety resources and risks of health threats.

Finally, the research reported in the present thesis relied heavily on the use self-report measures to assess the behavioural variables in the model. The reading distance behavioural measure in Study 8 was the only exception. The responses collected from such methodology could be vulnerable to social desirability, general response bias, and recall bias. Also, the assessment of behavioural and psychological variables using self-report might be subject to problems of external validity because the responses might not form a perfect representation of the real world (Andersen, McCullagh, & Wilson, 2007). The use of implicit association test (IAT; Greenwald, McGhee, & Schwartz, 1998) could potentially provide an alternative approach to the measurement of psychological variables as the responses are independent of rumination over the scale meaning and conscious processing. A previous study has successfully implemented IAT for the assessment of self-determined motivational orientation in various health behaviour such as exercise, dieting, and condom use (Keatley et al., 2011). Hence, developing an IAT measure for self-determined motivation, and social cognitive

variables (i.e., attitude, subjective norm, and PBC), and the use of objective behavioural measure (e.g., using heart rate monitor, step counter, and accelerometer to measure physical activity level; Standage et al., 2012; Standage, Sebire, & Loney, 2008) will be important for future studies.

Conclusion

The present thesis examined the integration of multiple theoretical concepts from three theories of motivation (SDT, TPB, and HMM) into a unified model to explain the process by which psychosocial, motivational, and social cognitive factors affect individuals' health and safety behaviour. Utilising an evidence-based integrated theoretical approach, the thesis provided a comprehensive explanation of multiple health and safety behaviour by addressing the shortcomings or gaps in the research that adopts either of the theories alone.

Such an endeavor is promising for the development of effective theory-based interventions, delivered by significant others such as supervisors in the workplace, sport instructors, and parents, that will lead to successful adherence to prevention behaviours to health and safety threats. I hope my thesis will have raised researchers' and practitioners' awareness of the benefits of adopting integrated theoretical approaches in the context of health and safety. I also hope researchers will be inspired to adopt integrated approaches in their research and approach this endeavor with critical but open mindsets toward a more comprehensive understanding of the intention and behavioural adherence of following health and safety guidelines.

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Appendix

Appendix A (Chapter 2)

Example items for the constructs used in Studies 1 and 2.

Construct (Cronbach's Alpha)	Sub-Dimension (Cronbach's Alpha)	No. of Items	Example Item	Scoring
Behavioural Regulation in Sport Questionnaire				
	Intrinsic motivation (α = .74)	4	I participate in my sport because I enjoy it	1 = not at all true, 7 = very true
Autonomous sport motivation (α = .93)	Integrated motivation (α = .72)	4	I participate in my sport because it's a part of who I am	1 = not at all true, 7 = very true
	Identified motivation (α = .72)	4	I participate in my sport because I value the benefits of my sport	1 = not at all true, 7 = very true
	Extrinsic motivation (α = .67)	4	I participate in my sport because I feel pressure from other people to play	1 = not at all true, 7 = very true
Controlled sport motivation (α = .89)	Introjected motivation (α = .78)	4	I participate in my sport because I would feel guilty if I quit	1 = not at all true, 7 = very true
	Amotivation (α = .73)	4	I participate in my sport but I question why I continue	1 = not at all true, 7 = very true
Treatment Self Regulation Questionnaire				
Autonomous treatment motivation (α = .75)	-	5	I have remained in treatment and carry out rehabilitation exercise because I feel like it's the best way to help myself	1 = not at all true, 7 = very true
Controlled treatment motivation (α = .82)	-	8	I have remained in treatment and carry out rehabilitation exercise because others would have been angry at me if I didn't	1 = not at all true, 7 = very true
Health Care Climate Questionnaire				
Physiotherapist-version (α = .85)	-	15	My physiotherapist encourages me to ask questions	1 = not at all true, 7 = very true
Coach-version (α = .90)	-	6	My coach listens to how I would like to do things	1 = not at all true, 7 = very true

General Causality Orientation Scale				
			Instruction: You are embarking on a new career. The most important consideration is likely to be:	
Autonomy orientation (α = .75)	-	12	How interested you are in that kind of work	1 = very unlikely, 7 = very likely
Controlled orientation (α = .82)	-	12	Whether there are good possibilities for advancement	1 = very unlikely, 7 = very likely
Theory of Planned Behaviour				
Treatment intention (α = .82)	-	2	I will try to exert effort in doing the rehabilitation exercises recommended by my physiotherapist over the forthcoming month	1 = strongly disagree, 7 = strongly agree

Appendix B (Chapter 2)

The script of the hypothetical sport injury scenario used in Study 2

"Imagine you have an important competition in a month, but unfortunately you have been injured in training. You can continue to train at the moment, but you feel that the injury seems to be getting worse and worse. The feeling of pain increases and the injured area swells more after each training session. Your physician suggests that you should stop training and undertake physiotherapy until you recover completely, but he/she suggests that the rehabilitation might take up to a month or more. You want to perform very well in the competition, but following the prescribed rehabilitation is incompatible with the pre-event training you require to get you in the best possible shape for the competition. This dilemma may be similar to a previous experience you have had with sport injury, and there are good reasons on both sides whether to follow or not to follow the rehabilitation program. Please put yourself into the situation and answer the following items according to how you would feel about the scenario. There are no right or wrong answers, so please respond to each question according to your own thoughts".

Appendix C (Chapter 4)

Scales information

Variable	Questionnaire	Dimension	Example Item	Anchors
Autonomy support from coaches	HCCQ (Williams et al., 1996)	Perceived Autonomy support	My coach listens to how I would like to do things	1 = not at all true, 7 = very true
Basic psychological need satisfaction	BNSSS (Ng et al., 2011)	Autonomy	In my sport, I have a say in how things are done	1 = not at all true, 7 = very true
		Competence	I am skilled at my sport	
		Relatedness	In my sport, I feel close to other people	
Motivation in sport	BRSQ (Lonsdale et al., 2008)	Intrinsic motivation	I participate in my sport because I enjoy it	1 = not at all true, 7 = very true
		Integration	I participate in my sport because it's a part of who I am	
		Identification	I participate in my sport because I value the benefits of my sport	
		Introjection	I participate in my sport because I would feel guilty if I quit	
		External motivation	I participate in my sport because I feel pressure from other people to play	
Motivation for sport injury prevention	TSRQ (Chan & Hagger, 2012b)	Autonomous motivation	I want to *prevent or avoid sport injury* because it is an important choice I really want to make	1 = not at all true, 7 = very true
		Controlled motivation	I want to *prevent or avoid sport injury* because I would feel guilty or ashamed of myself if did not	
Adherence	Adapted from Self-reported Injury Prevention Adherence Scale (Chan & Hagger, 2012a)	Frequency	How often do you work on improving your physical/ mental conditions to avoid injuries (e.g., warm-up, stretching, physical conditioning, resting adequately)?	1 = never, 7 = very often
		Effort	How much effort do you put on avoiding re-injury for your old injuries (e.g., use of ice, banding, taking supplements)?	1 = minimum effort, 7 = maximum effort
Injury beliefs	Adapted from MSAQ (Rundmo & Hale, 2003)	Safety commitment	I am concerned about safety in sport	1 = strongly disagree, 7 = strongly agree
		Injury priority	There is nothing more important than safety in sport	
		Fatalism concerning injury prevention	Sport injuries just happen, there is little one can do to avoid them	
		Attitude toward safety violation	Sometimes it is necessary to ignore safety regulations to perform better in sport	
		Barriers to safety communication	Talking to the others (e.g., athletes, coaches, and medical staff) about injury prevention is difficult.	
		Injury worry	I am a bit afraid when I think about sport injury	
General causality orientation	GCOS (Deci & Ryan, 1985a)		*Instruction: You are embarking on a new career. The most important consideration is likely to be:*	
		Autonomy orientation	How interested you are in that kind of work	1 = very unlikely, 7 = very likely
		Controlled orientation	Whether there are good possibilities for advancement	