PROPENSITY AND ATTAINMENT OF FLOW STATE

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"I, Stefan Koehn, declare that the PhD thesis entitled Propensity and Attainment of Flow State is no more than 100,000 words in length, exclusive of tables, figures, appendices, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work."

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ABSTRACT

In this thesis, I investigated the influence of personality and situational variables on the experience of flow in order to enhance flow state in tennis competition. Based on propositions of the sport-specific flow model (Kimiecik & Stein, 1992), I conducted three interconnected studies. In Study 1, I examined the relationship between personality variables and flow. In Study 2, I tested the effect of the interaction between two key personality variables, trait sport confidence and action control, and key situational variables, self- and externally-paced tasks, on flow state and performance. Finally, in Study 3, I investigated the efficacy of an imagery intervention designed to enhance confidence and action control to increase flow state and self-paced and externally-paced performance in tennis competitions.

The purpose of Study 1 was to investigate the influence of personality variables on dispositional flow and state flow in junior tennis players. I entered personality variables, which demonstrated moderate correlations with flow, into regression equations. Except for the Tellegen Absorption Scale (TAS), I entered the Action Control Scale-Sport (ACS-S), the Sport Imagery Questionnaire (SIQ), and the Trait Sport Confidence Inventory (TSCI) as predictor variables into stepwise multiple regression analyses with the Dispositional Flow Scale-2 (DFS-2; $N = 271$) and the Flow State Scale-2 (FSS-2; $N = 134$), respectively, as criterion variables. The results showed that trait sport confidence was the strongest predictor of dispositional flow, accounting for 32.83% of the variance, and action control was the strongest predictor of state flow, explaining 15.52% of the

variance. On a DFS-2 subscale level, confidence was the main predictor for challenge-skills balance and sense of control, whereas imagery use was the main predictor for clear goals, unambiguous feedback, concentration on the task at hand, and autotelic experience. In the FSS-2 regression analyses, action control was the strongest predictor for most of the entered criterion variables of state flow subscales, namely clear goals, unambiguous feedback, and sense of control.

The purpose of Study 2 was to test the Kimiecik and Stein's (1992) hypothesis that person and situation factors interplay in the generation of flow state. Based on the findings in the previous study, I chose examine interaction and main effects between two key personality characteristics, namely trait sport confidence and action control, and situational variables, such as a self-paced service task and an externally-paced groundstroke task, on flow state and performance in tennis. Following service and groundstroke performance, the participants, junior tennis players ($N = 60$) between 12 to 18 years, completed the FSS-2. Based on a median split on the TSCI, I assigned participants to groups of high or low confidence. I carried out a two-way repeated-measures ANOVA on flow state with high and low confidence as levels of the independent group factor and self-paced and externally-paced tasks as levels of the repeated measures factor. The results showed a significant main effect between groups of high and low confidence and flow, $F(1, 58) = 6.82$, $p < .05$, $\eta^2 = .11$. The interaction for flow state was not significant, but revealed a moderate effect size, $F(1, 58) = 2.64$, *ns*, $\eta^2 = .04$. I carried out similar ANOVAs on performance showing a significant main effect for performance. Participants demonstrated a greater accuracy in the groundstroke task than in the service task, showing a large effect size, $F(1, 58) = 12.74$, $p < .001$, $\eta^2 = .18$. Analyses of interaction effects between high and low confidence and self- and externally-paced tasks on performance outcome showed a moderate effect size, but was not significant, $F(1, 58) = 2.97$, *ns*, $\eta^2 = .05$. Following the same procedure for action control, I used a median split to divide participants into groups of action orientation and state orientation. There were no significant main or interaction effects between action- and state-oriented groups and flow. With regard to performance, a significant main effect was found for task type, with participants scoring higher on the groundstroke than the service task, and performance outcome, $F(1, 58) = 12.13$, $p < .001$, $\eta^2 = .17$, indicating a large effect size.

The purpose of Study 3 was to examine the effect of an imagery intervention on flow state and performance in tennis competition. The study included an A-B design with a baseline and post-intervention phase to evaluate the efficacy of imagery, using a standardised imagery script. I measured flow state and performance over a range of official ranking-list tournaments. I developed the imagery script based on findings of Study 1, taking into account correlational results between personality variables of action control, imagery use, and trait sport confidence and dimensions of flow. The script consisted of three parts, starting with a relaxation component, then imagery on self-paced performance of first and second serves, and, finally, imagery in externally-paced performance situations, including forehand and backhand groundstrokes. For the intervention, four male junior tennis players between 13 and 15 years of age worked with the imagery script three times a week for four consecutive weeks. Participants were of an advanced skill level, being ranked between 203 and 244 in the Australian Junior Ranking List at the beginning of the study. After the four-week intervention phase, all participants demonstrated an increase in service and groundstroke performance winners. In addition, participants increased their ranking-list position from beginning to end of the study between 24 and 145 positions. Visual inspection of the data revealed that three participants increased in state flow intensity across phases. In a social validation interview, which I conducted at the end of the study, three participants confirmed an increase in flow and confidence level after the intervention.

Overall, results confirmed several propositions of Kimiecik and Stein's (1992) sport-specific flow model. Firstly, dispositional personality variables, action control, imagery use, and trait sport confidence demonstrated a moderate relationship with flow. Secondly, significant and near-significant main and interaction effects were evident between situational and personal variables on the experience of flow state. Thirdly, an imagery intervention showed an increase in flow and performance. With regard to future research, I recommend the use of the flow model, as proposed by Kimiecik and Stein (1992), to further assess the influence of personality and situation characteristics and their interaction on flow. In addition, more studies on the flow-performance relationship would be fruitful to enhance theoretical understanding and to inform applied work.

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CHAPTER 1: INTRODUCTION

One of the main reasons why individuals participate in sports is the positive subjective experiences associated with these activities. Positive experience and well-being can arise from enjoyment and successful performance in sport, in terms of winning or performing well. Optimal experience can also be related to superior performance. Athletes performing at their best in competitions have characterised their optimal performance state as being totally absorbed in and focused on the task at hand, feeling confident and in control, while their body works effortlessly and automatically (Jackson, 1995, 1996; Jackson & Csikszentmihalyi, 1999). Csikszentmihalyi (1975, 1988a) called this state of optimal experience flow.

Flow is a positive state characterised by total immersion and a high level of enjoyment during the activity. Flow is often associated with feelings of intrinsic motivation, which increase people's participation, effort, and perseverance (Csikszentmihalyi, 1988c, 2000a). The flow concept is theoretically linked to concepts of self-actualisation, self-determination, well-being, peak experience, and peak performance. Several antecedents, also termed dimensions, of flow need to be present for athletes to experience flow. The flow dimensions are challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation, and autotelic experience.

The concept of flow has gained increasing attention by researchers of various disciplines, since its introduction by Csikszentmihalyi (1975). Flow has been found to be an important, universal construct, which has positive implications in work, leisure, recreation, and sport activities (Csikszentmihalyi, 1975, 2000a; Csikszentmihalyi & Csikszentmihalyi, 1988). The phenomenology and positive experience of flow in sport have generally been confirmed by sport performers of various skill levels in training and competition (Jackson, 1995; Jackson & Csikszentmihalyi, 1999; Russell, 2001).

Over the last 15 years, researchers in sport psychology have examined personality and situational variables that affect the experience of flow in sport. Initially, Jackson (1992) introduced qualitative findings on the experience of flow state in elite athletes of various team and individual sports. Even though there were differences in flow between various sports, results revealed that athletes experience flow in a similar way (Jackson & Csikszentmihalyi, 1999). In interviews with elite athletes from team and individual sports, Jackson (1992, 1995) found a range of personal and situational factors that facilitated, prevented, or disrupted flow in competition. Complementing these early qualitative findings on flow, Russell (2001) found that similar personal and situational factors affect flow in college athletes from team and individual sports. Young (2000), interviewing elite female tennis athletes on their flow experience, found that some factors have a similar influence on flow, as found by Jackson (1995) and Russell (2001), and that some factors were unique to the sample of tennis athletes.

The flow model, as proposed by Kimiecik and Stein (1992), provided a theory-based, sport-specific framework for the examination of flow. In the model, Kimiecik and Stein suggested that situational and personal factors, emphasising dispositional and state variables, would underlie and interact in the generation of flow state. Situational factors that would interplay with personality factors in the experience of flow were proposed as type of sport, competition importance, competitive flow structure, opponent ability, and coaches' behaviour.

The development of Kimiecik and Stein's flow model has spurred further quantitative and qualitative research, which increased the understanding of flow in sport. Researchers examined and pinpointed several dispositional variables, such as intrinsic motivation, perceived ability, and psychological skills, to be related to flow (Jackson, Kimiecik, Ford, & Marsh, 1998; Jackson, Thomas, Marsh, & Smethurst, 2001). Jackson and colleagues (1998, 2001) proposed that these variables are part of the autotelic personality. Csikszentmihalyi (1988a) defined the autotelic personality as a cluster of dispositions that facilitate the frequent experience of flow, in which flow experiences are rather independent of situational factors. Examining psychological variables underlying flow, however, has not been exhaustive and more research is necessary to detect key variables that influence athletes' propensity to experience flow.

Besides the influence of personality variables on flow, Kimiecik and Stein (1992) proposed interaction effects between personality and situational variables in the generation of flow. Situational factors that influence flow include differences between self-paced and externally-paced tasks, type of sports, individual and team sports, and open and closed skills. These situational factors influencing flow in sport, as proposed by Kimiecik and Stein, have rarely been subject to systematic examination in previous flow research. Singer (2000) proposed that different psychological processes underlie self- and externally-paced performances, which, in turn, could have diverse effects on flow. Therefore, a more structured, coherent, and theory-guided approach, is necessary, investigating the influence of situational factors, like self- and external-pacing, on flow.

An aspect of flow that was not directly included in the flow model is the relationship between flow and performance. Qualitative and quantitative findings corroborated the hypothesis that flow influences general performance and peak performance (Jackson & Roberts, 1992; Privette, 1983). Optimal experience that results in superior performance makes flow a highly desirable state for athletes. Flow, on the other hand, represents an ephemeral and volatile state that occurs infrequently and which is difficult to control voluntarily.

Researchers have made few attempts to intervene to enhance flow and sport performance, using hypnosis (e.g., Pates & Maynard, 2000; Pates, Cummings, & Maynard, 2002) and imagery means (Pates, Karageorghis, Fryer, & Maynard, 2003). Flow, however, is an influential and important state that needs to be examined in greater detail to increase understanding in theoretical and applied sport psychology. I chose imagery as intervention method, because imagery has been found to be a very powerful technique to increase psychological variables and achieve optimal performance (Hall 2001; Morris, Spittle, and Watt, 2005). Imagery can be used for the enhancement of confidence and motivation and the reduction of anxiety, which are key aspects of flow state. Equally important, individuals frequently use imagery to prepare for everyday (Csikszentmihalyi,

1975) or sport tasks (Morris et al., 2005). In contrast to hypnosis which requires professional guidance, it would be easier for athletes to efficiently use imagery than methods of hypnosis or self-hypnosis. Therefore, I developed an imagery script to enhance athletes' control of imagery to increase their flow state and performance in tennis competition.

Thus, my aims in this thesis were to examine personality variables underlying dispositional flow and flow state in tennis competition, to investigate the effect of key personality-situation interactions on flow state and performance in a training context, as proposed in the flow model (Kimiecik & Stein, 1992), and, finally, to examine the effects of an imagery intervention on the experience and attainment of flow state and performance in tennis competitions.

CHAPTER 2: LITERATURE REVIEW

Introduction

In this chapter, I present a definition of flow and the development of flow theory in connection to related concepts, such as self-actualisation, self-determination, well-being, arousal, the zone, hypnotic states, and peak moments, such as peak experience and peak performance. I then outline flow theory and the nine dimensions that encompass the experience of flow. I further extend this information by detailing the key characteristics of flow, including intensity and frequency of flow, as well as personal and situational factors influencing flow. In addition, I describe the association between flow and involvement in competition settings and between flow and performance. Theoretical advancements regarding flow in sports have been presented by Kimiecik and Stein (1992) through the proposition of an interaction model of flow in which personal and situational factors interplay in the generation of flow. Following the discussion of conceptual and methodological issues of the flow model, I evaluate the conceptual differences between self-paced and externally-paced tasks, as important situational factors. In the measurement section, I address both qualitative and quantitative approaches that have been proposed to assess flow. I particularly emphasise the development of questionnaires to measure state and dispositional flow in sport and physical activity. In the research section, I review qualitative and quantitative research on flow in sport. I consider studies that have examined personal variables and situational variables influencing flow, as well as studies that have investigated the effect of interactions between person and situation variables on flow. I then present information regarding the research on flow, concerning the connection between flow and performance. Several correlational studies have focused on the association between flow and subjective performance and objective performance outcomes. Furthermore, studies have employed hypnosis and imagery interventions to increase flow state and performance.

Based on the theoretical contentions and research findings, I make the proposition that additional psychological variables need to be examined that influence the experience of flow. Following the review of flow with regard to its theoretical foundation, measurements, and research findings, I conclude this chapter by stating the aims of the present thesis.

Definition of Flow

Flow has been defined in a sport and a non-sport context, emphasising personal and situational aspects of the flow experience. Flow state has been associated with enjoyment, intrinsic motivation, satisfaction, well-being, and full involvement in a specific activity (Csikszentmihalyi, 1975, 1988a). Csikszentmihalyi (1975) defined flow state as:

> action follows upon action according to an internal logic that seems to need no conscious intervention by the actor. He experiences it as a unified flowing from one moment to the next, in which he is in control of his actions, and in which there is little distinction between self and environment, between stimulus and response, or between past, present, and future. (p. 36)

Csikszentmihalyi (1988a) outlined that psychological aspects interact with situational conditions that provide a clear structure, clear goals, and unambiguous feedback, in the generation of flow. Sorrentino, Walker, Hodson, and Roney (2001) proposed that a match between situation and personal characteristics has an important influence on individuals' motivation and information processing, which subsequently affects flow. Sorrentino et al. (2001) defined flow as:

> feeling good about the self while engaging in the activity at hand. It occurs when the person engages in a situation that has a positive information value (attaining or maintaining clarity about the self for uncertainty-oriented vs. certainty-oriented persons, respectively) and the person is positively motivated to undertake the activity. (p. 198)

Sorrentino et al. emphasised that, when there is a mismatch between person and situation factors, flow is not going to occur, because of a lack of relevance or importance to the self. From this point of view, a match between personal and situational factors appears to be particularly vital in the generation of flow.

Within a sport context, Jackson (1992) defined flow as a "psychological process involving a state of total absorption into an activity and with experiential characteristics that make the experience so intrinsically rewarding that the experience of flow becomes a goal in itself" (p. 185). Introducing a sport-specific model of flow, Kimiecik and Stein (1992) adopted a definition from Csikszentmihalyi (1990), defining flow as "autotelic experience (performed for its own sake) accompanied by above average feeling states that begins when perceived challenges and skills are above average, and are in balance " (p. 146).

Previous definitions of flow have incorporated and highlighted dimensions of flow and processes underlying the generation of the flow state. In addition, the definitions have emphasised the connection between personal and situational aspects and flow. A working definition that includes the essential characteristics of the definitions stated in this section could be summarised as:

> Flow in sport is affected by personal and situational interactions, including a match between personal skills and current challenges in a structured activity that is important to the self, and which positively influences cognitive and motivational processes, being exclusively directed on the task at hand and leading to a holistic state characterised by absorption and positive affect, such as an autotelic experience.

This definition is not original, but it reflects key aspects of previous flow definitions. Following this working definition, I now examine theoretical and research evidence that has led to the conceptualisation of flow, before I review the literature on personal and situational variables influencing flow in sport.

The Development of Flow

Csikszentmihalyi (1975) developed the concept of flow for understanding the experience of enjoyment and absorption in the task at hand, which is detached from past or future influences, as an "ongoing process which provides rewarding experiences in the present" (p. 9). Originally, examinations focused on characteristics of why artists get absorbed into creative activities, such as sculpture and painting. Observing the artists' efforts, Csikszentmihalyi found that their work was characterised by an intense involvement in the various activities, which could be described as *enthralled* and *trancelike* states. At that time, motivational theories advocated external rewards as impetus for this kind of behaviour. Observations of the artists' involvement revealed that they were not propelled to complete their work to satisfy any external need, but their connection to and enjoyment in the activity seemed to accrue in completing the painting or sculpture. These experiences subsided as soon as their work was completed. Csikszentmihalyi concluded that the activity was self-contained and became an end in itself with no need for any additional rewards.

In association with teaching seminars and research projects, Csikszentmihalyi (1975, 2002) pursued the examination of characteristics of enjoyment in work and leisure activities. Interviews with surgeons, music composers, dancers, rock climbers, basketballers, and chess players contributed further insight into flow and its relationship to enjoyment, rewards, and intrinsic motivation. Across the various activities, one of the key findings was the connection between challenges and skills, which subsequently emerged to be one of the main components of flow theory. According to Csikszentmihalyi (1975), only when a person perceives a match between individual skills and situational challenges was flow likely to occur.

Besides the aspect of balancing challenges and skills, enjoyable and pleasurable activities appeared to be followed for their own sake, representing a means and goal in themselves. Csikszentmihalyi (1975) termed these experiences autotelic. Research interest in flow and autotelic experiences were spurred by several related concepts, such as self-actualisation, self-determination, well-being, arousal, being in the zone, hypnotic states, peak experience, and peak performance. In the following section, I will depict each of these concepts separately and highlight the relationship between these concepts and flow in general and possible links to flow in sport.

Flow and Related Theories and Concepts

The Concept of Self-Actualisation

Maslow (1962, 1968) developed the concept of self-actualisation as a main component in the humanistic theory of personality. Self-actualisation reflects a drive in human beings with a tendency to realise personal capacities and strive for self-fulfilment. Maslow (1968) introduced a model termed the hierarchy of needs, conceptualising lower- and higher-level needs. According to Maslow, lower-level needs are sleep, hunger, and safety, which are homeostatic in nature. These basic needs have to be satisfied before higher-level needs gain more importance. Higher-level needs include self-worth, competence, and self-fulfilment. Maslow deemed self-actualisation as the highest human need, which is characterised by discovering and extending individual potentialities. In contrast to basic needs, self-actualisation is not subject to homeostatic satisfaction, but reflects an ongoing and unsated need for personal development and growth. Similar to self-actualisation, Csikszentmihalyi (1988b) advocated that flow is detached from homeostatic influences. The purpose of flow is to enable individuals to grow, to fully function, and to make use of their potentialities. With regard to homeostasis, Seligman and Csikszentmihalyi (2000) distinguished between enjoyment and pleasure. The distinction is not universal, but, according to Seligman and Csikszentmihalyi, pleasure relates to homeostatic needs, which can arise from satisfying physical needs. Enjoyment and the experience of flow, on the other hand, go beyond homeostasis, including activities such as the active involvement in reading a book, and athletic or artistic performances, which increase individuals' capacities. Seligman and Csikszentmihalyi added that "enjoyment, rather than pleasure, is what leads to personal growth and long-term happiness" (p. 12).

Beyond the assessment of self-actualisation, Maslow (1968) examined individuals' peak experiences. Based on qualitative analysis, Maslow found a number of common characteristics in the cognition of people's peak moments in interpersonal, creative, mystic, intellectual, and athletic experiences. Maslow described peak experiences as transcending, unifying, fulfilling, desirable, and egoless, having their own value, achieved in circumstances where the perception of time is distorted or lost. Furthermore, during episodes of peak experiences individuals perceived the experience as complete, but detached from expedience, requiring the person's whole attention, and adding to the person's knowledge and growth.

Maslow (1968) concluded that characteristics of peak experience revealed similarities to the experiences of individuals high in self-actualisation. Based on the findings of peak experience, Maslow defined self-actualisation as:

> an episode, or a spurt in which the powers of the person come together in a particularly efficient and intensely enjoyable way, and in which he is more integrated and less split, more open for experience, more idiosyncratic,

> more perfectly expressive or spontaneous, or fully functioning, more creative, more humorous, more ego-transcending, more independent of his lower needs. (p. 97)

The phenomenology of Maslow's (1962, 1968) description of self-actualisation and peak experience resembled the experiences that Csikszentmihalyi (1975) found in artists. Csikszentmihalyi (1975) stated that his research interest was spurred by understanding artists' motivation that was underlying the extraordinary experiences in their activities. In addition, Csikszentmihalyi's work was aiming at how personal and situational characteristics affect these experiences, such as individuals' propensity to have peak experiences, and the intrinsic rewards, such as enjoyment, gained from the various activities.

Self-Determination Theory

Self-determination theory was developed for the examination of how external factors influence intrinsic motivation (Deci & Ryan, 1985). Deci and Ryan (1985) defined self-determination as the "capacity to choose and to have those choices, rather than reinforcement contingencies, drives, or any other forces or pressures, be the determinants of one's actions" (p. 38). Self-determination theory is based on the notion that human behaviour is motivated by three psychological needs, which are autonomy, competence, and relatedness with others. Sport activities provide a variety of situations to fulfil these needs. Deci and Ryan (2002) referred to autonomy as individuals' perception that they are the source of their own actions and behaviours. Autonomous behaviour characterises the expression of the self, with individuals perceiving value and initiation as part of their actions. Competence refers to individuals' perceptions of effectiveness of their skills and capacities with regard to meeting action opportunities. Relatedness refers to individuals' perceptions of connectedness and belongingness to other individuals and the community. This need relates to the security aspect in being with others in the here and now, which does not emphasise the attainment of some future outcome.

The perception of self-determined actions is a main factor for intrinsic motivation (Ryan & Deci, 2000). Deci and Ryan (2002) proposed a self-determination continuum, indicating at the extreme ends that intrinsic motivation reflects self-determined behaviour, whereas amotivation signifies nonself-determined behaviour. According to Ryan and Deci (2000), self-determined actions lead to more intrinsically-motivated results, with intrinsic motivation indicating the interest in participating in an activity for its own sake, which offers inherent satisfaction.

From a self-determination perspective, the connection between intrinsic motivation and flow in sport was described by Frederick-Recascino (2002):

> When individuals are in a state of intrinsic motivation, they experience choicefullness in their behavior, thereby fulfilling their need for autonomy. Additionally, they are at a level of optimal challenge, which fulfils their competence need. A state of intrinsic motivation is associated with feelings of satisfaction, enjoyment, competence, and the desire to persist at the activity. Sport and exercise for many individuals provide

> domains in which intrinsic motivation is frequently present. Experiencing "flow," or being in "the zone," widely discussed in athletic experience (Csikszentmihalyi, 1990, 1975) is understood in self-determination theory as representing the heightened awareness and feelings of well-being associated with intrinsic motivation. (p. 279)

Frederick-Recascino (2002) noted that intrinsic motivation, the experience of choicefulness, and challenge are important factors for positive experiences. One of the key concepts in self-determination theory and flow is the optimal challenge. Deci and Ryan (1985) proposed that within an optimally-challenging activity, the level of intrinsic motivation underlies the perceived competency. More particularly, feedback that reinforces one's perceived competency will increase the level of intrinsic motivation in sport. In the opposite event, Frederick-Recascino (2002) asserted that a loss of optimal challenge would increase athletes' perceived extrinsic control over their participation. Deci and Ryan (1985) underlined that the general model of flow, based on the match of individual skills and action opportunities, provides an understanding for optimal challenges. This offers the opportunity to examine the relationship between an activity and athletes' experience in the particular situation. The level of flow intensity would indicate the degree of athletes' optimal involvement in the activity.

To be able to make choices offers the opportunity to be more self-determined, which enhances intrinsic motivation (Deci & Ryan, 1985; Simon & McCarthy, 1982). The perception to be in the position to have opportunities increases intrinsic motivation and the possibility to get more strongly involved into the activity. Deci and Ryan (1985) argued that individuals prefer to feel free from the dependence of certain outcomes, which facilitates their immersion in the activity. Similarly, Csikszentmihalyi (1975) noted that flow is more likely to occur when the situation provides a range of action opportunities. Particularly the aspect of being creative within a certain activity offers the chance to make choices in order to develop something new. Choicefulness appears to be important to get immersed into the activity without thinking about possible outcomes. In addition, optimal challenge and intrinsic motivation are at the heart of both self-determination theory and flow theory. As proposed by Deci and Ryan (1985), the nature of flow may reflect a clearer manifestation of intrinsic motivation.

Well-Being

Well-being, as well as flow, relates to two important aspects of optimal experience and optimal functioning. Ryan and Deci (2001) distinguished between hedonic and eudaimonic well-being. Hedonism refers to well-being as pleasure and happiness, incorporating physical and mental aspects of pleasure. From a hedonistic point of view, well-being is viewed on a continuum between striving for pleasure and avoiding displeasure or pain, respectively. Eudaimonic well-being, on the other hand, highlights individuals' human potential and full functioning, thus, emphasising actualisation and realisation as part of well-being. Furthermore, Waterman (1993) proposed that eudaimonic well-being occurs when a person is entirely engaged in an activity. Diener, Sandvik, and Pavot (1991) asserted that the frequency, rather than the intensity, of optimal experiences, underlies well-being. Therefore, well-being develops through repeated positive experiences, rather than through strong and exceptional, but comparatively rare, experiences. In the same way, Csikszentmihalyi (1988c) argued that frequent involvement in flow would enhance the quality of experiences.

Csikszentmihalyi (1988b) advocated several long-term effects of frequent flow experiences. Individuals who repeatedly get into flow have more positive experiences and a higher quality of experiences with regard to well-being and happiness. Csikszentmihalyi (1996) noted that well-being and happiness in general are not actually part of the flow experience itself, but can be viewed as a result or as a consequence of flow.

Arousal

Arousal has been recognised as an important factor influencing performance and experience. In an early assessment of arousal, Yerkes and Dodson (1908) depicted a curvelinear, bell-shaped relationship between arousal and performance. The inverted-U association proposed that moderate arousal levels induce optimal performance, whereas higher or lower arousal levels result in low performances. Zaichkowsky and Baltzell (2001) proposed that arousal levels also influence cognitions, affect, and physiological functions. High arousal is manifested in cognitive activity, such as over-activation, nervousness, and feelings of anxiety, and in physiological activity, such as a higher heart and respiration rate. Low arousal, or under-activation, is signified by relaxation and a decrease in physiological activity.

Csikszentmihalyi (1975, 1988b) proposed that flow signifies an optimal arousal level between low and high arousal levels, which he labelled as boredom and anxiety. Boredom results from situations that do not offer action opportunities that are of interest to individuals. Having several action opportunities, individuals with high levels of anxiety perceive that they lack the capabilities to meet the situational demands and be successful, which leads to less optimal experience and performance. Csikszentmihalyi (1975) suggested that flow results from the interplay between situational challenges and personal skills, in which a balance between both factors results in flow, whereas an imbalance can either lead to boredom or anxiety.

The Zone

The term ‘the zone’ is frequently used in the sport psychology literature, outlining a state of high intensity, strong focus, superior performance (Young, 2000), and peak experience (Murphy & White, 1995), which is indicated by heightened awareness and intrinsic motivation (Frederick-Recascino & Morris, 2004). Tolson (2000) described *playing in the zone* as “when the body is brought to peak condition and the mind is completely focused, even unaware of what it’s doing, an individual can achieve the extraordinary” (p. 38). Being in the zone is characterised by complete focus and merging of body and mind, which is indicated by optimal information processing reflecting automaticity. The execution of a skilled movement requires little conscious attention and processing, which mirrors the state of mind when being in the zone or in flow (Cox, 2002; Csikszentmihalyi, 1990).

Young (2000) employed the terms zone and flow interchangeably, denoting an optimal experience and performance. Csikszentmihalyi’s (1975) initial concept of flow was illustrated as a corridor in which optimal experience is more likely to occur. Csikszentmihalyi referred to this zone of optimal experience and arousal as the “flow channel” (p. 51). To enter the flow channel, or the zone, individuals need to perceive a balance of personal skills and situational challenges. Being in this zone was reflected by the absence of anxiety, boredom, or relaxation, and would occur as a function of the challenge-skill balance. Dropping out of the zone is due to either challenge exceeding personal skills (anxiety), or skills surpassing situational challenges (boredom). To re-enter the flow channel would involve strengthening one’s skills or increasing current challenges to regain a match between these two components.

Hanin (1986, 1995) proposed a concept called individual zones of optimal functioning (IZOF). The IZOF are idiosyncratic, based on individual characteristics, and can occur at any point along the continuum of arousal and anxiety. Performance is optimal when ideal preperformance states, such as anxiety and emotions, are within a certain range. For instance, Hanin carried out repeated measurements to determine athletes’ optimal anxiety level, with assessments being conducted retrospectively or directly before performing. The average score, as measured by the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), reflected the athletes’ optimal preperformance state. According to Hanin, athletes’ mean anxiety score, which is measured over a period of time, plus or minus half a standard deviation, represents athletes’ optimal performance zone, facilitating superior functioning and performance. Researchers suggested that the IZOF model can be applied by using a multidimensional framework of anxiety, including cognitive and somatic anxiety measures (Krane, 1993), as well as considering a variety of emotions, such as anger, excitement, and joy, to assess athletes' IZOF (Gould & Udry, 1994). There are several conceptual similarities characterising experiences in the zone and flow. Some researchers have used these terms interchangeably (Young, 2000). Csikszentmihalyi (1975) proposed that optimal experiences emerge in a flow channel, graphically illustrating that flow experiences occur in a specific zone in which challenges and skills are in balance. To further test the applicability of flow with regard to the IZOF, research could be directed to examine whether there is an individual zone for optimal experiences of flow, using Hanin's (1986, 1995) assessment model.

Hypnotic States

Definitions of hypnosis have been formulated with regard to individuals' cognition, arousal, and experience, influencing subsequent behaviour on the basis of self- or externally-induced suggestions. Weitzenhoffer (2000) defined hypnosis as "an induced temporary condition of being, a state, that differs mentally and physiologically from a person's normal state of being" (p. 221). Hypnosis influences cognitive-behavioural processes, including changes in suggestibility, perception, and volition, such as control over one's movements and actions (Kirsch & Lynn, 1995; Westen, 1999).

Similarly, Csikszentmihalyi (1975) described deep flow experiences as altered states of consciousness, which can be perceived as trancelike and transcendent. The temporariness of flow state involves a process that leads to the extension of individual skills that go beyond a person's past capabilities. There is disagreement as to whether hypnotic states are best described as altered states of consciousness, such as a trance, or as interpersonal processes that involve readiness and compliance to follow hypnotic suggestions. In the state-nonstate controversy, Erickson (1980) proposed hypnotic states to be distinctly different from everyday states, highlighting hypnotic states as altered states of consciousness, with individuals being susceptible to suggestions. Non-state theorists, on the other hand, favoured propositions of social-cognitive theory, viewing hypnotic states as interpersonal processes. Consequently, individuals follow hypnotic inductions, because they have positive attitudes and expectancies that lead to cooperation with the hypnotic suggestions, which, in turn, induces a shift toward imaginative involvement (Spanos & Barber, 1974).

Cox (2002) asserted that hypnosis generally serves two major functions. Hypnosis involves a cognitive-behavioural process, which can be distinguished into a cognitive and a motivational function. From a cognitive point of view, hypnosis helps athletes to restructure thought patterns about themselves and their performance. From a motivational point of view, hypnosis can be used to facilitate athletes' efforts, to regulate arousal, to change emotions, and to reduce anxiety.

Previous research that examined the effect of hypnosis on sport performance (Baer, 1980; Morgan, 1972; Morgan & Brown, 1983) was summarised by Cox (2002), who considered results with regard to personal characteristics, effectiveness of hypnosis, and direction and intensity of hypnotic suggestions. According to Cox, personality characteristics of openness to experience and hypnotic susceptibility have been found to facilitate hypnosis-related inductions. Hypnotic suggestions should be positive in nature, so as to have a performance-enhancing effect on athletes. Furthermore, the effectiveness of hypnotic suggestions is stronger the deeper the athlete is hypnotised. Several researchers have emphasised that personal attitudes towards hypnosis, such as conviction, belief, and compliance are important aspects for the successful implementation of hypnosis interventions (e.g., Liggett, 2000; Sheehan & Robertson, 1996). A number of studies have used hypnosis as an intervention procedure to influence flow and performance in sport (e.g., Pates, Cummings, & Maynard, 2002; Pates & Maynard, 2000; Pates, Oliver, & Maynard, 2001). The majority of these studies found that hypnosis was effective at increasing both flow and performance.

Peak Moments

Peak moments in sport are reflected and operationalised in terms of peak experience and peak performance (McInman & Grove, 1991). Several researchers have discriminated between peak moments and peak performance (Privette, 1981, 1983). Writers also conceptualised the unique characteristics of peak experience (Garfield & Bennett, 1984; Maslow, 1962, 1968; Ravizza, 1977, 1984).

Peak Experience

Peak experience has been defined in different ways, such as “moments of highest happiness and fulfilment” (Maslow, 1962; p. 69), or as “intense and highly valued moment” (Privette, 1983; p. 1361). Comparing flow and peak experience, Privette (1983) argued that there are differences with regard to individuals’ involvement (e.g., active or passive), level of intensity, motivation, and goal characteristics. Privette proposed that peak experiences do not necessarily arise as a result of participation in a specific activity. Individuals could be in a passive mode, which is characterised by receptive and perceptual experiences. Privette outlined that peak experiences could be triggered spontaneously, which may occur in inactive or non-motivated states in everyday life, for instance, by listening to radio or music, watching television, dream scenarios, or forms of intoxication. In contrast, flow is highlighted by a strong active physical or mental involvement in a planned and structured activity, where challenges match individuals' skills, which includes experiences of joy and enjoyment.

Peak Performance

Several definitions have been proposed for peak performance. Privette defined peak performance as "behavior which exceeds one's average performance" (1982, p. 242), or as "superior functioning" (1983, p. 1361). Jackson and Roberts (1992) viewed peak performance as a "prototype of superior use of human potential" (p. 156), including physical as well as mental involvement. On a conceptual level, Jackson and Wrigley (2004) added:

> Peak performance refers to an outcome or achievement of superior functioning rather than to an internal experience of optimal feelings and perceptions. Optimal experience describes an inner psychological state while engaged in an effortful and challenging activity, whereas peak performance refers to the outcome or accomplishment as a consequence of

> that person's effort and sustained concentration. Simply put, peak performance refers to an outcome rather than an experience. (p. 426)

Based on Jackson and Wrigley's contention of the relationship between flow and peak performance, flow has a strong subjective component that cannot be directly evaluated by others, whereas the result of a peak performance may be objectively quantifiable by observations and comparing previous performances. In a similar vein, Kimiecik and Stein (1992) argued that peak experience and flow are rather subjective in nature, whereas peak performance is about objective results. Even though there are conceptual differences between flow and peak performance, Csikszentmihalyi (1993) noted that flow is tangentially related to peak performance, indicating that both states can occur at the same time.

Privette and Bundrick (1987, 1997) proposed an experience model, consisting of two dimensions that were termed as feeling and performance. As shown in Figure 2.1, both dimensions consist of seven different states, which gradually increase from lowest (total failure) to highest (personal best) performance and from lowest to highest feeling states, with neutrality as the centre point. According to Privette and Bundrick (1997), feeling states below neutrality were specified as boredom, worry, depression, and misery, as the most negative feeling state. States above neutrality were labelled as enjoyment, joy, ecstasy and highest happiness, as the most positive feeling state. According to the experience model, feelings of worry and boredom are counterproductive to superior performances. Both experiences are related to performances that are below average. Enjoyment, on the other hand, which is a key aspect of flow, would signify performances that are above standard.

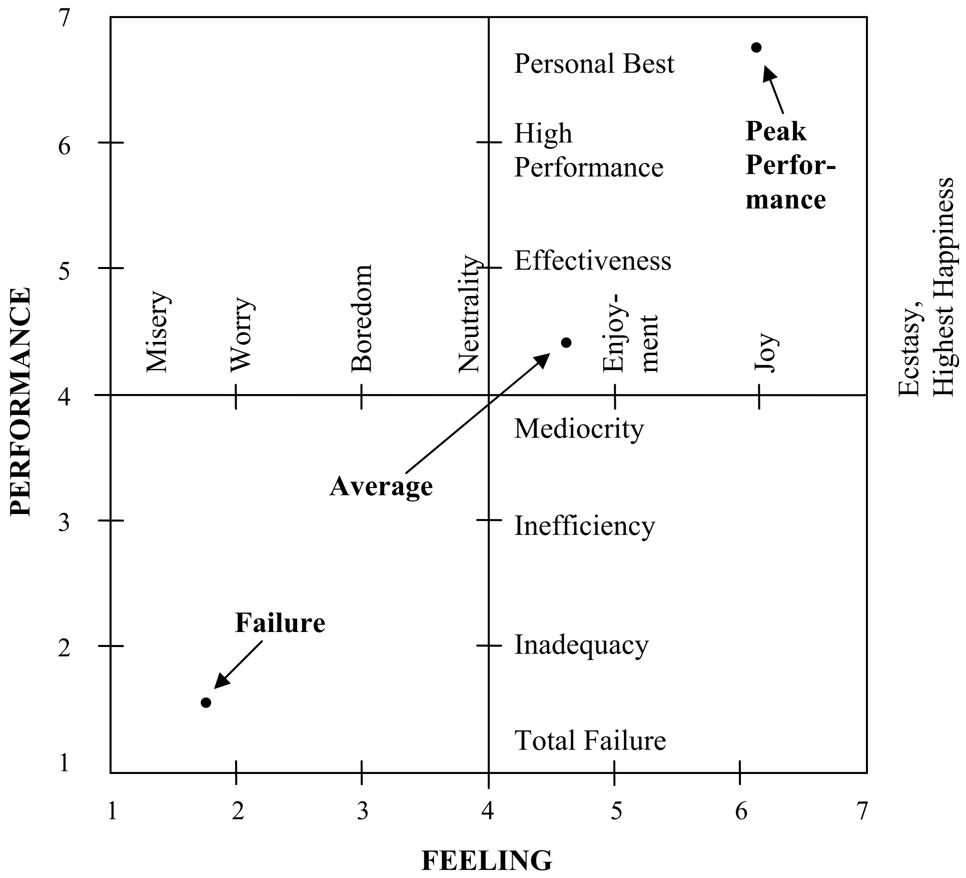

Figure 2.1. Experience model of feeling and performance

Testing the experience model, Privette and Bundrick (1997) examined 123 adults on their perceptions in various activities, such as sports, arts, and social services, to compare their feeling states in failure, average, and peak performance. The results showed that peak performances were characterised by factors of fulfilment, focus, play, and self in progress. In contrast, average performance revealed a lack of fulfilment, focus, and significance, whereas factors of play and sociability were reported as more important. Failing performances demonstrated most strongly an absence of fulfilment, focus, sociability, and self in progress. The results showed distinct differences in athletes' experience that were related to the various performance levels, indicating that the stronger the performance the more positive the experience.

Privette (1983) proposed several factors, such as absorption, joy, involvement, spontaneity, awareness, loss of time, and temporality, to be a reflection of communal aspects of peak performance and flow. According to Privette, experiences of flow and peak performance are characterised by active processes, indicating interactivity and responsiveness between athletes and their environments. Similar to Csikszentmihalyi's (1975) flow experience, Privette (1983) proposed that peak performance manifests in a holistic experience as indicated by a clear focus and a strong awareness of one's action and one's self.

The phenomenological description of flow and peak performance suggests that several experiences might be perceived similarly or are even shared in both states. Jackson (2000) provided an overview comparing characteristics of peak performance with those of flow as shown in Table 2.1.

Table 2.1

Attributes of Peak Performance and Flow

Peak Performance			Flow
Garfield & Bennett (1984)	Loehr (1982)	Cohn (1991)	Csikszentmihalyi (1990)
• Confidence • Physical / mental relaxation • Highly energised	• Confident • Low anxiety / physically relaxed • Energised	• Confident • Physically & mentally relaxed	• Challenge-skills balance
• Extraordinary awareness	• Automatic	• Immersed in present	• Action-awareness merging
	• Effortless		• Clear goals and unambiguous feedback
• Present-centred focus	• Focused/alert	• Narrow focus of attention	• Concentration on the task at hand
• In control	• In control • Mentally calm	• Feelings of control • No fear	• Sense of control
• Detached from external environment			• Loss of self-consciousness • Transformation of time • Autotelic experience

Confident and highly energetic experiences that occur during peak performance are perceived and reflected in flow as challenge-skills balance. Athletes, who perform at their peak, experience a high level of awareness and immersion in the activity, keeping a centred and narrow focus on the performance, while feeling in control. These aspects of peak performance are mirrored in the flow concept by dimensions of action-awareness merging, concentration on the task at hand, and sense of control. In the following section, I outline conceptual aspects of flow experiences, delineating the general structure and dimensions of flow in greater detail.

Flow Theory

This section is divided into two main parts. In the first part, I consider the theoretical aspects of flow. Csikszentmihalyi (1975, 1990, 2002) proposed a universal flow structure, consisting of nine dimensions. The development of the nine dimensions was based on several theoretical aspects, such as self-actualisation and peak experience, and research findings. In the second part, I address characteristics of flow that reflect important aspects of flow, including intensity and frequency of flow, the autotelic personality, flow activities, flow and competition settings, and the relationship between flow and performance.

Dimensions of Flow

Csikszentmihalyi (1990, 2002) and Jackson and Csikszentmihalyi (1999) proposed that in everyday life, and in sports in particular, a combination and interaction of nine flow dimensions facilitate the overall experience of flow. The dimensions are challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation, and autotelic experience. Even though the flow dimensions are conceptually different constructs, there are several overlaps and associations between the dimensions.

Challenge-Skills Balance

The challenge-skills balance is a major concomitant of flow theory, epitomising the main precondition to get into flow. The experience of a balance of challenges and skills is based on individuals' perceptions and their confidence that they can meet the various challenges. Jackson and Csikszentmihalyi (1999) illustrated the interplay of the two dimensions of situational challenges and personal skills on a continuum from high to low, as shown in Figure 2.2. Csikszentmihalyi (1988b) stipulated that the challenge-skills balance needs to be above average, for instance, in situations of high challenge requiring high skills, to experience flow.

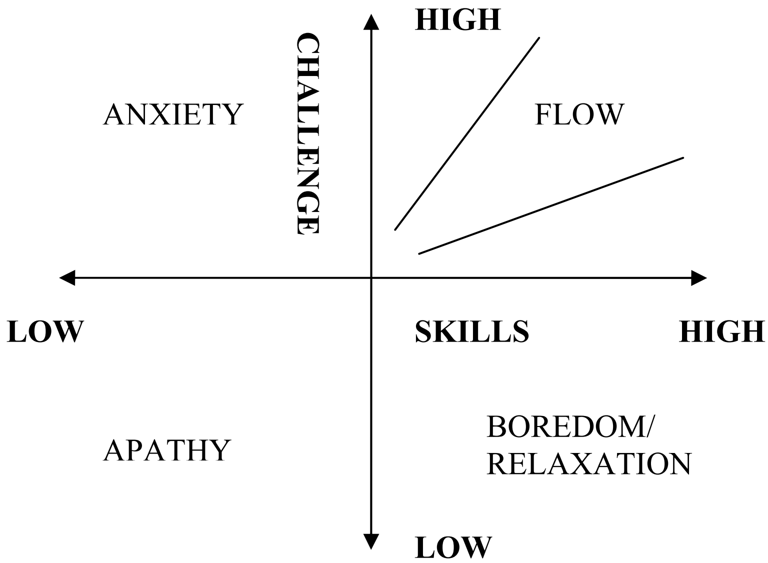

Figure 2.2. Flow state model

If the perception of a match of challenges and skills deviates on either side of the equation, flow state converts into states of boredom, relaxation, apathy, or anxiety. Hence, according to Csikszentmihalyi (2002) low-challenge/high-skill situations, in which performers' skills exceed current challenges lead to states of relaxation or boredom. Those situations lack stimulation, because the demands are relatively low and easy to master. Low-challenge/low-skill situations induce feelings of apathy. This situation is neither stimulating nor does the individual have the skills or expertise to master it, creating little or no interest. High-challenge/low-skill situations provoke states of anxiety. The situation is perceived as threatening, or, at least, not enjoyable, because challenges go beyond personal skills, which are inadequate or insufficient to successfully manage the situation.

Csikszentmihalyi (1975) illustrated flow as a positive relationship between challenges and skills, which he called the “flow channel” (p. 51). The widening of the flow channel in the upper right quadrant of Figure 2.2 (high/high) indicates that at very high challenge with very high skills flow is more likely to occur. If individuals drop out of the flow channel, there are two ways to re-attain flow. To get back into flow, individuals can aim for lower challenges that match and stimulate their current skills. On the other hand, individuals who keep pursuing challenges of a high level have to improve their skills to reach the challenge-skills balance to get back into the flow channel. To experience flow in sport, Jackson and Csikszentmihalyi (1999) asserted that challenges and skills need to match on a physical, mental, technical, and tactical level.

Action-Awareness Merging

Action-awareness merging signifies that the awareness of the self changes through the course of action. During periods of flow, body and mind are perceived as one unit, with the individual getting completely absorbed in the activity. One of the most distinguishing features of this state is that all worries, doubts, and thoughts concerning the self are not salient. Csikszentmihalyi (1975) advocated action-awareness merging as one of the clearest indications that someone is experiencing flow. All actions appear to be happening spontaneously, effortlessly, and automatically, with the individual being led by an *autopilot*. The individual or athlete is mentally and physically at one with their performance. Concentration is fully directed to the activity, while there is a lack of consciously reflecting and evaluating one's actions. The merging of action and awareness on one occasion, as an integrated whole, could be described as absorption or immersion (Csikszentmihalyi, 1975; Jackson & Wrigley, 2004).

Csikszentmihalyi (1988a) proposed that the coalescence of body and mind is likely to be the result of another flow antecedent, which he referred to as concentration on the task at hand. The total focus on one single activity keeps dysfunctional thought processes (e.g., preoccupations and distractions) out of consciousness and enables individuals to perform at their best.

Clear Goals

To get involved in an activity, individuals need to have a clear goal in mind that they pursue (Csikszentmihalyi, 1975). Csikszentmihalyi (2002) outlined that setting goals of low difficulty would hardly lead to enjoyment, because those types of goals are too easy to achieve. Enjoyment and flow will not occur in an activity, unless individuals are able to set challenging and attainable goals. In addition, clear goals can facilitate focus on and awareness of one's intentions, reflecting the main aspects of a game plan. That is, process goals enhance awareness of what to do next and facilitate concentration on the present, whereas performance goals, such as winning or outperforming, can increase motivation. On the other hand, becoming aware of not being able to reach performance-related goals might prevent or decrease flow. To maintain flow, a clearly defined, process-related goal is important to set a specific challenge to strive for, and on which to focus attention (Jackson & Csikszentmihalyi, 1999).

Unambiguous Feedback

Besides knowing what to do next, individuals in flow receive immediate and unambiguous feedback on how well actions were executed. There are two distinct ways of evaluating how successful a person performed, which are based on internal and external feedback, respectively (Jackson & Wrigley, 2004). Internal feedback refers to information about bodily movements, including tactile and kinaesthetic feedback. External feedback stems from sources outside the body, which are processed as visual, auditory, gustatory, or olfactory feedback. In most sports, internal and external feedback are evaluated in a convergent fashion, providing an overall impression of the performance and the results. For instance, tennis players evaluate their shots based on the smoothness of their movements and accuracy of hitting the sweet spot, highlighting sources of internal feedback. Also, tennis players may evaluate their shots on the visually accessible outcome, that is, whether the ball hit the anticipated location on the court. Both sources of feedback appear to be important to provide information about the quality of performance, which, in turn, affects the quality of experience, such as flow.

Concentration on the Task at Hand

Csikszentmihalyi (1988b) proposed that the most general characteristic of flow is concentration on a limited stimulus field on the task at hand. Csikszentmihalyi (1988b, 1993) referred to attention as a limited resource.

Attention and focus can involve relevant or irrelevant information processing. Flow, which is signified by episodes of total focus on imminent tasks, only selected, task-relevant information is processed (Csikszentmihalyi, 1990). Moran (1996) asserted that a strong task focus would simultaneously block out performance-debilitating thoughts, such as distractions and preoccupations. Therefore, individuals who direct all focus on task-relevant information are more likely to experience flow than individuals who lack focus. In addition, Csikszentmihalyi (1993) proposed that total focus on a limited field of stimuli is likely to lead to a merging of body and mind. Nideffer (1993) proposed that, depending on the sport, attention can vary on a narrow-broad dimension and on an internal-external dimension. For instance, athletes in sports requiring open skills, such as tennis players, need to shift their attention, more or less rapidly, from a broad-external focus (assessing the situation) to a narrow-external focus (performing in the situation). Jackson and Csikszentmihalyi (1999) proposed that athletes' concentration when they are in flow is signified by a rapid, effortless, and precise shift in attentional demands to detect cue information most relevant in the situation.

Sense of Control

Perceiving a sense of control is accompanied by feelings of comfort, security, relaxation, well-being, power, dominance, and predictability, while, simultaneously, perceiving the absence of a sense of worry and fear of failure (Csikszentmihalyi, 2002; Jackson & Csikszentmihalyi, 1999). Csikszentmihalyi (2002) stated that in situations of uncertain outcomes (e.g., the possibility of winning or losing) the ability to influence the outcome in their favour will result in athletes' experiencing feelings of control. The crucial point about experiencing control is not *being in* control, but the ability to *exercise* control in any given situation. Jackson and Csikszentmihalyi (1999) asserted that the feeling of control is a finely-balanced state. Similar to the challenge-skills balance, perceiving a minor sense of control may lead to states of anxiety, whereas the perception of highest levels of control indicates one's dominance and superior skills over situational challenges, which might induce boredom or relaxation.

Loss of Self-Consciousness

Csikszentmihalyi (1975, 2002) outlined the importance of the self to coordinate and integrate one's action with other individuals. Individuals are frequently preoccupied with self-reflecting and self-analysing thoughts, as well as worries and self-doubts. Csikszentmihalyi (2002) contended that:

> Loss of self-consciousness does not involve a loss of self, and certainly not a loss of consciousness, but rather, only a loss of consciousness *of* the self. What slips below the threshold of awareness is the *concept* of self, the information we use to represent to ourselves who we are. And being able to forget temporarily who we are seems to be very enjoyable. (p. 64)

With regard to sport, Jackson and Csikszentmihalyi (1999) asserted that through flow experiences the self expands, by gaining new skills, which leads to a more positive self concept. Csikszentmihalyi (1988c) added that "the strength of the self depends on the cumulative history of positive feedback one gets in high-challenge, high-skill interactions" (p. 370).

Time Transformation

The transformation of time refers to the aspect of flow that time within an activity seems to alter, either speeding up or slowing down. Depending on the sport, it might be that athletes experience that time passes faster (e.g., during a marathon) or slower (e.g., during a 100-m sprint). Csikszentmihalyi (1988b) indicated that time transformation is the consequence of an extremely deep flow experience and might not be experienced as frequently as other flow dimensions. Less intense flow states would not have the characteristic of time transformation. It seems possible that the experience of time could vary on the basis of whether performance is barely dependent on time measurement, such as tennis or cricket, or closely dependent on time measurement, such as running or swimming.

Autotelic Experience

Csikszentmihalyi (1975) introduced the term autotelic to signify that an activity can be fully engaged and involved in for intrinsic reasons, which are inherent in the activity. Csikszentmihalyi defined autotelic experience as a "psychological state, based on concrete feedback, which acts as a reward in that it produces continuing behavior in the absence of other rewards" (p. 23). The term *autotelic* stems from the Greek words auto ("self") and telos ("goal"), indicating that the activity is done for intrinsic rewards, rather than extrinsic rewards. Intrinsic rewards, for instance, are joy and enjoyment that emerge from an activity. Csikszentmihalyi (1993) proposed that the presence of the other eight flow dimensions turns individuals' perception into an autotelic experience, meaning that the activity being undertaken becomes self-contained and a goal in itself. That is, the activity is intrinsically motivating, self-rewarding, and a stimulus to participate in the activity for its own sake. Originally, Csikszentmihalyi (1975) distinguished between flow and autotelic experience, that is, an experience being “autotelic, we implicitly assume that it has no external goals or external rewards; such an assumption is not necessary for flow” (p. 36). Therefore, the autotelic experience could be viewed as a consequence of the other flow dimensions (Jackson & Csikszentmihalyi, 1999).

With regard to all flow dimensions, Csikszentmihalyi (2000a) reviewed the functions of flow dimensions, proposing a distinction between dimensions that are crucial to get into flow, labelled *flow conditions*, and dimensions that reflect the phenomenological experience during flow, labelled *flow characteristics*. According to Csikszentmihalyi, general conditions conducive of flow are based on experiences related to dimensions of challenge-skills balance, clear goals, and unambiguous feedback. Characteristics of flow that are experienced while being in flow are dimensions of concentration on the task at hand, action-awareness merging, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. Csikszentmihalyi’s distinction between flow conditions and flow characteristics is important for the development of interventions to increase flow, providing theoretical guidance for targeting main flow dimensions, such as challenge-skills balance, clear goals, and unambiguous feedback that have the capacity to induce flow state.

Characteristics of Flow Experiences

Csikszentmihalyi (1975, 1988b, 2002) proposed general characteristics of flow, that are important for the understanding of the experience of flow. Csikszentmihalyi addressed the importance of differentiating between intensity and frequency of flow, which has specific short-term and long-term implications. In addition, the autotelic personality, flow activities, competition settings, and performance can play an important part in the experience of flow.

The intensity of flow corresponds with flow state, signifying how strongly individuals perceive flow in one event at a specific time. The frequency of flow corresponds with dispositional flow, indicating how often individuals get into flow over a longer period of time. Flow experiences implicate several long-term effects for the individual, such as well-being, happiness, and quality of life. Csikszentmihalyi proposed that individual differences account for why some people experience flow more frequently than others, which is referred to as autotelic personality. In addition to personal factors influencing flow, Csikszentmihalyi suggested that the activity itself may induce flow. The activity needs to be structured, providing intrinsic rewards for the person involved in the activity. Competition, as a special form of an activity, is characterised by different reward structures, depending on whether the person is involved in direct or indirect competitions. Furthermore, performance itself can facilitate or debilitate the experience of flow. In the following subsections, I will address each of these characteristics in more detail.

Intensity of Flow Experiences

Flow intensity can be distinguished on a continuum between low and deep flow experiences (Csikszentmihalyi, 1975). The extreme ends of the continuum are characterised by lower complexity, indicating less intense flow experiences, whereas situations of higher complexity have the potential for deeper flow experiences. Csikszentmihalyi termed the extreme ends of the continuum *microflow* and *macroflow*, occurring in situations of low or high complexity, respectively.

Microflow refers to rather short and superficial episodes of flow which are mainly experienced in situations of everyday life (Csikszentmihalyi, 1975). Low levels of flow relate to activities that are rather unstructured and trivial in nature, such as chewing gum, listening to music, or having a coffee break. Microflow experiences generate and add structure to everyday activities and are perceived as states of vigilance. Csikszentmihalyi (1975) concluded that “the function of microflow experiences is to keep a person alert, relaxed, with a positive feeling about himself, a feeling of being spontaneously creative” (p. 177), which is important for everyday functioning. With regard to sports, activities in between performances, such as straightening the strings on a tennis racket or playing with tennis balls before serving, reflect such actions which might trigger microflow and may prepare athletes to experience deeper flow.

Deep flow experiences, or macroflow, provide high challenges and the opportunity of ongoing action in structured activities, which can occur in religious, professional, or sport activities, such as climbing, basketball, and chess

(Csikszentmihalyi, 1975). Deep flow occurs at a high level of complexity and requires the use of a greater part of individuals' mental and physical potentialities to match current challenges. These deep flow experiences provide individuals with the impetus for further skill development and personal growth (Csikszentmihalyi & Larson, 1984; Massimini & Carli, 1988).

Frequency of Flow Experiences

Several implications arise from the frequent experience of flow. Csikszentmihalyi (1988b) proposed that a higher frequency of flow implicates positive long-term consequences with regard to affect and quality of life. Csikszentmihalyi pointed out that individuals who frequently experience flow rate their general experience higher than individuals being less often in flow. Csikszentmihalyi (1993) noted that recollections of flow experiences coincide with feelings of being successful. From this perspective, the increased frequency of the flow experience helps in building confidence and self-esteem. Furthermore, the frequent experience of flow affects personal development, such as specific talents, creativity, as well as productivity and performance (Csikszentmihalyi, 1993). Particularly, the positive experience emerging from an activity provides athletes with the motivation to actively proceed and persevere within their sport (Jackson & Csikszentmihalyi, 1999).

Autotelic Personality

Csikszentmihalyi (1988b) contended that there are differences in individuals' propensity, which may determine the intensity and frequency of people's flow experiences. People have different abilities to transform general experiences in everyday life or sports into flow experiences. That is, while intrinsic rewards and enjoyment are immediately experienced in autotelic activities, individuals with an autotelic personality can also enjoy activities that bear little enjoyment for everybody else (Csikszentmihalyi, 1975). According to Csikszentmihalyi (2002), one of the key factors to experience flow depends on individuals' capacity to control consciousness. Individuals are able to find challenges in the various situations that finally match their skills to get into flow.

Besides control over consciousness, Csikszentmihalyi (1975, 2002) proposed personality variables, such as intrinsic motivation, confidence, autonomy, and lack of self-consciousness, as facilitators of flow. The entity of traits, which influence individuals' propensity to experience flow, is stated as autotelic personality (Csikszentmihalyi, 1975, 1988b, 1990). Individuals with an autotelic personality are intrinsically motivated, self-confident, and perceive the task as self-rewarding and enjoyable. In addition to personality variables that generally help individuals to get into flow, Csikszentmihalyi (1975) advocated that "each individual undoubtedly has his own threshold for entering and leaving the state of flow" (p. 52).

With regard to the autotelic personality in sport, Kimiecik and Stein (1992) noted that only little research has been undertaken to identify athletes' propensity to experience flow. Kimiecik and Stein suggested that dispositions, such as attentional style, task and ego orientation, perceived sport competence, trait anxiety, and trait sport confidence, might be part of the autotelic personality in sport. Several researchers have proposed the necessity to conduct more studies using dispositional measures to gain a more complete understanding of variables underlying the autotelic personality and examine individual differences in athletes' propensity to get into flow (Jackson et al., 1998; Kimiecik & Stein, 1992).

Flow Activities

Flow activities are posited on a continuum between simple and repetitive tasks up to complex tasks that entail a person's entire mental and physical capabilities (Csikszentmihalyi, 1975). Csikszentmihalyi proposed that enjoyment and flow can emerge from virtually any activity in work and leisure. The intensity and enjoyment of an experience partly depend on the engagement in either structured or unstructured activities. Unstructured flow activities could be everyday activities, such as having a break or watching television, which induce minor flow. Structured activities that follow specific rules require narrowed attention and skills to master the task, such as sports, offer deeper flow experiences. Beside the structure of the activity, deeper flow can only be experienced above a certain degree of complexity (Csikszentmihalyi, 1993, 2002). Complex activities that provide and facilitate action opportunities could occur in situations of competition, being creative, designing, discovering something new, or problem solving. In addition, Csikszentmihalyi (1975) asserted that the objective structure of the activity is less important than "the person's ability to restructure the environment so that it will allow flow to occur" (p. 53).

Furthermore, Csikszentmihalyi (1975) outlined that any activity provides various rewards, which can be classified on an autotelic continuum. The extreme ends of the autotelic continuum are signified by intrinsic rewards on the one end, and extrinsic rewards on the other. Intrinsic rewards are reflected by experiences, such as enjoyment, emerging from the activity itself. Extrinsic rewards, on the other hand, are signified by praise, money, or trophies. Activities in science, art, religion, and sports provide a range of intrinsic and extrinsic rewards. Individuals are more likely to experience flow by prioritising intrinsic rewards, opening up the opportunity to get immersed through task-related incentives and to dissociate from instrumental outcome-related consequences as signified by extrinsic rewards.

Flow and Competition Settings

Sport activities are bounded by a set of rules that promote specific action opportunities within training or competition situations. Both kinds of situation provide an array of intrinsic and extrinsic rewards that may influence flow. Training situations, on the one hand, offer fewer distractions, which could facilitate the experience of flow (Jackson & Csikszentmihalyi, 1999; Young, 2000). Competitions, on the other hand, are characterised as particularly stressful situations, in which athletes experience the pressure of winning or losing. Therefore, athletes' expectations of future outcomes can interfere with and disrupt the experience of the task at hand.

Csikszentmihalyi (1975) proposed different reward structures for direct or indirect competitions. Basketball and tennis are examples of direct competitions in team and individual sports. These sports are characterised as *zero-sum activities*, meaning that winning or losing are inherent aspects of the direct competition, producing the same number of losers and winners. The rewards from direct competition are mainly derived from *measuring self against others*, evaluating personal performance against the opponents' performance. Sports like dancing or rock climbing represent indirect competitions, in which athletes contend without immediately evaluating their performance against others. In those situations, athletes mainly derive rewards from *measuring their performance against their own ideal*. One important difference between the two competition settings is that athletes are able to exert more control over their performance in indirect competitions than in direct competitions. Because of sequential performances there is no immediate influence through the opponent, whereas direct competitions are interactive and athletes' performance directly depends on the opponents' performance. Therefore, positive, intrinsic rewards might be more readily available in indirect competitions, which might provide an immediate trigger for flow.

Similarly to Csikszentmihalyi (1975), Deci and Ryan (1985) argued that direct and indirect competitions provide different sources of rewards and feedback. Depending on the competitors' interpretation, rewards and feedback can be perceived as either controlling or informational. Controlling feedback becomes more important when the competition is undertaken for instrumental reasons, such as winning or aiming for recognition. Informational feedback in competition focuses on the athletes' effectiveness and competence. Deci and Ryan concluded that an increase in perceiving controlling feedback in any situation would debilitate intrinsic motivation, whereas an increase in the perception of informational feedback would facilitate intrinsic motivation. This argument also appears to be valid for the experience of flow. Interpreting feedback as instrumental and controlling by focusing on the achievement of a specific performance outcome would tend to prevent flow, because athletes are less likely to get immersed in the here and now. Their thoughts are revolving around some future result, such as winning, and rewards that are associated with this future result. Informational feedback, on the other hand, would constructively contribute to athletes assessing the performance at hand, which would be valuable information regarding athletes' competence and ability, adding to current experiences, such as flow.

Consequently, the way athletes' derive rewards appears to have an impact on flow and performance. The characteristics of the reward structure of the competition setting, as well as athletes' interpretation of feedback within the setting, seem to be important factors influencing the intensity of flow state.

Flow and Performance

An important aspect of the experience of flow in an activity or a competition is the perception of personal performance. Csikszentmihalyi (1975, 1993) reported a positive connection between flow and performance. Researchers have given little attention to a possible cause and effect relationship between flow and performance. One of the few studies on this topic was conducted by Massimini, Csikszentmihalyi, and Fave (1988), who examined individuals with different backgrounds, such as dancers, white collar workers, and students, to identify what marks the onset of their flow experience. The most frequent answer, given by over 40% of the respondents, was the activity itself. Massimini et al. concluded that "the performance of the activity was enough to trigger the experience" (p. 68). Jackson and Csikszentmihalyi (1999) supported this finding, outlining that "familiar stimuli often do facilitate immersion in the activity and help to bring about flow" (p. 89). Based on these research findings and theoretical discussions on flow and performance, there appears to be a causal relationship in which performance influences flow.

In addition, flow also seems to have an influence on performance. With regard to swimming, Csikszentmihalyi (1993) argued that students, who reported flow in a learning situation, made better progress than students who did not report flow. In addition, Jackson and Csikszentmihalyi (1999) argued that the preparation for a sport event, which culminates in physical and mental readiness, is important for the experience of flow. These theoretical propositions and research findings indicate that flow has the potential to positively influence performances. Therefore, the relationship between flow and performance appears to be reciprocal, in which flow influences performance and vice versa. At this point, the results are too vague to draw conclusions on whether there is a one-directional connection between flow and performance or between performance and flow. More research is needed to untangle the relationship between flow and performance and to further examine directional or reciprocal links. More importantly for this thesis, the positive connection between flow and performance is a crucial aspect for intervention studies, which would benefit from increasing both flow and performance. Even though there is no strong evidence on the directional effects between flow and performance, aiming to increase both flow and performance would be preferable, so that one or both variables further enhances the other. Even if flow does not have a direct effect on performance, it would be worthwhile to enhance flow, because of the benefits of flow for intrinsic motivation and, hence, effort and persistence, which would have a mediating effect on performance.

This section provided an overview of various characteristics of flow. Internal factors, including personality traits that reflect individuals' propensity to experience flow, which are collectively summarised as autotelic personality, and external factors, such as a structured activity and competition settings, can have a joint effect on the experience of flow. In the following section, I outline which personal and situational factors are vital for the experience of flow in sport and how they interact to facilitate flow.

Model of Flow in Sport

Kimiecik and Stein (1992) introduced a sport specific interaction framework, consisting of person and situation factors that influence flow. Kimiecik and Stein proposed that personality trait and state variables underlie flow. As shown in Figure 2.3, Kimiecik and Stein advocated personal dispositional variables as trait confidence, trait anxiety, attentional style, perceived sport competence, and goal orientation. In analogy to the dispositional variables, they proposed that personal state variables underlying flow include self-efficacy, state anxiety, concentration, perceived game ability, and game goals.

The model suggests that situational characteristics that include type of sport, competitive flow structure, competition importance, coach behaviour, and opponent ability, affect the experience of flow. Sport type characteristics can be further subdivided into variables such as individual and team sports, open and closed skills, and self-paced and externally-paced sports.

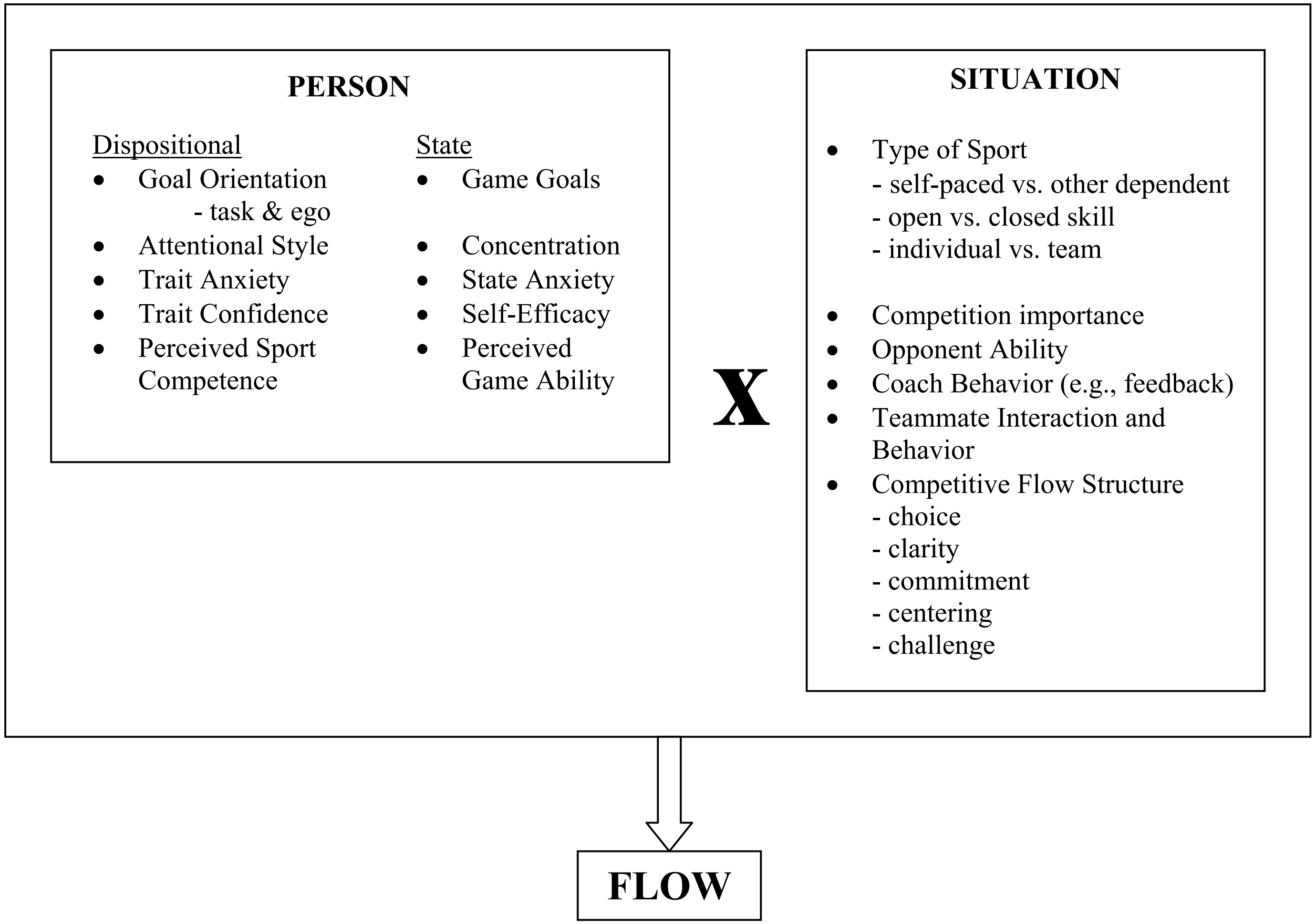

Figure 2.3. Model of person and situation factors underlying flow in sport

In addition, Kimiecik and Stein (1992) argued that interactions with coaches and teammates influence the experience of flow. Particularly, communicative interactions between coach and athlete seemed to be crucial for flow, as it contains important information just before performing. Furthermore, environmental factors that could have an influence on flow are summarised as *competitive flow structure*. This proposition stems from the results of research conducted by Rathunde (1988) on teenagers with different flow-related family backgrounds. Rathunde distinguished between autotelic and non-autotelic family contexts that would be facilitative or debilitative of flow.

According to Rathunde (1988), the context that facilitates flow is characterised by five factors. These factors are clarity of a stimulus field, meaningful challenge, perceived choice, centering focus on the task, and commitment. For flow to occur in a family context, all factors need to be experienced within a balance between rigidity and looseness. Teenagers in families who were frequently under- or overemphasising these variables experienced states of anxiety or boredom. This suggests a bell-shaped relationship between flow experience and environmental factors, with flow experiences being lower when the family context offers too much or too little emphasis on these variables (Rathunde, 1988). Therefore, Kimiecik and Stein (1992) concluded that, for flow to occur in sport settings, the way the "coach structures the practice and game environment has far reaching implications for whether or not his or her athletes experience flow" (p. 153). This discussion emphasises that the experience of flow is based on a highly individual perception of the environment, including task characteristics and the behaviour of significant others, such as coach and team mates.

More importantly than the description of factors influencing flow are the potential mechanisms linking personal and situational factors that underline how flow states occur. Kimiecik and Stein (1992) proposed that

> If flow is to be better understood in sport contexts, any research approach must address the interaction between person and situation factors. … The guiding question to the study of flow in sport should be, "How, when, where, and what person factors interact with situation factors to produce flow, boredom, anxiety, or apathy in athletes". (149)

According to Kimiecik and Stein (1992), an important situational factor influencing flow evolves from self-paced performances (e.g., tennis serves), in which athletes determine the initiation of a particular performance. Contrastingly, within externally-paced performances (e.g., tennis groundstrokes) athletes are forced to react to preceding actions by an opponent. Consequently, Kimiecik and Stein hypothesised that flow is easier to attain in self-paced than in externally-paced tasks.

With regard to the propensity of flow, Csikszentmihalyi (1975) and Kimiecik and Stein (1992) proposed that confidence is one of the main dispositional variables underlying flow. Trait confidence seems to be a particularly important variable to experience because highly confident athletes might find it easier to match their skills to current situational challenges to get into flow than athletes low in confidence. Kimiecik and Stein noted that researchers need to focus more closely on how interactions between personal and situational factors generate flow experiences. The list of factors, as presented by Kimiecik and Stein, is not exhaustive, and researchers need to choose variables that are "closely tied to subjective psychological states … that may occur during participation" (Stein, Kimiecik, Daniels, and Jackson, 1995; p. 134). This has several implications for the examination of flow in specific sports. For instance, tennis is an individual sport that requires a high skill level to succeed in competition. Consequently, tennis athletes need to be highly confident in their skills to master the various challenges when facing an opponent in competition. In addition, tennis performance involves two distinct task characteristics of service and groundstroke shots, reflecting self-paced and externally-paced task settings, respectively. The self-paced and externally-paced performance types require specific cognitive processes to meet the situational challenges.

Self-Paced and Externally-Paced Performance Situations

Performance situations in sport can be distinguished as to whether performances differ with regard to discrete or continuous skills, individual or interactive skills, or if they are self or externally paced. The particular performance situations put specific demands on psychological processes to perform successfully.

Singer (1988, 1998, 2000) developed a model outlining differences between self-paced and externally-paced performance situations in terms of psychological processes, which entail several cognitive and attentional demands. Lidor and Singer (2003) stated that the settings for self-paced actions, such as first and second serves, are rather predictable and stable, allowing the athlete to enact a specific plan. Self-paced tasks permit the implementation of preparatory and preperformance routines, to put the athlete in a state that is characterised by optimal arousal, confidence, and focus. Moran (1996, 2005) advocated that internalised preperformance routines include the development of an action plan prior to the performance, which increases attention and simultaneously blocks external distractions and prevents negative thoughts.

For the production of self-paced, high-level performances, Singer (2000, 2002) proposed five steps underlying self-paced performances. These steps include readying, imaging, focusing attention, executing, and evaluating. First, readying refers to rituals that athletes employ to attain an optimal preperformance state. These rituals can include preparation routines that are based on previous superior performances, to gain confidence and an optimal mental state. Second, imagery is used to facilitate confidence and the aspired performance. Imagery can be applied from an internal and external perspective. Using internal imagery, athletes can imagine the feeling of the movement from an internal perspective, which involves tension, rhythm, and coordination of contributing muscles. Using external imagery, athletes see themselves performing from outside, like being on a video tape, emphasising the anticipated ideal performance outcome, such as imaging a successful or winning performance. Third, focusing attention before the execution of the task is characterised by narrowed concentration, trying to intensify the focus on the most relevant performance cue. In agreement with Moran (1996), Lidor and Singer (2003) proposed that an increase in focus would alleviate distractions caused from within or outside athletes. Fourth, the execution of the task should be performed with a quiet mind, and disengaging from thoughts relating to the performance itself or possible performance outcomes, reflecting the phenomenological state of flow. Fifth, evaluating the effectiveness of the performance or the performance outcome through feedback information should be applied to adjust or improve steps leading up to the performance execution. Lidor and Singer (2003) argued that advanced tennis players, in contrast to beginners, should be "able to a) analyse the potential causes for the outcome and (b) reflect on a better way to serve next time, taking into consideration mechanical and psychological factors" (p. 82).

Externally-paced performance, on the other hand, underlies changing conditions that necessitate different cognitive and attentional processes than for self-paced performances. Externally-paced tasks require athletes' to be adaptable in coping with the specific situation (Singer, 2000). Singer (2000) proposed four different characteristics that contribute to athletes' performances in externally-paced situations, such as forehand and backhand groundstrokes in tennis. First, visual search is vital to detect the most important cues in the situation and from the opponent to determine opponents' action opportunities. Second, anticipation in interactive performance, such as ball sports, is crucial to reduce reaction time. Third, decision making is then based on the initial information gained in the situation and by the opponent's actions. Fourth, following the decision making, the action response is executed by taking into account temporal and spatial parameters in the current situation.

According to Singer (2000) and Lidor and Singer (2003), different cognitive processes are involved in self-paced and externally-paced task situations. Depending on the sport or the sport situation, such as training or competition, some or all of these processes might change in importance. For instance, tennis groundstrokes in training are generally structured when focusing on technical and tactical aspects of the performance. In a competition setting, groundstroke performance turns into a highly interactive task in which automated decision making and action response are crucial for successful performance. The level of awareness of the cognitive processes during performance could also be important for the flow experience. Lidor and Singer (2003) proposed that preparation towards a self-paced task should lead athletes to execute the performance with a *quiet mind*, signifying the disengagement from conscious thought processes in the task at hand, which is also reflected in episodes of flow. Initial results of studies comparing awareness and nonawareness strategies showed that nonawareness instructions resulted in higher self-paced performance (Singer, Lidor, & Cauraugh, 1993). Instructing participants to focus on preperformance aspects, but then try to perform with no conscious attention in terms of *clearing the mind*, was superior for the performance outcome than participants focusing on performance aspects. More research is needed to evaluate whether higher levels of flow contribute differently to performance outcomes in self-paced and externally-paced tasks. In addition, more specific research is required to test Kimiecik and Stein's (1992) hypothesis that self-paced performance tasks, such as tennis serves, facilitate flow more strongly than externally-paced performance, such as tennis groundstrokes.

Matched and Mismatched Situations Influencing Flow

Sorrentino et al. (2001) discussed the importance of matched and mismatched situations and the processes connected to the particular situation on the experience of flow. From the perspective of uncertainty theory, matched situations are characterised by the compatibility between situational and personal characteristics. According to Sorrentino et al., individuals generally differ in favouring certain or uncertain situations. In a matched situation, uncertainty-oriented individuals, in contrast to certainty-oriented individuals, would vary in their experience, information processing, and motivation in uncertain situations. Uncertainty-oriented individuals are motivated to gain more knowledge about themselves and the situation they are in, receiving most valuable information about their ability under uncertain conditions. Certainty-oriented individuals prefer situations that offer information that allows for maintaining clarity about themselves and their abilities. Sorrentino et al. proposed that individuals, who are uncertainty oriented, would be most highly motivated in situations of intermediate difficulty, providing the highest uncertainty about the outcome and representing the highest informational value by attaining new information and clarity about the self. A match between situation and personal characteristics would lead to an increase in systematic information processing, whereas a mismatch would debilitate systematic information processing (Sorrentino & Roney, 2000).

Furthermore, Sorrentino et al. (2001) proposed that in matched situations individuals perceive the situation as important to the self, whereas in mismatched situations flow is not going to occur, because individuals perceive a lack of importance, which will not involve the self system. For instance, a person who is uncertainty-oriented and success-oriented might not fully engage and feel bored in situations that have no positive information value, such as situations of extreme or low difficulty. Consequently, uncertainty-oriented individuals are more likely to experience flow in an uncertain situation, in which the possibility of succeeding and losing is equally high, than in a certain situation that most likely leads to success or failure. The requirement of a match between situational and personal characteristics to experience flow, as proposed in uncertainty theory, further supports possible interaction effects between personal and situational factors in the generation of flow, as indicated by Kimiecik and Stein (1992).

Measurement of Flow

The measurement of flow comprises both qualitative and quantitative approaches. In this section, I describe the main research attempts to measure flow. Csikszentmihalyi (1975) developed the concept of flow on the basis of results from in-depth interviews with surgeons, music composers, and athletes. To overcome limitations of conventional data collection, Csikszentmihalyi developed the Experience Sampling Method to assess flow at any time during various activities. Equipped with pagers and a sampling form, participants were beeped at different times and filled out a short questionnaire regarding their experience at that time. Based on qualitative findings on flow in general life, Jackson (1992, 1995, 1996) examined the flow experience in sport, using in-depth interviews. In addition, Sparkes and Partington (2003) assessed flow through narrative practice and story telling. Using quantitative measures, flow in sport has been examined on a state and a dispositional level. The Flow State Scale (*FSS*; Jackson & Marsh, 1996) was established to assess flow state, that is, the experience of flow on a specific occasion, whereas the Trait Flow Scale (*TFS*; Marsh & Jackson, 1999) measures the extent to which a person generally experiences flow in a specific context, such as training or competition situations. Based on item modifications to improve measurement of flow factors, the FSS and TFS were revised, producing the Flow State Scale-2 (*FSS-2*; Jackson & Eklund, 2002) and the Dispositional Flow Scale-2 (*DFS-2*; Jackson & Eklund, 2002). This section concludes with an evaluation of limitations in the assessment of flow emerging from the various studies incorporating flow measures.

Experience Sampling Method

The Experience Sampling Method (ESM), developed in the late 1970s, was a response to shortcomings manifesting in conventional methods of data collection, such as interviewing and questionnaires (Csikszentmihalyi & Csikszentmihalyi, 1988). The limits of retrospective assessment by recalling subjective experience were viewed as “stereotyped” and “inadvertently distorted” (Csikszentmihalyi, 2000b, p. xix). To receive data that reflect people’s experience in a more direct and accurate way, participants were provided with pagers and booklets to answer questions about their current activity and experience when the pager beeped. Participants were instructed to complete the sample questions immediately after they received the signal on the pager, occurring up to eight times per day (Csikszentmihalyi & Csikszentmihalyi, 1988). The Experience Sampling Form (ESF) contains open-ended questions with regard to the main activity the participants are presently involved in, whether they had to or wanted to do the activity, where they were and what they were thinking at the time the signal arrived. In addition, 10-point scales addressed the importance of the activity, as well as assessing the intensity of concentration, self-consciousness, and being in control of one's actions. On a 7-point bipolar scale participants' current mood states were measured on a range between happy and sad, active and passive, involved and detached, excited and bored, and tense and relaxed.

One of the main functions of the ESF was to investigate the relationship between challenges and skills with regard to the participants' experience. Two items addressed this relationship, asking "What were the challenges in this activity?" and "What were your skills in this activity?". These items were measured on a numerical scale anchored by 0 (*low*) and 9 (*high*). Theoretical contentions of flow, occurring through a match of challenges and skills, could not be confirmed. Analysis of ESF data revealed that participants did not necessarily experience flow when challenges and skills were perceived to be in balance. Additional studies by Massimini and Carli led to a more detailed definition for preconditions of flow, outlining that flow experiences would occur when challenges and skills are in balance and *above a certain level* (as cited in Csikszentmihalyi & Csikszentmihalyi, 1988, p. 260).

In-Depth Interviews

Based on qualitative findings by Maslow (1962, 1968), Csikszentmihalyi (1975) initially investigated experiences of flow through interview studies with surgeons, music composers, rock climbers, chess players, and basketball players. Csikszentmihalyi stated that the interview data confirmed various dimensions of flow, such as concentration on the task, being in control, and merging of action and awareness. Jackson (1992, 1995, 1996) employed an interview structure in her initial examinations of flow in sport. To establish external validity, Jackson (1995, 1996) assessed flow in elite and professional athletes from a range of individual and team sports. Jackson (1995) used an interview guide with questions focussing on three main areas. First, athletes were asked about an optimal personal experience and what the experience was like while being in flow. Athletes then addressed the most salient features of their flow experience and what aspects they were consciously aware of while being in flow. Second, questions addressed factors facilitating, preventing, or disrupting flow. Third, Jackson asked athletes about their perception of being able to control flow. Subsequent studies by Russell (2001) and Young (2000) employed similar interview guides, addressing controllability of flow and factors influencing the experience of flow. Jackson (1995) and Young (2000) proposed that qualitative examinations of flow in experienced, elite athletes were particularly fruitful, because those athletes were regarded as information rich cases (Patton, 1990).

Narrative Practice

Another qualitative approach to understand the complexity of flow in sport is narrative practice, or story telling (Sparkes & Partington, 2003). Sparkes and Partington (2003) argued that previous qualitative research mainly concentrated on content and phenomenal aspects of flow, whereas the narrative part, incorporating aspects of social, personal, institutional, and cultural conditions of how the story is presented, received little attention. Narrative practice takes contents and how an experience is communicated into consideration and may reveal interactions between both aspects. According to Sparkes and Partington, research questions on flow in sport regarding narrative practice should address *how* flow is constructed, depending on context, place, and time within different sport environments and subcultures. For instance, this method can be used to evaluate why there are consistencies or variations in flow experiences within or between athletes, sport groups, or subcultures, over a period of time.

Sparkes and Partington (2003) presented a case-study on flow that focused on male and female members of a white water canoe club. Gender-related differences were found in participants' reports on their flow experience. According to Sparkes and Partington, male participants were advantaged in their story telling more than female participants, because of having primary narrative resources within the club. Older, experienced athletes provided additional insight and vocabulary into flow to younger athletes within the sporting male subculture.

Flow State Scale

Based on qualitative findings, Jackson and Marsh (1996) developed and validated a quantitative measure of flow to assess the intensity of flow state in sport. The Flow State Scale (FSS) consists of nine subscales representing the nine dimensions of flow proposed by Csikszentmihalyi (1988a, 1992). The item development of the FSS was based on a multi-method approach of qualitative and quantitative evaluations. The item pool was formed on the basis of Csikszentmihalyi's definitions of the nine-dimensional flow structure, through previous quantitative flow and flow-related measures (e.g., Csikszentmihalyi & Csikszentmihalyi, 1988; Privette, 1984), and qualitative findings of research with elite sport athletes (e.g., Jackson, 1992, 1995). A questionnaire with 36 items and a longer version with 54 items were constructed, each utilising a 5-point Likert scale response format, anchored by 1 (*strongly disagree*) and 5 (*strongly agree*). The sample completing the questionnaires comprised 394 athletes from 41 different sports, including team and individual sports. Participants were aged between 14 and 50 years, and varied in skill level between recreational and national level.

The factor structure revealed that the 36-item version had better psychometric values for goodness of fit for a nine first-order and one higher-order factor model than the 54-item version of the FSS. Consequently, the 36-item FSS was examined in greater detail. Coefficient alpha scores for reliability varied on a subscale level between .80 and .86. Confirmatory factor analysis showed strong factor loadings among the 36 items, with a median factor loading of .74. The nine first-order factors loaded significantly on the one higher-order factor, with strongest correlations found for sense of control and challenge-skills balance, whereas lowest correlations were found for loss of self-consciousness and time transformation.

Stavrou and Zervas (2004) further investigated the FSS, grouping flow dimensions into three-higher order factors, with the aim to “better understand flow in a more parsimonious manner, and to find common characteristics among the first-order factors of the FSS” (p. 170). Considering conceptual, chronological, and cognitive aspects of the first-order factors, Stavrou and Zervas summarised flow dimensions of challenge-skills balance and clear goals into the higher-order factor labelled as *clearness of the state*, unambiguous feedback, concentration on the task at hand, and sense of control into the higher-order factor of *control of the situation*, and action-awareness merging, loss of self-consciousness, time-transformation, and autotelic experience into the higher-order factor of *absorption of the performance*. Hierarchical measurement models included a nine first-order-factor and three higher-order-factor models, which included a one-higher-factor model, and two three-higher-order factor models with factors of clearness of the state, control of the situation, and absorption of the performance. Stavrou and Zervas (2004) found that the hierarchical model including three higher-order factors and one first-order factor, to explain FSS factor intercorrelations, indicated a better fit of the data than the other hierarchical models tested, with a comparative fit index of .90. Consequently, Stavrou and Zervas concluded that FSS factors can be characterised by different conceptual and cognitive features.

These results may open up future research opportunities. Once these findings have been independently validated, flow could be examined in a more parsimonious way, which may increase sensitivity of flow measurements.

In an additional study, Marsh and Jackson (1999) assessed the external validity of the FSS in a sample of 385 athletes at the World Masters Games, competing in track and field, cycling, triathlon, and swimming. Participants completed two items on perceived sport ability, and one item on perceived success, perceived challenge, and perceived skill. In addition, three scales from the ESM were also included in the assessment, which where concentration, importance, and satisfaction. Except for perceived challenge, all employed measures showed a moderate to strong correlation with global flow state. Since the validation stage, the FSS has been widely used in sport psychology research (e.g., Russell, 2001; Stavrou & Zervas, 2004; Young, 2000).

Flow Trait Scale

The Flow Trait Scale (FTS) is a parallel version of the FSS, assessing the frequency of flow. The parallel structure of the TFS includes nine factors, following Csikszentmihalyi's (1988b) nine dimensions of flow theory. Marsh and Jackson (1999) developed and tested the TFS to assess how often athletes *typically* experience flow, that is, the frequency of flow. The item development was based on the existing flow state items, with a change from past to present tense to redirect the assessment of flow from one specific event to the general experience of flow in a particular situation. Therefore, the TFS consists of 36 items, with 4 items per subscale, that use a 5-point Likert scale response format anchored by 1 (*never*) and 5 (*always*).

The same sample that completed the FSS for assessing external validity completed the TFS (Marsh & Jackson, 1999). Psychometric support for the TFS was demonstrated by acceptable goodness of fit values, for both a nine first-order factor and one higher-order factor model with a root mean square error of approximation (RMSEA) of less than .05 and a relative noncentrality index (RNI) of over .9. Confirmatory factor analysis on factor loadings showed that trait flow items varied between .86 and .29. The highest factor loadings were found for action-awareness merging (Item 31) and concentration on the task at hand (Item 17), whereas loss of self-consciousness (Item 13) showed the lowest factor loadings. Most factor loadings of the TFS items remained above .70.

Assessments for the external validity of the TFS showed moderate to strong correlations to criterion factors of sport ability, flow summary, concentration, satisfaction, skills, and importance. Examining differences between global trait and global state flow, Marsh and Jackson (1999) found that global state flow revealed stronger correlations for all state-based criterion factors, whereas global trait flow showed stronger associations with dispositional criterion factors. Furthermore, almost all state flow subscales showed stronger correlations to the state criterion factors than trait flow subscales. A similar pattern was found for trait flow subscales and trait measures. There could be an effect of the similarity of formats of trait measures differing from state measures and vice versa, relating to the procedure of how the FSS was converted to the TFS (e.g., tense of questions). Marsh and Jackson concluded that "these results support the discriminant validity of the different flow factors and the separation of the flow state and flow trait factors" (p. 364).

Flow State Scale-2 and Dispositional Flow Scale-2

Based on statistical and conceptual considerations, Jackson and Eklund (2002) examined two revised versions of flow, assessing state and dispositional flow. Jackson and Eklund called the revised versions of the FSS and TFS the Flow State Scale-2 (FSS-2) and Dispositional Flow Scale-2 (DFS-2). The revision for both scales was considered necessary, because of statistical and conceptual issues of accurately measuring flow in a physical activity context. Previous statistical assessment of flow subscales identified weaker connections between loss of self-consciousness and time transformation, and the global flow factor (Jackson & Marsh, 1996; Marsh & Jackson, 1999; Vlachopoulos, Karageorghis, & Terry, 2000). Statistical weaknesses have also been found for one item on the unambiguous feedback subscale. This item was substantially related to the challenge-skills factor on a state level. A similarly strong connection was not found on a dispositional level. According to Jackson and Eklund (2002), this item could have been perceived by respondents as equivocal, and, therefore, generated different statistical results.

Jackson and Eklund (2002) repeated that Csikszentmihalyi had raised conceptual issues, concerning the item wording of sense of control and time transformation subscales, in a personal communication to them. Csikszentmihalyi outlined that the subscale focusing on athletes' control strongly stressed the perception of total control rather than a more moderate experience of sense of control. In addition, previous versions of flow questionnaires addressed lengthening, but not shortening, of time, which could have lead to statistical shortcomings (Jackson & Eklund, 2002).

As a consequence of statistical and conceptual inadequacies, Jackson and Eklund (2002) re-assessed the original 36 items of state and trait flow, including 13 additional re-worded items. Confirmatory factor analysis for the item evaluation and a cross-validation sample showed a good fit of the reworded items. Additional analysis of the FSS-2 showed acceptable Cronbach's alpha coefficients ranging from .80 to .90 on a subscale level. Confirmatory factor analyses of the FSS-2 demonstrated acceptable fit of the nine first-order factor and one higher-order global factor model of state flow for the non-normed fit index (NNFI; > .90), the comparative fit index (CFI; > .90), and the RMSEA (< .06). The DFS-2 subscales showed acceptable reliability values, ranging between .81 and .90. Confirmatory factor analyses demonstrated acceptable fit of the nine first-order factor and the higher-order, global factor, model of dispositional flow for the NNFI (> .90), the CFI (> .94), and the RMSEA (< .05). So far, Jackson and Eklund assessed first-order and higher-order factor models, but not three-factor models as conducted by Stavrou and Zervas (2004) with the FSS. Similar modeling could be done on the FSS-2 and DFS-2 to provide further insight into the connection of flow dimensions in the generation of flow.

Limitations of the Measurement of Flow

Measuring flow is challenging because of the nature of flow, which is a highly complex, transient, and subjective state. Csikszentmihalyi (1992) noted that flow is a complex psychological state and researchers should not *reify* flow experiences, by equating flow with a certain score on a flow measure. According to Csikszentmihalyi, the complexity of flow imposes difficulties in measuring flow state, that is, any flow measure would only provide a reflection of this state. In addition, flow varies with regard to its intensity and frequency. Depending on the specific definition of flow, flow could either occur several times during the day with little intensity, which Csikszentmihalyi termed microflow, or flow can be defined as very intense experiences, which occur less often or only once in a sporting career.

Flow as a subjective state cannot be assessed directly, requiring methods of introspection. Athletes need to reflect on their flow experience to retrospectively assess flow, which involves memory functions and cognitive reconstruction to provide an estimate of the intensity of flow in a past event or for a specific period of time. Csikszentmihalyi (1975) developed the ESM to overcome this methodological limitation as a way to do an immediate assessment of flow. Participants were required to reflect on their current state whenever they received a random beep on their pager. The downside of this method is that the beeping might interrupt the current activity, and thinking and assessing flow could disrupt the current flow state. With regard to sports, most activities would not offer any performance breaks to examine flow, because they represent continuous activities (e.g., long-distance running, cycling, swimming). Even in sports that offer frequent breaks for athletes, such as tennis, reflecting on one's experience would possibly interfere and disrupt flow. To avoid interferences of measurement on flow, flow state should be examined after performance with athletes reflecting on their experience during the event. Brewer, Van Raalte, Linder, and Van Raalte (1991) noted that the effect of performance outcome on self-report assessments of psychological states could be compromised by methods of retrospective introspection. In addition to a standardised measure of flow, interview techniques would give more insight into what athletes' perceived to cause flow, how flow state developed during a performance, and what changed the intensity of flow state. Therefore, a multi-method approach including qualitative techniques would provide more specific information about, and prevent misinterpretation of, flow experiences in competition settings.

It is important to understand what flow is and how people experience flow. Interviews are useful for this type of research, however, quantitative research is also needed to test specific propositions about flow (e.g., antecedents, concomitants, consequences) for which a particular score is required. To examine flow, it is possible to consider flow in terms of the nine dimensions that have been used by Csikszentmihalyi's (1975, 1988b) flow theory. Csikszentmihalyi (1992) asserted that "as long as we keep the essential component of the experience the same, we will be still talking about the same phenomenon" (p. 183). The flow experience has been widely supported by research as a nine-dimensional construct (e.g., Csikszentmihalyi, 1990; Jackson, 1996). This characterisation of flow has been operationalised most clearly in the sport context by the DFS-2 and FSS-2. Using the same measure of flow state provides a good indication for the intensity of flow in a specific performance situation, and allows for comparisons of flow state across events.

Research on Flow in Sport

In this section, I examine research on variables influencing flow in sport. This section is divided into six subsections. First, I outline qualitative research studies on flow in sport, focusing on factors facilitating, disrupting, or preventing flow. Second, I report results of research on personality variables influencing state and dispositional flow in sport. Third, I review situational variables that influence flow, but have rarely been taken into consideration as main objectives within previous research. These situational variables include skill level, individual versus team sports, competition versus training contexts, and self- versus externally-paced situations. Fourth, I address interaction effects between personal and situational variables influencing flow. Fifth, I depict the relationship of flow and performance in sport, focusing on research examining the connection of subjective and objective performance to flow state. Sixth, I consider intervention research that aimed to increase flow state and performance.

Qualitative Results

Qualitative investigations on flow during sport performance have focused on three main research topics. Firstly, to refine the understanding of the flow construct, as proposed by Csikszentmihalyi (1975, 1988b), in a sport context, several studies have analysed qualitative results and their connection to flow dimensions (e.g., Jackson, 1996; Sugiyama & Inomata, 2005; Young, 2000). Secondly, researchers have used qualitative analysis to examine factors facilitating, disrupting, or preventing flow in sports (e.g., Jackson, 1992; Jackson, 1995; Russell, 2001; Young, 2000). Thirdly, researchers have analysed interview data to investigate participants' perceptions of being able to control the flow state (Sugiyama & Inomata, 2005) and to control factors facilitating, preventing, and disrupting flow in sport (e.g., Jackson, 1995; Russell, 2001). In addition, in a qualitative study, Sugiyama and Inomata (2005) examined psychological states related to precompetition experience and its influence on flow. Several previous studies employed similarly structured interviews to examine the importance of flow, and factors influencing flow. The findings of these studies will be presented concurrently to point out similarities or differences in the flow experience between groups of elite athletes from various sports (Jackson, 1992; Jackson, 1995), college and university athletes (Russell, 2001; Sugiyama & Inomata, 2005), and elite tennis players (Young, 2000).

Table 2.2

Qualitative Studies on Flow

Study	Participants	Aim	Results
Jackson (1995)	28 elite athletes between 18 and 35 years of age	To identify factors influencing flow	Factors of confidence, preparation, and readiness were most frequently reported to facilitate flow; situational conditions and non-optimal preparation and readiness were most frequently reported to disrupt or prevent flow.
Jackson (1996)	28 elite athletes between 18 and 35 years of age	Importance of flow dimensions during performance	Flow dimensions most athletes experienced during performance were reported as autotelic experience, action-awareness merging, concentration on the task at hand, and paradox of control.
Young (2000)	31 female elite tennis players who competed on an international level	To identify factors influencing flow	Physical and mental preparation was most frequently reported to facilitate flow; situational conditions and inappropriate focus were most often reported to disrupt and prevent flow in competition. Flow dimensions of concentration on the task at hand and paradox of control were most frequently mentioned as part of the flow state in tennis.

Table 2.2 (*continued*).

Study	Participants	Aim	Results
Russell (2001)	42 college athletes between 17 and 27 years of age, competing in team and individual sports	To identify factors influencing flow	The factor of pre-competitive plans was most frequently reported to facilitate flow; non-optimal situational influences and non-optimal preparation and readiness were most frequently reported to disrupt or prevent flow.
Sugiyama & Inomata (2005)	29 Japanese athletes between 18 and 29 years of age, competing in individual sports on a nation level	(i) States leading to flow (ii) Psychological state during flow	Preperformance states of being self-confident, relaxed, positive, focused, motivated, and absence of negative thoughts were reported to lead up to flow state. Main characteristics during flow were relaxation, confidence, and motivation.

Note. Studies are presented in chronological order.

Importance of Flow Dimensions

Using in-depth interviews, Jackson (1996), Sugiyama and Inomata (2005), and Young (2000) assessed athletes' responses regarding the importance of the nine dimensions of flow, as proposed by Csikszentmihalyi (1975, 1988b). Jackson (1996) examined the flow experience among 28 elite athletes, who competed on an international level and were between 18 and 35 years of age. Athletes represented seven sports, including cycling, field hockey, rowing, rugby, swimming, track and field, and triathlon. Sugiyama and Inomata (2005) investigated the flow experience among semi-professional and university athletes, who were between 18 and 29 years of age, representing three sports, namely, track and field, skating, and swimming. Young (2000) assessed the flow experience among 31 elite tennis athletes, who were aged between 18 and 23 years, competing within professional tournaments. Each sample included male and female athletes, except for the study by Young (2000), which focused on a sample of female tennis players.

All nine dimensions of flow were frequently experienced by the athletes from the various samples. Jackson (1996) reported that over 80% of the elite athletes she interviewed reported that the autotelic experience, action-awareness merging, concentration on the task at hand, and sense of control were antecedents of their frequent flow experiences. Jackson concluded that these dimensions of flow could be more significant for the flow experience in elite athletes than the challenge-skills balance, clear goals, unambiguous feedback, loss of self-consciousness, and time transformation dimensions.

Young (2000) found that the most frequent dimensions of flow experienced in elite female tennis players were concentration on the task at hand (71%), action-awareness merging (68%), and sense of control (68%). Sugiyama and Inomata (2005) stated the most common flow dimensions among university athletes were concentration on the task at hand (96.6%) and unambiguous feedback (82.8%), with three dimensions receiving a percentage score of 72.4%, (action-awareness merging, clear goals, sense of control). Across the three studies, most frequently cited flow dimensions (> 65% of the athletes) were concentration on the task at hand, action-awareness merging, and sense of control. On the other hand, dimensions that were reported most infrequently (< 40% of the athletes) in these studies were loss of self-consciousness, time transformation, and challenge-skill balance. Interestingly, challenge-skill balance, which is considered to be one of the most important dimensions to get into flow (Csikszentmihalyi, 1975), received a low rating from each of the samples.

Comparing the results from the three studies, athletes gave support to the argument that dimensions of concentration on the task, sense of control, and action-awareness merging were of general importance across several sports to experience flow. Other dimensions indicated strong difference across the samples. For instance, Jackson (1996) and Sugiyama and Inomata (2005) reported autotelic experience to be most frequently stated within their samples, 96% and 96.2%, respectively, whereas Young (2000) found that autotelic experiences in tennis competitions occurred rather infrequently (24%). In contrast to the Jackson (1996) and Sugiyama and Inomata (2005) studies, Young investigated a sample that was gender and sport specific. Compared to the other samples, lower scoring on eight out of nine flow dimensions for elite tennis athletes could indicate that specific performance or situational demands, or a combination of both, influence the experience of flow. Young concluded that flow in tennis is an unstable and volatile state. The results of the Jackson (1996), Young (2000), and Sugiyama and Inomata (2005) studies has provided some evidence for the general importance of some flow dimensions. More research needs to be conducted that aims to detect similarities and differences in flow between sports with contrasting task characteristics. These findings would be valuable to develop sport-specific interventions that aim to increase critical flow dimensions to enhance flow state.

Factors Facilitating Flow

Jackson (1995) examined factors facilitating flow in 28 elite athletes from a range of team and individual sports. Dimensions facilitating flow, which athletes frequently referred to, were pre-competitive and competitive plans and preparation (64%), confidence and positive attitude (64%), optimal physical preparation and readiness (57%), and achieving optimal arousal level before competing (57%). Being prepared and feeling confident and ready to perform had a strong influence on elite athletes’ flow experience.

Replicating and extending qualitative examinations on the experience of flow in sport, Russell (2001) assessed flow in 42 college athletes, aged between 17 and 27 years, who were involved in a variety of team and individual sports. Russell extracted nine factors facilitating flow. The most frequent statements were related to optimal pre-competitive plans (52.4%), optimal physical preparation

(48%), and confidence and positive thinking (48%). Similar to the responses from elite athletes (Jackson, 1995), Russell (2001) found that college athletes also emphasised factors of feeling confident and being prepared to get into flow. A lower percentage of athletes referred to these factors, compared to the Jackson study, indicating that confidence and preparation are also important for college athletes to get into flow, but they were not as pervasive as they were for elite athletes. Similarly, Young (2000) formed several dimensions that helped female tennis players to get into flow. Participants reported physical and mental preparation (77%), positive mood (77%), experience and control of arousal (65%), and motivation (58%) as the most frequent factors that accompanied their flow experiences.

All samples emphasised that factors of confidence and preparation frequently facilitated their flow experience. Samples consisting of elite athletes also stressed control of arousal as another important factor to get into flow. Elite tennis players referred to mood and motivation as critical for frequent flow experiences, which appeared to be less important for the Jackson and Russell samples. This indicates that specific differences between sports exist regarding factors that induce flow. Tennis athletes, who were purposefully sampled in the Young (2000) study, face specific task characteristics in competition, such as fast moving objects that require fine-skilled performance over a long, indefinite period of time. More research is necessary to pinpoint the influence of specific task characteristics on flow state.

With regard to the overall results, confidence and optimal preparation, in terms of mental and physical preparation, and competition plans, appear to be key aspects that facilitate flow. Jackson and Csikszentmihalyi (1999) encapsulated the importance of being prepared to experience flow, stating that preparation increases confidence, which, in turn, facilitates flow. These findings provided critical evidence for aspects, such as confidence, and physical and mental preparation, that need to be accounted for in future intervention studies to facilitate and increase flow state.

Factors Disrupting Flow

The majority of researchers (Jackson, 1995; Russell, 2001; Young, 2000) found that athletes' flow experience is most frequently disrupted by external conditions that are related to the environment or the performance situation. Regarding the general dimension of the environmental / situational factor, the lack of specificity and attribution as to whether situational or environmental factors have a stronger disruptive influence on flow limited the interpretational value of the results. This dimension encompassed a multitude of higher-order themes, which was the most diverse dimension in the Jackson (1995) and Russell (2001) studies. Environmental factors related primarily to weather conditions, whereas situational factors involved aspects, such as mechanical failure, negative feedback from coach, negative referee decision, and stoppage of play. Crowd response, on the other hand, could be an environmental (e.g., home versus away competition) or situational factor (e.g., single incident that the crowd responded to during the competition). In general, the results indicated that flow investigations in settings with high ecological validity, such as competitions, need to take into account that external factors (environmental and situational factors) might represent a main cause for interfering with and disrupting athletes' flow experience.

Factors Preventing Flow

A final aspect of the Jackson (1995), Russell (2001), and Young (2000) studies referred to factors preventing flow. Jackson (1995) generated nine general dimensions from the sample responses, reporting that non-optimal preparation and readiness (75%) were most frequently reported to prevent flow. Other general dimensions that frequently prevented flow experiences, as reported by the participants, were non-optimal environmental and situational conditions (64%), lacking confidence and negative attitude (43%), and inappropriate focus (36%). Russell (2001) found similar factors preventing college athletes from getting into flow, including factors of non-optimal physical preparation and readiness (48%), inappropriate focus (40%), and non-optimal environment / situation (21%), and non-optimal confidence / positive thinking (17%). Even though there were differences in participants' skill level, Jackson (1995) and Russell (2001) reported similar dimensions preventing flow experiences. Young (2000) outlined that three factors of inappropriate focus (58%), preparation problems (55%), and non-optimal mood (55%) had the strongest effect on preventing flow in tennis. Across the three studies, common characteristics that prevented flow state were mainly related to difficulties in athletes' preparation and readiness, as well as focus and confidence. Intervention studies that aim to increase flow should take these results into account, because they appear to be particularly important in a competition context.

In summary, these qualitative results revealed that a range of factors facilitated, disrupted, and prevented flow. Factors related to confidence, preparation, and readiness were most frequently reported as main facilitators of flow. Non-optimal situational and environmental conditions were most often stated as the main characteristics to disrupt flow. A combination of non-optimal preparation / readiness and situational factors prevented participants from attaining the flow state. The prevention of flow state appears to involve absence of facilitators and presence of distractors. More studies need to address the turning point when athletes appear to get into or out of flow. In addition, the ratio of absence and presence of facilitators and distractors could provide evidence for the intensity of flow state, which would add more information to quantitative measures of flow. Generally, these results indicated that the absence of personal facilitators and the presence of situational disrupters seem to avert athletes' flow experience. The frequency of statements on flow made by the respondents indicated that situational and personal factors, mental and physical performance factors, as well as pre-competition and competition states, influenced the experience of flow. Based on these results, it appears that an interaction between internal, personal factors and external, situational factors affect flow, which supports propositions of Kimiecik and Stein's (1992) flow model.

Controllability of Flow

Another aspect of qualitative studies of flow was to investigate whether flow is perceived as controllable. Investigating controllability of factors facilitating, preventing, or disrupting flow, Jackson (1995) and Russell (2001) found that a majority of athletes had the perception that they had control over their flow experience. Jackson (1995) reported that 79% of the elite athletes in her study reported being able to control flow, whereas 21% stated that flow was not a state that could be controlled. Athletes appeared to have more control over factors that facilitated and prevented flow, than over factors that disrupted flow (Jackson, 1995). Russell (2001) found that 64% of the college athletes thought that they had control over flow, whereas 36% of the athletes perceived flow as uncontrollable. In a recent study by Sugiyama and Inomata (2005), 71% of athletes reported being able to control flow, whereas 29% of the sample athletes did not think they could control it. In addition, Young (2000) stated that elite tennis athletes reported controllability over several antecedents of flow, which confirms previous results (e.g., Jackson, 1995).

The qualitative results on flow have generally indicated the positive nature of flow experiences in sport and the usefulness of flow during performance. The frequency of reported flow factors facilitating, disrupting, and preventing flow across the studies underline that personal factors, such as confidence and preparation, appear to be specifically important to induce flow, whereas situational factors bear more importance to prevent flow. Assessment of the frequency of factors influencing flow provides important information for intervention studies that aim to increase flow in sport and competition. Further research on personal variables, such as confidence, and situational variables, such as task characteristics, is needed to obtain a more detailed understanding of variables influencing flow state to develop tailored and task specific interventions to increase flow.

Flow and Personality Variables

With regard to personality variables, two inherent aspects of flow are related to motivation and anxiety. Csikszentmihalyi (1975, 1988b) proposed that intrinsic motivation is one of the main psychological variables to induce flow, whereas anxiety, as the antithesis of flow, would be a critical variable to prevent flow. Research on personality variables influencing flow has mainly examined the relationships between flow and anxiety (Jackson et al., 1998; Stavrou & Zervas, 2004), flow and types of motivation, including intrinsic, extrinsic, and amotivation (Jackson et al., 1998; Kowal & Fortier, 1999), and the connection between situational and contextual motivation and flow (Kowal & Fortier, 2000). This subsection reviews research on the influence of the various personality variables on flow.

Table 2.3

Studies Examining Flow and Personality Variables

Study	Participants	Flow Measure	Personality Variables	Results
Jackson & Roberts (1992)	200 college athletes, between 17 and 25 years of age from eight different self-paced and externally-paced individual sports	10-item scale assessing several characteristics of flow	Goal orientation; perceived ability	Perceived ability and mastery orientation accounted for 13% of the variance in flow state. Competition orientation and highest level competed at did not significantly predict flow.
Stein, Kimiecik, Daniels, & Jackson (1995)	44 recreational athletes between 18 and 55 years of age competing in tennis	Measure of 8 characteristics of flow	Goal orientation; competence; confidence	Flow state was not significantly related to goal orientation, competence, or confidence.
Catley & Duda (1997)	163 recreational golfers, with an average age of 33.2 years	11-item scale assessing several characteristics of flow	Pre-competitive mental and physical readiness	Moderate to strong correlations were found between frequency and intensity of flow and confident readiness and positive focus. Pessimism was negatively related to flow frequency and intensity.

Table 2.3 (*continued*).

Study	Participants	Flow Measure	Personality Variables	Results
Jackson, Kimiecik, Ford, & Marsh (1998)	398 recreational athletes between 26 and 85 years of age from self- and externally-paced individual sports	FSS, TFS	Goal orientation; intrinsic motivation; perceived sport ability; competitive trait anxiety	Perceived ability and anxiety were significantly related to state and dispositional flow. No substantial correlations (> .30) were found between flow and goal orientation and intrinsic motivation, except for the experience stimulation subscale.
Kowal & Fortier (2000)	104 competitive swimmers between 18 and 64 years of age	FSS	Situational motivation; contextual motivation	Flow was significantly related to situational and contextual motivation, mastery, competence, and relatedness, revealing moderate to strong correlations.
Jackson, Thomas, Marsh, & Smethurst (2001)	236 athletes from individual sports between 16 and 73 years of age	FSS, DFS	Self-concept; psychological skills	Moderate to strong correlations were found between self-concept and psychological skills and dispositional flow. Strongest criterion variables for DFS and FSS were challenge-skills balance, sense of control, clear goals, and concentration.

Table 2.3 (*continued*).

Study	Participants	Flow Measure	Personality Variables	Results
Stavrou & Zervas (2004)	385 athletes between 16 and 38 years of age, competing in various individual sports	FSS	Goal orientation; trait anxiety; trait confidence; state anxiety	Task orientation, trait confidence, state confidence was positively related to state flow, whereas trait anxiety and state cognitive anxiety was negatively related to flow. Most correlations were moderate in magnitude. Weaker or no correlations were found between somatic anxiety and flow.
Koehn, Langenkamp, & Morris (2005)	111 advanced junior tennis players between 11 and 18 years of age	DFS	Action vs. state orientation	Action orientation was stronger related to flow than state orientation, showing strong effect sizes on global flow, autotelic experience, and concentration on the task at hand.

Note. Studies are presented in chronological order.

Jackson and Roberts (1992) investigated the effect of motivational constructs of perceived ability and orientation towards mastery and competitiveness on frequency of flow. For this study, Jackson and Roberts developed the flow and goal orientation scale. Questionnaires were administered to 200 athletes who competed in a variety of individual sports. Stepwise multiple regression analyses revealed that perceived ability and mastery orientation significantly predicted flow. Further assessment using median splits revealed that participants high in perceived ability scored higher on flow than participants low in perceived ability. A similar result was revealed for task orientation, showing that the group of participants high in mastery orientation scored higher on flow than the group of participants scoring low on mastery orientation. One of the main findings was that mastery orientation was more strongly related to flow than competitive orientation. Jackson and Roberts concluded that the absence of the connection “between competitive orientation and flow suggests that focusing on the outcome and/or outperforming others may not help athletes achieve a state of functioning characterized by a full focus on the task and a sense of control and effortlessness” (p. 165). These finding supports theoretical propositions by Csikszentmihalyi (1975), underlining that flow is self-contained and is more readily experienced through a focus on present, rather than future, rewards. This aspect of flow is important for studies that aim to increase flow and performance in competition, which could be influenced by athletes’ competitive orientation. Even though athletes compete to win, the main focus during competition should not be on future results, but on the task at hand.

Stein et al. (1995) examined goal orientation, confidence, and competence as antecedents of flow state during a tennis tournament, entered by 44 recreational athletes between 18 and 55 years of age. Participants completed Duda's (1992) measure on task and ego orientation, the Task-Ego Orientation in Sport Questionnaire (TEOSQ), and two questions assessing current perception on their level of confidence and competence prior to the competition. Flow state was assessed after the competition, using a non-standardised 8-item measure of flow. In addition, quality of the experience was assessed by two questions on how enjoyable the match was perceived to be and how satisfied the participant was with their match performance. A median split on the flow scale divided participants into groups of high and low flow. The *t*-test results showed no significant differences between groups of high and low flow on the tested variables, except for satisfaction of match performance, revealing that the high-flow group was more satisfied with their performance than the low-flow group. The results could have been influenced by methodological shortcomings in using non-standardised measures and by the reduction of the data by employing a median split.

Catley and Duda (1997) tested the effect of psychological antecedents on intensity and frequency of flow experiences in golf. The sample included 163 recreational golfers with a mean age of 33.2 years, varying in golf experience between 1 and 65 years. Self-developed measures of confidence, focus, motivation, positive thinking, physical readiness, and relaxation were administered before a 9- or 18-hole golf round. Flow was examined after the completion of the round, employing a non-standardised flow scale, addressing 11 characteristics of flow, which were extracted from previous studies (Jackson, 1992; Jackson & Roberts, 1992) and the flow literature (Csikszentmihalyi, 1975). Catley and Duda (1997) assessed flow frequency on a 9-point Likert scale, which was anchored between 1 (*almost never*) and 9 (*almost all the time*). Flow intensity was also assessed on a 9-point Likert scale anchored by 1 (*I hardly felt like this*) and 9 (*I really felt like this*). Moderate to strong correlations were found for antecedents of confidence and positive focus on flow intensity and flow frequency. Even though antecedents might change substantially between pre-performance and performance state, the prospective type of design highlighted the pervasive influence of confidence and pre-round readiness variables on intensity and frequency of flow. Catley and Duda (1997) concluded that confidence and readiness should be the main factors in interventions to develop flow. This study reflects one of the few attempts by researchers to examine flow by employing a prospective design. The results showed that confidence and focus are particularly important variables for intervention studies aiming to increase personality variables, such as confidence, to enhance flow state. On the other hand, caution about these findings is warranted, because the constructs under investigation were operationalised through non-standardised measures.

Jackson et al. (1998) investigated the influence of motivation, anxiety, goal orientation, and perceived ability on trait flow, measured by the TFS, and state flow, measured by the FSS. The sample included 398 competitive athletes in individual sports, namely cycling, swimming, track and field, and triathlon.

Motivation was assessed through the Sport Motivation Scale (SMS; Pelletier, Fortier, Vallerand, Tuson, Briere, & Blais, 1995) for intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation was measured toward accomplishments, intrinsic motivation to know, and intrinsic motivation to experience stimulation. Competitive trait anxiety was measured by the Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, 1990) regarding worry, concentration disruption, and somatic anxiety. Jackson et al. also employed the Perception of Success Questionnaire (PSQ; Roberts & Balague, 1991) to measure task and ego orientation, and the Perceived Sport Ability measure, as previously used by Jackson and Roberts (1992). Moderate correlations were found for both trait and state flow and perceived sport ability. The connection between total trait anxiety and flow revealed the expected negative relationship, which was moderate in strength, for both dispositional flow and state flow. Intrinsic motivation to experience stimulation, referring to the excitement and pleasure that emerges from movements in a certain activity, was the only motivational subscale that was significantly related with flow on a trait and state level. Correlations of less than .30 for goal orientation, extrinsic motivation, and amotivation were excluded from further examination. Employing standard multiple regression analyses, 38% of the variance in global trait flow was explained by perceived sport ability, concentration disruption, and intrinsic motivation. With regard to state flow, perceived sport ability, intrinsic motivation, and the anxiety-worry dimension accounted for 27% of the variance.

Assessing the connection between flow dimensions and personality variables, Jackson et al. (1998) employed two canonical correlation analyses to evaluate associations on a subscale level, between perceived sport ability, anxiety subscales, and the intrinsic motivation-stimulation subscale as predictor variables and dimensions of state and dispositional flow as criterion variables. Loadings that were high for state and dispositional flow dimensions were found for challenge-skills balance, concentration on the task at hand, and sense of control. Perceived sport ability showed the strongest loading for trait flow, whereas anxiety-worry displayed the strongest loading for state flow. Even though canonical correlation results were helpful in detecting the strongest loadings for the sets of variables, this analysis tool does not offer information pinpointing predictor variables that loaded strongly on specific flow dimensions. More detailed analyses on a subscale level, using multiple regression techniques with flow dimensions as criterion variables, are needed to obtain more specific relationships between flow dimensions and personality variables. In contrast to previous results on flow and athletes' orientation (Jackson & Roberts, 1992), Jackson et al. did not find meaningful connections between flow and goal orientation. The way Jackson et al. assessed goal orientation was different from Jackson and Roberts (1992), who measured athletes' ego and goal orientation related to "the way they usually felt about competition" (p. 160), whereas Jackson et al. (1998) measured athletes' ego and goal orientation with regard to "when they feel most successful in their sport" (p. 364). These two approaches indicate that ego and goal orientation are more likely to show significant differences with flow in a general sport context, whereas the inclusion of the success component might overlay the influence of these personality differences on flow. Therefore, future studies that examine the connection between flow and personality variables might be more conclusive when the assessment of personality variables is not based on success, but on general perception.

Kowal and Fortier (2000) investigated directional influences of social factors, such as perceptions of success, motivational climate, and motivational mediators, such as perceptions of competence, autonomy, and relatedness, on motivation, and whether motivation, in turn, effects flow. Motivation was assessed from both a situational and contextual perspective. Flow was measured through the FSS (Jackson & Marsh, 1996), situational motivation through the Situational Motivation Scale (SMS; Guay & Vallerand, 1995), and contextual motivation by an adapted version of the Sport Motivation Scale (Pelletier et al., 1995). Kowal and Fortier hypothesised that self-determined situational motivation would have a positive impact on state flow, whereas contextual motivation would be positively influenced by situational motivation and flow state. Data was collected from 104 elite swimmers at two points in time. At Time 1, situational questionnaires were administered on flow state, social factors, motivational mediators, and situational motivation. At Time 2, corresponding contextual questionnaires of social factors, motivational mediators, and contextual motivation were completed by the participants. Using path analysis, Kowal and Fortier found partial support for the tested model. With reference to the relationship of flow and motivation, situational mediators had a strong effect on situational motivation (R^2 = .37), which, in turn, significantly predicted flow state (R^2 = .19). As hypothesised, situational motivation significantly predicted contextual motivation, whereas no significant links were found between flow state and contextual motivation. Kowal and Fortier concluded that, on a state level, flow can be viewed as a consequence of motivational determinants, with motivational processes underlying flow state. The lack of significant difference between flow state and contextual motivation could be due to methodological issues. Flow was measured with regard to intensity at one point in time, but not in relation to how often participants experience flow. The inclusion of a dispositional flow measure would have provided more conclusive evidence regarding the relationship with contextual motivation.

Jackson et al. (2001) investigated the association between personality variables of self-concept and psychological skills and athletic experiences of state and dispositional flow. Flow state was measured by the FSS and dispositional flow by the DFS. Participants also completed the Elite Athlete Self-Description Questionnaire (EASDQ; Marsh, Hey, Johnson, & Perry, 1997), which assesses athletes' self-concept, and the Test of Performance Strategies (TOPS; Thomas, Murphy, & Hardy, 1999), which measures athletes' use of psychological skills. The sample consisted of 236 athletes competing in cycling, orienteering, and surf life saving, which require continuous, endurance-based performances. Jackson et al. found moderate to strong correlations between global dispositional flow and self-concept and psychological skills. Strongest associations with flow were found for self-concept subscales of mental competence and overall performance, and psychological skills subscales of emotional control, negative thinking, and activation. Dispositional flow subscales that showed the lowest correlation coefficients with the personality variables were time transformation and loss of self-consciousness. Hierarchical regression analyses showed that self-concept and psychological skills accounted for 64% of the variance in dispositional flow. Even though self-concept and psychological skills explained a large proportion of the variance in dispositional flow, each variable contributed a small amount of unique variance, 6% and 10%, respectively. Similar to the analysis by Jackson et al. (1998), canonical correlation analyses were employed to evaluate associations on a subscale level, with dimensions of state and dispositional flow as criterion variables and subscales of self-concept and psychological skills as predictor variables. Highest loadings were found for state and dispositional flow dimensions of challenge-skills balance, clear goals, concentration on the task at hand, and sense of control. With regard to the Jackson et al. (1998) study, this study provides further evidence that specific flow dimensions, such as challenge-skills balance and sense of control, in combination with personality variables, could be critical links in the experience of flow. The use of canonical correlations was helpful in detecting associations between sets of variables, but the number of multiple dependent and multiple independent variables does not allow for a specific assessment between personality characteristics and flow dimensions. Even though the sample-variable ratio of 10 participants per variable was met (Hair, Anderson, Tatham, & Black, 1995), the number of 23 variables in the canonical correlation analysis limited meaningful interpretations between the specific predictor and criterion variables. More detailed analysis is necessary to develop interventions that aim to enhance crucial personality characteristics in connection with dimensions of flow to increase flow state.

Stavrou and Zervas (2004) investigated the relationship between state flow, measured through the FSS (Jackson & Marsh, 1996), and trait personality variables of trait sport confidence, anxiety, and goal orientation. The trait variables were measured through the Trait Sport Confidence Inventory (TSCI; Vealey, 1986), the Sport Competition Anxiety Test (SCAT; Martens, 1977), and the TEOSQ (Duda, 1992). Participants were 385 competitive athletes between 16 and 38 years of age from individual sports, such as archery, cycling, skiing, shooting, swimming, table tennis, tae-kwon-do, and technique swimming. The results demonstrated that trait anxiety was negatively related to flow dimensions, except for transformation of time, whereas confidence showed a positive connection with flow. Low to moderate correlations were found for trait anxiety and loss of self-consciousness, sense of control, and time transformation. Moderate correlations emerged between trait sport confidence and sense of control, concentration on the task at hand, challenge-skills balance, loss of self-consciousness, and clear goals. Task orientation showed a generally stronger connection with flow dimensions than ego orientation, which supports previous results by Jackson and Roberts (1992). Stavrou and Zervas found moderate correlations of task orientation with challenge-skills balance, clear goals, and autotelic experience.

In addition, Stavrou and Zervas (2004) examined the association between state flow and the development of state-anxiety and state-confidence prior to and during competition. Participants completed the Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump, & Smith, 1990), measuring cognitive anxiety, somatic anxiety, and confidence. The sample completed the CSAI-2 one day, and one hour prior to the competition, and half an hour after the competition to retrospectively measure the experience for each variable. Flow state was also measured retrospectively after the competition. Negative connections with moderate to strong coefficients were found between cognitive anxiety and flow dimension of challenge-skill balance, unambiguous feedback, concentration on the task at hand, sense of control, and loss of self-consciousness, over the three measurement occasions. The trend showed a general increase of cognitive anxiety from the first to the third measurement point. A similar, but positive, trend was found for state confidence and flow, showing moderate to strong correlations with dimensions of flow. The strongest connections were found between state confidence and the flow dimensions of challenge-skills balance, sense of control, unambiguous feedback, autotelic experience, clear goals, and concentration on the task at hand. Findings of the Stavrou and Zervas (2004) study showed significant correlations between cognitive anxiety and self-confidence and flow state, showing increases from before to during the competition. No inferences can be drawn as to whether the level of cognitive anxiety was perceived as facilitative or debilitative, because the measures did not include a directional scale that would have provided information about participants' interpretation of their perception of state anxiety. Overall, cognitive anxiety and self-confidence variables showed moderate to strong correlations with flow on a trait and state level. This is a rare example of a study in which personality characteristics were measured several times, providing more insight into the development of state anxiety and state confidence before and during an event in relation to flow state.

Koehn, Langenkamp, and Morris (2005) investigated the effect of action control on flow in tennis competition. The sample consisted of junior tennis players of an advanced skill level, who frequently entered tennis tournaments. The participants completed the Action Control Scale-90 (Kuhl, 1994b) and a German translation of the Trait Flow Scale. The results indicated that action orientation was more strongly related to flow than state orientation, showing strong effect sizes for global flow and for flow dimensions of autotelic experience and concentration on the task at hand. The findings provided evidence that action orientation is a critical personality variable to experience flow in tennis competitions. The results could have been limited by a lack of psychometric testing of the TFS following the translation procedure. Further studies to substantiate the association between flow and action control are required, using fully validated German versions of the TFS or the DFS–2, which has since replaced the TFS.

In summary, research results have supported propositions of the flow model that trait and state personality variables were associated with flow experiences in sport. Correlational evidence has been found for personal trait and state variables of motivation (Jackson et al., 1998; Kowal & Fortier, 2000), anxiety (Jackson et al., 1998; Stavrou & Zervas, 2004), and confidence (Stavrou & Zervas, 2004) as underlying variables of flow. More research is needed to corroborate findings regarding personality variables that have rarely been examined, such as action control, which may account for personal differences in experiencing flow.

Flow and Situational Variables

Previous research on flow has mainly focused on personality variables underlying flow. Little research has explicitly addressed situational variables, such as performance settings, sport types, support, and skill level, which may influence flow.

Using qualitative methods, researchers have reported that factors of confidence and optimal preparation and readiness most frequently facilitated flow (e.g., Jackson, 1995; Young, 2000). On the other hand, situational and environmental variables have been repeatedly reported as main factors to disrupt or prevent flow, which was influenced by the opponent, the crowd, or by negative referee decisions (Jackson, 1995; Russell, 2001; Young, 2000). As shown in Table 2.4, this subsection reviews quantitative studies on situational variables that affect flow.

Table 2.4

Studies Examining Flow and Situational Variables

Study	Participants	Flow Measure	Situational Variables	Results
Young (2000)	31 female elite tennis players who competed on an international level	FSS	Training vs. competition setting	A *t*-test for independent means showed that flow was experienced more frequently in tennis training than in tennis competition.
Russell (2001)	42 college athletes aged between 17 and 27	FSS	Individual vs. team sports	The results indicated no significant differences in flow state between athletes of individual and team sports.
Rees & Hardy (2004)	130 advanced tennis players, with a mean age of 18.4 years	4-item flow scale	Support	Significant correlations were found between flow and support dimensions of emotional, esteem, and tangible support.
Jeong, Morris, & Watt (2005)	89 professional Korean dancers aged between 20 and 38	FSS-2, DFS-2	Training vs. competition setting	Dispositional flow was generally stronger in training than in a competition context, whereas most of the state flow subscales were perceived to be stronger during competition than in training.
Morris & Koehn (2005)	72 junior tennis players aged between 12 and 18	FSS-2, DFS-2	Training vs. competition setting	A *t*-test for independent means revealed that ranking-list players scored higher than club players on dispositional and state flow in training and competition settings, showing moderate to strong effect sizes.

Note. Studies are presented in chronological order.

Previous studies have investigated samples including both team and individual sports, combining two disparate task types and performance situations (e.g., Russell, 2001; Stavrou & Zervas, 2004). Kimiecik and Jackson (2002) argued that different findings in studies examining competence and flow in swimming (Kowal & Fortier, 1999) and golf (Stein et al., 1995) may be accounted for by differences in type of sport. Russell examined flow state between athletes from team sports, including baseball, basketball, football, softball, and volleyball, and individual sports, including swimming, triathlon, track, and wrestling. Russell found no significant differences between team and individual sports and flow state. The examination of these team and individual sports could have been too general to detect significant differences between sport type and flow. Similar characteristics were shared by team and individual sports, that is, some sports (e.g., basketball, wrestling) were open skilled and externally paced. In addition, the performance characteristics within the individual sports were not uniform, showing extreme task differences with regard to closed-skilled (swimming) and open-skilled (wrestling) activities. Therefore, the task characteristics between team and individual sports were partly overlapping, whereas extreme differences within the tasks were apparent for individual sports. More detailed research, comparing sports whose task characteristics are distinctly different, is needed to gain a deeper understanding as to whether the global nature of sport types, such as individual versus team sports, or the more specific characteristics of task types, such as open- versus closed-skilled or self- versus externally-paced performance, influence athletes' flow experience in competition.

Several studies examined flow within a single sport. The task characteristics varied between open-skilled and mainly externally-paced performance, in sports like tennis, and closed-skilled, self-paced performances, such as dance. In a sample with 31 female professional tennis athletes, Young (2000) examined differences between flow in training and competition situations. A *t*-test for independent means showed that professional tennis players experienced flow more often in training than in competition situations. This difference might have arisen because competition settings encompass more distracting or disrupting factors that influence flow than training settings.

Rees and Hardy (2004) examined the influence of social support dimensions, such as emotional, informational, esteem, and tangible support on competitive pressure and flow. Participants were 130 advanced tennis players with a mean age of 18.4 years. Rees and Hardy found significant correlations between flow and support dimensions of emotional, esteem, and tangible support. Furthermore, participants who reported a high level of pressure during competition, but simultaneously stated that they had strong emotional support, experienced higher levels of flow. “It is apparent that the potentially negative effect of competition pressure on flow was ‘buffered’ for those with high emotional support” (p. 330). Caution is warranted when interpreting these conclusions, because Rees and Hardy used a short measure of flow, consisting of four items. The short flow scale employed may not encompass all aspects or dimensions that are important for the flow experience in tennis competitions, which might reduce confidence in the strength of the results.

Jeong, Morris, and Watt (2005) assessed differences in flow between training and performance situations. The sample of 89 professional Korean dancers aged between 20 and 38 completed the DFS-2 twice with regard to their frequent experience of flow in training and performance, and completed the FSS–2 one time after a training session and one time after performance. The *t*-test for dependent means showed that there were no significant differences for dispositional flow across contexts, but there was a significant difference in state flow, showing higher scores for flow state during performance than in training. This result is opposite to Young's (2000) investigation; she found a higher flow state during tennis training than tennis competition. Dancers' more intense flow state during performance could be related to the task characteristics. In contrast to tennis, which mainly involves open skills, dancers follow a closed-skill routine, which is self-paced and has been rehearsed repeatedly. Therefore, task characteristics could make a strong difference to the experience of flow in competition.

Morris and Koehn (2005) investigated differences in skill level and the experience of dispositional and state flow in tennis training and competition. Participants were 38 club level and 34 ranking list players between 12 and 18 years of age. Demographic information showed that, on average, ranking-list players had 1.30 years more experience in tennis and spent 7.40 hours per week more on court training than club players. All participants completed the DFS-2 and the FSS-2 twice, assessing flow in a competition and training setting. Ranking-list players scored higher than club players on dispositional and state flow in training and competition. Moderate to strong effect sizes were found for dispositional and state flow in both settings between ranking-list and club players.

The results of research have corroborated that situational factors can effect flow in training and competition. To date, situational factors have not been as strongly researched as personality factors. One of the main findings on the influence of situational variables has been that training and competition settings can influence flow. In addition, task type and task characteristics can also affect the experience of flow. Research on sports, like tennis, that mainly require open and mainly externally-paced skills, has shown that flow was stronger in training than in competition (Morris & Koehn, 2005; Young, 2000). Dancing, on the other hand, requiring a routine of closed and self-paced skills, showed stronger flow in competition than in training (Jeong et al., 2005). These results indicated that flow intensity could be stronger in training settings for open-skilled, externally-paced tasks (tennis), whereas competition settings might be more disruptive for flow in tennis, but provide a beneficial environment for flow regarding closed-skilled, self-paced performance tasks (dancing). This is a crucial aspect that should be taken into consideration when intervention studies are designed that aim to increase flow in a training or competition setting for a particular sport. Beside qualitative studies, little research has been conducted to examine the impact of specific situational variables, investigating which conditions are facilitative or preventive for the experience of flow. So far, situational influences on flow have mainly been addressed on a general level, evaluating differences between training and competition settings. More research is needed examining the influence of situational differences between more specific task characteristics, such as open and closed skills or self-paced and externally-paced performances on flow state.

Interaction Effects of Personal and Situational Variables on Flow

When examining flow, Stein et al. (1995) proposed that researchers should study those variables that have associations with subjective states during sport participation. Absorption is one of the descriptors of flow, which has been widely employed to characterise the experience of flow (Jackson & Csikszentmihalyi, 1999). Tellegen and Atkinson (1974) proposed hypnotic susceptibility as one variable that is closely related to absorption.

The relationship between flow and hypnotic susceptibility was examined within an exercise setting by Grove and Lewis (1996). The aim of the Grove and Lewis study was to investigate main and interaction effects between the trait factor of hypnotic susceptibility and the state factor of prior sport experience and the situational factor of time of assessment on flowlike states. The sample consisted of 96 circuit trainers, who were tested over a period of six weeks. Flowlike states were measured through a subset of the Privette Experience Questionnaire (PEQ; Privette & Bundrick, 1987), encompassing absorption, clear focus, and intrinsic motivation. Hypnotic susceptibility was measured once at the beginning of the study by the Wickram Experience Inventory (WEI; Wickramasekera, 1988). The top 40% of the high-scoring participants on the WEI were termed high in hypnotic susceptibility, whereas the bottom 40% were labelled as low in hypnotic susceptibility. Flowlike states were assessed half way through and at the end of each training session. Grove and Lewis (1996) divided the sample into groups of high and low experience. Participants who had been training for more than six months were categorised as the high-experience group, whereas participants who had been training for less than six months were classified as the low-experience group. With regard to flowlike states, no overall interaction effects were found for between-subject factors of time of assessment (early versus late in the training session), prior experience (more versus less than six months), hypnotic susceptibility (high versus low), and the within-subject factor of time (Week 1 to 6). A trend toward a two-way interaction with a small effect size was found between hypnotic susceptibility and prior experience. That is, participants high in hypnotic susceptibility and with more than six months experience in the exercise activity had stronger flowlike states than the other groups. A significant interaction effect was found between the personal variable of hypnotic susceptibility and the situational variable of time of assessment and flowlike states, showing a moderate to large effect size. With regard to time of assessment, participants reported that the intensity of flowlike states increased from the early to the late stages of a single training session. Highly susceptible participants showed a stronger increase in flow from the first to the second flow measurement than participants low in hypnotic susceptibility. Grove and Lewis concluded that the distinction between personal and situational factors of Kimiecik and Stein's (1992) interaction framework of flow was useful in a non-competitive sport activity.

The training setting and the exercise task in the Grove and Lewis (1996) study provided an accommodating environment for measuring flow twice, half way through and at the end of the session, because circuit training included natural breaks between activities. These breaks were used to complete the flow state measure. A competition setting, on the other hand, might be less favourable for this type of repeated flow measurement, because athletes could feel distracted by filling out the FSS-2. Even though some competitions provide natural breaks (e.g., changeover in tennis, quarter time in basketball), completing an abbreviated version of the FSS-2 could influence athletes' experience and performance. That is, thinking about and reflecting on flow during performance could affect and disrupt the experience of flow state. Measuring flow several times during a practice match in tennis, however, would provide important information for the development of flow intensity during performance.

Russell (2001) examined effects between gender and sport setting on flow. The sample consisted of 42 college athletes from different sport settings, including team and individual sports. Flow state was assessed on a subscale level, employing the nine dimensions of the FSS (Jackson & Marsh, 1996). The MANOVA-analysis showed no significant main effects for gender or sport setting, and no significant interaction with flow subscales. The only significant main effect was found for sport setting, showing that athletes in team sports reported experiencing a stronger action-awareness merging than athletes in individual sports.

The results of research on interaction effects have revealed some support for joint effects of personal and situational variables on flow. Hypnotic susceptibility appears to be facilitative of flow in training. Assessing flowlike states by a non-standardised measure and on a global level might have limited the results by Grove and Lewis (1996). Russell (2001) found significant results on a subscale, but not on a global flow, level. The results indicated that the measurement of global flow state is not sensitive enough to pick up interaction effects between personal and situational variables. Future studies should take participants' and task characteristics into account when designing studies that aim to examine the effect of person and situation interactions on flow and performance.

Correlational Studies on Flow and Performance

Research on flow in sport has examined several aspects of the flow-performance relationship. As shown in Table 2.5, previous studies investigated links between flow and peak performance (Jackson & Roberts, 1992; Koehn, 2004), flow and objective performance outcomes (Jackson et al., 2001), and flow and subjective performance assessment (Jackson et al., 2001; Stavrou & Zervas, 2004; Young, 2000).

Table 2.5

Correlational Studies on Flow and Performance

Study	Participants	Flow Measure	Performance Variable	Results
Jackson & Roberts (1992)	200 college athletes between 17 and 25 years of age from eight different self-paced and externally-paced individual sports.	10-item scale assessing several characteristics of flow	Peak performance	Results showed that flow in peak performance was stronger than flow in general competitions. Also, flow was stronger in best than in worst performances.
Jackson, Thomas, Marsh, & Smethurst (2001)	208 athletes competing in road cycling, surf life saving, and orienteering.	FSS	Self-report through 11-point Likert scale, objective performance measure, e.g., finishing position	Significant results between subjective ratings and objective performance outcomes and state flow dimensions of autotelic experience, clear goals, and challenge-skills as particularly strong predictors.
Stavrou & Zervas (2004)	385 athletes between 16 and 38 years of age, competing self-paced and externally-paced individual sports.	FSS	Subjective performance on a 11-point bipolar Likert sca	The performance self-assessment showed moderate to strong correlations with most of the flow state subscales. Strongest correlations were found for autotelic experience, challenge-skills balance, and unambiguous feedback

Note. Studies are presented in chronological order.

Jackson and Roberts (1992) examined the flow-peak performance relationship in sport competitions, hypothesising that flow would underlie athletes' peak performance. Jackson and Roberts investigated the flow-peak performance relationship using quantitative and qualitative methods. Participants described factors of focused attention, enjoying the experience, and feeling in control as the most common aspects of their best competition performance. In addition, comparing means of frequency of flow experiences in competitions and flow experiences in best performances, results revealed that flow was more intense in best performances than in competitions in general.

Young (2000) interviewed professional tennis athletes with reference to one outstanding performance in competition and dimensions of flow. Over 50 percent of the players referred to flow dimensions of concentration, sense of control, action-awareness merging, clear goals, and unambiguous feedback being part of their most outstanding competition. Young concluded that flow was related to optimal performance, but that this optimal performance was not necessarily associated with a winning performance.

Jackson et al. (2001) examined the relationship between athletes' flow state and perceived performance and real performance results in surf life saving, road cycling, and orienteering. Jackson et al. developed a self-report performance scale for participants to evaluate their event specific performance compared to how they perform in similar competitions in general on an 11-point scale, anchored by 0 (*extremely low*) and 10 (*extremely high*). Subjective performance ratings and objective performance results, measured by finishing position and errors in orienteering, were entered as criterion variables into a standard multiple regression equation, with dimensions of flow state, as measured by the FSS (Jackson & Marsh, 1996), as predictor variables. The results revealed that dimensions of flow state explained 46% of the subjective performance rating, 33% of errors in orienteering, and 13% of the actual performance outcome. Subjective performance was significantly predicted by flow state dimensions of autotelic experience and challenge-skills balance. Errors in orienteering were significantly predicted by autotelic experience, clear goals, action awareness merging, and unambiguous feedback. Finishing position was significantly predicted by clear goals, challenge-skills balance, and action-awareness merging. Flow dimensions of autotelic experience, clear goals, and challenge-skills balance were the strongest predictors of performance variables, each contributing significantly toward two performance aspects. The results of the Jackson et al. study demonstrated the important association between flow dimensions and subjective performance, and between flow and ecologically-valid performance outcomes. The performance-outcome variables were particularly meaningful for the various sports, including finishing position and errors in orienteering. Future studies investigating the flow-performance link should examine flow state with regard to crucial, ecologically-valid performance variables, which address core components of the performance.

Stavrou and Zervas (2004) investigated the relationship between flow and subjective performance. In a sample of 385 athletes from individual sports, participants were asked to make a note of the performance goal set for the competition with regard to their discipline, such as distance in metres for the long jump or overall points in archery. Following the competition, participants reported their actual performance outcome. Participants were then asked to assess their performance with regard to their pre-competition performance goal on a bipolar scale anchored by -5 (*very low performance*) and +5 (*very high performance*). The subjective performance measure was positively connected with flow state for the specific competition. Moderate to strong correlations were found for all flow subscales, except time transformation, which was the only subscale not significantly related to flow. The strongest associations between performance assessment and flow were found for autotelic experience, challenge-skills balance, unambiguous feedback, and sense of control.

Most of the studies on flow and performance have provided evidence underlining a positive connection between flow and measures of objective and subjective performance. Associations between flow and performance have been mainly confirmed by athletes in individual sports, such as tennis, cycling, and swimming.

Intervention Studies on Flow and Performance

Another line of research has investigated the effect of interventions on flow state and performance. Using single-subject, multiple-baseline designs, several studies have aimed to increase flow state and performance, in sports like golf (Pates & Maynard, 2000; Pates, Oliver, & Maynard, 2001), basketball (Pates et al., 2002; Pates, Maynard, & Westbury, 2001), and cycling (Lindsay, Maynard, & Thomas, 2005). All studies assessed flow and performance within a training task, except for Lindsay et al. (2005), who examined flow and performance in a competition setting. The studies used either a hypnotic intervention (Pates & Maynard, 2000; Pates et al., 2001, 2002; Lindsay et al., 2005) or an imagery intervention (Pates, Karageorghis, Fryer, & Maynard, 2003). Studies using a hypnosis treatment followed a similar procedure, applying a four-stage hypnosis intervention, consisting of relaxation, hypnotic induction, hypnotic regression, and trigger-control techniques. As shown in Table 2.6, studies varied in the application of trigger-control techniques, employing either individualised triggers (Lindsay et al., 2005) or standardized triggers (Pates et al., 2002).

Table 2.6

Intervention Studies on Flow and Performance

Study	Participants	Design	Dependent Variables	Intervention Procedure	Results
Pates & Maynard (2000)	Three male golfers (handicap 24 - 18) of 21 years of age	Single-Subject, ABA-design	(i) Flow state (FSS); (ii) Golf chipping accuracy, self-paced training task	Relaxation, hypnotic induction, imagery, hypnotic regression, self-selected music as trigger control	Two participants increased in mean flow after the intervention, several data points overlapped, more so with Baseline 1 than with Baseline 2. Mean performance improved for all participants; less overlap between intervention and baseline phases
Pates, Maynard, & Westbury (2001)	Three male college athletes from a basketball squad between 17 and 19 years of age	Single-Subject, ABA-design	Basketball jump- and set-shot accuracy, self-paced training task	Relaxation, hypnotic induction, imagery, hypnotic regression, word as individualised trigger control	Strong performance increase during intervention phase with little (one data point) or no overlap before (Baseline 1) or after (Baseline 2) intervention phase Participants reported that focus, confidence and relaxation was increased during intervention performance.
Pates, Oliver, & Maynard (2001)	Five male golfers (handicap 24 - 11) of 21 years of age	Single-Subject, AB-design	(i) Flow state (FSS); (ii) Golf putting accuracy, self-paced training task	Relaxation, hypnotic induction, imagery, hypnotic regression, natural, standardised trigger (putter grip)	All participants increased in flow state and performance from baseline to intervention phase, with little overlap of data points between phases.

Table 2.6 (*continued*).

Study	Participants	Design	Dependent Variable	Intervention Procedure	Results
Pates, Cummings, & Maynard (2002)	Five male college athletes from a basketball squad between 19 and 23 years of age	Single-Subject, AB-design	(i) Flow state (FSS); (ii) Basketball three-point shooting, self-paced training task	Relaxation, hypnotic induction, imagery, hypnotic regression, the basketball was used as natural, standardised trigger	All participants increased in flow and performance from baseline to intervention phase, with little overlap of data points between phases.
Pates, Kara-georghis, Fryer, & Maynard (2003)	Three female college athletes from a netball squad between 19 and 21 years of age	Single-Subject, AB-design	(i) Flow state (FSS); (ii) Netball, self-paced shooting	Internal imagery of flow and performance, self-selected music as trigger	Two participants increased in mean flow, whereas the third participant showed overlapping data points between intervention and baseline phase. All three participants increased in shooting performance.
Lindsay, Maynard, & Thomas (2005)	Two male (21 and 32 years) and one female (23 years) elite cyclist	Single-Subject, AB-design	(i) Flow state (FSS); (ii) Cycling competition	Relaxation, hypnotic induction, imagery, hypnotic regression, individualised and natural trigger	Mean flow increased for all participants, but two participants reported strongest flow scores in the baseline phase. Mean performance increased for two participants and decreased for one participant.

Note. Studies are presented in chronological order.

Pates and Maynard (2000) investigated the effect of a hypnosis intervention on flow and performance in golf. Participants were three golfers of 21 years of age with a handicap ranging between 24 and 18. Using an A-B-A research design, participants' flow and performance were tested in a self-paced golf-chipping training task. Performance was assessed through chip-shot accuracy, measuring the distance between the final position of the ball and the hole. After completing the baseline phase, Pates and Maynard delivered hypnosis training, consisting of four stages, relaxation, induction, regression, and a trigger-control technique. Self-selected music was used as a trigger by the golfers to re-experience their optimal performance. Participants received an audiotape of the training session, which they continued to listen to at home on a daily basis over seven days and on each day of the intervention. The post-intervention phase started after participants reported that the experience of their optimal performance could be triggered by remembering the specific music. Participants were asked to remember the music they selected before each chip shot. Results showed that two participants increased in mean flow after the intervention, whereas one participant decreased in mean flow. For all participants, several data points showed an overlap between Baseline 1 and post-intervention phase. During Baseline 2, participants were instructed to perform chip shots without using the trigger. Participants' flow scores equalled or dropped below the initial baseline score. Performance accuracy increased from Baseline 1 to post-intervention phase, and decreased from post-intervention phase to Baseline 2 for all three golfers.

Pates et al. (2001) examined the effect of hypnosis on basketball performance. The experience during the baseline and treatment phases was assessed in a follow-up interview. Participants were three male college basketball players aged between 17 and 19 years. Employing an A-B-A design, participants' performance was assessed in jump-shooting, from around the free-throw area, and in set shooting from the free throw line. After completion of the baseline performance, participants were introduced to the four-stage hypnosis intervention, which was similar to previous hypnosis treatments (e.g., Pates & Maynard, 2000). Individually, participants chose a word that they used as a trigger to re-experience their optimal performance. Each participant received an audiotape of the training session, which they listened to every day for a period of seven days and every day during the intervention phase. Finally, participants were asked to use the trigger word before they performed a set or jump shot. Results showed a substantial increase in set- and jump-shot performances, with little overlap between Baseline 1 and treatment data points. A substantial decrease in set- and jump-shot performances followed when the trigger was removed between treatment and Baseline 2. In the following interview, all participants stated that, during the intervention phase, using the trigger they perceived an increase in confidence, focus, and positive thoughts while performing. This indicates that besides the direct effect of the intervention on performance, several cognitive processes that were not explicitly addressed in the intervention, but appeared to be associated to performance, could have emerged as a by-product of either the intervention or the performance increase. Based on this finding, Pates et al. (2001) pointed out that intervention components need to be assessed separately to determine their specific effects on performance and cognitions that are related to performance.

In contrast to the first two studies, following intervention studies on flow employed an A-B design, which did not require participants to return to baseline conditions. Pates et al. (2001) investigated the effect of hypnosis on flow state and golf-putting performance. The five participants were 21 years of age with a golf handicap between 24 and 11. Performance accuracy involved a standardised putting task, by measuring the distance between the ball and the hole. Following the baseline phase, participants received one hypnosis live session, which was similar to the hypnosis treatment employed by Pates and Maynard (2000). The participants also received an audiotape, to which they were asked to listen every day for a period of seven days until the start of the post-intervention phase. The grip of the golf putter was chosen as a standardised and natural trigger to release experiences related to their best competitive performance. The results showed that all five participants increase in flow from baseline to post-intervention phase. Putting performance increased after the intervention. Participants showed little overlap of flow and performance data points across phases.

Pates et al. (2002) examined the effect of hypnosis on flow and basketball three-point shooting performance. Participants were five university basketball players between 19 and 23 years of age. Three-point shooting performance was measured from standardised shooting positions. Pates et al. used the basketball as a natural, standardised trigger and incorporated a similar hypnosis treatment as in the Pates and Maynard (2000) study. The audiotape that followed the steps of the intervention was used by the participants every day for a period of seven days, marking the time between the end of the baseline phase and the beginning of the post-intervention phase. The results showed that all participants increased in flow state and performance. The increase was substantial with little overlap between baseline and post-intervention data points.

Pates et al. (2003) investigated the effect of imagery and self-selected music on flow and performance. Participants were three college netball players between 12 and 19 years of age. Performance consisted of netball shooting, with four shots from each of the three court positions, within a set of 11 performance trials. Flow was assessed retrospectively through the FSS (Jackson & Marsh, 1996) after the completion of each performance trial. Following the baseline phase, Pates et al. gave an explanation on the characteristics of flow to the participants. Participants were instructed to first recall images and experiences that reflected a personal flow experience, and, then, to rehearse this image of flow and their performance from an internal perspective. Complementing the use of imagery, participants were instructed to select music that they thought would correspond to and facilitate their own flow experience. After participants reported to have had experiences reflecting flow while listening to the music, participants started the post-intervention performance trials. Participants performed netball shots from the same positions as before in the baseline phase, but this time participants were listening to the self-selected music while performing. The results indicated that two out of three participants increased in flow and all three participants increased in performance.

In summary, the results by Pates and colleagues (2000, 2001, 2002) showed that hypnosis interventions were generally effective in increasing flow and performance in a training setting. Furthermore, the results of the Pates et al. (2003) study provided evidence for the effectiveness of a solely imagery-based intervention to positively influence flow state and performance. Although researchers might not be trained for the administration of hypnosis interventions, imagery interventions appear to provide a suitable alternative to enhance flow and performance.

Lindsay et al. (2005) employed a four-stage hypnosis intervention, similar to the studies by Pates and colleagues (2001, 2002), to assess flow and performance in cycling. Participants were elite, competitive cyclists between 21 and 32 years of age. Lindsay et al. (2005) examined the effectiveness of hypnosis in a competition situation, using a natural, but individual, trigger to increase flow state. Initially, participants were guided through live hypnosis training. Then, triggers were chosen, such as the ticking of the cassette of the bike's rear wheel, the feeling of the handlebars, and the sight of the finish line. Participants were asked to listen to the hypnosis training on an audiotape, which was then repeated on a daily basis. The results showed that all participants revealed a mean increase in flow from baseline to post-intervention phase. The increase, however, was characterised by a number of overlapping data points between phases, with two participants revealing their highest flow scores in the baseline phase. Lindsay et al. concluded that the hypnosis intervention was helpful for one participant to effectively increase flow. In addition, Lindsay et al. found that two out of three participants improved their mean performance scores. The data point scores varied widely, showing inconsistent patterns between baseline and post-intervention phase. Evaluating the effectiveness of their hypnotic intervention in a competition context, Lindsay et al. (2005), argued that individuals who would lack a positive attitude towards the intervention and would demonstrate a limited use and ability to generate images, would not gain the same performance improvements from the intervention as other participants. Several researchers have emphasized that personal preconditions, such as conviction and compliance in the efficacy of imagery and hypnosis use are important aspects for the successful implementation for these kinds of interventions (Liggett, 2000; Sheehan & Robertson, 1996). Lindsay et al. (2005) provided some evidence on the effectiveness of interventions to increase flow and performance in ecologically-valid competition settings. More research is needed aiming to increase flow and performance during competition, because the results would be particularly valuable, which has important implications for athletes, trainers, and sport psychology practitioners.

In summary, research has provided evidence that interventions can effectively increase flow and performance. Interventions using hypnosis and imagery showed a substantial increase in flow state and performance in a training situation. In a competition situation, results showed overlapping data points for flow and performance scores between baseline and post-intervention phases (Lindsay et al., 2005). The controlled training environment appears to involve fewer distractions than the competition setting, which could have facilitated stronger flow and performance. More studies are needed, however, that address the effectiveness of interventions in competitions, offering more ecologically-valid results.

Dispositional Variables Underlying Flow

Considering the existence of theoretical notions of flow (e.g., Csikszentmihalyi, 1975, 1988a) and limited research findings, there has not yet been substantial examination, in terms of comprehensive studies, of personality variables in relation to flow. Existing theoretical propositions and research findings point to the potential of certain variables underlying the experience of flow. I now discuss four such variables, action control, imagery use, absorption, and sport confidence.

Action Control

Kuhl (1994a) established the theory of action control in personality and anxiety research, focusing on need for achievement and fear of failure, in which fear of failure emerged to be a two-dimensional construct. Kuhl found that intensity of anxiety varied for success-oriented and failure-oriented participants. Being confronted with high levels of anxiety, success-oriented individuals showed different coping patterns to failure-oriented individuals. Failure orientation had an inhibitional and ruminating effect on highly-aroused individuals, whereas success orientation corresponded with an active coping pattern. Kuhl (1994a) subsequently called the passive mode of processing "state" orientation and the active mode "action" orientation. Kuhl and Kazén (1994) defined action-oriented individuals as "flexible in changing the focus of their attention to whatever happens to be the most adequate action plan in a given situation" (p. 298), whereas state-oriented individuals "show a repetitive and dysfunctional focusing on fixed aspects of present, past, or future states" (p. 298). For instance, Kuhl (1994a) contended that in a failure context, action-oriented individuals disengage more easily from unsuccessful performances and keep their focus on the upcoming task, whereas state-oriented individuals are signified by preoccupation and ruminating thoughts about prior failure, which inhibit ongoing and future actions. During the decision-making process, action-oriented individuals would show initiative, whereas state-oriented individuals display hesitation. In a performance-related context, state-oriented individuals swap prematurely to a new task display volatility, whereas performance-related action orientation signifies the ability to get immersed into an ongoing and enjoyable activity. With reference to sport settings, Beckmann and Kazén (1994) asserted that "performance-related action orientation indexes the ability to get absorbed in an activity, which is a crucial prerequisite of the so called flow experience" (p. 440). Jackson and Csikszentmihalyi (1999) highlighted concentration on the task at hand as a clear indication of being in flow and absorption as a sign of deep flow experiences. Koehn et al. (2005) examined the connection between performance-related action orientation and flow in competition. Advanced junior tennis players with a disposition towards action orientation reported that they experienced flow and dimensions of flow more frequently than their state-oriented counterparts. Particularly large effect sizes were revealed for global flow, concentration on the task at hand, and autotelic experience. Theoretical propositions from action control and flow theory (Beckmann & Kazén, 1994; Jackson & Csikszentmihalyi, 1999), as well as research results (Koehn et al., 2005) indicate that action orientation is an underlying variable related to flow in sport contexts.

Imagery Use

In his analytic framework of imagery effects, Paivio (1985) proposed two orthogonal functions of imagery, cognitive and motivational dimensions. Both functions are further subdivided into specific and general categories. For instance, specific and general functions of cognitive imagery use consist of images of particular motor skills and comprehensive match strategies, respectively (Martin, Moritz, & Hall, 1999). Martin et al. (1999) outlined that motivational functions of imagery use are represented by images of specific goals, optimal arousal, and successful coping. Establishing and validating the Sport Imagery Questionnaire (SIQ), Hall, Mack, Paivio, and Hausenblas (1998) confirmed the distinction between cognitive and motivational use of imagery within competitive athletes. In addition, Hall et al. found that the motivational-general dimension of imagery use divided into two components. One component is connected to motivational imagery on an emotional level and was labelled “arousal”. The second component is connected to images of being confident and in control, and was termed “mastery”. Based on Hall et al.’s (1998) conception of imagery use and Csikszentmihalyi’s (1975) proposition of flow dimensions, there is theoretical support that imagery functions, such as cognitive specific and motivational general-mastery imagery, would underlie flow dimensions of challenge-skills balance, clear goals, concentration on the task at hand, and sense of control. Jackson and Csikszentmihalyi (1999) stated that imagery assists in developing and focusing on clear goals, and Munroe, Giacobbi, Hall, and Weinberg (2000) proposed that imagery could be useful in maintaining concentration on the task at hand. There appears to be substantial theoretical and research evidence for a positive relationship between imagery use, flow state, and performance.

In addition, several interventions in sport have examined the effects of imagery on personality variables that appear to be linked with flow, such as self-confidence (Callow, Hardy, & Hall, 2001; She & Morris, 1997) and self-efficacy (Callery & Morris, 1997), and effects of imagery on competition performance (Kendall, Hrycaiko, Martin, & Kendal, 1990). Pates et al. (2003) provided research evidence regarding the effectiveness of using imagery to increase flow and performance. Morris, Spittle, and Watt (2005) advocated that "imagery, which is specifically directed at the antecedents in a particular sport context, should enhance the experience of flow" (p. 327). Theoretical implications and research findings have indicated the positive influence of imagery in increasing performance and changing cognitions, such as confidence and antecedents of flow (Pates et al., 2003; Morris et al., 2005). The results indicate that imagery is not only one of the personality variables underlying flow, but also a main vehicle to increase flow state.

Absorption

In a literature review on the nature of absorption, Roche and McConkey (1990) defined absorption as a "characteristic of the individual that involves an openness to experience emotional and cognitive alterations across a variety of situations" (p. 92). Tellegen and Atkinson (1974) referred to absorption as "total attention, involving a full commitment of available perceptual, motoric, imaginative and ideational resources to a unified representation of the attentional object" (p. 274). Tellegen and Atkinson established the construct of trait absorption based on research results regarding hypnotic susceptibility. Absorption demonstrated strong correlations with hypnotic susceptibility and showed consistent correlations with hypnotic susceptibility across several samples. In a meta-analysis, Roche and McConkey (1990) confirmed the close relationship between hypnotic susceptibility and absorption. From a phenomenological point of view, Jackson and Csikszentmihalyi (1999) emphasised that athletes in flow are "in a state of consciousness where one becomes totally absorbed in what one is doing, to the exclusion of all other thoughts and emotions" (p. 6). With reference to the flow components, Jackson and Csikszentmihalyi asserted that time distortion, loss of self-consciousness, and action-awareness merging are signs of a deep flow experience, occurring when the athlete gets totally absorbed into the activity. The general psychological findings on absorption (Tellegen & Atkinson, 1974), phenomenological descriptions of absorption and flow in sport (Jackson & Csikszentmihalyi, 1999), and research findings on hypnotic susceptibility and flow in sport (Grove & Lewis, 1996) lead to the proposition that trait absorption is one of the main personality variables underlying the experience of flow. Perhaps, surprisingly, there has been no research on absorption and flow, but initial examinations should be undertaken, given the key role claimed for absorption in the flow experience.

Trait Sport Confidence

Emerging from general concepts of self-confidence, such as self-efficacy (Bandura, 1977, 1986, 1997), perceived competence (Harter, 1978), and movement confidence (Griffin & Keogh, 1982), Vealey (1986) developed a sport specific conception of confidence. Vealey (1986) defined sport confidence as “the belief or degree of certainty individuals possess about their ability to be successful in sport” (p. 222). Vealey distinguished between event specific state sport confidence and global trait sport confidence. Conceptually, trait sport confidence is the belief or degree of certainty that individuals *usually* possess about their ability to be successful, whereas state confidence is defined as the belief or degree of certainty individuals possess *at one particular moment* about their ability to be successful in sport (Vealey, 1986). Furthermore, Vealey (2001) developed an integrative model of sport confidence in which confidence is viewed as a single construct distributed on a continuum that varies from trait- to state-like. That is, confidence depends on the time frame that is used as a reference point, so it could be more state-like, with regard to the last competition, or more trait-like, when referring to athletes’ confidence over the last season or the past year. In the re-conceptualisation of confidence, Vealey proposed reciprocal relationships between sport confidence, sources of sport confidence, and consequences of sport confidence. Sources of confidence relate to the three domains of achievement, such as mastery and demonstration of ability; self-regulation, such as physical and mental preparation; and social climate, such as social support and vicarious experience by watching successful performances by other athletes. The consequences of sport confidence impact on athletes' affect, behaviour, and cognition, which Vealey labelled the ABC triangle. Hence, high levels of confidence would affect the way athletes feel, behave, and think, which in turn influences the level of confidence. Performance is a result of interactions between sources and levels of confidence. Vealey also proposed that performance outcome can re-influence the constructs from which it emerged. Vealey's confidence framework provided theoretical support for the interplay between confidence and cognitions and affect, such as flow and performance.

With regard to flow, Jackson and Csikszentmihalyi (1999) stressed that confidence is an important prerequisite to experience flow and becomes a crucial component in mastering high challenge-high skill situations. Challenges for advanced and elite athletes are normally very high and skills remain comparatively consistent over a period of time. Confidence, on the other hand, can vary enormously between two occasions. Therefore, confidence is a crucial factor for performance and flow experience (Jackson & Csikszentmihalyi, 1999). Kimiecik and Stein (1992) proposed a joint influence of trait and state factors on flow. Stavrou and Zervas (2004) reported moderate correlations of trait sport confidence with several dimensions of state flow, such as sense of control, concentration on the task at hand, challenge-skills balance, loss of self-consciousness, and clear goals. In qualitative research on flow in elite (Jackson, 1995) and college (Russell, 2001) athletes, Jackson and Russell reported confidence as being one of the main factors facilitating the attainment of flow. Theoretical propositions (Jackson & Csikszentmihalyi, 1999; Kimiecik & Stein,

1992) and research findings (e.g., Jackson, 1995; Stavrou & Zervas, 2004) have indicated that confidence is one of the key personality variables connected to flow.

The Present Thesis

This literature review established an information base for the development of the thesis, underlining that personality and situational factors are important for the experience of flow. The sport specific model of flow, as proposed by Kimiecik and Stein (1992), has provided a theoretical framework for the interaction between personal and situational factors on flow. Although previous research has taken aspects of this model into consideration, there is little research explicitly examining the propositions of the flow model to develop interventions to increase flow in competition.

So far, research on flow has largely been exploratory. Relatively little is known about personal and situational factors, their interrelationship and influences on flow, and, subsequently, on performance. Consequently, this thesis will explicitly focus on particular situational aspects, such as self-paced and externally-paced action, as well as on personality variables that are proposed by theory and research to affect flow state. More specifically, valuable information will be attained by the examination of trait factors underlying dispositional flow and state flow, which have not been examined previously. Furthermore, the proposed thesis will investigate whether trait factors that affect flow influence performance independently or if the intensity of flow state might have implications for performance.

The present thesis incorporates theoretical propositions and research findings, as discussed in the literature review, to conduct three interconnected studies. Thus, my aims in this thesis were threefold: firstly, to examine several specific personality variables that are proposed to underlie dispositional flow and flow state; secondly, to investigate the effect of personality-situation interactions on flow and performance; and thirdly, to evaluate the effectiveness of an intervention, designed to enhance such personality and situational variables, on flow state and performance in tennis competitions. To investigate these aims, in Study 1, I examined athletes' propensity towards flow by assessing the connection between stable personality variables of action control, imagery use, absorption, and trait sport confidence on dispositional and state flow. A secondary aim of this study was to investigate the link between flow state and performance during tennis competition. Although, performance is not part of the Kimiecik and Stein (1992) flow model, research provided evidence for a positive relationship between flow and performance (e.g., Jackson et al., 2001; Pates et al., 2002, 2003; Stavrou & Zervas, 2004), which has important implications for intervention studies aiming to increase flow and performance. In Study 2, I employed a factorial design to examine the interaction between person and situation factors on flow state and performance. Person factors that showed the strongest association with flow in Study 1 were further examined in their interplay with situational factors in a tennis training task. With regard to situational factors, I chose task type to assess differences between self-paced (service) and externally-paced (groundstroke) tasks on flow, as proposed in the flow model (Kimiecik & Stein, 1992), and performance. In Study 3, I developed an intervention procedure, based on the results, regarding personality and situational variables, in Studies 1 and 2, to increase flow state and performance in an ecologically-valid setting, namely tennis competitions. The intervention aimed to increase antecedents of flow to enhance flow state. I used a single-case A-B design to assess the effects of the intervention. The thesis concludes with a general discussion, pulling together the results and discussions of the three studies and presenting directions for further development, regarding the conceptualisation, future research, and implications of flow in sport.

CHAPTER 3: PERSONALITY VARIABLES AND THE EXPERIENCE OF DISPOSITIONAL AND STATE FLOW

Introduction

As reported in the literature review, flow is a common and positive experience in sport for athletes of varying skill level in training and competition settings. Positive experience and well-being in sport can arise from enjoying the activity and successful performance, in terms of winning or performing well. Csikszentmihalyi (1975) attributed differences in optimal experiences to situational factors, such as a structured activity, and to personal factors, such as personality traits. With regard to personality traits, differences in individuals' propensity could account for the intensity and frequency of their flow experiences. The entity of dispositional variables underlying flow is termed autotelic personality (Csikszentmihalyi, 1975, 1988b). Kimiecik and Stein (1992) proposed that a cluster of trait variables, namely confidence, perceived sport competence, and attention style, could represent aspects of the autotelic personality, exerting a positive influence on the experience of flow in sport.

A limited amount of research has investigated personality variables underlying frequency and intensity of flow. The main aim of this study was to examine the influence of four personality variables, namely, action control, imagery use, absorption, and trait sport confidence, on dispositional flow and flow state in tennis competitions. The selection of these variables was based on their theoretical and research links to flow, as outlined in Chapter 2. Examining athletes' dispositions towards flow will help researchers to understand processes underlying flow. Further information related to athletes' flow experiences could assist sport psychologists in designing interventions to increase confidence, effective use of particular types of imagery, action control, and absorption in sport performance, as ways to enhance flow, which is considered to be valuable for enjoyment and motivation.

Method

Participants

I invited junior tennis players of up to 18 years of age from metropolitan and regional Melbourne who had at least one year of competition experience to participate in this study. From 336 tennis players, who returned a signed consent form, I received 271 complete data sets for dispositional measures, representing a return rate of 80.66%. Out of the 271 junior tennis players, 134 participants provided additional information for state measures of flow and performance. The overall sample (N = 271) consisted of 187 male and 84 female players, between 11 and 18 years of age (M = 14.31; SD = 1.59), who participated frequently in tennis competitions. Participants had been involved in tennis for an average of 6.66 years (SD = 2.51) and in tennis competitions for a mean of 4.28 years (SD = 1.88). Participants had a mean training intensity of 9.19 hours per week (SD = 5.87) and competed frequently in tennis tournaments (Mdn = 6–10 per year). The skill level in this sample varied widely, including club level and ranking-list players. Ranking-list players (n = 109) were listed in the Australian or New Zealand Ranking List, ranging between position 17 and 1,647 (Mdn = 289) at the time the data was collected. Those players generally competed on a state or national level, with the top players (*n* = 21) competing in international events and holding an ITF world junior ranking-list position. The majority of players (*n* = 162) mainly entered club and non-ranking-list tournaments in metropolitan Melbourne and regional Victoria.

Measures

Demographic Information

I gathered demographic information (Appendix D) with reference to the participants' age, gender, years of tennis experience, years of competitive experience, hours of tennis practice per week, number of tournaments entered per year, and ranking list position. Three open-ended items asked whether the respondents participated in other sports than tennis, the reasons why they participated in tennis in general, and why they participated in tennis competitions.

Marlowe-Crowne Social Desirability Scale-Short Form

The Marlow-Crowne Social Desirability Scale-Short Form (MCSDS-SF; Reynolds, 1982) assesses social desirability as one form of response bias, which can affect results in self-report measures in social and psychological research. The development of a short version of the Marlowe-Crowne scale was stimulated by the exclusion of the original, longer version (33 items) in a number of studies (Reynolds, 1982). Socially-desirable responding on a specific measure is reflected by significant correlations between the MCSDS-SF and self-report measures under investigation. The MCSDS-SF consists of 13 items with a true-false response format. Scores range between 0 and a total of 13, with 8 or more usually considered indicating socially desirable responding (Reynolds, 1982). The

MCSDS-SF has internal consistency reliability, measured through the Kuder-Richardson Formula 20, of .76 (Reynolds, 1982). I present the MCSDS-SF in Appendix E.

Dispositional Flow Scale-2

The Dispositional Flow Scale-2 (DFS-2; Jackson & Eklund, 2002) consists of 36 items representing nine subscales, each comprising four items assessing one of the nine dimensions of flow. Thus, the nine subscales represent the nine flow dimensions of challenge-skills balance, merging of action and awareness, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. The subscales showed acceptable reliability values, ranging between .81 and .90. The response format is a 5-point Likert scale anchored by 1 (*never*) and 5 (*always*), assessing respondents' frequency of flow experiences. Interpreting the flow scores, Jackson and Eklund (2004) noted that two score types can be obtained from the flow scale, regarding the subscale score for each dimension and the overall, global flow score. The dimensional scores can be represented as summed scores or as mean scores. Presenting mean scores for the various flow dimensions makes interpretation of the single dimensions easier, because the mean scores can be assessed against descriptors of the response format. Low mean scores of 1 and 2 indicate that participants *never* or *rarely* experience these flow dimensions. Jackson and Eklund argued that a moderate score of 3 signifies that athletes experience flow *sometimes* during the activity. Because flow is a difficult state to attain, a moderate flow score indicates that flow is experienced “at a better than average frequency” (p. 19). According to Jackson and Eklund, high scores of flow around 4 (*frequently*) or 5 (*always*) could reflect individuals with autotelic personalities. Jackson et al. (2001) found a mean score for global dispositional flow of 3.68 points, indicating that athletes of their sample experienced flow on a regular basis, more than half of the time they were involved in the particular activity. One of the main objectives of the DFS-2 was to “aid in the understanding of the autotelic personality, which could be a factor in explaining individual differences in the propensity to experience flow” (Jackson & Wrigley, 2004; p. 439). Item examples of the nine dimension are reflected in “My abilities match the high challenge of the situation” (challenge-skills balance), “Things seem to happen automatically” (action-awareness merging), “I know clearly what I wanted to do” (clear goals), “I am aware of how well I am performing” (unambiguous feedback), “My attention is focused entirely on what I am doing” (concentration on the task at hand), “I have a sense of control over what I am doing” (sense of control), “I am not concerned with how others may be evaluating me” (loss of self-consciousness), “It feels like time goes by quickly” (time transformation), and “I really enjoy the experience” (autotelic experience). The DFS-2 has been frequently used during the validation stage (Jackson & Eklund, 2002), during a recent validation study to establish a Japanese version of dispositional flow (Kawabata, Jackson, & Mallett, 2005), and to examine athletes’ propensity of flow in sport (Fletcher, 2003) and dance (Jeong et al., 2005). I present the DFS-2 in Appendix F.

Action Control Scale-Sport

The Action Control Scale-Sport (ACS-S; Beckmann & Elbe, 2003) is based on Kuhl's (1994b) Action Control Scale-90 to assess the various forms of action control in sport. The ACS-S consists of 36 items with two alternative answers per item (a or b), one answer reflecting an action-oriented response and the other answer indicating a state-oriented response. The ACS-S contains three subscales, consisting of 12 items each. The subscales focus on performance-related (volatility subscale; item example "When doing my sport, A. I do not even think about interrupting the activity, B. I occasionally want to interrupt this activity to do something else"), failure-related (preoccupation subscale; item example "When I achieve less than I had expected during an important competition, A. I can let it be and turn to other things, B. it is difficult for me to do anything at all"), and decision-related (hesitation subscale; item example "When I must decide between two different strategies in a competition, A. I quickly choose one of the alternatives and do not think about the other, B. it is easy for me to decide for one or the other alternative") action versus state orientation. The ACS-S internal consistency analysis revealed acceptable alpha values of .70 (volatility), .72 (hesitation) and .74 (preoccupation) for the three subscales. High scores on each of the subscales reflect action orientation, whereas low scores indicate state orientation. Scores on the subscales range between 0 and 12, with higher scores indicating action orientation and lower scores signifying state orientation. Previous studies using the predecessor of the ACS-S, the ACS-90, employed median splits to examine differences in state and action orientation.

Generally, subscale scores around seven or higher classified individuals as action oriented, whereas scores of six or less categorised people as state oriented (e.g., Haschke, Tennigkeit, & Kuhl, 1994; Koehn et al., 2005). After being recently established, the ACS-S is applied in this study for the first time, outside of the development stages of research. I present the ACS-S in Appendix G.

Sport Imagery Questionnaire

The Sport Imagery Questionnaire (SIQ; Hall et al., 1998) was employed to assess how often athletes use five different types of imagery. The SIQ measures five types of imagery use, cognitive specific (CS; item example "I can consistently control the image of a physical skill"), cognitive general (CG; item example "I imagine alternative strategies in case my event/game plan fails"), motivational specific (MS; item example "I image myself winning a medal"), motivational general-arousal (MG-A; item example "I imagine the stress and anxiety associated with my sport"), and motivational general-mastery (MG-M; item example "I imagine myself appearing self-confidence in front of my opponents"), which were identified by exploratory factor analysis. The SIQ consists of 30 items with 6 items per subscale. Thus, items are rated using a Likert response format, scaled from 1 (*rarely*) to 7 (*often*). In contrast to the DFS-2, there are just two descriptors in the SIQ response format for the extreme ends of the scale, whereas "statements that fall within these two extremes should be rated accordingly along the rest of the scale" (Hall, Stevens, & Paivio, 2006, p. 36). During the validation stage of the SIQ, Hall et al. (1998) found that participants more frequently used motivational functions of MG-M (M = 5.48) and MG-A (M

= 5.06) than cognitive functions of CS (*M* = 4.84) and CG (*M* = 4.84). The motivational function MS (*M* = 4.33) showed the lowest mean scores of all imagery subscale measures. The alpha coefficients for the five scales ranged from .70 to .89 (Hall et al., 1998). The SIQ has been frequently used in sport (e.g., Martin et al., 1999). I present the SIQ in Appendix H.

Tellegen Absorption Scale

The Tellegen Absorption Scale (TAS; Tellegen, 1982) assesses the tendency to get absorbed into situations of everyday life. The TAS consists of 34 items and six factors, comprising responsiveness to engaging stimuli (7 items, example “When I listen to music, I can get so caught up in it that I don't notice anything else”), synesthesia (7 items; example “Some of my most vivid memories are called up by scents and smells”), enhanced cognition (7 items; example “Sometimes thoughts and images come to me without the slightest effort on my part”), oblivious and dissociative involvement (6 items; example “If I wish, I can imagine (or daydream) some things so vividly that they hold my attention as a good movie or story does”), vivid reminiscence (3 items; example “I can sometimes recollect certain past experiences in my life with such clarity and vividness that it is like living them again or almost so”), and enhanced awareness (4 items; example “I sometimes "step outside" my usual self and experience an entirely different state of being”). The items describe everyday situations that can be absorbing. Absorption ratings vary between 0 and 100% of the time. In the space provided next to each item, participants write down the percentage to indicate how often they experience states of absorption in each situation. To calculate the frequency of absorption, a mean score of the items' subscale provides information on how often the individual experiences the specific aspects of absorption, for instance, 30% or 60% of the time. There are no interpretive norms available for the TAS. In a previous study, Glisky, Tataryn, Tobias, Kihlstrom, and McConkey (1991), who employed a five-point Likert scale, found an average score of 80 and a standard deviation of 18. The TAS showed an internal consistency reliability of .88 and a test-retest reliability of .91 (Tellegen, 1982). The TAS has been frequently used in personality research (e.g., Baer, Smith, & Allen, 2004; Roche & McConkey, 1990), but has rarely been administered in a sport context (Dunlap, 2006). I present the TAS in Appendix I.

Trait Sport Confidence Inventory

The Trait Sport Confidence Inventory (TSCI; Vealey, 1986) was developed to assess how confident athletes generally feel, when they compete in sport. Items on the inventory ask the participants to compare themselves to the "most confident athlete you know" (Vealey, 1986, p. 244). The inventory consists of 13 items, with no subscale components, utilizing a 9-point Likert scale anchored by 1 (*low*) and 9 (*high*). An item of the TSCI read "Compare your confidence in your ability to perform under pressure to the most confident athlete you know". The item scores distinguish between low (scores from 1 to 3), moderate (scores from 4 to 6), and high (scores from 7 to 9) confidence. Trait sport confidence scores are obtained through a mean score or a summed score by adding up scores for the 13 items. Global confidence summed scores between 13 and 39 reflect a low level and scores between 91 and 117 signify a high level of overall competition confidence. Global confidence scores in between those extremes represent a moderate level of confidence. Cronbach's alpha coefficient was measured as .93 for the TSCI, with test-retest reliability in two studies of .83 and .86, respectively (Vealey, 1986). The TSCI has been frequently employed during the validation stage (Vealey, 1986) and in sport research studies (e.g., Stavrou & Zervas, 2004; Vealey, 1988). I present the TSCI in Appendix J.

Flow State Scale-2

The Flow State Scale-2 (FSS-2; Jackson & Eklund, 2002) consists of the same subscale structure as the DFS-2, including nine subscales with four items per subscale. The scoring procedure for the FSS-2 is the same as for the DFS-2. Being a state measure, the FSS-2 is used to assess the intensity of flow on one particular occasion, such as during a specific tennis competition match. Cronbach's alpha coefficients for the FSS-2 ranged from .80 to .90 on a subscale level (Jackson & Eklund, 2002). The FSS-2 response format incorporates a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Jackson and Eklund (2004) proposed that moderate scores of 3 (*neither agree nor disagree*) for flow dimensions represent that there is no strong indication that the person has or has not experienced the specific attributes of flow. An overall score of 108, averaging to a score of 3 on each item, would provide inconclusive evidence of whether the athlete experienced flow. In previous studies, flow state has been commonly presented as a summed overall score of global flow. These studies were mainly intervention studies to outline differences in flow state before and after the treatment (e.g., Pates et al., 2001, 2002). To avoid misinterpretation on a global level, flow dimensions need to be assessed separately to examine whether some dimensions contribute more strongly to the overall score than others. With flow state scores providing a range between 36 and 180 points, Lindsay et al. (2005) found mean pre-intervention flow scores between 101 and 109.5, and mean post-intervention scores between 112.4 and 133.7. The results indicated that athletes experienced qualities of flow for some time during the activity. Csikszentmihalyi (1992) reminded researchers not to equate a questionnaire score with flow, "the concept of flow describes a complex psychological state that has important consequences for human life. Any measure of flow we create will only be a partial reflection of this reality" (p.183). Therefore, flow scores should be interpreted with caution, providing an indication of more or less flow-like states for a particular event. To capture and interpret flow more accurately, flow state might be better addressed on subscale levels than on a global level. The FSS-2 has been frequently used during the validation stage (Jackson & Eklund, 2002). In addition, the FSS-2 has been employed in a recent validation study to establish a Japanese version of state flow (Kawabata et al., 2005), and to examine athletes' intensity of flow in sport (Wagner & Delaveaux, 2003) and dance (Jeong et al., 2005). I present the FSS-2 in Appendix K.

Subjective Performance Assessment

The self-report performance measure is based on propositions by Kimiecik and Stein's (1992) flow model and on qualitative findings on flow in sport (Jackson, 1995; Young, 2000). With regard to subjective performance questionnaires administered previously (e.g., Jackson et al., 2001; Stavrou &

Zervas, 2004), participants in this study evaluated their competition performance compared to how they generally perform in similar competitions (e.g., participants were asked to evaluate the ranking-list competition against previous ranking-list tournaments or the non-ranking list competition against previous non-ranking list matches). Performance assessments were made on an 11-point bipolar scale anchored by -5 (*very poor*) and +5 (*excellent*), with 0 as average. Item ratings focused on overall technical, tactical, and mental performance, as well as ratings on specific technical performances that include first and second serves, and forehand and backhand groundstrokes. Additional ratings, using a 11-point bipolar scale with extreme ends of -5 and +5, assessed situational match factors of competition importance, anchored by *not important at all* and *extremely important*, competition commitment, anchored by *very low* and *very high*, perceived certainty about competition outcome, anchored by *very uncertain* and *very certain*, and competition preparation, anchored by *not at all* and *very much so*. I present the measure of subjective performance in Appendix L.

Performance Outcome

Performance was measured by the overall match result (competition won or lost) and number of games won. Performance results were obtained from the participants themselves after the completion of the tournament match. In addition, the final results of participants' competition could be viewed on a Tennis Australia website, showing the official tournament draws and match results.

Procedure

The research was approved by the Victoria University Ethics Committee. I requested access from a range of tennis centres and tournament directors, who conducted tennis tournaments in metropolitan Melbourne, Australia. These tournaments were categorised as junior ranking list tournaments for players between 10 years and 18 years. I established contact with private training programs, tennis academies, such as the Melbourne International Tennis School (MITS), state and national tennis development programs from Tennis Australia, Melbourne, and the Victorian Institute of Sport (VIS). The tennis program administrators, tournament directors, or coaches of the various tennis programs forwarded the information statement and consent forms to the players. Following standard consent procedures, the parents of underage players, who wanted to join the study as volunteers, signed the consent form.

All participants received oral and written information about the measures. First, I explained to the participants what the questionnaire was about and how to complete the questionnaire. Second, I asked the participants to read the introductory section, before they moved on to the test items. Written information on how to complete the measure included an introductory part on top of each questionnaire. For instance on the ACS-S, the introductory part explained how to answer each item by giving an opening example. Circling an action- or state-oriented response indicated a general action tendency when the participant was in this particular situation. In the introductory section of each questionnaire, I marked the most important information in bold, which repeatedly appeared on top of the sheet for the consecutive pages of the questionnaire. This way, I tried to ensure that participants kept their focus on the main issues of the questionnaires throughout the completion.

Before and throughout the completion of the measures, I encouraged participants to ask questions both immediately after hearing and reading instructions, and at any time during the session. With reference to the flow measures, I particularly emphasised that participants should answer each item of the DFS-2 on the basis of their general experiences in tennis competitions, whereas the FSS-2 was answered on the basis of players' experiences during the competition match that they had just completed.

Firstly, I approached participants who were part of the various squads and training programmes based in Melbourne. Participants completed the trait questionnaires before or after a training session. I administered the questionnaires in the following order, Demographic Information, MCSDS-SF, DFS-2, ACS-S, SIQ, TAS, and TSCI. I pointed out that these measures are dispositional measures with no connection to the players' current training session and should be answered, except for the MCSDS-SF and TAS, on their general experience in tennis competitions. Secondly, I attended tournaments where participants competed. Participants filled out the FSS-2 after the completion of their competition match. Following the FSS-2, participants completed the subjective performance assessment, comparing their performance in the last competition match to how they perform in similar competitions in general. I collected the questionnaires immediately after completion. After completion of the FSS-2, I asked participants about their match result. I also checked each participant's official tournament result made available online by Tennis Australia. Several participants sent the completed FSS-2 and subjective performance assessment to me. In the event that participants (n = 21) sent the questionnaires back via mail, space was provided to indicate how long after the match the players started to fill out the FSS-2. Participants started to fill out the FSS-2 between 20 and 50 minutes after the end of their competition match. Overall, participants spent between 45 and 75 minutes completing the entire set of questionnaires. Following completion of all aspects of the study, I thanked the participants for volunteering for and contributing to this study.

Data Analyses

I applied Pearson's Product-Moment Correlation Coefficient (r) to examine relationships between personality variables and dispositional and state flow. I then entered personality variables that revealed significant and meaningful correlations with flow into stepwise multiple regression models, with dispositional flow and state flow as criterion variables. I chose to employ stepwise multiple regression analysis, because this regression analysis has the advantage that it allows for the examination of how strongly each predictor variable contributed to the regression model. In contrast, standard multiple regression analysis would have included all variables, showing overlapping variances between predictors. In addition, the theoretical basis was not substantial to provide the order of entering the variables in hierarchical regression analysis. Limitations of regression analysis include measures that are unreliable, groups that are restricted by range, and if the correlation is curve linear. Beside the investigation on a global level, I used stepwise regression techniques to examine flow on a subscale level, with dispositional flow and state flow subscales as criterion variables and personality variables as predictor variables. Acknowledging previous statistical approaches of studies using canonical correlations to examine flow and personality variables on a subscale level (e.g., Jackson et al., 1998, 2001), in this study, I preferred multiple regression techniques, because regression results pinpoint more accurately the strength of the connections between specific flow dimensions and the predictor variables. Evaluations of multiple regression results will also benefit future studies by targeting the most relevant dimensions of flow to include in interventions to increase flow state. I employed correlation coefficients and *t*-tests for independent means to analyse the relationship between subjective performance ratings and objective performance outcome and flow state.

Results

I present the results in five subsections. First, descriptive statistics contain information on means, standard deviations, and internal reliability, employing Cronbach's alpha coefficients for the measures administered in this study. In the second subsection, I examine correlations between social desirability and dispositional and state flow and personality variables. In the third subsection, I investigate correlations reflecting relationships between dispositional flow and flow state, demographic information, and personality variables. In the fourth subsection, I enter personality variables that revealed significant connections with flow as predictors into stepwise multiple regression models with dispositional and state flow as criterion variables. I examine dispositional and state flow on a global and subscale level. For personality variables that significantly predicted flow, I employ additional stepwise regressions to test which of the personality subscales are associated with flow dimensions. In the fifth subsection, I examine the relationship between flow state and performance.

Descriptive Statistics

Reasons for tennis involvement were most frequently mentioned by the participants as “to have fun”, “because it is enjoyable”, and “I love the game”. Out of the whole sample, 168 participants (62.0%) mentioned at least one of these aspects as the main reason for playing tennis in general, and 119 participants (43.9%) reported at least one of these as their main reason for competing in tennis. Several ranking-list players referred to fun, enjoyment, and love of the game as main reasons to play tennis (48.6%) and to compete in tennis (27.5%). Non-ranking list players reported fun and enjoyment more often than ranking list players as reasons to play tennis (71.0%) and to enter tennis competitions (54.9%). Other reasons to play tennis included physical aspects, e.g., “to keep fit”, and social aspects, e.g., “to be with friends”, “meet new people”. Reasons for joining tennis competitions included various aspects of winning, such as “to become a professional player”, and ranking list achievements, such as improving one’s ranking. Table 3.1 shows the descriptive information for dispositional and state flow and the four personality measures used in the present study.

Cronbach’s alpha values for internal consistency reliability showed acceptable values for dispositional flow ($\alpha = .91$) and state flow ($\alpha = .91$), and for personality variables of action control (α = .74), imagery use (α = .94), absorption (α = .95), and trait sport confidence (α = .94). The internal consistency for flow on a subscale level showed satisfactory values varying from .71 to .84 for dispositional flow and from .70 to .84 for state flow. Personality subscale variables which dropped under the desirable lower limit of .70 (Nunally, 1978) were hesitation and volatility of the ACS-S, and vivid reminiscence of the TAS.

Table 3.1

Means, Standard Deviations, and Alpha Coefficients (α) for the DFS-2, FSS-2, ACS-S, SIQ, TAS, and TSCI

	DFS-2			*FSS-2*		
	M	*SD*	*α*	*M*	*SD*	*α*
Challenge-Skills Balance	3.77	.59	.78	3.69	.73	.70
Action-Awareness Merging	3.50	.66	.79	3.39	.82	.79
Clear Goals	4.05	.66	.78	3.94	.75	.76
Unambiguous Feedback	4.02	.66	.82	3.97	.73	.73
Concentration on the Task at Hand	3.66	.73	.83	3.57	.87	.84
Sense of Control	3.79	.55	.71	3.61	.79	.79
Loss of Self-Consciousness	3.51	.88	.82	3.53	.85	.74
Time Transformation	3.25	.87	.84	3.26	.97	.82
Autotelic Experience	4.13	.67	.79	3.81	.95	.84

	ACS-S		
	M	*SD*	*α*
Preoccupation	6.92	2.84	.71
Hesitation	6.86	2.19	.45
Volatility	7.85	2.31	.56

Table 3.1 (*continued*).

	SIQ		
	M	*SD*	*α*
Cognitive Specific	4.86	1.08	.85
Cognitive General	4.71	1.11	.83
Motivational Specific	4.71	1.36	.89
Motivational General-Arousal	4.62	1.08	.80
Motivational General-Mastery	5.25	1.12	.89
		TAS	
	M	*SD*	*α*
Engaging Stimuli	3.85	1.89	.78
Synesthesia	3.57	1.98	.82
Enhanced Cognition	4.35	1.90	.80
Oblivious/Dissociative Involvement	4.97	1.83	.74
Vivid Reminiscence	4.86	1.84	.43
Enhanced Awareness	4.30	1.93	.69
		TSCI	
	M	*SD*	*α*
Global	5.88	1.30	.94

Note. DFS-2 = Dispositional Flow Scale-2; Flow State Scale-2 = FSS-2; ACS-S = Action Control Scale-Sport; SIQ = Sport Imagery Questionnaire; TAS = Tellegen Absorption Scale; TSCI = Trait Sport Confidence Inventory. All measures $N = 271$, except FSS-2, $n = 134$.

The mean scores for global dispositional flow and state flow were 3.74 (*SD* = .45) and 3.64 (*SD* = .53), respectively. With regard to dispositional flow, dimensions received mean scores between 3.25 (time transformation) and 4.13 (autotelic experience), indicating that athletes commonly perceived flow attributes in competition, varying between some of the time and often. Flow dimensions that athletes reported to experience most frequently were autotelic experience, clear goals, and unambiguous feedback. With regard to state flow, dimensions ranged from 3.26 (time transformation) to 3.97 (unambiguous feedback). The mean scores demonstrated that athletes' flow intensity varied between neither agree nor disagree and agree, providing no strong indication for flow and its attributes to be experienced during competition. The strongest dimensions of flow state were unambiguous feedback, clear goals, autotelic experience, and challenge-skills balance. Dimensions of flow that scored particularly high on both dispositional and state flow measures were autotelic experience, clear goals, and unambiguous feedback. Lowest scores on both scales were reported for action-awareness merging, loss of self-consciousness, and time transformation.

The personality variable of action control was the only variable that involved a dichotomous answer format. The descriptive results showed that the mean of over six for each subscale indicated that participants showed a slightly stronger tendency towards action orientation than state orientation. Mean scores on the preoccupation (6.92) and hesitation (6.86) subscales were similarly high, whereas the mean score for the volatility subscale (7.85) was higher than the other subscale means, signifying a stronger tendency towards action orientation during performance. The personality variables that were assessed on a Likert scale showed a mean score of 4.83 for imagery use (on a 7-point scale), 4.32 for absorption (on a 10-point scale), and 5.88 for confidence (on a 9-point scale). With regard to imagery use, participants reported to most frequently employ imagery functions of motivational general-mastery, indicated by a mean score of 5.25. The other imagery use subscale scores varied between 4.62 (motivational general-arousal) and 4.86 (cognitive specific), signifying that athletes employed all imagery functions at least some of the time. With regard to absorption, participants indicated that less than 50% of the time their experience matches with the content given in the absorption scale. On an absorption subscale level, participants reported lowest mean scores for synesthesia (3.57) and highest scores for oblivious/dissociative involvement (4.97). The trait sport confidence score indicated that participants generally experienced a moderate level of confidence during tennis competitions. The main focus of the present study, however, was the analysis of personality variables of action control, imagery use, absorption, and confidence on a global level, which showed acceptable internal consistency alpha values.

Correlations between Social Desirability, Flow, and Personality Variables

With reference to social desirability, participants scored a mean of 6.65 (*SD* = 1.90) on the MCSDS-SF. The sample's mean reflects no strong bias towards true- or false-responses, which is supported by a relatively small standard deviation. Except for the ACS-S, which showed a slightly negative significant relationship with the MCSDS-SF, $r = -.15$; $p < .05$, no significant correlations emerged between social desirability and the personality variables and trait and state flow. The significant correlation found between MCSDS-SF and ACS-S, however, appears to be rather weak to have had a major influence on the results. Nonetheless, analyses including the ACS-S should be viewed with caution.

Correlations between Flow, Demographic Information, and Personality Variables

Several significant correlations were found between demographic information and dispositional and state flow. With regard to dispositional flow in tennis competition, the demographic variable training hours per week was most highly correlated with flow, $r = .39$; $p < .001$. Interestingly, dispositional flow was negatively related to age, $r = -.12$; $p < .05$, and competitive tennis experience in years, $r = -.12$; $p < .05$, signifying that younger and less competitively experienced players reported that they experienced flow more regularly than older players and players who had been playing tennis competitions for several years. No statistically significant relationship was found between general tennis experience in years and frequency of flow. A *t*-test for independent means revealed that there were no significant differences between gender and dispositional flow, but ranking-list players ($M = 3.84$; $SD = .42$) experienced flow more frequently than nonranking-list players ($M = 3.68$; $SD = .45$), $t(269) = 2.78$, $p < .01$. With regard to state flow, a significant correlation was found between demographic information and flow. Hours of training per week was positively related with flow state, $r = .26$; $p < .01$. In addition, ranking-list players ($M = 3.79$; $SD = .52$) reported a higher intensity of flow state in tennis competition than nonranking-list players ($M = 3.55$; $SD = .52$), $t(132) = 2.54$, $p < .05$. Table 3.2

shows Pearson's Product Moment Correlation Coefficient (*r*) between dispositional and state flow and the personality variables.

Table 3.2

Correlation Coefficients (r) between Dispositional and State Flow and Personality Measures

Variable		Trait Sport Confidence	Imagery Use	Action Control	Absorption
Global	Trait	.57***	.57***	.40***	.01
	State	.34***	.31***	.39***	-.08
CSB	Trait	.56***	.51***	.33***	-.04
	State	.19*	.31***	.28**	-.05
AAM	Trait	.31***	.29***	.18**	.16**
	State	.17*	.10	.25**	.06
CG	Trait	.38***	.46***	.28***	-.03
	State	.25**	.19*	.32***	-.11
UF	Trait	.33***	.36***	.20**	-.02
	State	.22**	.28**	.30***	-.03
CTH	Trait	.41***	.41***	.37***	-.03
	State	.38***	.24**	.35***	-.18*
SC	Trait	.47***	.44***	.37***	.02
	State	.22**	.16	.32***	-.05
LSC	Trait	.28***	.21***	.23***	-.04
	State	.22**	.16	.21*	-.09
TT	Trait	.21***	.24***	.08	.03
	State	.06	.18*	.02	.09
AE	Trait	.41***	.41***	.32***	.04
	State	.26**	.21*	.27**	-.08

Note. CSB = Challenge-Skills Balance; AAM = Action-Awareness Merging; CG = Clear Goals; UF = Unambiguous Feedback; CTH = Concentration on the Task at Hand; SC = Sense of Control; LSC = Loss of Self-Consciousness; TT = Transformation of Time; AE = Autotelic Experience.

**p* < .05. ***p* < .01. ****p* < .001.

For global dispositional flow, the personality variables revealed correlations with moderate to strong effect sizes. The correlation coefficients ($p < .001$) ranged between .57 for trait sport confidence and imagery use, and .40 for action control. For global state flow, correlation coefficients ($p < .001$) varied between .39 for action control, .34 for trait sport confidence, and .31 for imagery use. Absorption did not show any significant correlations with dispositional and state flow on a global level, and only isolated significant correlations on a subscale level. Therefore, absorption was omitted from any further analysed with flow.

On a dispositional flow subscale level, trait sport confidence, imagery use, and action control showed the strongest connections ($p < .001$) with dimensions of challenge-skills balance, clear goals, concentration on the task at hand, sense of control, and autotelic experience, ranging between .28 and .56. Dispositional flow subscales that showed a moderate correlation of $r \geq .30$ with at least two of the personality variables were included as criterion variables in the regression analyses. Strictly speaking, action control did not meet this criterion on the clear-goals subscale, but was also included in the analysis. Although action control showed slightly lower correlations than the cut-off criterion in this exploratory analysis, action control still appeared to be an important variable, revealing stronger correlations with clear goals on a state level. Therefore, associations between the TSCI, SIQ, and ACS-S scores and DFS-2 subscales were examined in more detail using stepwise multiple regression analyses.

On a state flow subscale level, action control demonstrated the strongest correlations ($p < .001$) with concentration on the task at hand, sense of control, clear goals, and unambiguous feedback, ranging between .30 and .35. Confidence was most strongly related to concentration on the task at hand and imagery use to challenge-skills balance. Overall, the personality variables showed the lowest connections with state flow subscales of transformation of time, loss of self-consciousness, and action-awareness merging. The relationships between state flow and the personality variables are examined in more detail using stepwise multiple regression analyses.

Stepwise Multiple Regression Analyses

I performed several test to examine whether the variables used in the regression analyses met the various assumptions in relation to linearity, normality, and heteroscedasticity. The dependent variables (DFS-2, FSS-2) and the predictor variables (ACS-S, SIQ, TAS, and TSCI) showed observed values that closely matched with expected normal linearity. All measures showed a normal distribution with minor skewness for FSS-2 (-.06), DFS-2 (.05), ACS-S (.02), and TAS (.02). Distributions for SIQ (-.29) and TSCI (-.35) were slightly stronger skewed compared to the other measures. Results of the Kolmogorov- Smirnov test further confirmed normality among the variables. In addition, I used the Levene test to examine heterogeneity of variance, indicating that this assumption was met among the variables.

In addition, I performed tests to detect outliers on each of the measures. Three outliers were found, that is one participant scored very high on the TAS and one participant scored very low on the TSCI and the DFS-2. As a very limited number of outliers were found, I decided to keep the original sample size.

Personality Variables and Dispositional Flow

Stepwise multiple regression models were calculated with global dispositional flow and with the flow subscales as criterion variables. Criterion variables were selected based on correlational results, demonstrating a substantial connection between flow dimensions and personality variables with $r \geq .30$, which is considered essential for meaningful interpretations (Jackson et al., 1998). Taking these requirements into account, global dispositional flow and flow subscales of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience were selected as criterion variables. Predictor variables of trait sport confidence, imagery use, and action control were entered in a stepwise fashion into the regression equation to detect the strongest predictor of flow, as well as predictors that contribute significantly to flow. The results for the multiple regression analysis between dispositional flow and the personality variables are presented in Table 3.3.

Table 3.3

Stepwise Multiple Regression Analysis of Personality Variables Predicting Dispositional Flow

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Global Flow					
$R^2 = 45.2$; $F = 73.29$	TSCI	.534	.047	.573***	32.83
	SIQ	.197	.032	.368***	8.29
	ACS-S	.621	.141	.213***	4.00
Challenge-Skills Balance					
$R^2 = 38.1$; $F = 54.72$	TSCI	.077	.007	.558***	31.14
	SIQ	.023	.005	.277***	5.06
	ACS-S	.064	.022	.147**	1.90
Sense of Control					
$R^2 = 30.9$; $F = 39.80$	TSCI	.061	.007	.474***	22.47
	ACS-S	.094	.023	.238***	5.02
	SIQ	.018	.005	.228***	3.42
Concentration on the Task at Hand	SIQ	.043	.006	.405***	16.40
$R^2 = 25.9$; $F = 31.17$	ACS-S	.152	.030	.282***	7.45
	TSCI	.029	.012	.181**	2.02

Table 3.3 (*continued*).

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Autotelic Experience					
$R^2 = 24.4$; $F = 28.66$	SIQ	.040	.005	.413***	17.06
	ACS-S	.110	.027	.226***	4.80
	TSCI	.032	.011	.199**	2.47
Clear Goals					
$R^2 = 24.1$; $F = 42.44$	SIQ	.044	.005	.461***	21.25
	ACS-S	.074	.027	.174**	2.82
Unambiguous Feedback					
$R^2 = 15.2$; $F = 24.04$	SIQ	.035	.005	.360***	12.96
	TSCI	.026	.011	.183**	2.22

Note. Only significant beta weights are shown ($n = 271$).

*$p < .05$. **p < .01. ***$p < .001$.

The regression analysis for global dispositional flow demonstrated that the set of three predictor variables was significant, $F(3, 267) = 73.29$, $p < .001$, explaining 45.2% of the variance in dispositional flow. The strongest predictor of flow was trait sport confidence, accounting for 32.83% of the variance in global dispositional flow. Furthermore, imagery use added 8.29% of unique variance, and action control added another 4.00% of unique variance to dispositional global flow.

Regression results with dispositional flow subscales as criterion variables revealed that the three predictor variables accounted for the variance in challenge-skills balance (38.1%), sense of control (30.9%), concentration on the task at hand (25.9%), autotelic experience (24.4%), and clear goals (24.1%). The strongest predictor was trait sport confidence predicting 31.14% of variance in challenge-skills balance and 22.47% in sense of control. Imagery use was the strongest predictor for clear goals (21.25%), autotelic experience (17.06%), concentration on the task at hand (16.40%), and unambiguous feedback (12.96%). The beta weights for all main predictors were above .35 and significant at a .001-level.

Overall, trait sport confidence and imagery use were the strongest predictors of flow dimensions. The most frequent predictor of dispositional flow subscales was imagery use, contributing significantly to all tested flow subscales. Action control contributed significantly to the flow criterion variables between 7.45% and 1.90%. Action control was not entered as predictor variable for unambiguous feedback, because the correlation was substantially lower than the criterion cut-off.

Personality Variables and State Flow

Stepwise multiple regression models were calculated with global state flow and flow state subscales as criterion variables. Criterion variables were selected based on correlational findings. As expected, dimensions of state flow showed correlations with trait personality variables that were less strong compared to dispositional flow dimensions. Therefore, the cut-off criterion for including flow subscales in the regression analysis was set at $r \geq .25$. Taking these requirements into account, global state flow and flow subscales of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task, and autotelic experience were selected as criterion variables, and trait sport confidence, imagery use, and action control as predictor variables. As shown in Table 3.4, two predictor variables of action control and trait sport confidence significantly contributed to global state flow, $F(3, 131) = 16.24$, $p < .001$, explaining 19.9% of the variance. The strongest predictor of global flow was action control, accounting for 15.52% of the variance, with trait sport confidence adding 4.37% of unique variance.

Table 3.4

Stepwise Multiple Regression Analysis of Personality Variables Predicting State Flow

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Global Flow					
R^2 = 19.9; F = 16.24	ACS-S	1.431	.291	.394***	15.52
	TSCI	.279	.104	.209**	4.37
Concentration on the Task at Hand	TSCI	.085	.018	.378***	14.29
R^2 = 19.5; F = 15.89	ACS-S	.163	.056	.247**	5.24
Challenge-Skills Balance					
R^2 = 13.6; F = 10.27	SIQ	.034	.009	.308***	9.49
	ACS-S	.118	.047	.211*	4.08
Unambiguous Feedback					
R^2 = 12.9; F = 9.68	ACS-S	.168	.046	.301***	9.06
	SIQ	.023	.009	.205*	3.84
Autotelic Experience					
R^2 = 10.3; F = 7.51	ACS-S	.196	.061	.271**	7.34
	TSCI	.045	.022	.185*	2.96
Clear Goals					
R^2 = 10.2; F = 15.00	ACS-S	.182	.047	.319***	10.18

Note. Only significant beta weights are shown (n = 134).

*p < .05. **p < .01. ***p < .001.

Regression results on state flow subscales as criterion variables revealed that a set of two predictor variables accounted for most of the variance in concentration on the task at hand (19.5%), challenge-skills balance (13.6%), unambiguous feedback (12.9%), and autotelic experience (10.3%). The strongest predictors were trait sport confidence for concentration on the task (14.29%), imagery use for challenge-skills balance (9.49%), and action control for unambiguous feedback (9.06%) and autotelic experience (7.34%). Additionally, action control was the sole predictor for clear goals, accounting for 10.18% of the variance. The beta weights for all main predictors were above .30 and analyses were significant on a .001-level, except for autotelic experience. The most frequent predictor of state flow was action control, contributing significantly to global state flow and all flow subscales tested.

Imagery Subscales and Dispositional Flow

Based on the significant regression results between flow and global personality variables, in this subsection, I further investigate which specific personality subscales significantly predict flow. Predictor variables are cognitive and motivational subscales of imagery use. Action control subscales were omitted from this analysis, because subscales of hesitation and volatility showed low reliability scores of .45 and .56, respectively, which were substantially below the commonly accepted limit of .70 (Nunally, 1978). Absorption subscales did not show significantly meaningful associations with flow and were, therefore, omitted from further analysis.

Imagery use consists of five subscales, named cognitive specific (CS), cognitive general (CG), motivation specific (MS), motivation general-arousal (MG-A), and motivation general-mastery (MG-M). These subscales were entered as predictor variables. Previous results showed that imagery use significantly predicted global dispositional flow and dispositional subscales of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience (Table 3.3). These flow dimensions were entered as criterion variables. The regression results for imagery use and dispositional flow are presented in Table 3.5.

Table 3.5

Stepwise Multiple Regression Analysis of Imagery Functions Predicting Dispositional Flow

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Global Flow					
$R^2 = 31.8$; $F = 41.54$	CS	1.229	.128	.505***	25.50
	CG	.688	.160	.290***	4.84
	MG-M	.404	.169	.171*	1.44
Challenge-Skills Balance					
$R^2 = 30.3$; $F = 38.63$	CG	.174	.019	.490***	24.01
	MG-M	.100	.024	.285***	4.58
	CS	.066	.026	.181*	1.66
Sense of Control					
$R^2 = 21.9$; $F = 37.55$	CG	.147	.018	.443***	19.63
	CS	.068	.024	.198**	2.25
Clear Goals					
$R^2 = 21.7$; $F = 37.10$	MG-M	.168	.022	.428***	18.32
	CG	.097	.029	.245**	3.39
Autotelic Experience					
$R^2 = 19.0$; $F = 31.41$	MG-M	.160	.022	.404***	16.32
	MG-A	.077	.026	.190**	2.62

Table 3.5 (*continued*).

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Concentration on the Task at Hand					
$R^2 = 16.0$; $F = 25.45$	CG	.162	.025	.367***	13.47
	MG-M	.091	.033	.209**	2.47
Unambiguous Feedback					
$R^2 = 14.7$; $F = 23.10$	CS	.144	.023	.354***	12.53
	MG-M	.075	.029	.190**	2.19

Note. CS = Cognitive Specific; CG = Cognitive General; MG-M = Motivation General-Mastery; MG-A = Motivational General-Arousal ($n = 271$).

*$p < .05$. **$p < .01$. ***$p < .001$.

The results show that cognitive and motivational subscales of imagery use significantly predicted global dispositional flow. Imagery subscales of CS, CG, and MG-M accounted for 31.8% of the variance of global flow. The cognitive subscales of CS and CG explained 25.50% and 4.84%, respectively, of the variance in global dispositional flow. On a flow subscale level, CG accounted for most of the variance in challenge-skills balance (24.01%), sense of control (19.63%), and concentration on the task at hand (13.47%), CS explained most of the variance in unambiguous feedback (12.53%), and MG-M was the strongest predictor for clear goals (18.32%) and autotelic experience (16.32%). The results show that both cognitive and motivational aspects of imagery significantly predicted global dispositional flow and dimensions of dispositional flow.

Imagery Subscales and State Flow

With regard to state flow, global imagery use significantly predicted global state flow and state dimensions of challenge-skills balance and unambiguous feedback (Table 3.4). These flow dimensions and global state flow were entered as predictor variables. As shown in Table 3.6, MG-M was the sole predictor of global state flow and dimensions of state flow, challenge-skills balance, and unambiguous feedback. Predictions were significant on a .001-level for global state flow and challenge-skill balance, in which MG-M explained 11.70% and 14.59% of the variance, respectively.

Table 3.6

Stepwise Multiple Regression Analysis of Imagery Functions Predicting State Flow

Criterion Variables	*Predictor Variables*	*B*	*SE B*	*BETA*	*Unique Variance (%)*
Global Flow					
$R^2 = 11.7$; $F = 16.92$	MG-M	.999	.243	.342***	11.70
Challenge-Skills Balance					
$R^2 = 14.6$; $F = 21.82$	MG-M	.172	.037	.382***	14.59
Unambiguous Feedback					
$R^2 = 6.7$; $F = 9.25$	MG-M	.117	.038	.260**	6.76

Note. MG-M = Motivation-General Mastery ($n = 134$).

*$p < .05$. **$p < .01$. ***$p < .001$.

The imagery functions of CS, CG, and MG-M appear to be important variables in the experience flow. With regard to cognitive aspects of imagery, CS was the strongest predictor of global dispositional flow, and CG revealed to be the strongest predictor for several dimensions of dispositional flow. With regard to motivational aspects of imagery, MG-M contributed significantly to dispositional global flow, to most dimensions of dispositional flow, and was the only imagery variable that significantly predicted global state flow and dimensions of state flow.

Flow State and Performance

Correlation coefficients were calculated between global flow state and subjective performance assessments. In Table 3.7, the results showed correlations with moderate to strong effect sizes between flow and variables related to competition performance. Assessing competition performance overall, correlations between .41 and .52 were found between flow state and participants' ratings on their technical, tactical, and mental match performance. Specific technical performance ratings on service and groundstroke performance and flow ranged between .33 for second serves and .46 for forehand groundstrokes. Correlations between flow state and situational competition factors varied between .37 for competition importance and .62 for competition commitment.

Table 3.7

Pearson's Product Moment Correlation Coefficients (r) between Flow State and Performance and Situational Factors

	Flow State			
	Technical	Tactical	Mental	
Overall Performance Assessment	.52***	.41***	.42***	
	Service		Groundstroke	
	1st	2nd	FH	BH
Specific Performance Assessment	.40***	.33***	.46***	.44***
	Import.	Commit.	Certainty	Prepar.
Situational Competition Factors	.37***	.62***	.45***	.49***

Note. FH = Forehand; BH = Backhand; Import. = Competition Importance; Commit. = Competition Commitment; Certainty = Certainty towards competition outcome; Prepar. = Competition Preparation (n = 134).

***$p < .001$.

On a flow subscale level, strong correlations (r > .50) were found between competition commitment and challenge-skills balance, clear goals, and autotelic experience, and between technical performance and sense of control. In addition, moderate to strong correlations were found for several flow and performance variables, as shown in Table 3.8.

Table 3.8

Pearson's Product Moment Correlation Coefficients (r) between Flow State Subscales and Performance and Situational Factors

	State Flow								
	CSB	AA	CG	UF	CTH	SC	LSC	TT	AE
Technical	.42	.32	.39	.25	.32	.52	.16	.14	.49
Tactical	.33	.26	.26	.14	.25	.40	.16	.13	.41
Mental	.27	.24	.25	.10	.36	.40	.24	.09	.42
1st Serve	.40	.27	.23	.17	.23	.30	.21	.08	.40
2nd Serve	.19	.22	.22	.07	.22	.24	.18	.12	.37
Forehand	.40	.38	.32	.14	.26	.45	.18	.13	.41
Backhand	.35	.23	.39	.20	.33	.42	.20	.09	.37
Importance	.41	.21	.32	.15	.21	.22	.13	.16	.32
Commitment	.56	.27	.56	.37	.39	.49	.26	.19	.51
Certainty	.35	.23	.29	.26	.28	.41	.24	.16	.35
Preparation	.47	.22	.49	.35	.36	.35	.23	.09	.32

Note. CSB = Challenge-Skills Balance; AAM = Action-Awareness Merging; CG = Clear Goals; UF = Unambiguous Feedback; CTH = Concentration on the Task at Hand; SC = Sense of Control; LSC = Loss of Self-Consciousness; TT = Transformation of Time; AE = Autotelic Experience.

Furthermore, flow state (*n* = 112) was examined with regard to the objective competition outcome. The flow state experience of some participants was examined in tournaments that took place in regional Melbourne or overseas which were not listed on the Tennis Australia website. Therefore, the performance outcome information for participants who did not report the match result on the questionnaire and joined either type of tournament could not be retrospectively retrieved from the Tennis Australia online service. The majority of players won their competition matches (59.82%). A significant positive correlation was found between flow state and number of games won, $r = .28$; $p < .01$. In addition, significant differences emerged between flow intensity and participants who won or lost their competition matches, $t(110) = 3.56$, $p < .001$.

A more detailed analysis on a subscale level showed that participants who won their competition match experienced stronger flow than participants who lost the competition. Except for time transformation, all other flow subscales showed higher scores for winning than for losing the competition. In particular, significant results with strong effect sizes were found for sens of control and autotelic experience. In addition, moderate to strong effect sizes between groups were found for challenge-skills balance, clear goals, unambiguous feedback, and loss of self-consciousness. These results are presented in Table 3.9.

Table 3.9

Differences between Competition Won and Lost and Flow State Subscales

Flow State Subscales	Competition Won *M*	Competition Won *SD*	Competition Lost *M*	Competition Lost *SD*	*t*	*p*	*d*
CSB	15.16	2.50	13.96	3.42	2.15	.034	.42
AA	14.16	2.88	13.02	3.34	1.92	.058	.37
CG	16.24	2.88	14.68	3.11	2.70	.008	.52
UF	16.34	2.76	15.18	3.18	2.04	.044	.40
CTH	14.67	3.36	13.84	3.82	1.21	.231	.23
SC	15.42	2.57	12.98	3.63	4.15	.000	.81
LSC	14.76	3.58	13.16	3.27	2.48	.015	.48
TT	12.76	3.68	13.06	4.23	.405	.686	.08
AE	16.34	3.08	13.32	4.27	4.34	.000	.84

Note. CSB = Challenge-Skills Balance; AAM = Action-Awareness Merging; CG = Clear Goals; UF = Unambiguous Feedback; CTH = Concentration on the Task at Hand; SC = Sense of Control; LSC = Loss of Self-Consciousness; TT = Transformation of Time; AE = Autotelic Experience.

Discussion

The main purpose of this study was to investigate the influence of confidence, imagery use, action control, and absorption on the experience of dispositional and state flow in tennis competition. The results supported theoretical propositions and empirical findings, which predicted that trait sport confidence, imagery use, and action control would underlie flow. The combination of these personality variables was particularly important in predicting dispositional flow on a global and subscale level. In addition, action control was the strongest predictor of global state flow and contributed to all state flow subscales tested.

At the outset of the study, I investigated correlations between demographic information and dispositional and state flow. The results indicated that flow experiences occurred more frequently and more intensely for participants who had more years of tennis training. With regard to skill level, ranking-list players reported higher scores on the dispositional and state flow measures than nonranking-list players. In contrast, there were divergent results on flow in association with age and years of competition experience. Age and competition experience displayed negative relationships with dispositional flow, signifying that younger players and players with less competition involvement experienced flow more regularly. These equivocal findings with competition experience negatively, and number of tournaments positively, related to frequency of flow may be due to the level of tournaments played at different ages, as well as to reasons why participants enter tournament play. Younger players joined mainly club tournaments or other non-ranking list tournaments, which could be perceived as less competitive and stressful, and more fun oriented. Kimiecik and Stein (1992) argued that situational factors, such as competition importance, interact with dispositional variables in the generation of flow. The perceived importance of the competition matches might have been different for ranking and non-ranking list players. In addition, non-ranking list players mentioned fun-related reasons and enjoyment more frequently than ranking-list players for their involvement in tennis and tennis competitions.

Non-ranking list players appeared to prioritise social reasons and experiences related to and emerging from the activity itself, whereas ranking-list players favoured more often outcome-related aspects, namely winning and ranking-list improvement. This may partly account for the contrary findings on flow with regard to competition experience and tournaments entered per year. Another explanation could be that younger participants experience competition pressure as less intense and less pervasive, which could change with higher levels of competition play. With regard to competition pressure in advanced teenage tennis players, Rees and Hardy (2004) examined the influence of social support on flow and competition performance. Rees and Hardy found that participants who reported a high level of pressure during competition, but simultaneously stated they had strong social and emotional support, experienced higher levels of flow, than participants who reported that they received less support.

In this study, a number of players, particularly the non-ranking players, reported that they were involved in several sports at the same time, such as cricket, basketball, or netball. Therefore, tennis might not have had the highest priority for these participants. No significant gender differences were found in frequency and intensity of flow, which supported previous research findings (e.g., Jackson et al., 2001; Russell, 2001), confirming that male and female athletes appear to experience flow in sports in a similar way.

This study revealed two main findings of the regression analyses for dispositional and state flow. First, a substantial amount of variance in dispositional flow was significantly predicted by trait sport confidence, imagery use, and action control, with trait sport confidence accounting for the greatest amount of variance. Second, action control emerged to be the strongest predictor of state flow and the main predictor of several state flow dimensions.

Trait sport confidence was strongly related to dispositional flow and moderately related to state flow. This finding substantiates theoretical contentions of Kimiecik and Stein (1992). Trait sport confidence explained a substantial amount of variance in dispositional and state flow. This result underlines the importance of confidence as one of the main correlates of flow. More specifically, on a dispositional subscale level, trait sport confidence was the strongest predictor of challenge-skills balance and sense of control. From a flow perspective, Csikszentmihalyi (1975, 1988b) proposed that a balance of challenges and skills opens up the opportunity to experience flow, whereas a misbalance of high situational demands and lower personal skills can lead to anxiety. From an anxiety perspective, Martens, Vealey, and Burton (1990) proposed confidence and cognitive anxiety are located on opposite ends of the same continuum, which means that athletes' levels of confidence increase as their cognitive anxiety lowers. Following the theoretical argument on anxiety and flow of Martens et al. (1990) and Csikszentmihalyi (1975, 1988) might explain why confidence had a strong influence on dispositional flow on a global and subscale level. The connection between confidence and flow has been confirmed qualitatively and quantitatively by several studies, focusing on a variety of individual sports, such as swimming, track and field, shooting, cycling (Stavrou & Zervas, 2004), and tennis (Young, 2000), and team sports, such as baseball, basketball, football, softball, and volleyball (Russell, 2001). The results of this study on confidence and flow strongly corroborate earlier findings. Therefore, confidence appears to be one of the key personality variables underlying dispositional and state flow in competitive sports in general and in tennis in particular.

As far as I am aware, imagery use has not been employed as a correlate of flow in previous studies, although, intervention studies by Pates and Maynard (2000) and Pates and colleagues (2001, 2002) used hypnosis, in which imagery was one part of the intervention procedure, to increase flow. Results of the present study showed a strong relationship between imagery and dispositional flow, underscoring theoretical propositions as formulated by Jackson and Csikszentmihalyi (1999). Additionally, imagery use revealed a moderate correlation with state flow, underlining the relevance of the connection between imagery and flow in tennis. Jackson and Csikszentmihalyi (1999) stated that "visualizing the event beforehand, focusing on key elements of the performance as if viewing them on a video screen, helps many athletes make their goals real and their performance more effortless" (p. 85). To explain the effects of imagery use on flow is difficult at this point in time, because no comprehensive theories of imagery functioning have been developed (Morris et al., 2005). Existing theories, such as the psychoneuromuscular hypothesis (Jacobsen, 1931) or cognitive theories, e.g., symbolic learning theory (Sackett, 1934), focused on the influence of imagery in a motor learning context, such as skill acquisition and skill learning (Murphy, 1994).

As Morris et al. (2005) noted, in the area of sport psychology the use of imagery is far more encompassing, which includes the influence of imagery on psychological variables, such as enhancing confidence (Callow & Hardy, 2001) and self-efficacy (Callery & Morris, 1997). Schmidt and Lee (1999), however, proposed that through mental rehearsal "the learner can think about what kinds of things he or she might try, can predict the consequences of each action to some extent on the basis of previous experiences with similar skills, and can perhaps rule out inappropriate courses of action" (p. 312). This argument could not only be appropriate for learners, but also for skilled athletes and competitors. Particularly, this aspect of imagery use to rule out inappropriate courses of action, or stated positively, to use imagery to generate a *blueprint* (Jackson & Csikszentmihalyi, 1999) of what to do, could be facilitative especially for the flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, and sense of control. Correlational findings of this study further supported this argument, as imagery use was moderately to strongly related to these dimensions of dispositional flow. In addition, the use of imagery would take up information-processing capacity, which is not available for debilitative processes, such as worries or ruminations, which may lead to dysfunctional thoughts (Moran, 1996, 2005). Therefore, imagery use could give the athlete an idea of what to do, instead of what not to do, while simultaneously blocking out intrusive and counterproductive thoughts that may influence the performance and the experience of flow.

In addition, imagery is often depicted as involvement and absorption in a highly positive and pleasurable version of some behaviour. At the global level, an imagery experience could really involve flow or a close facsimile of flow, which, like other thoughts, emotions, and behaviours, could then be transferred to the actual situation. The question still remains of how one creates an imagery experience that has an impact on flow. The answer to this would probably prioritise the investigation on characteristics of flow, such as having clear goals, concentrating fully, receiving positive and unambiguous feedback, performing at one's highest levels in terms of challenge-skills balance, and feeling in control.

The results on action control suggested that participants who were more action oriented than state oriented experienced flow more frequently and more intensely in tennis competition. Action control showed significant connections with dispositional and state flow on both a global and subscale level. In addition, action control was the only personality variable that strongly contributed (.001-level) to global dispositional and state flow. The results also indicated that action control significantly predicted various dimensions of dispositional flow, such as sense of control, autotelic experience, and concentration on the task at hand, and dimensions of state flow, such as clear goals and unambiguous feedback. Therefore, action control emerged to be another important variable in conjunction with flow.

To understand the connection between flow and action control, anxiety is a particularly important variable as an integral part of both flow theory and action control theory. Csikszentmihalyi (1975, 1988a) asserted that anxiety is the antithesis of flow, state anxiety signifying the counterpart of state flow. A situation in which action opportunities are limited and perceived as overly demanding and exceeding personal skills will lead to worry or anxiety. Previous results on anxiety in sport showed that athletes' may perceive anxiety levels as either facilitative or debilitative (e.g., Jones & Hanton, 2001; Jones & Swain, 1992). Jones and Hanton (2001) presented a checklist of feeling states to reflect on swimmers' pre-competitive states. The results showed that athletes who experienced cognitive anxiety as more facilitative scored higher on positive feeling states, such as being confident, motivated, focused, and relaxed, than athletes experiencing cognitive anxiety as debilitative. Similarly, within action control theory, Kuhl (1985, 1994a) found that in anxiety-inducing situations, some individuals were able to use proactive coping strategies, termed action orientation, whereas a propensity towards passive coping strategies was termed state orientation. Based on these theoretical notions, action-oriented individuals appear to handle situations more constructively to gain or regain a balance between situational challenges and personal skills to get back into the flow channel (Csikszentmihalyi, 1975). The theoretical hypothesis by Beckmann and Kazén (1994) that performance-related action orientation is a precondition to get into flow was given support by Koehn et al. (2005), in a study with German junior tennis players, and was further corroborated by results of this study.

The results of the present study indicated similarly strong connection between action control and dispositional and state flow. Evaluations of these results need to take into consideration how action orientation, rather than state orientation, fits the demands of tennis competitions. Tennis competitions are characterised by self-paced service performances and externally-paced groundstroke performances, which require the player to focus on and react to fast-moving shots, entailing quick decision making. Assessing tactical decision-making, Roth and Strang (1994) found that soccer athletes with decision-related action orientation showed a better decision quality, in terms of accuracy, and made faster decisions than athletes with decision-related state orientation. These previous studies on action control showed a positive influence of action orientation on flow experience (Koehn et al., 2005) and performance (Roth & Strang, 1994) in sport. The results of this study provided more evidence that action control, or more specifically, the propensity towards action orientation, instead of state orientation, seems to facilitate the experience of flow in tennis competition.

Overall, the results indicated that the personality variables of confidence, imagery use, and action control correlate with the frequent experience of flow and several dimensions of flow. Furthermore, action control appeared to be particularly strong on a state level. These findings suggest that a combination and interplay between confidence, imagery use, and action control may facilitate the experience of flow.

Surprisingly, absorption was not significantly related to either global dispositional or state flow. This finding is not consistent with the result of the only other study I have found on absorption and flow. Dunlap (2006) found a positive connection between the TAS and DFS-2. The sample of the Dunlap study consisted of college students, including Division I athletes and non-athletes, who were older than participants in this study. The age difference between the college sample and the sample of this study could account for the different results on flow and absorption. Flow subscales on the DFS-2 and FSS-2 that, based on the literature (Jackson & Csikszentmihalyi, 1999), should have been more closely related to absorption are action-awareness merging, concentration on the task at hand, loss of self-consciousness, and time transformation. The only significant associations emerged between the TAS and action-awareness merging (trait flow) and concentration on the task at hand (state flow), but the connections were too low for a meaningful interpretation of the results. Between the TAS and the DFS-2 and FSS-2 subscales, most correlation coefficients ranged between -.08 and .06, indicating that there was virtually no link between absorption and flow. This could be due to the generic contents and structure of the TAS measure. All other measures employed in this study were sport specific, whereas the TAS assessed absorption in everyday life.

With regard to flow state and performance, participants disclosed a strong connection between subjective performance ratings and flow during competition. There appears to be a particularly important relationship between perceived performance of specific technical aspects, such as service and groundstrokes, and flow state. General situational factors of competition commitment, competition importance, perceived certainty about competition outcome, and competition preparation appear to be equally important factors in the experience of flow state. With regard to objective performance outcomes, the data suggests that being more successful, in terms of winning games, is associated with a higher flow state. More studies are needed to assess situational and performance factors that influence flow state. Special attention should be given to the flow-performance relationship, with regard to the influence of specific performance types, such as open and closed skills or self-paced and externally-paced tasks.

Methodological Issues

General methodological issues concern test reliability and response bias. The questionnaires applied in this study were found to be reliable, in terms of internal consistency. Deviations from the desirable .70 score (Nunally, 1978) were found for the action control subscales, hesitation and volatility, and the absorption subscale vivid reminiscence. The reason for lower internal consistency scores could be related to the settings addressed in the ACS-S and TAS. The items of the ACS-S referred to a training or competition situation, whereas most of the scales employed in this study regarding flow, confidence, and imagery use addressed a competition setting. The TAS, on the other hand, exclusively referred to situations of everyday life. The assessment of action control and absorption that were not confined to one specific sport situation could have influenced the lower subscale alpha scores in both measures. On a global level though, internal consistency values were above .70 for all employed measures.

Testing for response bias, the Marlowe-Crowne Scale on social desirability showed no significant correlations with trait and state flow, confidence, imagery use, and absorption. A significant, but rather weak, association, $r = .15$, was detected between social desirability and action control. The response bias could be partly due to the response format, because the Marlowe-Crowne Scale and the ACS-S consist of dichotomous items, whereas the remaining scales consist of Likert or percentage scales with a wider range of response options. I concluded that none of the personality measures showed strong patterns of social desirability responding.

I identified two noteworthy limitations of this study, which are related to a) age, and b) using a non-sport specific measure. The first limitation of this study was that I included teenage athletes between 11 and 18 years of age. It is possible that younger participants may have misconstrued some of the items. In particular, a few items on the TAS caused participants to ask about the meaning of specific words, such as *eloquent* or *insurmountable*. With regard to flow, Jackson and Eklund (2004) advocated that 15 years of age would be a suitable lower age limit for the DFS-2 and FSS-2. Jackson and Eklund also mentioned that this lower age limit would only provide a “rough guide” (p. 21). Weiss, Kimmel, and Smith (2001) conducted a study on sport commitment and enjoyment, a variable closely related to the flow concept, with junior tennis players between 10 and 18 years of age. Weiss et al. did not report any difficulties in applying quantitative measures with younger participants. In addition, no complications were found by Koehn et al. (2005) with junior tennis players aged 10 to 18 years, assessing dispositional flow and action control in competition, using German language versions of measures. In previous validation studies of the FSS, Jackson and Marsh (1996) and Doganis, Iosifidou, and Vlachopoulos (2000) included participants of 14 years of age. Several concerns and limitations were addressed in both studies, but not with regard to age range. The mean age in this study was over 14 years and the results did not show any apparent limitations (e.g., internal consistency) by including younger athletes.

Specific test measures for children and teenagers should be preferred to test versions constructed for adults. The population-specific information on flow in tennis competition, however, provided useful indications for future intervention studies to help adolescents in their development to increase flow in competitive sports. With regard to personality variables, in a four-year study, Seidel (2005) found that athletes aged between 10 and 19 were more stress-tolerant, with reference to action orientation during competitions, than athletes with state orientation. The aspect of supporting the personal and sport-specific development of junior athletes needs to be one of the major concerns in competitive sports. This is particularly important for young athletes who perform at a high national or an international level and for sports, in which athletes have to peak comparatively early, which include gymnastics, swimming, and tennis. Future research should adjust questionnaires to younger age groups to gain more accurate information, which will then help to design more appropriate interventions.

The second limitation of this study was the inclusion of a non-sport specific measure of absorption. Absorption was the only personality measure that was not significantly related to either global trait or state flow. This could be due to the generic contents and structure of the TAS. The TAS consists of items which refer to absorptive experiences in a variety of contexts, such as poetic language, music, art, watching TV and movies, nature, textures, and other experiences in everyday life. These general experiences may have a marginal relevance to flow in tennis, as the data suggested. Some experiences, such as “the crackle and flames of wood stimulate my imagination”, may occur rarely in general life. Situations depicted by items, such as “when I listen to music, I can get so caught up in it that I don’t notice anything else” may occur more frequently and have more relevance to sport. For instance, Pates et al. (2003) found that an intervention with self-selected music in combination with imagery enhanced flow and performance in young female netball players.

Absorptive experiences, as referred to in the TAS, are of a general nature, which may or may not involve a structured activity. Tennis competitions, on the other hand, are highly structured by certain rules and require specific technical, tactical, and mental skills to succeed. Athletes specifically train and prepare themselves for competing in tournaments. Therefore, the frequency and intensity of flow experienced in tennis competition is likely to have different patterns to the frequency of absorptive experiences in everyday life. In addition, the TAS relates to various situations that reflect either active or passive characteristics of absorption, whereas flow in tennis competition is signified by highly active involvement with regard to mental and physical performance. For example, a TAS item with rather passive characteristics read “I can be deeply moved by a sunset”, whereas an item with active characteristics read “While acting in a play, I think I could really feel the emotions of the character and "become" her/him for the time being, forgetting both myself and the audience”. Evaluating the nature of the TAS items, there are approximately 16 items that address passive situations. Flow, on the other hand, is reflected by active involvement in the task at hand. Jackson and Csikszentmihalyi (1999) asserted that there is no passive experience of flow in sport. Flow is experienced by the intentional, proactive use of either mental or physical skills, or a combination of both, in a specific, structured activity. It might be, that the phenomenological experience of absorption, as reported by athletes and others when they are in flow, is simply a bi-product, whereas concentration on the task at hand, which is measured in the DFS-2 and FSS-2, is an important antecedent of flow.

There are differences between the TAS items and the flow items, as incorporated in the DFS-2 and FSS-2, which might have played a pivotal role in limiting associations found for the TAS. Therefore, a sport-specific absorption measure could have given more insight into the strength of the relationship between absorption and flow in tennis competition. As far as I am aware, no such scale existed at the time the study was conducted. Further examination of the relationship between absorption and flow is warranted, given the central place of absorption in the conceptualisation and phenomenology of flow in sport.

Implications for Practice

In this investigation of flow in junior tennis players, I found that three personality variables of trait sport confidence, imagery use, and action control were related to flow in tennis competition. Effective interventions to enhance flow in competition should be developed to increase flow experience of junior tennis athletes. Particularly, the finding that imagery use in general, as well as cognitive imagery functions in particular, showed strong correlations with dispositional flow opens up possibilities to include imagery for practical applications, such as interventions. Imagery use is categorised into cognitive and motivational functions (Paivio, 1985). Designing imagery interventions to increase flow, researchers and practitioners need to understand which imagery functions are related to flow and dimensions of flow. There is little research on imagery interventions targeting flow. Although initial findings on successfully using imagery to enhance flow have been reported by Pates et al. (2003), a systematic approach in designing and implementing imagery-based intervention studies on flow has, as yet, not been proposed. Furthermore, interventions on flow state should include particularly important flow dimensions of challenge-skills balance, concentration on the task at hand, and sense of control showed higher correlations, whereas loss of self-consciousness and time transformation indicated zero to low correlations.

Based on the findings of this study, interventions on flow should include action control, imagery use, and confidence, because all variables showed moderate to strong correlations with flow. For instance, given strong correlation and regression results, sport psychologists should adopt strategies to shift state-oriented athletes toward action orientation, which would benefit their experience of flow. Future imagery interventions should target the enhancement of flow and performance, as a growing body of research suggests a connection between flow and performance. For instance, research findings on hypnosis as an intervention method suggested that both flow and performance were positively affected by hypnosis (e.g., Pates, et al., 2001; Lindsay et al., 2005). The results of the present study provide information that can help to implement imagery-guided training programs to enhance specific flow dimensions and performance in tennis competition, which would be valuable for junior players.

Future Research Specific to this Study

Future studies should take the correlational and regression results of this study into account and incorporate these findings to develop and examine interventions to increase the intensity and frequency of flow in competition. Promoting confidence, imagery use, and action control in competition could facilitate athletes' propensity towards flow, which, in turn, might have positive implications for performance, enjoyment, and motivation.

Confidence was found to be strongly related to flow, which corroborated previous research (Stavrou & Zervas, 2004). On a subscale level, trait sport confidence showed strongest connections with challenge-skills balance and sense of control. This appears plausible as athletes need to be confident to feel in control and to perceive a match between situational challenges and personal skills. Further research on the connection between confidence and flow dimensions is warranted as confidence is one of the main variables related to flow and successful performance. Interventions aiming to increase confidence and dimensions of flow could have a positive effect on flow state and performance. In addition, performance accomplishments have a large influence on confidence (Bandura, 1986). Thus, increasing confidence should enhance flow and performance, which should increase confidence again, leading to further increases in flow. Research should go beyond examining single sequences of confidence–flow–performance to investigate two or more cycles of these variables, testing for such spiralling effects.

Results on action control showed a strong connection to flow state. The nature of action control is reflected in the positive, active engagement in, and commitment to, the performance situation, which is signified by the action orientation variable. Aspects of action control, such as performance-related action orientation, reflect the ability to get absorbed into the task at hand, warrant further examination for their effect on flow. Beckmann and Kazén (1994) claimed that action orientation, in contrast to state orientation, is a precondition to get into flow. Koehn et al. (2005) found some evidence that athletes high in performance-related action orientation experienced flow more frequently in competition. Both action control and flow variables should be further examined on a subscale level to enhance the understanding of the relationship between characteristics of action and state orientation and specific dimensions of flow. More detailed knowledge could lead to intervention studies to increase flow in sport. Previous interventions on action control showed that a shift from state to action orientation was facilitated by the use of self-talk and self-instructions (Brunstein, 1994). Self-talk, which has frequently been used in a sport context to control athletes' thoughts and increase performance (Bunker, Williams, & Zinsser, 1993), appears to be a valuable intervention method to enhance action-oriented thoughts. In addition, imagery is often used in interventions alone or alongside self-talk, and has frequently been shown to be effective for developing psychological variables. Given its association with flow in the present study, imagery is another variable with potential for use in interventions to enhance action control to facilitate flow.

The finding that imagery is a substantial predictor of flow is particularly interesting, for two reasons. Firstly, on a theoretical level, cognitive and motivational characteristics appear to play an important role in both imagery and flow constructs, which could develop further understanding of the mechanisms influencing and underlying flow. Studies should examine these exploratory findings on flow and imagery in more detail. For instance, examinations could focus on which cognitive and motivational functions of imagery are particularly important in the prediction of flow dimensions in various sports. Research questions could address how and why single cognitive and motivational functions of imagery, or a combination of both, have an influence on flow. Secondly, on an applied level, imagery can be used as a vehicle to implement interventions to enhance flow directly (Pates et al., 2003) or to increase dimensions of flow, which in turn will increase flow state. Results of the present study showed that cognitive and motivational aspects predicted global flow, as well as various dimensions of flow. The results suggested that dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience would be particularly valuable to target in future imagery intervention studies.

Also, research should more specifically examine the importance of flow dimensions in the generation of flow state itself. Csikszentmihalyi (2000a) made the general theoretical proposition that specific flow dimensions, including challenge-skills balance, clear goals, and unambiguous feedback, could be critical for inducing flow state, whereas other flow dimensions might be concomitants of flow experiences, but less critical antecedents of flow. In this study, I found that on a dispositional and state level, flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience showed stronger correlations with the personality variables than action-awareness merging, loss of self-consciousness, and time transformation. Previous results on flow and perceived sport ability, anxiety, intrinsic motivation (Jackson et al., 1998), and psychological skills (Jackson et al., 2001) have generally supported this finding. Focusing on specific flow dimensions would increase the sensitivity to detect important connections between flow and personality variables. Further investigations could aim to shed more light on the importance of flow dimensions for specific sports and the interaction of flow dimensions in the generation of flow.

Finally, future research on flow in sport would benefit from the development of a sport-specific absorption measure. Absorption has been frequently used to describe flow characteristics. Jackson and Csikszentmihalyi (1999) referred to being absorbed in an activity as one of the essential aspects of flow. Thus, the absence of noteworthy relationships between absorption and flow was surprising. On methodological grounds, I have tried to account for this, arguing that the TAS is a generic measure of absorption, with many items that have little relevance for sport and which reflect passive states, whereas flow signifies active states. Thus, on a conceptual level, it would be interesting to examine whether a sport-specific measure of absorption would be likely to produce stronger associations with flow than in the present study, which would increase the understanding of the concepts of flow and absorption. Furthermore, considering active and passive notions in developing absorption-related items could further underline the proposed activity-based nature of flow (Privette, 1983). Future research could address whether the active cognitive and physical engagement in the activity is a key characteristic to experience flow by separately correlating active and passive aspects of absorption with flow.

This study was the first out of three proposed studies, which examined personality variables underlying dispositional and state flow. The study results gave support to theoretical and research-based predictions that trait sport confidence, imagery use, and action control underlie the frequency of flow experiences in tennis competition. With reference to flow state, the research showed cognitive and motivational aspects of imagery use to be fruitful for further investigations to increase the intensity of flow. These findings need to be further examined in intervention studies.

CHAPTER 4: THE INFLUENCE OF PERSONAL AND SITUATIONAL FACTORS ON FLOW STATE

Introduction

Kimiecik and Stein (1992) proposed a sport-specific concept of flow in which flow results from the interaction of individual characteristics and a structured activity. The model suggests that a range of personality factors, dispositional and state variables, and situational factors affect flow state. In this study, I examined the effects of stable personality variables and different training tasks on flow. Based on findings in Study 1, I chose to examine the effect of trait sport confidence and action control on flow state, because both personality variables showed a significant influence on flow on a dispositional and, more importantly, on a state flow level. This result from Study 1 opened up the opportunity to further examine the effect of confidence and action control on flow state in a specific performance context Considerations of the literature suggested that imagery is a valuable medium for developing and presenting interventions, so, I will employ imagery in that way in Study 3. In the previous study, both variables significantly predicted flow, that is, action control was the strongest predictor of state flow, and confidence was the strongest predictor of dispositional flow. In addition, Kimiecik and Stein proposed confidence to be one of the main personality variables inducing flow state in sport. With regard to situational factors, I investigated the influence of differences in task type, namely self-paced service and externally-paced groundstroke tasks, on flow state. Tennis consists of self-paced first service and externally-paced groundstroke performance, which appears to be an adequate sport for testing task differences. Singer (2000) developed a framework for self-paced and external-paced tasks that highlights distinct differences between task types. In agreement with Kimiecik and Stein, I hypothesised that self-paced tasks would be more likely to induce flow, because performance is self-initiated and not dependent, as in externally-paced situations, on the opponent's preceding performance. To examine flow during self- and externally-paced tennis performance required a specific task setup to be able to assess flow and performance separately and objectively. Even though the developed performance tasks are less complex, for instance with regard to decision making, than performance in a competition match, the training setting appeared to be more appropriate to test flow across task types. Therefore, the aim for this study was to examine the interaction effect between key personality variables, including trait sport confidence and action control, and the situational variable of task type (self-paced and externally-paced) on flow state and performance in tennis. This study will provide significant information on how personal and situational variables interact to build flow state and how the interaction of disposition and situation affects performance. The results from this investigation will provide valuable information in the context of propensity and attainment of flow state.

Method

Participants

I recruited 60 junior tennis players of both genders, who were between 12 and 18 years of age. All participants had several years of general tennis experience and tennis competition experience. At the time of the data collection, 18 participants were listed in the Australian Junior Ranking List, whereas 42 participants were club players.

Measures

Demographic Information

I gathered demographic information with reference to the participants' age, gender, years of tennis experience, years of competitive experience, hours of tennis practice per week, number of tournaments entered per year, and ranking list position.

Flow State Scale-2

The Flow State Scale-2 (FSS-2; Jackson & Eklund, 2002) was the self-report instrument used to assess flow state. I described the FSS-2 in the previous chapter and the FSS-2 is presented in Appendix K. In this study, I used the FSS-2 to retrospectively measure the intensity of flow state for the service and the groundstroke task. I administered the FSS-2 following the completion of each task.

Trait Sport Confidence Inventory

The Trait Sport Confidence Inventory (TSCI; Vealey, 1986) was the self-report instrument I used to assess trait sport confidence in tennis. I described the TSCI in the previous chapter, and the TSCI is presented in Appendix J.

Action Control Scale-Sport

The Action Control Scale-Sport (ACS-S; Beckmann & Elbe, 2003) was the self-report instrument I used to examine action and state orientation in sport. I described the ACS-S in the previous chapter, and the ACS-S is presented in Appendix G. Previous studies measuring action control on the ACS-90, the predecessor of the ACS-S, frequently used median splits to investigate differences between action and state orientation. Median splits have been employed either on the entire scale to address overall differences (Beckmann, 1989), or on a subscale level to examine specific differences in action and state orientation with regard to preoccupation (Strang, 1994), hesitation (Roth, 1993), or volatility (Beckmann, 1987).

On-Court Performance Measurement

Performance comprised a tennis-serving task and a tennis-groundstroke task. First, I describe the on-court equipment that I used in both tasks to measure shot accuracy and ball speed. Second, I explain the pilot study for the establishment of the target sizes. Third, I outline the final set-up for the service task, and, fourth, I address the set-up for the groundstroke task.

Equipment and specifications. Participants performed in a service task and in a groundstroke task. For both tasks I provided a basket of 30 balls for six practice shots and for 24 test shots. To measure performance, two video cameras recorded performance outcomes, with regard to accuracy, and one radar gun recorded the peak velocity of each shot to assess speed-accuracy trade offs between practice and test for service and groundstroke shots. In addition, I used a ball machine to feed the balls into the forehand and backhand corner in the groundstroke task.

For both tasks, I employed drop-down lines to mark the main target areas. The drop-down lines had a yellow colour to be distinctly different from the surface colour of the training courts. For the extended target areas, dashed lines were indicated by grey drop-down squares with 5 cm length of side. The dashed lines could be easily identified in the video footage. In the performance setting, participants stated that the drop-down squares were rather difficult to detect from their baseline position, and were not perceived as a distraction from the main target areas.

I videotaped performances on Sony Mini Digital Video Cassettes, DVM60, for post-performance analysis. Both video cameras operated on 1.80 m tall tripods. I recorded participants' performance, in order to add to the reliability and validity of the performance measurement, in the event that the performance outcome could not be determined by sight. Using a frame-by-frame analysis, performance outcomes, that is, the spot where the ball hit the ground, could be accurately determined. This method of assessment was only necessary for several first serves.

I employed a sport radar gun to measure ball speeds for first and second serves, and for forehand and backhand groundstrokes for all practice and test performances. The ball speed was measured by the Stalker Pro Radar Gun. According to the manufacturers' manual, the following specifications are given. The measurement accuracy varies by ± .169 km per hour. The sample rate includes 31 to 250 readings per second. The target acquisition time is .01 seconds and the maximum range for objects of the size of a tennis ball is 120 m. The radar gun is a cordless, battery-operated device that can be used for tracking continuous speed or peak speed by pointing the gun towards the measurement object. For the peak speed function, the trigger of the radar gun needs to be pulled before the expected peak speed of the object until some time after. With regard to tennis ball speed, the measurement interval commenced just before the racket hit the ball and covered the ball flight from the player to the net, to adjust for target acquisition time. The radar gun displays the fastest measurement over the period of time the trigger was pulled.

Testing for speed differences between practice shots and performance shots, I used the radar gun to verify that no decrease in speed occurred from practice to performance shots, which could positively influence performance accuracy in terms of speed-accuracy trade-offs. In conjunction with the radar gun, I employed the microphone function of one of the cameras, which I placed near the radar gun, to verbalise the maximum speed of each service performance. That means, after the radar gun displayed the peak speed, I immediately added this information to the video recording by making a comment on the maximum speed.

For the groundstroke task, I employed the Elite One ball machine. The Elite One ball machine has a corner-to-corner sweep, is adjustable to flexible ball speed, and timing can be set for frequent ejections. The ball machine was adjusted so that the ball travelled with an initial velocity of 85 km per hour when ejected. The interval time between shots was set with 5 seconds to allow fluent movement from sideline to sideline (8.04 m) and providing enough time for movement without undue fatigue for participants.

Pilot study. In a pilot study, I established the target sizes for the service and groundstroke tasks. Initially, eight individuals of both genders between 12 and 15 years of age and with skill levels similar to the intended study participants were tested on both performance tasks. Employing various target sizes for the service task, I placed two target areas in each service box, with one target area being located at the centre line and the other target area being located at the singles sideline. The shapes of the targets were square for down-the-line serves and rectangular for cross-court serves. I examined three pilot-test target sizes for serves down-the-line, namely 0.5 m by 0.5 m, 0.75 m by 0.75 m, and 1 m by 1 m. The target sizes for rectangular targets for cross-court serves were 1.5 m by 0.5 m, 1.5 m by 1 m, and 2.5 m by 1 m. The extended target area varied between 50 cm and 75 cm in radius around the main service target areas. For the groundstroke task, I positioned square target areas in each corner of the court, enclosed by the singles sideline and the baseline. The two target squares were 2 m, 2.5 m, and 3 m length of side for the groundstroke task. The extended target area varied in size between 75 cm and 100 cm.

Within both performance tasks, I measured performance outcome through visual inspection on-court and through video recordings. First, I visually assessed each performance outcome and documented immediately on paper where the ball hit the ground. I used paper copies of the court set-up for the service (Appendix P) and groundstroke (Appendix Q) tasks, on which I marked the ball-ground contact point. Second, after the on-court assessment, I compared the video recordings with the on-court documentation to verify participants' performance outcomes.

Based on the results of the pilot study, I chose the final target size with regard to the performance outcome that indicated a balance between task challenge and participants' skills. That is, participants in the pilot study demonstrated that an approximately equal amount of balls hit the main target areas, the extended target area, and the general court area for service and groundstroke performance.

Court set-up for the service task. For the main study, I employed service targets with a rectangular size of 1 m by 2.5 m for cross-court serves and 1 m by 1 m squares for down-the-line serves, including a 50 cm extended target area for all targets. The main target areas for the serving task are indicated by the solid lines in red, whereas green and orange signify the extended target areas.

The radar gun was placed 3 m behind the centre of the baseline. One camera was placed near the radar gun behind the baseline, whereas the second camera was positioned 3 m from the doubles sideline and halfway between the net and the baseline to record performance outcomes from a service-line angle.

For the service performance, participants were requested to deliver six first and second serves as part of a practice and warming up phase, followed by 24 shots, consisting of 12 first and 12 second serves. Participants repeated let serves as they would in competition. The score for each service performance ranged between 1 and 4 points, with 4 points reflecting a highly accurate service, which hit the main target area, indicated by the red lines in Figure 4.1.

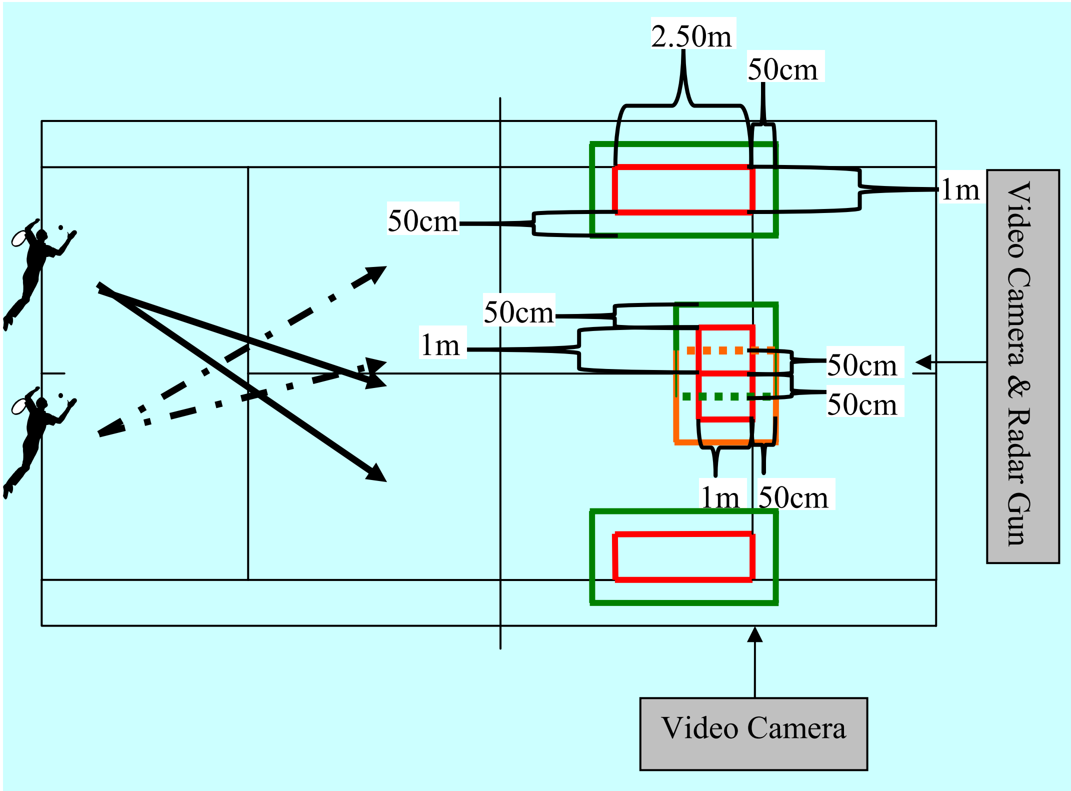

Figure 4.1. On court set-up for the self-paced service task

Participants scored 1 point for serves into the net, 2 points when the ball went over the net, but missed the service box substantially (> 50 cm radius), 3 points when the ball hit the ground close to the target area (< 50cm radius), and 4 points when the ball hit the target area inside the service box. Thus, for the service task, participants could score a total between 24 and 96 points. Participants began with the service task practice and test performance after they indicated that they understood all aspects of the tasks and were ready to perform. After the practice shots, I reminded participants that the test performance starts from then on.

Court set-up for the groundstroke task. Figure 4.2 shows the court set-up with the main target areas for the groundstroke task. I employed targets which were 2.5 m by 2.5 m in size, including a 75 cm extended target area. A ball machine placed the balls alternately to the participants' forehand and backhand corner. After hitting six practice balls to the corners of the court, the participants continuously hit 24 balls, 12 forehand and 12 backhand shots, into the main target areas marked in red, as the balls were projected to them by the machine.

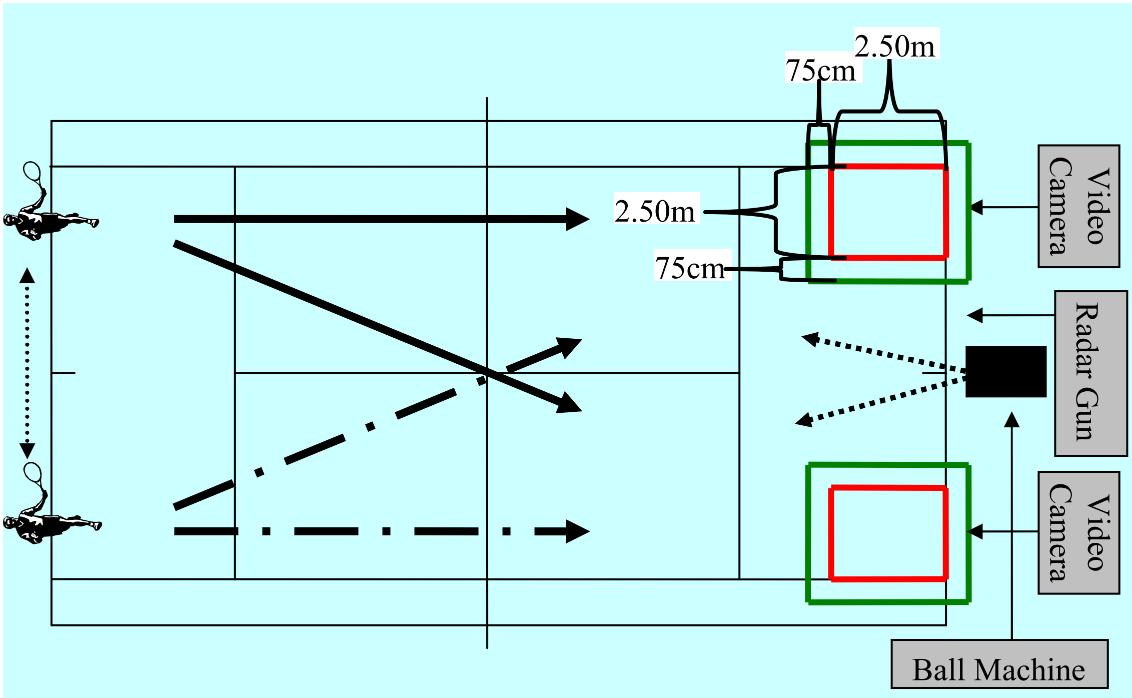

Figure 4.2. On court set-up for the externally-paced groundstroke task

Two video cameras and one radar gun were present to record the participants' performance results and ball speeds. I positioned the video cameras behind each of the target areas, approximately 3 metres beyond the baseline. I positioned the radar gun approximately 3 m behind the centre of the baseline, close to the ball machine.

Similar to the service performance, the groundstroke performance consisted of six shots in a warm-up phase, followed by 24 groundstrokes, including 12 forehand and 12 backhand shots. A ball machine fed the balls to participants' forehand and backhand corners in an alternating fashion. Participants aimed their groundstrokes to two target areas in the forehand and backhand corner on the other side of the court, with two sides bounded by the baseline and single sideline. Participants scored 1 point for groundstrokes into the net, 2 points for shots that missed the target area substantially (> 75cm radius), 3 points when the ball hit the ground close to the target area (< 75cm radius), and 4 points when the ball hit the main target area. Thus, for the groundstroke task, the total score ranged between 24 and 96 points. After participants indicated they were ready to perform, I started the video cameras and ball machine. After the practice shots, I stopped the ball machine indicating the end of the practice phase and I reminded participants that the test phase starts from then on.

Procedure

The research was approved by the Victoria University Ethics Committee. I established contact with tennis squads that were part of Tennis Australia and Tennis Victoria training programs based in Melbourne. In addition, I approached private training programs in metropolitan and regional Melbourne. The tennis program administrators or coaches of the various tennis programs forwarded the information statement and consent forms to the players. Following standard consent procedures, the parents for all underage players, who wanted to join the study as volunteers, signed the consent form.

I encouraged participants to ask questions both immediately after hearing and reading instructions, and at any time during the test sessions. The instructions for the service task required the participant to hit a first serve, followed by a second serve, into the deuce service court. Subsequently, participants continued to perform first and second serves into the ad service court, the deuce service court again, and so on, following a service order comparable to a competition setting. Participants were instructed to treat each pair of service shots as a first service and second service attempt. As I explained to the participants, the aim was to hit as many balls into the main target areas as possible, by performing the individual first and second service routine.

The service and groundstroke performance tasks were measured during training sessions at two different times. At Time 1, I measured participants' service performance and assessed the intensity of flow state after the completion of the service task. At Time 2, I measured participants' forehand and backhand groundstroke shots and the intensity of flow state following the groundstroke performance. Collecting the data on two separate occasions was due to practical considerations. The construction of each performance task took between 10 to 12 minutes. Testing one participant on the service task and, immediately after, on the groundstroke task, would have meant dismantling one set-up and setting up the other and then reversing this for every participant. In addition, participants could only be tested sequentially, with one participant performing at a time. Testing participants within their training sessions needed to be coordinated with the coaches' training schedules. In addition, the training sessions lasted between 45 and 120 minutes, in which flow and performances data could be gathered. For each participant, the time for the introduction to and the performance of the tennis shots was between 10 and 12 minutes for the service task and between 5 to 8 minutes for the groundstroke task. Following the test performance, participants took several minutes to complete the FSS-2. For these practical reasons, I collected data on flow and tennis performances at two training sessions.

Each participant was granted a 10-minute break after the training drills and before testing began to ensure physical and mental readiness for the test performances. I explained the court set-up to each participant and emphasised what the aim of the performance task involved stressing that they should use their normal competition first and second service. After participants indicated they understood all components of the task, the participants then got into position at the baseline and performed the practice services and then the test services. I marked the performance results of the service shots immediately on paper (Appendix O). The participants completed the FSS-2 immediately after the conclusion of the performance task. With reference to the flow measures, I gave explicit instructions to the participants in writing and orally to answer each item of the FSS-2 on the basis of their specific experiences during the performance they just completed. On a separate occasion, after the service task was completed, participants performed an externally-paced forehand and backhand groundstroke task, which I documented immediately on paper (Appendix P). After the completion of the task, participants filled out the FSS-2 to reflect flow state during that task. I compared the on-court paper documentation of the performance outcome with the video footage to verify that the balls hit the ground in the specific court area marked on paper. Following completion of all aspects of the study, I debriefed and thanked the participants for volunteering for and contributing to this study.

Data Analyses

I applied Pearson's Product-Moment Correlation Coefficient (r) to examine relationships between flow states and performance outcomes for self- and externally-paced tasks, demographic information, and personality variables of confidence and action control. I carried out median splits on the TSCI and the ACS-S to obtain groups of high and low confidence, and groups of action and state orientation, respectively. I decided to use median splits, instead of testing upper and lower quartiles, because the overall numbers of participants would have led to 15 participants per group, which, in turn, would have substantially increased the risk of making a Type I error. I then employed two-way repeated measures ANOVA to examine a) the main effect of the independent group variable of high and low confidence on flow and performance, b) the main effect of the repeated measure self- and externally-paced tasks on flow and performance, and c) the interaction effect on flow and performance of high and low confidence and self- and externally-paced tasks. In addition, I employed univariate statistics for main effects to detect differences between groups. I conducted the same analysis using two-way repeated measures ANOVA to investigate main and interaction effects between flow and performance for the independent groups variable of action and state orientation. To examine differences, I used eta squared to express R^2, which is another common name for this measure of effect size (Aron & Aron, 2003).

Results

The results are presented in four subsections. In the first subsection, descriptive statistics contain information on means and standard deviations for demographic information, flow state, and performance accuracy for the service and groundstroke tasks, and personality variables. In addition, I present statistics on mean scores for groups of high and low confidence and for groups of action and state orientation on flow state and performance in the service task and groundstroke task. In the second subsection, the preliminary analyses, I examine the whole sample to gain more information on flow and performance between task types. I present correlational results between flow states and performance outcomes regarding the service and groundstroke tasks, as well as connections between demographic information and personality variables, and flow and performance. In the third subsection, I analyse the main and interaction effects of high and low confidence and task types on flow and performance. In the fourth subsection, I analyse the main and interaction effects of action and state orientation and task types on flow and performance.

Descriptive Statistics

Descriptive statistics include information on demographics, trait sport confidence, action control, and measurements of flow state and performance in the self-paced and externally-paced conditions for the entire sample ($N = 60$). The sample consisted of 15 female and 45 male junior tennis players with a mean age of 13.83 years. Participants' had several years of tennis experience ($M = 5.83$) and competition experience ($M = 3.75$). Alpha coefficients were calculated for the measures showing acceptable internal consistency values for flow state in the service task, α = .93, and the groundstroke task, α = .95, and for personality variables of trait sport confidence, α = .96, and action control, α = .71. Table 4.1 presents the sample's scores for demographic information, flow state, performance, and personality variables.

Table 4.1

Means, Standard Deviations, Minimum and Maximum Scores on the Tested Measures and Variables

Measures and Variables	*M*	*SD*	Minimum	Maximum
Demographic Information				
Age	13.83	1.45	12	18
Tennis exp. (years)	5.83	2.65	1.5	12.0
Competition exp. (years)	3.75	1.77	1.0	10.0
Training hours per week	7.57	6.04	1.0	25.0
Flow State				
Service	137.00	18.29	99	174
Groundstroke	135.22	20.26	89	170
Performance				
Service	56.53	6.99	43	74
Groundstroke	59.43	7.22	43	75
Personality Variables				
Trait Sport Confidence	74.42	18.26	25	107
Action Control	21.40	4.46	13	33

Note. Exp. = Experience.

Participants had several years of tennis and competition performance. Even though the weekly training hours were quite high (*M* = 7.57), the standard deviation of 6.04 indicated that participants differed strongly in their weekly training intensity. In addition, the amount of competition play varied broadly among the participants. With regards to tennis tournaments, 40% of the participants entered between 1 to 5 tennis tournaments per year, 36.7% joined between 6 to 10 tournaments, and 23.3% competed in 11 to 25 tournaments per year.

The descriptive results showed that participants reported similar flow state scores for the service (137 points) and groundstroke (135.22 points) task. With regard to performance accuracy, participants' produced higher performance scores in the externally-paced groundstroke task (*M* = 59.43) than for the self-paced service task (*M* = 56.53). The set-up of both tasks allowed scoring between a minimum of 24 and a maximum of 96 points. The mean performance scores for the service and groundstroke performance indicated that both performance situations represented a medium task difficulty. Participants performed less accurately for first serves (*M* = 27.67; *SD* = 4.01) than for second serves (*M* = 28.87; *SD* = 4.39). With regard to groundstroke accuracy, the mean results showed that forehand shots (*M* = 30.03; *SD* = 4.33) were slightly more accurate than backhand shots (*M* = 29.40; *SD* = 4.43).

Table 4.2

Performance Accuracy and Velocity for the Service and Groundstroke Tasks

Service Task				Groundstroke Task			
1st		2nd		FH		BH	
Accuracy							
M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
27.67	4.01	28.87	4.39	30.03	4.33	29.40	4.43
Velocity							
M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
128.20	21.17	107.94	18.66	89.73	15.61	73.27	13.92

Note. FH = Forehand; BH = Backhand.

A paired-sample t-test showed that the differences between forehand and backhand shot accuracy were significant ($t(1, 59) = 3.51$, $p < .001$) with participants scoring higher in the groundstroke than the service task. Mean difference between first and second serves and between forehand and backhand performance were not significant.

The velocity for first serves ranged between 81.50 kilometres per hour (kph) and 164.83 kph, with a mean speed of 128.20 kph (*SD* = 21.17). Second service speed varied from 75.83 kph to 144.42 kph, with a mean speed of 107.94 kph (*SD* = 18.66). The speed for groundstrokes ranged between 51.34 kph and 123.54 kph for forehand shots, and from 40.56 kph to 114.43 kph for backhand shots. The mean speed for forehand shots was 89.73 kph (*SD* = 15.61) and for backhand shots was 73.27 kph (*SD* = 13.92). Participants mainly used forehand topspin or forehand drive shots, whereas on the backhand side participants employed topspin and drive shots, as well as backhand slice, which is normally played at a slower pace. Testing for speed-accuracy trade-offs, a *t*-test for dependent means showed a significant result for speeds of first and second serves between practice and test assessments, $t(1, 58) = 2.549$, $p < .05$. The data for mean speed showed that participants increased in service speed (kph) from practice ($M = 117.18$; $SD = 19.31$) to test assessment ($M = 118.97$; $SD = 18.93$) by 1.79 kph. No significant differences were found for groundstroke performance speed between practice and performance phases.

Participants' scores on trait sport confidence ranged between 25 and 107 points on the scale which has a possible range of 104 points, showing a median score of 76.5 points. Based on the median split, I divided the sample into high and low confidence groups, with 30 participants in each group. The high-confidence group had a mean score of 88.73 points (*SD* = 8.64) and the low-confidence group a mean score of 60.10 points (*SD* = 13.40). Groups' scores for flow and performance are shown in Table 4.2. Action control scores ranged between 13 and 33 points, on the scale which has a possible range of 36 points. The median for action control was 21, with a mean score of 21.4 points. Therefore, participants scoring 22 points and higher were categorised as action oriented, whereas participants scoring 21 points and less were categorised as state oriented. The mean score for the action-oriented group was 25.33 (*SD* = 3.11) and the mean score for the state-oriented groups was 18.18 (*SD* = 2.24).

Table 4.3

Means and Standard Deviations for Flow and Performance in the Service and Groundstroke Tasks for Groups of High and Low Confidence

		Groups			
		High Confidence		Low Confidence	
Measurements		*M*	*SD*	*M*	*SD*
Flow	Service	140.90	19.62	132.50	16.31
	Groundstroke	142.33	18.34	127.83	19.45
Performance	Service	56.00	6.26	57.07	7.72
	Groundstroke	60.30	6.69	58.57	7.74

The high-confidence group scored higher on flow for both task types than the low-confidence group. Comparing flow scores for each group, the group with high confidence revealed the highest flow score in the groundstroke task, whereas the low-confidence group showed the highest flow score in the service task. With regard to performance outcome, the high-confidence group had lower mean scores in the service task, but performed more accurately in the groundstroke task, than the low-confidence group.

Differences between action and state orientation are presented in Table 4.3. Action-oriented participants scored higher on flow state in the service and groundstroke task than state-oriented participants. With regard to task type, the action-oriented group showed higher flow scores in the service task than in the groundstroke task, whereas the state-oriented group scored similarly in both tasks.

Table 4.4

Means and Standard Deviations for Flow and Performance in the Service and Groundstroke Tasks for Groups of Action and State Orientation

		Groups			
		Action Orientation		State Orientation	
Measurements		*M*	*SD*	*M*	*SD*
Flow	Service	141.30	18.03	132.94	18.08
	Groundstroke	137.70	21.67	132.97	18.86
Performance	Service	55.26	6.85	57.58	7.04
	Groundstroke	58.33	7.83	60.33	6.67

The scores for performance outcome showed that state-oriented participants had a higher mean for service and groundstroke performance than action-oriented participants. With regard to task type, participants of both groups of action and state orientation had lower means for the service than for the groundstroke performance.

In summary, the descriptive analyses showed that groups of confidence and action control differed marginally in flow means between service and groundstroke tasks, ranging within 15 points for lowest and highest flow scores of 127.83 and 142.33. The performance outcome scores showed similar results for confidence and action control groups, varying marginally between 55.26 points and 60.33. Before I used inferential statistics to assess significant differences between groups on flow and performance, I examined the connection between task types for flow and performance. General, exploratory analysis between task types appears to be particularly important because both tasks reflect unique test situations for the assessment of flow and performance.

Preliminary Analysis

Pearson's Product-Moment Correlation Coefficient (*r*) was employed to gain more insight into flow states and performance outcomes for the service and groundstroke tasks. Strong correlations were found between flow states in the service and groundstroke tasks, $r = .71$; $p < .001$, and for performance outcomes between the two tasks, $r = .60$; $p < .001$. Less strong connections were found between flow state and performance outcome for the service task, $r = .28$; $p < .05$, and for the groundstroke task, $r = .33$; $p < .05$. Personality variables showed moderate correlations with flow state. Using Fisher's z transformation to comparing participants' confidence in the self-paced with the externally-paced task, the results showed that confidence had a stronger association with flow in the externally-paced task, $r = .41$; $p < .01$, than in the self-paced task, $r = .27$; $p < .05$. Action control was significantly related to flow state for the service task, $r = .31$; $p < .05$, but not to flow state in the groundstroke task. No significant connections were found between personality variables and performance outcomes. Demographic information showed no significant correlations with flow states, but some demographic variables were correlated with performance outcomes in the service and groundstroke task. Strong connections were found between training hours per week for service performance, $r = .54$; $p < .001$, and groundstroke performance, $r = .52$; $p < .001$. With regard to the participants' skill level, ranking-list players ($n = 18$) scored higher for service and groundstroke performance than non-ranking list players ($n = 42$). An independent-sample *t*-test showed a significant difference between participants' service performance depending on skill level, $t(58) = 3.65$; $p < .01$, and for groundstroke performance depending on skill level, $t(58) = 4.38$; $p < .001$.

Effects of Confidence and Task Types on Flow and Performance

In the two-way, repeated measures ANOVA, the result on the main effect for within-subject differences between service and groundstroke tasks for flow was not significant, $F(1, 58) = 1.80$, *ns*, showing an effect size of $\eta^2 = .01$. A significant main effect on flow state was found between groups of high and low confidence and flow, $F(1, 58) = 6.82$, $p < .05$, $\eta^2 = .11$. The medium effect size accounted for 11% of the variance.

Additional univariate analysis employing *F* tests for simple effects (Winer, 1971) showed a significant result with a medium to large effect size between groups of high- and low confidence on flow in the groundstroke task, $F(1, 58) = 8.86$, $p < .01$, $\eta^2 = .13$. No significant difference was found between high and low confidence for flow in the service task, but scores approached significance with a medium effect size, $F(1, 58) = 3.25$, *ns*, $\eta^2 = .05$.

The interaction effect of high and low confidence and self- and externally-paced tasks on flow was not significant, $F(1, 58) = 2.64$, *ns*, $\eta^2 = .04$. As shown in

Figure 4.3, the difference in flow between confidence groups was larger for the groundstroke task than for the service task. The small to medium effect size, however, indicated a trend toward an interaction effect between the high- and low-confidence groups and task type on flow state.

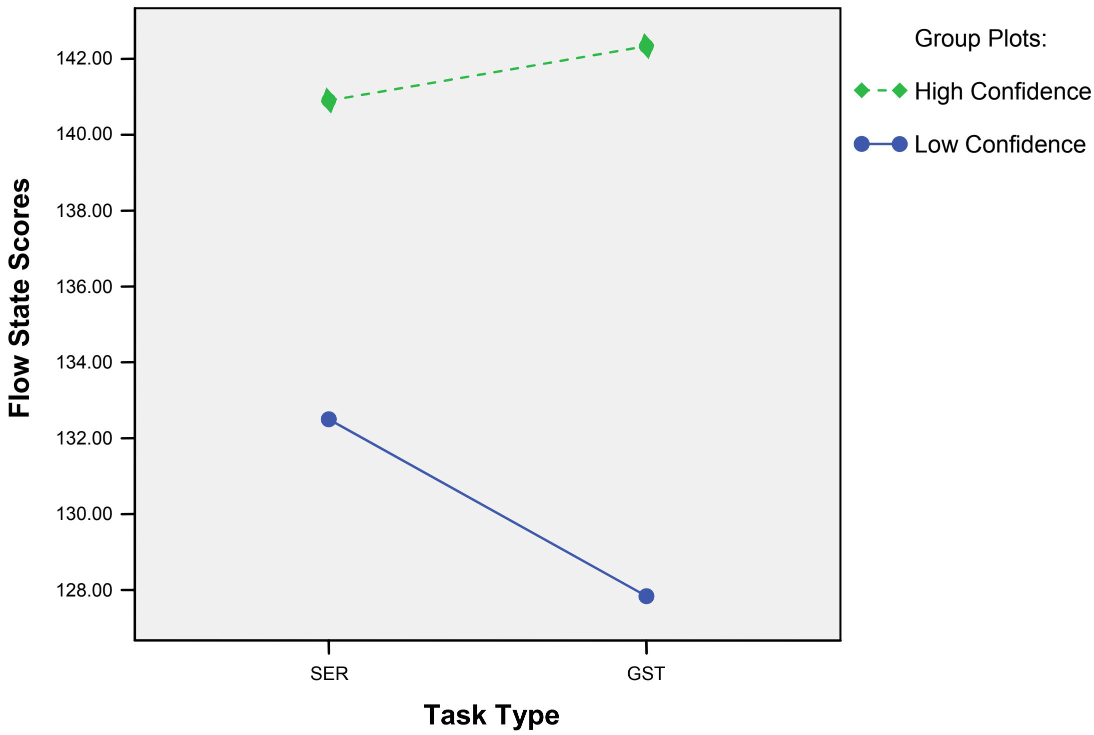

Figure 4.3. Flow state scores on the service (SER) and groundstroke (GST) tasks for high- and low-confidence groups

With regard to performance outcomes, the result of the two-way, repeated measures ANOVA on the main effect between task types of service and groundstroke for performance outcome was significant, showing a large effect size, $F(1, 58) = 12.74$, $p < .001$, $\eta^2 = .18$. That is, participants scored significantly higher on the groundstroke than the service task. The results showed a large effect size between performance tasks that accounted for 18% of the variance. A univariate analysis revealed that performance outcomes between task types did not differ significantly for groups of high and low confidence.

The analysis of high and low confidence in self- and externally-paced tasks for performance outcome showed no significant effect, $F(1, 58) = 2.97$, *ns*, $\eta^2 = .05$. The medium effect size indicated a trend towards a disordinal interaction effect for performance outcome. As shown in Figure 4.4, both high- and low-confident groups showed a higher performance outcome in the groundstroke than in the service task.

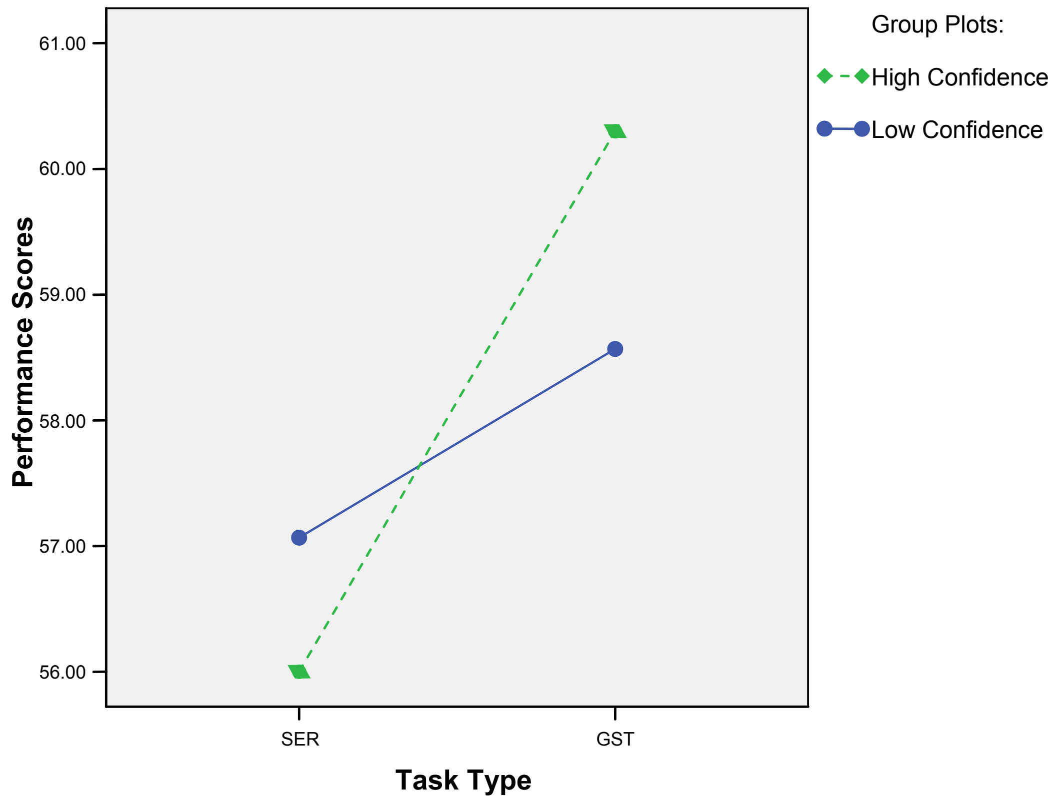

Figure 4.4. Performance scores on the service (SER) and groundstroke (GST) tasks for high- and low-confidence groups

In summary, a significant main effect between groups of high and low confidence was found for flow. A significant main effect was found between task types for performance outcome. In addition, a trend towards an ordinal interaction effect was detected between confidence and task type for flow, whereas a trend towards a disordinal interaction effect was found for the groups across self-paced and externally-paced tasks for performance outcome.

Effects of Action Control and Task Types on Flow and Performance

Figure 4.5 shows that action-oriented participants scored higher on flow in the service and the groundstroke task.

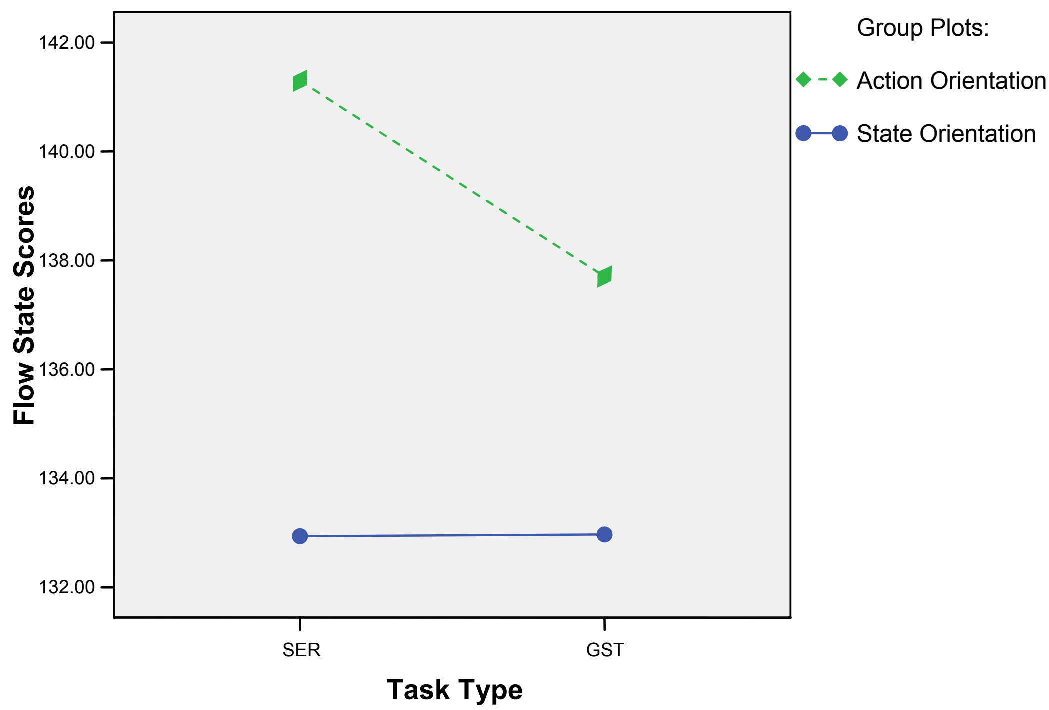

Figure 4.5. Flow state scores on the service (SER) and groundstroke (GST) tasks for groups of action and state orientation

The results for the main effect between groups of action and state orientation on flow was not significant, $F(1, 58) = 2.18$, *ns*, with an effect size of $\eta^2 = .03$. A similar result was found assessing the main effect of task type on flow. Differences in task type for action- and state-oriented groups on flow were not significant, $F(1, 58) = 1.76$, *ns*, showing a small effect size, $\eta^2 = .02$. In addition, there was no significant interaction effect between groups and skill types on flow state, $\eta^2 = .02$.

With regard to performance outcome, Figure 4.6 shows that both action- and state-orientation groups scored higher in the groundstroke than in the service task. A significant main effect was found for task type on performance outcome, $F(1, 58) = 12.13$, $p < .001$, $\eta^2 = .17$, indicating a large effect size. The effect size for performance outcome between the groundstroke and the service task accounted for 17% of the variance.

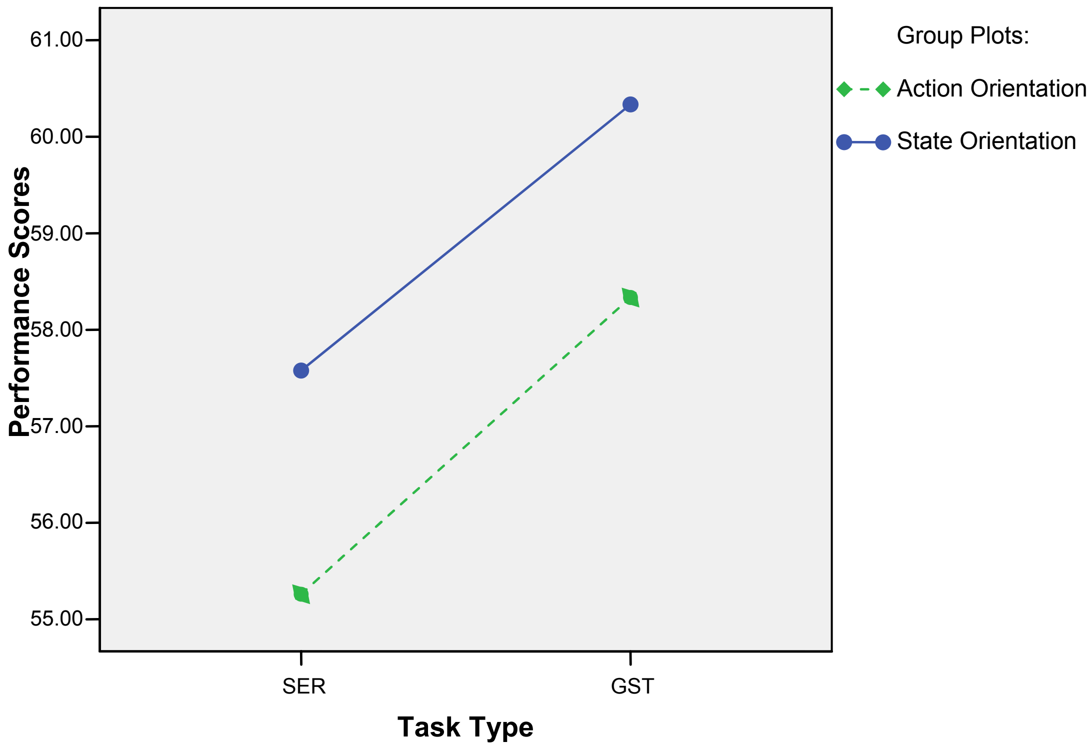

Figure 4.6. Performance scores on the service (SER) and groundstroke (GST) tasks for groups of action and state orientation

A univariate analysis showed no significant main effects between action and state orientation groups for service and groundstroke performance. There was no significant main effect between action and state orientation groups for performance outcome. In addition, there was no significant interaction effect, $F(1, 58) = 1.38$, *ns*, between action control groups and task type for performance outcome, revealing a low effect size, $\eta^2 = .01$.

In summary, there were no significant interaction effects between groups of action and state orientation and task types for flow state or performance outcome. A significant main effect was found between task types and performance outcome. The differences between task types on performance outcome were not significantly influenced by group characteristics of action orientation or state orientation.

Discussion

The main purpose of this study was to examine the interaction effect between dispositional variables and task types on flow state and performance. This study followed the proposition of Kimiecik and Stein (1992), who advocated that flow state is influenced by the interaction of personal and situational factors. I found evidence for a trend towards an ordinal interaction for confidence and flow, suggesting that groups with high and low confidence interplay with task types in the experience of flow state. The ordinal interaction is visibly present for flow, but it is likely to be statistically overwhelmed by the main effect of task type. In addition, the results showed a trend towards a disordinal interaction for confidence and performance, indicating that confidence and task types influence performance outcome. I found no significant interaction effect or trend towards a significant interaction between action- and state-oriented groups and task types for flow. The results indicated that stable personality variables of confidence and action control differ considerably in their interaction with task types on flow state. Based on the evidence presented in this study, the findings suggest that confidence, as a stable personality factor, and task type, as a situation factor, can influence the experience of flow in a training task, which supports propositions of Kimiecik and Stein's (1992) flow model. The results are not conclusive at this point, but these findings provided important evidence for possible interaction effects between personality and task characteristics on flow state.

Because there were no significant interaction effects for flow and performance, the main effects of personality and task type differences on flow states and performance outcomes can be interpreted directly. Participants reported a global flow score of 137 points for the service and 135.22 point for the groundstroke task. Jackson and Eklund (2004) noted that mean scores of 3 (*neither agree nor disagree*) on the FSS-2 items do not show a strong indication of flow. There are 36 items so a score of 3 on each would be reflected in flow state scores of 108. The total flow scores for the service and groundstroke task indicated that participants experienced a reasonable level of flow state or, at least, there was a strong experience of specific flow attributes. Although the maximum flow score of 180 is considerably higher than the flow states experienced in the tennis tasks, researchers in previous studies investigating flow state in field tasks, such as golf chipping (Pates & Maynard, 2000) and golf putting (Pates et al., 2001), found that a majority of flow assessments in the baseline phase were between 120 and 140 points. Based on the reports by Jackson and Eklund (2004) and the research findings by Pates and colleagues (2000, 2001), participants in this study appeared to have experienced flow of a moderate intensity during the tasks.

The results showed that participants high in confidence experienced flow more intensely than participants low in confidence across task types. This finding strengthens previous theoretical propositions (Jackson & Csikszentmihalyi, 1999) and research findings (Stavrou & Zervas, 2004) that there is a general link between high confidence and flow state. For participants who were highly confident in their skills to control the situation, confidence had a facilitative effect on flow state. This was confirmed by the results showing significant differences between groups of high and low confidence in the externally-paced groundstroke task, which indicated that the level of confidence is critical to experience flow during groundstroke performance, in which athletes were less in control than they were in the service task.

An unexpected result was that there were no significant differences between task types and flow state. Kimiecik and Stein (1992) hypothesised that self-paced tasks, rather than externally-paced tasks, would induce flow, because athletes are not required to react to opponents' performance. The mean scores were marginally higher for the service task than for the groundstroke task. Even though this finding is consistent with propositions of flow theory (Kimiecik & Stein, 1992), there were no substantial differences between task type and flow experience. A possible explanation for this result could be that the set-up of the training tasks influenced the experience of flow. The modified performance tasks should have had stronger effects on flow in the groundstroke task, because the service task was nearly identical to service performance in training or competition. The groundstroke task, on the other hand, changed in various ways from regular groundstroke situations. Participants performed groundstroke shots which were fed by a ball machine, controlling for ball speed, ball direction, and alternation of shots. Before performing, participants were informed about the feeding mechanism of the ball machine, the ball speed, target areas, task duration, and task intensity. These characteristics of the groundstroke task reflected a more controlled setting than usual training or competition settings in which participants are used to perform. One of the main differences to a regular groundstroke situation was the absence of an opponent or hitting partner, reflecting a rather interactive performance situation. The opponent was replaced by a ball machine, constituting a repetitive performance condition. The task was predictable and quite rhythmic, requiring participants to hit forehand and backhand shots in an alternating manner. Theoretically, it is the absence of predictability, which would be expected to disrupt flow. With regard to tennis serves, if flow is a common experience in self-paced tasks, maybe it is more prevalent in closed skills, where a whole sequence of movements occurs in a predictable order, such as a gymnastics floor exercise or dance or ice skating routine, which are self-paced and closed. In tennis, each service is followed by an open-skill, externally-paced phase, and, even in practice, services are discrete tasks, not a continuous one like routines in closed-skill sports.

According to Kimiecik and Stein (1992), the absence of the interaction between athlete and opponent should have had a positive influence on participants' flow scores in the externally-paced groundstroke task. Even though the groundstroke task did not involve opponent interferences, there are several ways in which the use of a ball machine could have negatively influenced the flow experience. Csikszentmihalyi (1975) stated that individuals choose certain activities, because they provide specific conditions and experiences that are only found under these circumstances. Altering the groundstroke conditions from an interactive to a repetitive task might not offer the same flow-producing experience as a regular groundstroke situation. Therefore, the players might not have perceived the groundstroke task as an autotelic activity that induces flow. Furthermore, Csikszentmihalyi asserted that autotelic activities display specific characteristics, including the opportunity to be competitive, as reported by basketball players, or creative, such as discovering something new, as reported by chess players and dancers. In this study, both, the competition and creativity components were largely reduced in the test condition of the groundstroke task by the predictability of the ball machine's delivery location and the corresponding target. Therefore, the set-up of the externally-paced task might not have provided optimal conditions to experience flow in tennis. The task challenge was not as great as in a match situation for the groundstroke performance. The lack of challenge could have led to an imbalance between challenge and skill, that is, participants could have perceived the challenge presented to be substantially lower than the skill they possessed, which could have negatively influenced one of the most important preconditions to get into flow.

The results showed significant differences between task types and performance outcome. Groups of high and low confidence scored substantially higher on groundstroke performance than on service performance. Even though conducting a pilot study to set up a service and groundstroke task that reflects a balance between situational challenges (target sizes) and participants' technical skills, the results showed that it was easier for participants to perform in the groundstroke task. With regard to cognitive processes during externally-paced performance, Singer (2000) proposed important characteristics of externally-paced tasks, such as visual search, anticipation, reaction, and decision-making. These cognitive processes were substantially reduced during the groundstroke task, because of the use of a ball machine. The reduction of inherent cognitive processes in externally-paced performance might have further contributed to the aspect that the groundstroke condition was not pure enough to simulate performance in a training situation, let alone in competition. Consequently, the set-up, and the target size in particular, could have been easier for the groundstroke task than for the service task. This, in turn, resulted in substantially higher scores for groundstroke performance, but probably contributed to reduced challenge.

The results on action control and flow state showed that action orientation more strongly influenced flow than state orientation across both tasks. Even though the results did not reach significance, this finding is consistent with previous results of Study 1 that action orientation, rather than state orientation, is facilitative of flow in tennis. One important aspect of action orientation is to get involved and immersed in the activity, which appears to be particularly important for the experience of flow. State orientation, on the other hand, is signified by volatility, which indicates that athletes' focus and thoughts deviate from the task at hand. The mean differences in flow scores between groups of action and state orientation showed that cognitive processes that underlie action orientation had a positive influence on the experience of flow state in the service and groundstroke tasks. The results of this study need to be further investigated in situations that include performance characteristics more strongly related to aspects of action control. These could include, for instance, disengagement from failure and initiation of action plans, which are two important aspects of action orientation. Taking into account findings in Study 1 that showed that action orientation was a strong predictor of flow state in tennis competitions, it appears plausible that more complex performance situations require more specific action planning, tactical decision making, and dealing with failure. Consequently, competition, rather than training, performance could have triggered mediating processes of action and state orientation that, in turn, could produce stronger differences in flow state between action- and state-oriented athletes.

With regard to performance outcomes, state-oriented participants scored higher than action-oriented athletes in the service and groundstroke tasks. This result is contrary to findings of previous research. Several researchers have found that action orientation was superior to state orientation for self-paced and externally-paced performance (Beckmann, 1989; Strang, 1994). It is possible that the effect of action and state orientation would have led to different performance outcomes when the performances involved characteristics more strongly related to action control aspects that required planning or coping with failure. For instance, Strang (1994) examined the effect of a failure induction on tennis players in a groundstroke task. High standard tennis players were instructed to hit groundstrokes into a marked target, which, similar to this study, included a ball machine feeding the balls to the forehand and backhand corner in an alternating manner. The groundstroke task was performed twice. The first session assessed participants' baseline scores. Before the onset of the second session, participants were separated into action- and state-oriented athletes, based on a median split on the failure-related preoccupation subscale of the Action Control Scale, which is a parallel version of the ACS-S. Also, Strang employed Levine's (1971) discrimination task to induce "failure" and "success" before participants performed in the task for a second time. The results showed that only action-oriented athletes in the failure-condition increased their performance outcome significantly between sessions. This finding supports the argument that a performance set-up more specifically directed towards aspects of action control would have facilitated greater differences between action and state orientation in the performance outcome.

Comparing the correlational results between flow state and performance outcome, personality variables were significantly related to flow states, but not to performance outcome. On the other hand, the demographic aspect of training hours per week was connected to performance outcomes, but not to flow states. These results indicated that flow states and performance outcomes were influenced by specific, but separate, antecedents. In addition, the association between flow state and performance outcome was moderate in strength for the service and the groundstroke task, respectively. There appears to be a positive connection between flow and performance. More research is needed to substantiate possible connections between flow and performance, and whether performance could be another factor influencing flow state.

Methodological Issues

My selection of personal and situational variables in this study was based on theoretical propositions by Kimiecik and Stein's (1992) flow model, asserting that confidence and differences in task types would influence flow state. In addition, research evidence gleaned in Study 1 substantiated Kimiecik and Stein's proposition that confidence is one of the major personality variables underlying flow. Also, I found action control to be a strong predictor of flow state. Testing propositions of interactions between personality and situational factors in a field study raised several methodological issues. I identified two noteworthy limitations of the study: a) the use of median splits, and b) the on-court performance task

The first limitation of this study was the employment of median splits to investigate the effect of personality differences on flow. With regard to action control, action and state orientation reflect two constructs with contrasting cognitive processing styles. The mean score for the sample was midway along the ACS-S scale, with a moderate standard deviation, indicating an approximation to a normal distribution. The scores on the ACS-S do not identify participants as extremely action- or state-oriented, but mostly a bit to one side or the other of neutral. Therefore, the identification of action and state orientation through a median split limited the classification of two groups with extreme personality characteristics.

Median splits reflect a common approach to examine personality differences, such as action and state orientation. Previous studies have frequently employed median splits on the ACS-90, a predecessor and parallel version of the sport-specific ACS-S, to investigate differences between action- and state-oriented athletes with regard to preoccupation (Strang, 1994), hesitation (Heckhausen & Strang, 1988), and volatility (Beckmann, 1987). I acknowledge, on the other hand, that median splits bear the disadvantage of reducing meaningful information on a continuous scale into two categorical variables, which can lead to a loss of power and to spurious results (MacCallum, Zhang, Preacher, & Rucker, 2002; Maxwell & Delaney, 1993).

In this study, the situational characteristics naturally provided two distinct task-type variables, whereas making a distinction between psychological variables, such as confidence and action control, had to be done artificially and it was imperative to examine person-situation interactions on flow state. Although correlational statistics can be used in the context of assessing influences of person factors, the separation of a continuous psychological variable into two categories has been frequently used to investigate research question addressing interaction effects. For instance, previous research on interaction effects on flow took this aspect into account by omitting participants who scored near the median (Grove & Lewis, 1996; Jackson & Roberts, 1992).

Examining the top and bottom 40% of the sample, Grove and Lewis (1996) argued that the groups were distinctly separated in their capacities for hypnotic susceptibility. In this study, the range of scores on trait sport confidence and action control approximated a normal distribution. Based on the low numbers of participants in this study, taking out the participants who scored near the median would have reduced the power of the study. Testing 30 participants in each cell maintained approximate power of 80%, whereas a reduction in participants would substantially decrease power to obtain medium effect sizes (Cohen, 1988).

Future studies need to consider whether the use of median splits is an option in the examination flow. Some researchers have argued against the use of median splits (MacCallum et al., 2002; Maxwell & Delaney, 1993). Even though there might be a cost by dichotomising psychological variables, testing for interaction effects between situational and personality variables using median splits might represent a feasible option to analyse individual differences influencing flow. To retain a high level of power and control, as proposed by Grove and Lewis (1996), future studies need appropriate sample sizes to conduct analysis between those people who show more extreme differences in personality variables to produce significant and valid results, such as by excluding a percentage of those with moderate scores

The second limitation of this field study was the on-court performance task. Task issues are related to the observations that a) participants performed on the training court, and b) the task characteristics, especially in the groundstroke task, deviated from a general training or competition situation. Firstly, participants were instructed on the court site, which bears the potential for several distractors to confound the results on flow and performance. For instance, weather conditions (e.g., wind, heat), light conditions (e.g., position of the sun, floodlight), and the presence of onlookers (e.g., squad mates, parents) could have had a potentially distracting effect for the participants. Each factor in itself or a combination of these factors could have had a negative impact on flow and performance. Secondly, inherent characteristics of the on-court performance tasks could have had a similar or even stronger effect on flow than environmental characteristics. The duration of the performance was only several minutes. The results of the Grove and Lewis (1996) study indicated that circuit trainers increased in flow from early to late in the circuit training session. The training session lasted for approximately 45 minutes, whereas participants in this study continuously performed for approximately 5 to 8 minutes. Although, the service task was all done in one block, it is comprised of discrete service performances, which might form breaks in continuity. In addition, the relatively short duration of the tennis tasks could have limited the opportunity for participants to experience changes in flow, such as increases in flow intensity, from onset to conclusion of the task, as found by Grove and Lewis (1996).

With regard to task difficulty, the pilot study was conducted to determine appropriate target sizes for the main study. Particularly, selecting target sizes based on results that indicated a balance between situational challenges and personal skills appeared to be a methodologically sound procedure to examine flow. The results showed that groups generally scored higher on groundstrokes than on service shots. Further analysis is needed to determine whether participants in the main study perceived a difference in difficulty between the service and groundstroke task. Grove and Lewis (1996) noted that the individual selection of the task difficulty from session to session, such as number and type of exercises in circuit training, could have provided experiences of choice and competence, which subsequently facilitated flow. Csikszentmihalyi (1975, 1988b) stated that providing a range of options would have a positive influence on flow. Future studies need to further investigate whether externally-selected or self-selected task difficulty has a stronger effect on the experience of flow.

Measuring speed-accuracy trade offs was a valuable technique to gather more information on what could have had an influence on performance accuracy. Comparing speed measurements between practice and test performance showed an interesting result that supported the previous argument on issues related to task difficulty in a training setting. Participants increased in service peak speed from practice to test performance. This is an unexpected result, because the task was directed at performance accuracy, which I expected to lead to a decrease in peak speed from practice to test performance, based on a substantial literature on speed-accuracy trade-offs (Fitts, 1954; Flach, Guisinger, & Robison, 1996; Schmidt, Zelaznik, Hawkins, Frank, & Quinn, 1979). The pilot study was used to determine target size and did not involve the radar gun to test peak speed. It is possible that the presence of the radar gun in the main study, combined with the absence of negative consequences in the training task, had a positive motivational effect on participants' performance speed and reduced perceptions of anxiety or pressure to make mistakes. The repetitive nature of the service task did not include a return of serve, as opposed to a competition situation that is more interactive with an opponent to return the serve. Even though participants were reminded to serve as if they were in a competition situation, the absence of pressure from a receiving opponent could have decreased participants' perception of the task difficulty, which, in turn, led to an increase in service speed.

Future studies should take these limitations into consideration when designing and conducting field studies on flow. Adjusting performance tasks to the test conditions could have a negative influence on the results, particularly when examining a volatile state like flow. In contrast, researchers should adjust test and measurement instruments to the authentic performance task when investigating flow. Therefore, examinations of interactions of personal and situational variables on flow and performance might reveal stronger results in a real-world investigation, such as a competition setting, rather than a training task. Even though control over test variables decreases and the influence of confounding variables is higher in a real-world setting, the performance tasks are authentic and the results bear stronger ecological validity.

In a similar vein, Perry and Morris (1995) noted that studies including analogue tasks that were conducted in a laboratory setting to increase measurement accuracy, but bear little ecological validity, would lead to low motivation and lack of ego involvement within the test sample. Mainly, test settings for laboratory or field tasks suit methodological aspects, such as measurement needs to examine specific variables, but are not designed to pique participants' interest, which can lower their commitment and involvement in the artificial task set-up. Therefore, it could be that the perception of the task-related challenge-skills balance might not have been sufficient to trigger flow. In addition to athletes' perception of a balance between these two components, athletes need to perceive the task as personally important, that is, they are ego-involved in and committed to the task at hand. These aspects are supported by results in Study 1, showing moderate to strong positive correlations between competition importance and competition commitment and flow state. Put another way, challenge is not the same as task difficulty, namely task difficulty relates to an objective assessment of the task without personal involvement, whereas challenge consists of a subjective component, indicating that the athlete is interested, committed, and ego-involved in the task, experiencing the task and task outcomes as personally important. There appears to be a qualitative difference between task difficulty and challenge in the context of flow and challenge-skills balance.

With regard to flow theory, Csikszentmihalyi (1975) pointed out that the challenge-skills balance is an important precondition to get into flow, but Csikszentmihalyi also suggested that other aspects in relation to the challenge-skills balance could be crucial aspects that affect flow. The challenge component is particularly important, because, to get into flow, individuals need to adopt or develop a personal interest that reflects the relevance and importance of the association between the self and the activity, which is similar to ego-involvement and, in flow terminology, addressed by Csikszentmihalyi as *autotelic involvement*. Beyond the perception of a balance between situational challenges and personal skills, various activities, such as team sports, chess, basketball, or tennis, have salient features that distinguish them from other sports, which make them distinctive and provide unique individual experiences and involvement that relate to camaraderie, discovery, creativity, or competition. Csikszentmihalyi (1975) stated that, “common to all these forms of autotelic involvement is a matching of personal skills against a range of physical or symbolic opportunities for action that represent *meaningful* [italics added] challenges to the individual” (p. 181). Therefore, the possible lack of ego-involvement and meaningful challenges in performance during training tasks further supports the argument to test interaction effects on flow in an ecologically-valid competition setting to further develop an understanding of personal and situational influences on flow state.

Future Research Specific to this Study

Based on the findings and the methodological issues raised in this study, the main direction for future research is that it should examine how differences in situational factors, specifically task characteristics, interplay with person factors to influence flow and whether the interaction between person and situation factors in relation to flow and performance is stronger in an ecologically-valid competition setting than in a training setting.

The connection between task duration and flow appears to be a crucial aspect, when testing interaction effects related to flow in a training setting. In this study, the performance tasks lasted between 5 to 12 minutes, which reflects a rather short duration of performance, compared to the study by Grove and Lewis (1996), who examined flow during performances that lasted between 30 and 45 minutes. Grove and Lewis found that flow increased from early to late in the training session, showing a stronger increase for individuals who were high, rather than low, in hypnotic susceptibility. Future studies should examine whether there are differences in flow state between performances that last for short, moderate, or long periods of time that interplay with personal variables, influencing flow. For instance, within-group differences between groundstroke tasks that last for 5, 15, and 30 minutes would offer more insight into the effect of performance duration on the depth of flow. Similarly, the effect of action and state orientation on flow could have been more substantial with ongoing task duration. One aspect of action control assesses individuals' ability to get immersed into the task, as measured by the performance-related scale. Providing more time on task to athletes might be a critical factor in detection of individual differences between action and state orientation and flow state.

One aspect that warrants further investigation is the effect of task difficulty on flow state. This aspect could be further studied in the context of setting up failure in an actual tennis task and then observing effects for action- and state-oriented players in a less difficult performance task. A similar service and groundstroke set-up as used in this study could be employed. At Time 1, the sample should perform in a failure condition, aiming at target areas that are substantially smaller than in this study to induce failure. At Time 2, the target areas should be enlarged to standard conditions, as employed in this study, and participants perform again shortly after completing the failure condition. This research approach could provide more evidence for different effects of action and state orientation on flow and performance. This might shed more light on the unexpected result that action-oriented participants scored higher on flow state in both tasks, whereas state-oriented participants scored higher on performance in both settings.

Another important aspect for future studies is the examination of interaction effects between personal and situational factors related to flow state and performance in ecologically-valid settings. In comparison to the training situation, the interaction between players in a competition would more strongly stimulate the cognitive processes involved in the self-paced and externally-paced tasks. Particularly, performing the groundstroke training task appeared to be rather repetitive, lacking the interaction of a competition rally. A competition situation would involve the use of more cognitive strategies to successfully perform in self- and externally-paced tasks, as proposed by Singer (2000).

To get into flow in a tennis competition, athletes could either follow an offensive performance strategy (e.g., aiming for winning shots) or a defensive performance strategy (e.g., keeping the ball in play until the opponent makes an unforced error). Both strategies, playing winning or consistent shots, would offer an individual challenge-skills balance for athletes and, therefore, could be similarly effective in the production of flow. Consequently, highly confident players would be more efficient at playing more winners or being more consistent in keeping serves and groundstrokes in play than low confident players, which, in turn, would make them experience higher flow. With regard to action control theory, aiming for winning shots would increase the possibility of making errors. Athletes with a disposition towards action orientation would have more control over cognitive processes to help them deal with failure than state-oriented players. That is, action-oriented athletes disengage faster from previous failure and continue aiming for winners, whereas state-oriented athletes, who are more preoccupied with failure, which would lead to more unforced errors. In addition, action control theory predicts that state-oriented players would be more hesitant in finishing off a rally with a direct winner, whereas action-oriented players would show more initiative. Also, action orientation facilitates athletes' getting more strongly immersed into the performance, whereas state-oriented athletes would be more volatile. Therefore, the impact of the interaction between personality variables of confidence and action control, and self-and externally-paced performance should disclose stronger effects on flow in a competition, than in a training, setting. With regard to ego-involvement, state orientation is more likely to occur in a competition setting than in a training setting, when an athlete is highly invested in a situation and a task that has more importance, or even serious consequences. In a competition situation, athletes might be more likely to ruminate on unforced errors or bad luck than in training or field-study task. The results of research in competition settings would reflect strong ecological validity and generalisability of interaction effects on flow.

In conclusion, the influence of confidence is important for the experience of flow for self-paced and externally-paced tennis performance. In addition, action control appears to be a potentially crucial variable that can influence flow state and performance in tennis. More research is needed to further understand interaction effects between personality variables, such as confidence and action control, and task types, such as service and groundstroke performance, and their impact on flow state. Factorial designs are particularly important because they offer a more complex view on personality and situation differences in athletes' flow experience. The assessment of interaction effects in relation to flow state and performance would further benefit from measuring personal and situational variables in a competition context.

CHAPTER 5: THE EFFECT OF AN IMAGERY INTERVENTION ON FLOW STATE AND PERFORMANCE IN TENNIS COMPETITION

Introduction

Testing propositions of Kimiecik and Stein's (1992) flow framework, Studies 1 and 2 showed that personality and situational variables both had an influence on flow. Consequently, the propositions put forward in this model appear to be useful as guidelines to identify key variables for the development of interventions aimed at increasing flow.

In Study 1 of this thesis, results showed that trait sport confidence, imagery use, and action control were associated with flow on a dispositional and a state level. With regard to dispositional flow, trait sport confidence was the strongest predictor of global flow and dimensions of challenge-skills balance and sense of control, whereas imagery use was the main predictor for clear goals, unambiguous feedback, concentration on the task at hand, and autotelic experience. Action control and confidence were the main predictors of state flow. Consequently, confidence, imagery use, and action control were shown to be important variables underlying flow.

Based on these results, imagery appeared to be a crucial variable that could be employed as a vehicle for the delivery of an intervention procedure to increase flow. Previous studies have supported the usefulness of a four-stage hypnosis intervention (e.g., Lindsay et al., 2005; Pates et al., 2001, 2002), including trigger-control techniques, and an imagery intervention (Pates et al., 2003) in combination with music to increase both flow state and performance. To date, there has been no research that employed a standardized imagery script to enhance flow state and performance in a competition setting.

In Study 2, I examined the influence of an interaction effect of stable personality variables of trait sport confidence and action control and situational variables, namely self-paced and externally-paced performance tasks, on flow and performance. A trend towards an interaction emerged between confidence and task types on flow, indicating that tennis athletes high in confidence scored higher in the service and groundstroke task than athletes low in confidence. There was no trend towards an interaction effect for action control groups and task types, but the training setting could have debilitated action-control effects on flow. With regard to performance, I found significant differences between self-paced and externally-paced performance outcomes. In general, the results showed that personal variables had a stronger influence on flow state, whereas differences in task type had a bigger effect on performance outcome. Consequently, an imagery intervention that includes personality factors, namely confidence and action control, specifically addressing self- and externally-paced performance situations would optimise the effect of an intervention on flow state and performance.

Several studies underlined the importance of imagery positively influencing personality variables, flow, and performance. Previous imagery interventions in sport have successfully used imagery to enhance variables closely linked to performance, such as self-confidence (e.g., Callow et al., 2001) and self-efficacy (Callery & Morris, 1997), and to increase performance in a training or competition setting (Morris et al., 2005). In a meta-analysis on mental practice, Feltz and Landers (1983) found that imagery is more effective in connection with cognitive tasks than it is for motor or strength tasks. In addition, Feltz and Landers proposed that mental rehearsal facilitates focused concentration on a specific skill. In an interview study, elite Japanese athletes reported that parts of their flow experiences were accompanied by images of seeing themselves performing (Sugiyama & Inomata, 2005). Pates et al. (2003) found that an imagery intervention in conjunction with music increases flow and performance in a training setting. Jackson and Csikszentmihalyi (1999) reported that imagery helps athletes to more strongly experience flow dimensions, such as clear goals. More specifically, Morris et al. (2005) advocated, “imagery, which is specifically directed at the antecedents in a particular sport context, should enhance the experience of flow” (p. 327). There appears to be substantial theoretical correspondence between imagery and the experience of flow, as well as research-based evidence of the effectiveness of imagery to increase flow state, performance, and personality variables, such as confidence, related to flow. Thus, I proposed to employ imagery as the medium for delivery of an intervention aimed to enhance flow state and performance in tennis.

In this thesis, the development of the imagery intervention resulted from propositions of Kimiecik and Stein’s (1992) flow model and findings of Studies 1 and 2, corroborating characteristics of the flow model. Study 1 demonstrated that confidence and action control are important personality variables underlying flow. For the intervention, I chose imagery as a vehicle, because of the strong connection between imagery and flow, as found in Study 1, and the reported effectiveness of imagery to increase flow and performance (e.g., Pates et al., 2003). In addition, imagery interventions have been shown to be beneficial for changing and enhancing psychological variables related to flow, such as confidence (Callow et al., 2001). Consequently, based on these previous results, I developed an imagery script tailored to enhance confidence and action control in relation to flow. I predicted that this would facilitate the experience of flow. The script emphasised particularly strong connections between the personality variables of confidence and action control and flow dimensions of challenge-skills balance, clear goals, concentration on the task, sense of control, and autotelic experience that came up as the most salient features of flow in tennis competition in Study 1. The results in Study 2 showed that there was a significant difference in performance outcome between the self-paced service and externally-paced groundstroke task. I found large effect sizes between task types and performance when examining confidence and action control groups. Therefore, I developed an imagery intervention that addressed self-paced and externally-paced performance situations separately to increase flow state and performance in tennis competition. In agreement with Stavrou and Zervas (2004), I hypothesised that an increase in flow state would be accompanied by an increase of performance.

It seems to be pivotal to examine these variables in a competition context. Findings in Study 2 indicated that modified task characteristics in field conditions had a substantial effect on the performance outcome and athletes' ego-involvement in the task, which could have negatively influenced the experience of flow. Csikszentmihalyi (1975) advocated that people's autotelic involvement in activities that represent meaningful challenges should positively affect the experience of flow. Consequently, to conduct research in real competition settings would facilitate ego-involvement in the task, thus, providing results with strong ecological validity for flow and performance.

The aims of this study are twofold. First, I examined the effect of an imagery intervention on personality variables of confidence and action control to increase flow dimensions and, thus, to intensify flow state. Second, I investigated the effect of the imagery intervention on performance in self-paced and externally-paced performance situations in tennis competition. This study will make an original contribution to the examination of an imagery intervention on flow state and performance. Evaluating the effectiveness of the imagery intervention could further benefit theoretical aspects of the flow model, adding evidence to the influence of imagery types on personality variables affecting antecedents of flow. Furthermore, the intervention could shed more light on the connection between flow state and performance outcomes in a competition setting. From an applied perspective, aiming to increase flow state could have a positive effect on participants' quality of competition experience and competition performance.

Method

Participants

I recruited four male junior ranking-list players from metropolitan Melbourne. I chose these participants, because of similarities in age, competition experience, and ranking-list position, contributing to a homogeneous sample. The participants were between 13 and 15 years of age when the study commenced. Their tennis experience ranged from 3.5 to 7 years (*M* = 5.63) and their competition experience from 2 to 4 years (*M* = 3.00). The participants spent between 9 and 25 hours per week on the tennis court training (*M* = 14.88). They entered between 6 and 20 tournaments per year, which were mainly ranking-list tournaments, including national championships. At the outset of the study, the players' ranking-list positions ranged between 203 and 244 in the Australian National Junior Ranking List for 10 to 18 year-old players.

Table 5.1

Demographic Information for Participants 1 to 4

Measure and variable	Participants			
	1	2	3	4
Demographic Information				
Age	15	13	13	14
Tennis experience (years)	7	3.5	7	5
Comp. experience (years)	4	3	2	3
Training hours per week	9	25	13	12.5
Tournaments per year	6-10	11-15	11-15	16-20
Ranking (outset)	214	203	221	244

Note. Comp. = Competition. SIAM = Sport Imagery Ability Measure.

Design

I employed a single-case design to examine the effect of imagery on flow and performance. Researchers have identified several advantages for the use of single-case designs in applied settings (Bryan, 1987; Hrycaiko & Martin, 1996; Kazdin, 2001; Marlow, Bull, Heath, & Shambrook, 1998; Shambrook & Bull, 1996). The proposed argument mainly focuses on advantages of single-case designs to detect intervention effects on performance, which appears to be a valid argument to evaluate intervention efficacy for psychological variables, such as flow. Zaichkowsky (1980) and Bryan (1987) argued that minor performance enhancements could have a practical significance for the individual athlete and competitor, whereas, in a group context, small performance increments could not be pinpointed or would possibly not reach statistical significance. Single-case studies require a small number of three to five participants, which is considered to be an adequate sample size to gain sufficient information to evaluate performance and performance-enhancing interventions (Hrycaiko & Martin, 1996).

In the single-case design, measurements are repeatedly taken and evaluated over a period of time, emphasising individual fluctuation margins in performance. Ongoing measurement is valuable for athletes and coaches themselves to establish performance developments. Athletes act as their own control to assess intervention effects between baseline and post-intervention conditions. This is also important for an applied setting, because all athletes benefit from performance-enhancing interventions, and single-case designs do not require a non-treatment control group (Hrycaiko & Martin, 1996).

Finally, Hrycaiko and Martin (1996) advocated that single-case designs facilitate the examination of intervention effects from an athlete's point of view, incorporating a concluding interview as part of the social validation of the study.

Wollman (1986) noted that the efficacy and success of the intervention partly depends on athletes' thoughts, feelings, and attitudes towards the intervention, proposing that "certain factors that are not directly manipulated (e.g., subject characteristics, experimental setting) … lead to certain experiences and resulting performance effects" (p. 137). Previous studies have demonstrated that this type of design is beneficial to test the efficacy of treatments and interventions on variables, such as flow and performance (e.g., Pates et al., 2002, 2003).

Based on these propositions and research findings, I employed a single-case A-B, multiple-baseline design to evaluate the efficacy of an imagery intervention for increasing flow state and performance. Measuring participants' flow state and performance in a competition setting required that the intervention complemented the participants' training and competition schedule. This was satisfactorily achieved by incorporating a nonconcurrent design (Barlow & Herson, 1984). That is, the baseline commenced for each participant at different points in time and the baseline phase varied in length until each participant met a stability criterion. The intervention design required observations on flow state and performance throughout baseline and post-intervention phases. I introduced the intervention to each participant after the participant met a stability criterion. The stability criterion was attained when the participants' flow states were steady or flow revealed a trend that was opposite to the intended treatment effect (Hrycaiko & Martin, 1996).

Measures

Demographic Information

I gathered demographic information (Appendix D) with reference to the participants' age, gender, years of tennis experience, years of competitive experience, hours of tennis practice per week, and number of tournaments entered per year.

Modified Flow State Scale-2

The FSS-2 was the self-report instrument I used to assess flow state in competition, as described in Chapter 3. For this study, I modified the original version of the FSS-2 by including two additional response scales to the original response scale to assess flow experience in tennis competition. This modified version measured the intensity of flow for each competition set. Accordingly, participants responded to each item twice or three times, depending on the number of sets played. This modification appears to be appropriate to gain more accurate information on the development and variation of flow intensity over the course of a competition match. Measuring flow once for the entire competition would not give any indication whether flow varied with regard to the outcome of the set. Previous results highlighted that flow is an ephemeral and volatile state (Jackson, 1995; Young, 2000) that can be influenced by performance outcomes (Jackson et al., 2001). Each set in tennis competition unfolds differently, which, in turn, could influence players' flow state. The validity of the FSS-2 should not be compromised, as there are no response format or item modifications. The modified version of the FSS-2 is presented in Appendix T.

Sport Imagery Ability Measure

The Sport Imagery Ability Measure (SIAM; Watt, Morris, & Andersen, 2004) assesses athletes' imagery ability in sport. Athletes imagine each of four generic sport scenes for a duration of 60 seconds. The four scenes refer to participants' imagery ability with regard to the home venue, a successful competition, a slow start, and a training session. Following each set, athletes respond to 12 items with reference to that particular scene. The 12 imagery ability items consist of specific dimensions, including control, vividness, ease, speed of generation, and duration, as well as modalities, including kinaesthetic, tactile, visual, auditory, olfactory, and gustatory senses associated with the image. In addition, one item assesses emotion experienced during each scene. Participants make their response on a 100-mm analogue scale, anchored by opposing statements, for instance, *no feeling* and *very clear feeling* for the tactile modality of imagery. If a participant had a clear feeling of the image, placing a cross at the 90mm spot would be scored as 90 points on the scale which ranges between 0 (left end of the scale) and 100 (right end of scale). The items comprising each dimension or modality are added up for each of the four scenes in the SIAM to create an overall score for each dimension or modality, respectively. The overall score for each dimension or modality varies between 0 and 400 points. Through the validation process, the SIAM revealed alpha values between .66 and .87. The SIAM has been used frequently during validation processes (Watt et al., 2004; Watt, Morris, Lintunen, Elfving, & Riches, 2001). In this study, the SIAM

(Appendix U) was administered to ensure that participants had sufficient imagery ability to perform the imagery tasks in the script.

Competition Performance Measure

I assessed competition performance by focussing on the number of winners from first serves, and forehand and backhand groundstrokes. Winning shots were considered direct winners, as well as shots where the opponent was unable to reach and hit the ball in a controlled manner (e.g., hitting the ball on the frame). I videotaped the competition matches of each player and subsequently analysed their performances, transcribing the service and groundstroke performance outcome on paper (Appendix V). Rallies that ended with either player hitting a volley at the net position were not included in the performance assessment, as net situations appear to be different from baseline situations. In addition, I included participants' ranking list position at the onset and conclusion of the study as an objective and ecologically-valid measure of performance.

Adherence Log

I handed out an adherence log to the participants to keep track of the participants' experiences during the imagery sessions and provide them with the opportunity to note any changes in their experiences. The booklet provided participants space to comment on their imagery, regarding how strongly and vividly they experienced the various images relating to flow and tennis performance. In addition to these comments, participants rated their experiences of imaging serves and groundstrokes on scales that measure vividness and clarity of the images. I present the adherence log in Appendix X.

Social Validation Interview

To further explore the effectiveness of the intervention and what the participants experienced during the course of the study, I interviewed each participant after the conclusion of the study and transcribed their responses verbatim. This type of interviewing for the purpose of social validation is a common procedure in single-case studies (Barlow & Hersen, 1984). The duration of the interview ranged between 15 and 25 minutes. The contents of the interview focused on differences in flow experiences and performance between baseline and post-intervention phase, as well as variables that could have been altered through the intervention, such as imagery use, confidence, and action control. I also asked participants about their commitment to using imagery in the intervention and post-intervention phase. In addition, I addressed whether participants noticed any changes in relation to competition importance and competition commitment, their certainty or uncertainty about competition outcomes, and their mental and physical preparation for the competition matches.

Imagery Intervention

For the intervention, I developed a standardised imagery script based on the correlational findings in Study 1. I found moderate to strong correlations between flow dimensions and personality variables of imagery use, confidence, and action control. I translated the strongest correlations between flow and personality variables into written form and integrated these findings into two common performance situations in tennis. The performance situations involved service and groundstroke shots. The script included both stimulus and response propositions (Lang, 1977, 1979). Stimulus propositions are content-related images, which are descriptive in nature. Response propositions are related to the actual response, in terms of imaging specific actions or behaviours. For instance, stimulus specific propositions in the imagery script read: “Now, you are standing at the baseline, seeing your opponent waiting for you to serve on the other side of the net”. An example of response specific propositions read “You are confident in your skills, even in tough match situations, knowing that you have the ability to meet the challenge. It is hard to serve right in this corner of the service box, but you know you can hit the spot with a really fast and heavily spun ball”. Lang (1977) advocated that stimulus and response propositions within imagery would increase the connections between learning and performing.

The imagery script consisted of three parts, including relaxation, imagery of first and second serves, and imagery of forehand and backhand strokes. Images of successful and winning performance, as well as images of being confident and in control were incorporated into the script to enhance flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience, which were the flow dimensions that correlated highly with personality variables of confidence and action control in Study 1.

With regard to flow, I translated significant connections between the imagery use functions and flow dimensions into the script. That is, I linked cognitive-specific, cognitive-general, and general-motivational mastery functions of imagery with the most salient flow dimensions. For instance, putting emphasis on cognitive-specific images and challenge-skills balance read “You know you have the skills to hit the ball into the anticipated target area”, and “You know you have the skills and confidence to hit winning baseline shots”. Images regarding the cognitive-general function related to tactics and specific goals. An example of the association between cognitive-general imagery and the flow dimensions of clear goals read “The closer the ball comes the more focused you are, knowing that you will hit the ball into a specific target area”. The script also emphasised imagery functions of general-motivational mastery, which was strongly correlated with flow dimensions in Study 1. The motivation general-mastery function includes images of mastery, being confident, and feeling in control. The significant connection between mastery and flow dimensions, with regard to challenge-skills balance, read “It is hard to serve right in this corner of the service box, but you know you can hit the spot with a really fast and heavily spun ball”, with regard to unambiguous feedback “The visual feedback about the service performance gives your confidence an extra boost”, and with regard to autotelic experience “In your mind’s eye, image yourself performing perfectly; you are confidently hitting forehand and backhand winners while having fun”.

Similarly, I incorporated personality variables by translating significant connections between flow and confidence and action control into the script. Confidence was a crucial aspect in the development of images of general-motivational mastery. The emphasis of confidence and mastery images in regard to flow was important, because of the strong connection between the personality variable of confidence and flow found in Study 1. For instance, the connection between confidence and mastery imagery emphasising sense of control, read "You feel in control and confident about the winning serve". Accentuating the link between confidence, mastery imagery, and autotelic experience, read "You are hitting winning serves while feeling confident and having fun". With regard to action control, a disposition towards action orientation showed a significant relationship with flow in Study 1. I addressed the connection between action control and flow by including sentences that aimed to promote action-oriented thoughts. Several studies have found self-talk to be a beneficial technique to shift individuals from state to action orientation (Brunstein, 1994; Stiensmeier-Pelster & Schürmann, 1994). Therefore, self-talk in combination with imagery was chosen to increase participants' action-oriented thoughts during competition. Consequently, sentences carrying action-oriented contents stood out from the rest of the imagery script indicated by quotation marks, indented letters, and putting the sentence on a separate line. An introductory sentence indicated the following self-talk sentence through phrases that read "You say to yourself" or "You think to yourself". I linked action-control contents with several aspects of flow that read, with regard to challenge-skills balance, "I am up to the serving task", with regard to concentration on the task at hand, "My concentration focuses entirely on the next serve", and with regard to sense of control, "I have total control over my baseline shots".

With reference to performance, the script consisted of subsections that addressed the sequence of three important parts of the service and groundstroke performance, namely pre-shot routine, vital aspects during performance, and performance outcomes. With reference to pre-shot routines, I instructed participants to imagine preparing themselves for a serve or baseline shot, visualising the match situation for that game and point from an external imagery perspective that included their own and their opponent's position on court. During the shot, the description of the performance switched from an external to an internal imagery perspective. The internal imagery perspective particularly emphasised the kinaesthetic aspects of the performance, that is, the sensory information associated with movements involved in the process or technique of performing the shot. Finally, I instructed participants to image a successful performance outcome, such as hitting a winning serve or groundstroke.

The three parts of the performance situations included imagery of visual, auditory, and kinaesthetic senses, such as feeling the grip of the racket and the tennis ball, as well as imaging the muscles contract and relax. The use of senses was primarily connected to imagery functions of cognitive-specific skills to execute a shot. For service performance, aspects of this image were reflected in sentences like "You toss the ball; you can feel how the ball lifts off your hand, describing a line, which is perfect for your serve. Simultaneously, you are swinging your racket backwards and upwards". In addition, participants imaged their service and groundstroke routine as part of their game plan and strategy, addressing cognitive-general functions of imagery. For instance, imaging a sequence of several groundstrokes, I directed images of the final forehand or backhand stroke the way that participants saw themselves hitting the ball crosscourt or down-the-line into target areas in the right and left side of the court.

Imaging the whole performance situation and giving a proper response to various shots was intended to develop and enhance the participants' strategies and game plans on court. I present the imagery script in Appendix W.

Procedure

The research was approved by the Victoria University Ethics Committee. I requested access to players in junior tennis squads run by Tennis Australia and private tennis clubs in Melbourne, Australia. Coaches passed on the information statement to the junior players. Players who wanted to participate in this study as volunteers returned the consent form signed by their parents. To ensure participants had at least moderate skills in the use of various aspects of imagery, I administered the SIAM, in which participants had to reflect on the clarity, vividness, controllability, and intensity of senses that occurred within their images. Evaluating the results of the SIAM was indicative of individual differences in generating specific images, which might have influenced the efficacy of the imagery intervention. I also requested access and consent from tournament directors to videotape participants' competition performance at the various ranking list tournaments. After the completion of each competition match, I asked participants to fill out the modified version of the FSS-2 on their flow experience during the competition. Baseline observations included five (Participants 1 and 2) or four (Participants 3 and 4) competition matches, respectively, which took place over a period of three to five weeks.

The intervention consisted of an education phase, an acquisition phase, and a practice phase (Weinberg & Gould, 2003). First, individually or in a group session, I informed participants about the importance of cognitive techniques, influencing competitive performance. Second, I instructed participants on how to use the imagery scripts. Third, I asked participants to use imagery as an off-court training routine to integrate imagery into their preparation for training sessions and competition matches. Immediately after the conclusion of the baseline phase, I introduced the imagery script to the participants and explained how to independently work with the script. I gave all participants the same information and instructions orally and in written form. To enhance understanding of the intervention, I guided the participants through all parts of the imagery script. For instance, I informed the participants what the specific parts of the script were about and how to use them. Then, participants read through the service and groundstroke situations in the script. Finally, participants practised imaging the subparts of the script. During the imagery practice, participants imagined the sequence of pre-shot routine, performance of service and groundstroke shots, and successful performance outcomes separately. After they had familiarised themselves with the various parts of the script and reported being able to control their images, participants imagined the entire performance situation. Further, I encouraged participants to ask questions and clarify any difficulties they experienced during the introductory session. At the end of the session, I handed out the adherence log to the participants for use following each imagery practice to comment on their experience, such as vividness and clarity of the images during the practice session.

The imagery intervention lasted four weeks. I instructed participants to practice imagery three times per week, with each session taking approximately 10 to 15 minutes. The instructions for the self-reliant use of the script included a) to imagine vividly, as if they actually were in this particular situation, b) to use all the senses within the images, that is, images should include visual, auditory, kinaesthetic (within the muscles), tactile (perceiving of touching racket and tennis ball), and olfactory (such as the aroma of new balls or the smell of the court surface) aspects of competition matches, c) to imagine clearly and in detail what this situation and the performance are like, and d) to control the images (e.g., seeing oneself being successful).

Following the intervention phase, I instructed participants to use imagery for 10 to 15 minutes as competition preparation. I assessed participants' flow state and performance again. The post-intervention phase lasted between three and five weeks to observe and analyse six (Participants 1 and 2) and four (Participants 3 and 4) competition matches, respectively. After the completion of the post-intervention phase, I conducted a social validation interview with each of the participants to assess differences in their experience between phases and the perceived effectiveness of the intervention on flow state and performance. Finally, I debriefed participants on their performance and flow experience and thanked them for their involvement in, and support of, the study.

Data Analyses

To analyse differences between baseline and post-intervention conditions, first I assessed graphs plotting measures of flow state and performance through visual inspection. I then used the split-middle technique (Kazdin, 1982; White, 1974) to investigate changes in intensity of flow experiences and percentage of winning serves and groundstrokes across games between baseline and post-intervention phases. The calculation of the split-middle involves several steps to examine differences between test phases (White 1971, 1972, 1974). The trend for each phase is graphically depicted by a celeration line that characterises the rate of change over time for the measures in that phase. First, to construct the celeration line, the number of data points within one phase is summed up and subsequently divided into two equal halves by a vertical line, bisecting the number of sessions or trials. Second, each half is further subdivided into two smaller halves by vertical lines, indicating the median number of sessions as shown on the abscissa. These median lines either go directly through a data point, in the event that there is an uneven number of points or between two data points, resulting in an equal number of data points on either side. Third, for each half, a horizontal line intersects with the vertical lines, creating four quarters for the first and second half of the phase. The horizontal line represents the median that splits the data into the same number of data points above and below the horizontal line. Fourth, the quarter-intersect line straight line connects the two intersections of the two halves. Fifth, the celeration line, representing the trend of the specific phase, needs to be evaluated to see whether 50% of the data points of the phase are situated above and below the trend line. In some instances, the line needs to be adjusted by drawing a parallel line above or below the original line to achieve a split-middle trend.

The examination of the change of the dependent variable should include the analysis of the celeration or trend line in each phase and the change of level between phases (Barlow & Hersen, 1984; Kazdin, 1982). With regard to the trend line, the change within each phase, can be calculated by the ratio of the two intersections in each phase. Dividing the first and second intersection of the phase numerically expresses the slope of the trend line. Comparing differences between baseline and intervention phase, a change in slope can be calculated by dividing the numerically larger slope by the numerically smaller slope. In a similar way, the change in levels is measured by the variation between baseline and post-intervention celeration lines. The ratio of the level of the celeration line before the intervention and the level of the celeration line after the intervention are compared. That is, the higher numerical value is divided by the lower numerical value to signify differences of the intersection between baseline and post-intervention phase. A positive change in slope and level is represented by a multiplication sign (x), whereas a negative change is signified by a division sign (÷). According to Barlow and Hersen (1984) and Kazdin (1982), differences in the measurement between phases are summarised by changes in slope and level.

Hrycaiko and Martin (1996) advocated that several assessment characteristics needed to be present to draw accurate inferences from interventions with a great degree of confidence. The intervention effect is stronger when a) the replication of the effect is evident across a number of participants, b) the overlapping data points between baseline and post-intervention phase are minimal, and c) an effect is detected near the onset of the post-intervention phase, followed by a sustained increase. After the completion of the flow and performance assessment, I conducted a content analysis of the social validation interview, aiming to extract information on participants' experience that could be important for the assessment of factors that facilitated or debilitated flow state and performance.

Results

I present the results in five subsections. In the first subsection, I describe the participants' demographics, imagery ability, and usage of the adherence log. In the second subsection, I analyse the influence of the imagery intervention on flow state. In the third subsection, I examine the effect of the imagery intervention on service performance in tennis competitions. In the fourth subsection, I examine the effect of the imagery intervention on groundstroke performance in tennis competition. In the fifth subsection, I interview participants regarding their use and perceived effects of imagery on flow state and performance.

Descriptive Information

Participants completed a subjective measure of imagery ability, the SIAM, a multimodal-multidimensional measure of imagery ability. Participant 1 reported the highest scores on almost all subscales, scoring particularly high on potentially important imagery ability characteristics, such as vividness, control, duration of the image, the kinaesthetic sense, and the visual sense. Participant 3 demonstrated highest scores for tactile and emotion subscales. Participant 3 also showed high scores of over 330 on vividness and control of the image. Participants 2 and 4 revealed slightly lower scores on nearly all subscales than Participants 1 and 3.

Participants 2 and 4 reported SIAM subscale scores between 147 and 296, and 45 and 295 points, respectively. Table 5.2 shows the participants' scores on imagery ability. Summarising the imagery ability scores, the means for all participants were reasonably high, with scores generally above 200 points, except for the olfactory and gustatory subscales. These subscales appear to be less important, as both characteristics play a minor role in tennis competitions. The pre-intervention results of this study provided evidence that the four participants would be able to effectively employ imagery as part of their off-court training program.

Table 5.2

Imagery Ability Scores for Participants 1 to 4

SIAM	Participants			
	1	2	3	4
Vividness	362	286	345	254
Control	345	296	338	265
Ease of Generation	350	268	324	235
Speed of Generation	332	256	296	252
Duration	373	248	327	295
Visual	335	284	326	284
Auditory	336	265	308	235
Kinaesthetic	344	257	279	266
Olfactory	310	147	154	109
Gustatory	315	209	69	45
Tactile	320	199	354	194
Emotion	330	251	337	212

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In the adherence log, all participants confirmed they had frequently practiced imagery during the intervention period, indicating they had completed each of the 12 imagery sessions. The time in between sessions varied between two and four days, due to participants' tennis-related and school-related commitments. The imagery sessions were held during afternoon and evening hours between 4.00 pm and 8.30 pm. The mean session duration varied from 10 minutes for Participant 4 to 16 minutes for Participant 1. Participants 2 and 3 reported a mean session duration of 11 and 13 minutes, respectively. With regard to the development of vividness and clarity of the images, all participants reported a general increase from previous sessions throughout the intervention phase.

Intervention Results on Flow State in Competition

Figures 5.1 to 5.4 illustrate the development of flow state for Participants 1 to 4, respectively, from the onset to the conclusion of the study. The abscissa represents the number of each competition match played and the ordinate reflects the intensity of flow state, with flow scores ranging between a minimum of 36 and a maximum of 180 points. The dashed lines signify the mean values (M) of flow state in the baseline and post-intervention phases. For each phase, I present the range (R) of the flow scores throughout the testing phase. The solid lines reflect the celeration line, indicating the trend of flow state in each phase. The dotted line, extending from the baseline phase, represents the ongoing trend from the baseline celeration line, which assists in comparing baseline with post-intervention trends. To assess changes in flow state between baseline and post-intervention phases, I addressed differences in means (which is measured by subtracting the higher from the lower mean), slopes, and levels. In addition, I included the letter 'L' for those data points where the participant lost the particular match.

Participant 1

Between baseline and post-intervention phase, Participant 1 showed an increase of flow mean by 23.30 points and an increase in level by 31.47 points, which was the strongest increase among all participants. As shown in Figure 5.1, Match 2 revealed the highest flow score in the baseline phase, representing the only overlapping data point with measurements in the post-intervention phase.

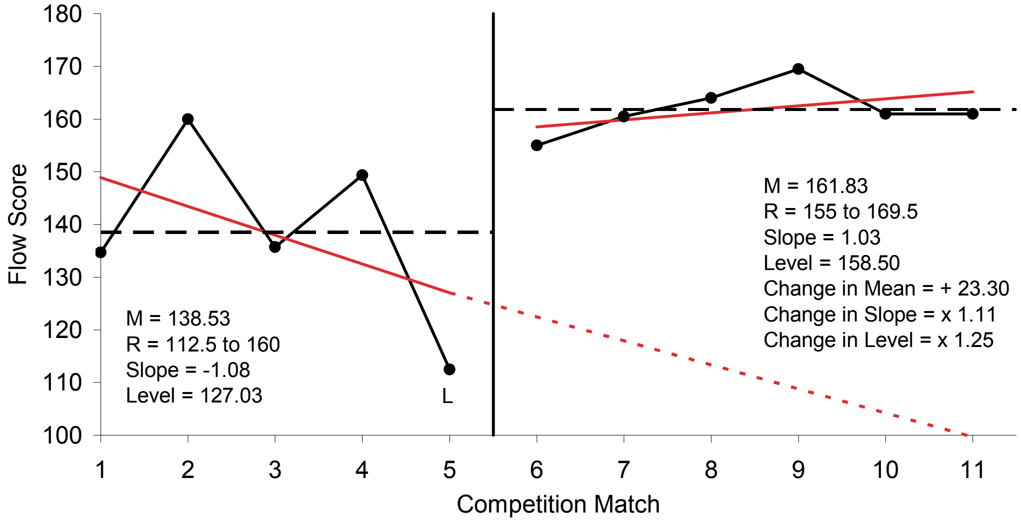

Figure 5.1. Flow scores across phases for Participant 1

A high deviation of flow scores was detected for the baseline phase, ranging over 47.5 points. Following the intervention, the flow experience became more stable, which is reflected in a smaller deviation from the mean, with flow scores varying within 14.5 points for the final six matches. The negative trend in slope of -1.08 in the baseline phase was reversed into a positive, almost horizontal trend of +1.03 within the post-intervention phase. Participant 1 showed a positive change in slope and level between baseline and post-intervention phase. The change from a negative to a positive trend in slope across phases for flow state was only detected for Participant 1.

Participant 2

In the baseline phase, Participant 2 reported a mean flow score of 108.90 points, which was the lowest baseline mean for flow of all participants. The increase in mean flow between phases was 15.41 points. As shown in Figure 5.2, the slopes in both phases were negative, with the slope in the post-intervention phase increasing in steepness.

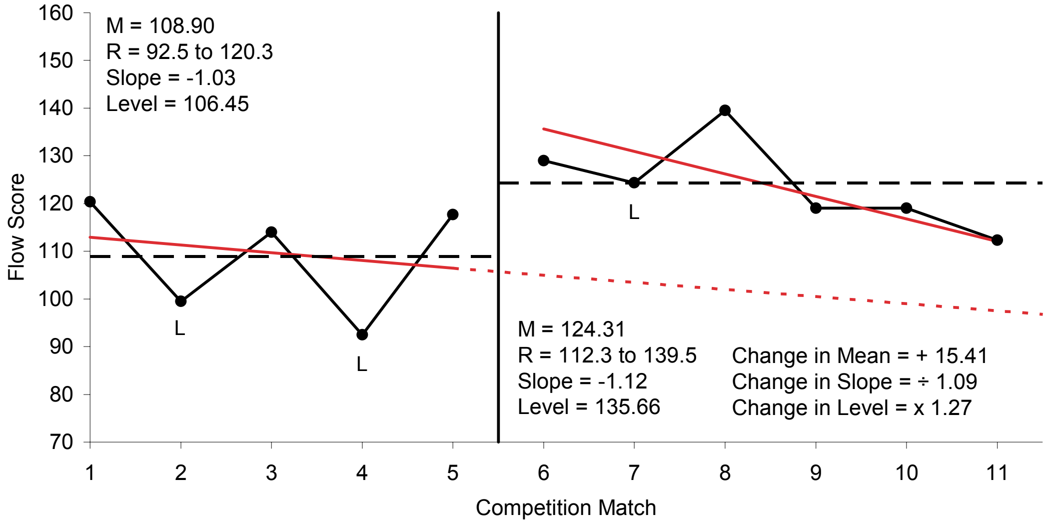

Figure 5.2. Flow scores across phases for Participant 2

Even though the change in slope was negative, Participant 2 showed positive change in level (x 1.27). All flow post-intervention measurements for Participant 2 stayed above the celeration line from the baseline phase. The flow scores dropped towards the end of the post-intervention phase, with three data points overlapping between phases. Even though Participant 2 lost Match 7, the flow score was higher than the baseline scores.

Participant 3

Between baseline and post-intervention phase, Participant 3 reported an increase in mean flow, signified by the dashed lines, of 4.25 points. This was the lowest increase in flow for all participants. The increase in level, however, was 21.10 points. The flow pattern was similar for both phases, delineating an increase of flow state for the first three matches, with flow state dropping strongly at the end of each phase. Two data points in the post-intervention phase were the highest flow scores overall. The other two data points overlapped with baseline assessments. Flow scores deviated substantially over 35.7 points for the baseline phase and across 36.5 points for the post-intervention phase. As shown in Figure 5.3, Participant 3 demonstrated a slightly negative change in slope and a positive change in level.

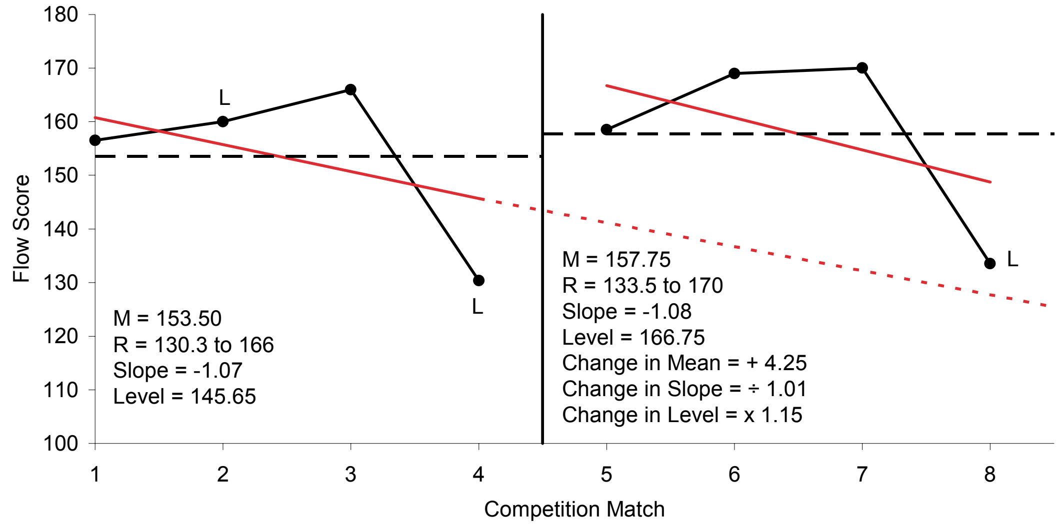

Figure 5.3. Flow scores across phases for Participant 3

Participant 4

Between baseline and post-intervention phase, the mean flow score for Participant 4 decreased by 13.08 points. Participant 4 was the only participant who showed a decrease in flow between phases. Within the baseline phase, the flow score for Participant 4 stayed almost the same, ranging over 9 points, which is the smallest variation in flow measured throughout the study. As shown in Figure 5.4, the slope was negative for both phases and increased in steepness for the post-intervention phase, which was the steepest post-intervention slope of all participants. Across phases, Participant 4 showed a slightly negative change in slope and no change in level. Three data points of the post-intervention phase (Matches 5, 6, and 8) were located near to or on the extrapolated line, illustrating that these data points closely matched the ongoing baseline trend.

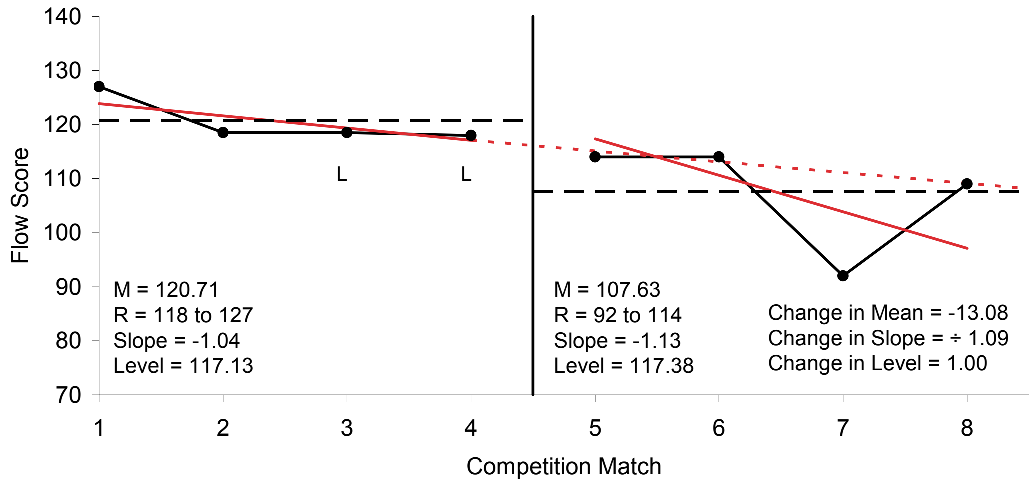

Figure 5.4. Flow scores across phases for Participant 4

In summary, the mean flow state increased after the intervention for Participants 1, 2, and 3, whereas Participant 4 showed a decrease in flow state. For Participants 1, 2, and 3, the increase in mean flow varied between 4.25 and 23.3 points, and the increase in level varied between 21.10 and 30.47 points at the onset of the post-intervention phase.

Intervention Results on Service Performance

Figures 5.5 to 5.8 illustrate the results of the participants' service performance before and after the intervention. The abscissa represents the number of competition matches played and the ordinate reflects service-performance scores. Participants' service performance was measured in percentage of direct winners, ranging between 0 and 41.94 %. I calculated the performance percentage scores based on the ratio of first service winners to service points played overall. Similar to the presentation of the results on flow state, the dashed lines signify the mean values (M) of service performance in the baseline and post-intervention phases. For each phase, I present the range (R) of the performance scores throughout the testing phase. The solid lines reflect the celeration line, indicating the trend of service performance in each phase, and the dotted line, extending from the baseline phase, represents the ongoing trend from the baseline celeration line. To assess changes in service performance between baseline and post-intervention phases, I addressed differences in means, slopes, and levels. Data points with the letter 'L' indicate that the participant lost that particular match.

Participant 1

In Figure 5.5, Participant 1 showed an increase in mean service performance from 7.85 to 13.03 points. This means that Participant 1 improved the number of winners played between baseline and post-intervention phase by 5.18 percentage points.

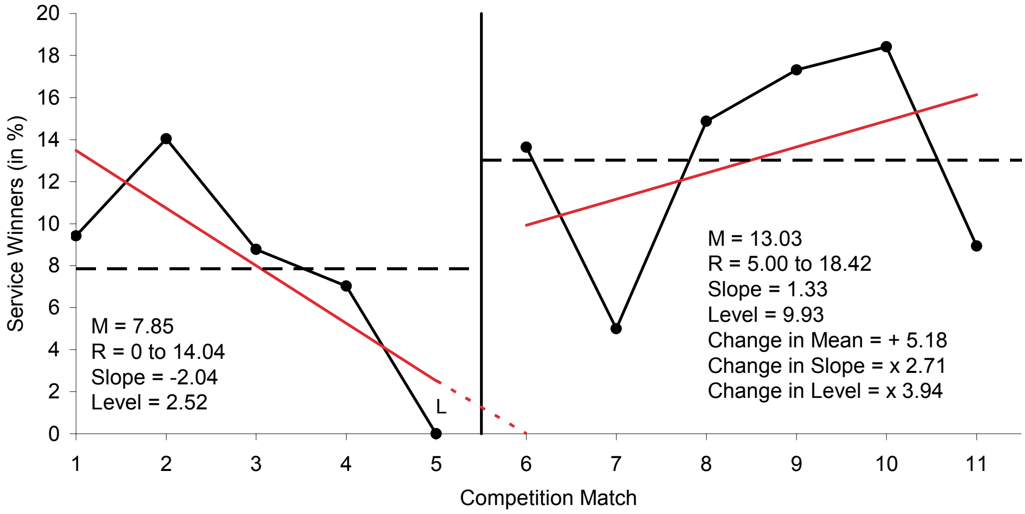

Figure 5.5. Service performance across phases for Participant 1

In the baseline phase, service performance decreased steadily from Match 2 and reaching the lowest point in Match 5, with no winners scored. The slope reversed from a negative to a positive trend (x 2.71), indicating a positive intervention effect. In addition, the level of performance increased from 2.52 before the intervention to 9.93 after the intervention (x 3.94). In the post-intervention phase, three performance assessments (Matches 6, 7, and 11) overlapped with baseline performances, whereas the highest percentage of service winners was reached in Matches 8, 9, and 10. The range between highest and lowest performance scores was similar for both phases, varying within 14.04 points in the baseline phase and ranging within 13.42 points in the post-intervention phase.

Participant 2

In Figure 5.6, Participant 2 showed a strong increase in service performance from 4.35 points in the baseline phase to 24.12 points in the post-intervention phase. A positive change could be detected for slope and level. The service performance showed a sustained increase after the intervention with only one data point overlapping. The trend in the post-intervention phase was still negative, but the trend line was close to horizontal.

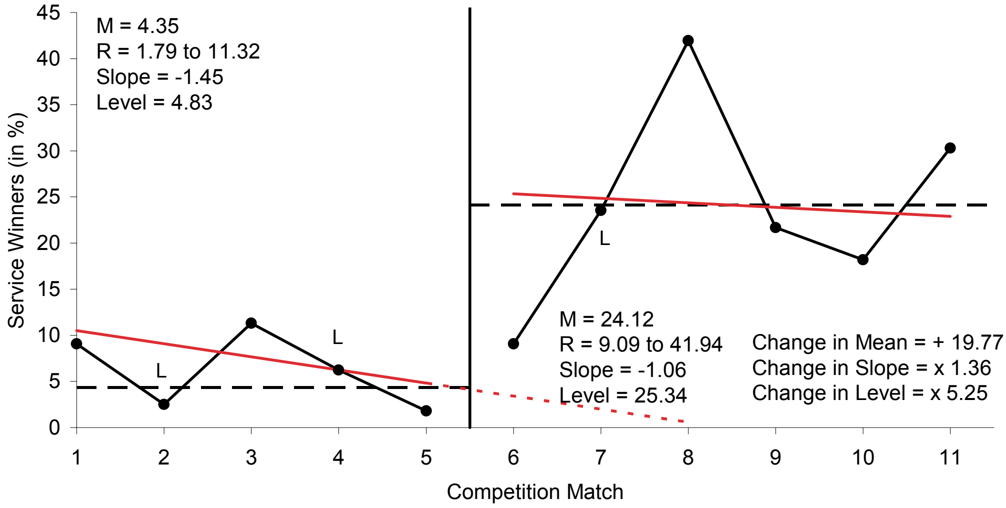

Figure 5.6. Service performance across phases for Participant 2

Participant 3

From baseline to post-intervention phase, Participant 3 showed an increase in service performance of 5.04 mean points. Figure 5.7 shows that the slope changed from a positive trend to a negative trend in the post-intervention phase, whereas a positive change was found for level. Three data points of the post-intervention phase, which represented the highest performance scores, remained above the celeration line, indicating a positive intervention effect. Even though service performance in Match 8 dropped under the extrapolated celeration line, all post-intervention performances remained above pre-intervention performance assessments, indicating a sustained increase in performance following the intervention.

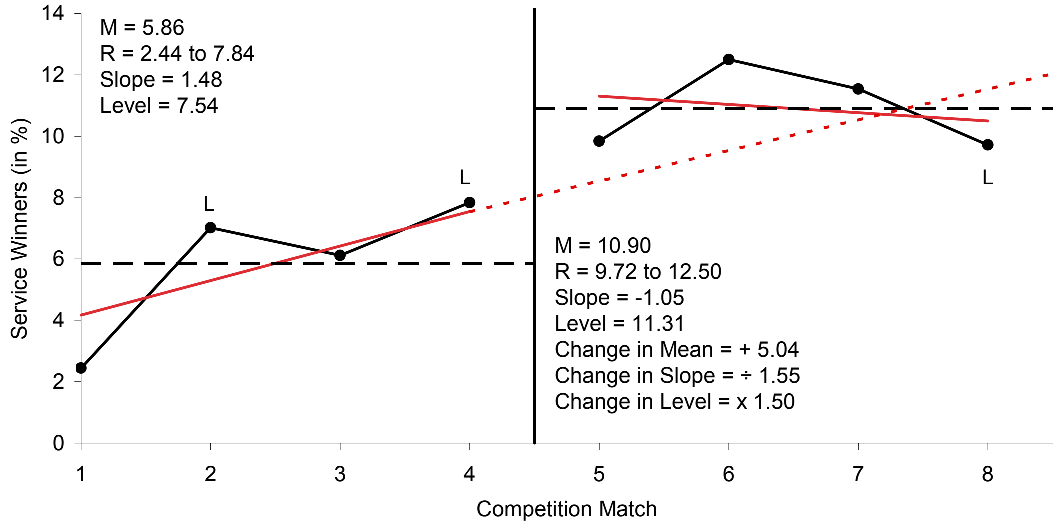

Figure 5.7. Service performance across phases for Participant 3

Participant 4

Figure 5.8 illustrates that Participant 4 increased in service performance by 7.17 mean points across phases. Substantial positive changes were found for slope (x 3.21) and level (x 10.67).

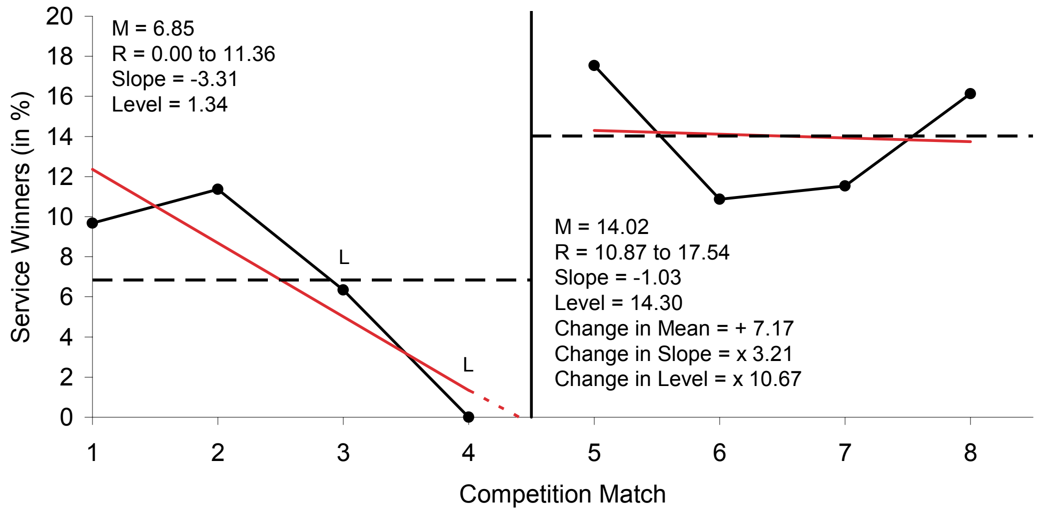

Figure 5.8. Service performance across phases for Participant 4

Within the baseline phase, performance dropped steadily from Match 2, reaching the lowest score with no winning first serves in Match 4. The service performance trend showed a strong negative slope before the intervention and decreased to a nearly horizontal trend (-1.03) after the intervention.

Intervention Results on Groundstroke Performance

Figures 5.9 to 5.12 illustrate the results of the participants' groundstroke performance before and after the intervention. The abscissa represents the number of competition matches played and the ordinate reflects groundstroke-performance scores. Groundstroke performance was measured in terms of percentage of direct winners, including the combined number of forehand and backhand winners. Overall, the groundstroke percentage scores ranged between 3.15 and 30.77 %. I calculated the performance percentage scores based on the ratio of groundstroke winners to overall points completed in a groundstroke rally. The symbols and lines bear the same meaning as in the presentation for the service performance.

Participant 1

Figure 5.9 shows an increase in groundstroke performance from 12.90 to 16.66 points. Changes for slope and level were positive from baseline to post-intervention phase. The lowest scores were reported for Matches 4 and 5 at the end of the baseline phase. Following the intervention, the change in level was 16.75 points. Matches 6 and 7 marked the highest groundstroke performance scores.

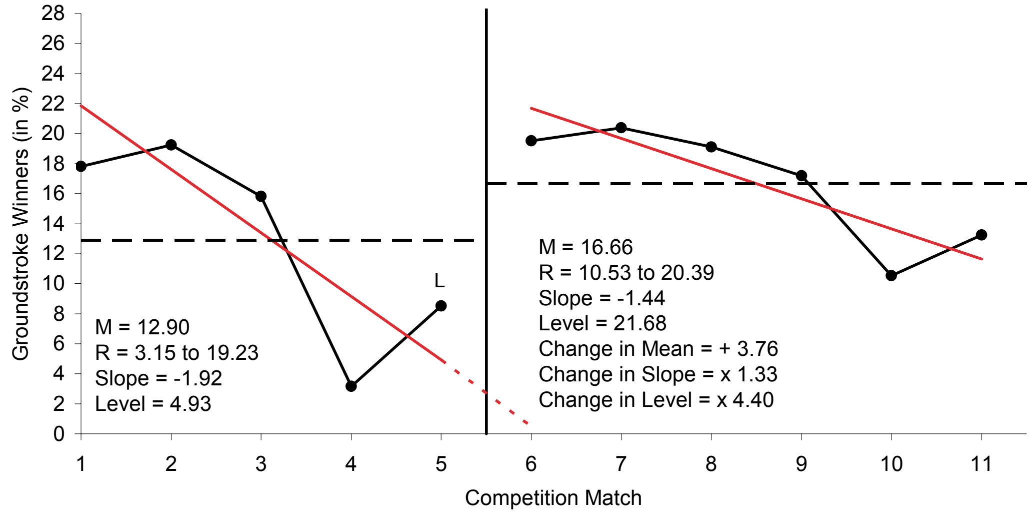

Figure 5.9. Groundstroke performance across phases for Participant 1

Opponents in Matches 1 and 2 were not listed in the national junior rankings, whereas opponents in Matches 4 and 5 were ranked higher by 45 and 31 places, respectively. Following the intervention, the negative trend in the post-intervention phase was less strong, although the opponents' performance level appeared to be higher than in the baseline phase with all contenders being ranking-list players. Particularly, opponents in Matches 7 to 10 were ranked 29 to 118 positions higher than Participant 1. By the end of the study, Participant 1 increased his Australian national junior ranking list position by 145 places from number 214 at the start of the study to number 69 by the end of the study.

Participant 2

In Figure 5.10, Participant 2 demonstrated a mean increase in groundstroke performance by 5.73 points. The slope in the baseline-phase indicated a positive trend. Even though the change for the post-intervention slope was negative, all data points, except two, remained over the celeration line.

Participant 2 showed a positive change in level (x 1.62). In the baseline phase, all competition opponents were listed in the junior ranking list.

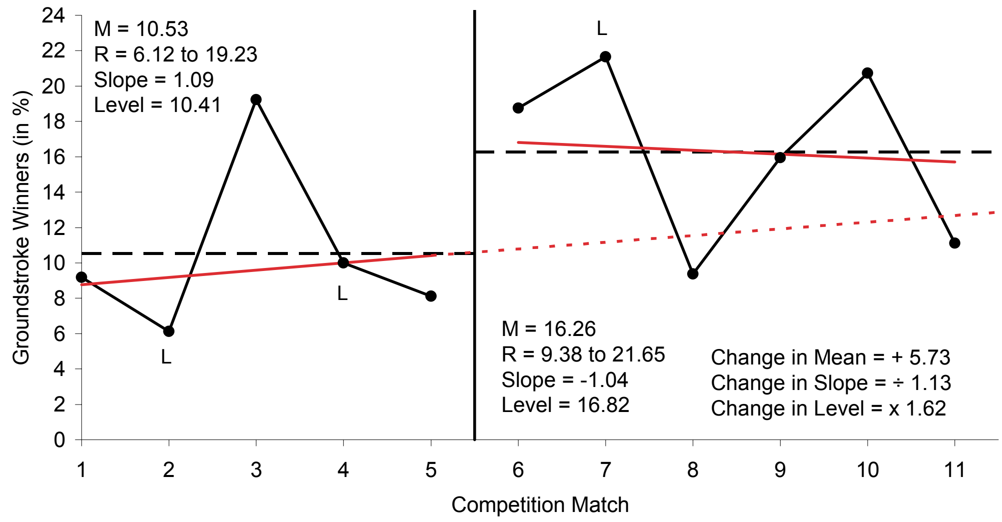

Figure 5.10. Groundstroke performance across phases for Participant 2

Opponents in Matches 1, 2, and 4 were listed between 22 and 136 ranks higher than Participant 2. Within the post-intervention phase, Participant 2 competed against ranking list players in all matches, except Match 8. In Matches 6 and 7, Participant 2 played against opponents with a higher or similarly high ranking, whereas in other matches opponents were ranked between 57 and 206 positions lower than the participant. By the end of the study, Participant 2 improved his ranking by 27 positions.

Participant 3

In Figure 5.11, Participant 3 showed a strong increase in groundstroke performance by 14.61 mean points and positive change in level (x 1.16) from baseline to post-intervention. Performance results of Participant 3 also indicated a positive trend from the beginning to end of the baseline phase. In Match 4, groundstroke performance was substantially higher than in the first three matches, which had a strong positive influence on the baseline trend.

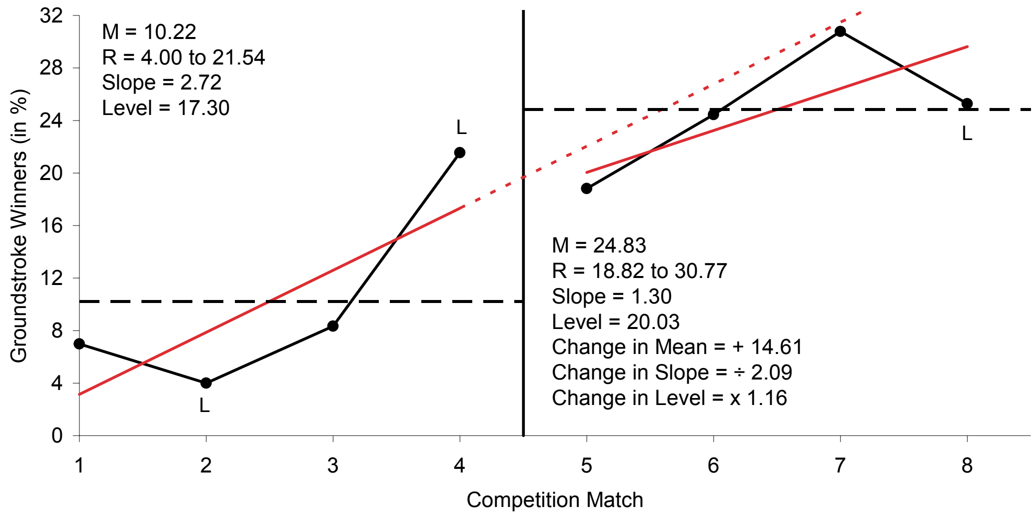

Figure 5.11. Groundstroke performance across phases for Participant 3

The extrapolated baseline trend indicated no evident learning effect from the imagery intervention with all post-intervention data points being below the extended line. On the other hand, Participant 3 revealed the strongest increase of mean groundstroke performance out of all participants. In addition, there was only one overlapping data point (Match 4) between phases, which suggests a positive learning effect.

All of Participant 3's opponents were listed in the junior rankings, with higher ranking list positions for two competitors in the baseline phase (Matches 2 and 4) and one in the post-intervention phase (Match 8). Participant 3 improved his ranking from 221 to 139 in the National Junior Ranking List.

Participant 4

Participant 4 showed an increase in mean groundstroke performance and a positive change in slope and level between baseline and post-intervention phase. Participant 4 increased his groundstroke performance by 11.34 mean points. The performance drop in Matches 6 and 7 signified the only overlap with performance in pre-intervention matches.

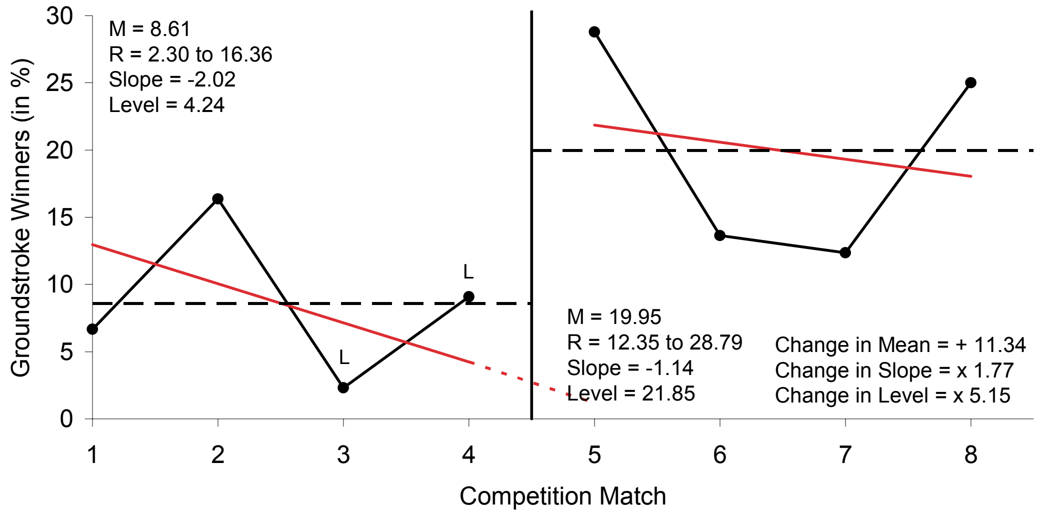

Figure 5.12. Groundstroke performance across phases for Participant 4

In all competition matches, Participant 4 faced opponents who were listed in the junior rankings. Matches 3, 4, and 8 were played against higher ranked competitors. Participant 4's groundstroke performance dropped substantially for Matches 6 and 7, which were played at the National Junior Championships. In Match 8, Participant 4 won against an opponent who was 64 positions higher in the rankings. Participant 4 improved his national ranking from 244 at the start to 173 at the end of the study.

In summary, the results, as shown in Table 5.3, revealed that after the intervention all participants increased in service and groundstroke performance. From baseline to post-intervention phase, Participants 1, 2, and 3 increased in flow state, whereas Participant 4 showed a decrease. Particularly, Participant 1 showed a substantial enhancement in flow after the intervention.

Table 5.3

Participants' Mean Scores on Flow and Performance before and after the Intervention

		Participants			
		1	2	3	4
Flow	Baseline	138.53	108.90	153.75	120.71
	Post-Intervention	161.83	124.31	157.75	107.63
Service Performance	Baseline	7.85	4.35	5.86	6.85
	Post-Intervention	13.03	24.12	10.90	14.02
Groundstroke Performance	Baseline	12.90	10.53	10.22	8.61
	Post-Intervention	16.66	16.26	24.83	19.95

In the intervention, the imagery script focused on six flow dimensions to increase flow state. The change in flow dimensions from baseline to post-intervention phase is shown in Table 5.4. Participants 1 and 2 showed an increase in these flow dimensions, whereas only some flow attributes increased for Participants 3 and 4. Participant 1, who displayed the strongest increase in flow, the intervention had the most substantial effect on dimensions of autotelic experience, sense of control, challenge-skills balance, and concentration on the task at hand. Challenge-skills balance was the dimensions that showed an increase from baseline to post-intervention phase across all participants.

Table 5.4

Participants' Flow Subscale Scores before and after the Intervention

Flow Sub-scales	Participants							
	1		2		3		4	
	BL	P-I	BL	PI	BL	PI	BL	PI
CSB	17.20	20.00	12.93	14.06	17.38	18.88	14.08	14.25
CG	19.66	20.00	11.50	13.58	17.00	17.38	15.38	12.75
UF	16.37	19.00	11.70	14.08	19.25	19.25	15.75	15.75
CTH	15.97	18.50	14.00	16.33	15.75	15.38	14.88	12.00
SC	16.97	20.00	11.00	13.75	19.00	18.00	14.50	11.88
AE	15.67	20.00	9.60	11.50	18.75	18.88	13.13	10.75

Note. BL = Baseline Phase; P-I = Post-Intervention Phase. CSB = Challenge-Skills Balance, CG = Clear Goals, UF = Unambiguous Feedback, CTH = Concentration on the Task at Hand, SC = Sense of Control, AE = Autotelic Experience.

Social Validation Interview

Following the conclusion of the data analysis, I conducted a social validation interview with each of the participants. The interviews were held at the participants' training ground at the conclusion of one of the training sessions. In the interview, all participants expressed their interest in and commitment to adhere to using imagery as an addition to their regular on-court training routine. Participant 1 reported a strong commitment in using imagery. In addition to practising the weekly sessions, Participant 1 stated that he employed imagery extensively in the post-intervention phase as a pre-match preparation. Participants 2, 3, and 4 did not report such a strong commitment to use of imagery.

Participants 1, 2, and 3 reported the general usefulness of working with the script to prepare themselves and “to get psyched up” for the competition. Participant 2 reported that imagery was a constructive way of preparing himself for a match and leaving him less nervous and more pumped before a competition. Participant 4, on the other hand, reported that working with the script had a more relaxing than stimulating effect on his match preparation. Participants emphasised that different aspects of the script’s contents were particularly helpful for them. Participant 1 reported that the emphasis on confidence facilitated his flow experience and performance on court. He also noted that working with the script became easier the more often he used it, which was also expressed by Participant 2. Participant 2 reported that before the intervention he noticed that his mind frequently wandered off and he was easily distracted from the actual task. Following the intervention, Participant 2 noticed a strong increase in keeping his mind focused on the task at hand, which he tried to achieve through self-talk as included in the script. Similarly, Participant 3 reported that he felt more concentrated and composed during competition, once he had started working with the script. Participant 4 indicated that the imagery situations, as outlined in the script, were not specific to suit the way he was playing competition matches. The participant reported that he would have preferred working with a more individualised script. The comments of Participant 4 indicated a lack of commitment to use imagery as competition preparation.

Comparing experiences of flow between baseline and post-intervention phase, Participants 1, 2, and 3 reported that the experience of flow increased following the intervention. A general finding was that imagery helped most of the participants to increase flow aspects, such as concentration, which was perceived as heightened and “exclusive concentration” (Participant 2), feelings of control, and having a clear goal in mind. Participant 1 also noticed a substantial increase in awareness, which he described as being “more awake” and “more alert” related to what he was doing on court. Participant 1 explained that he realised at an early stage during the match how the match unfolded between him and his opponent. For instance, Participant 1 felt he was more aware of what tactics his opponent used and how these tactics caused errors and mistakes to his game, as well as how he could counteract his opponent’s actions. Participant 1 was the only participant who mentioned that he felt he had some sort of control over his flow experience, and that he perceived an intense state of flow at an early stage of the competition, even during warm-up. Participant 3 reported that generally flow built up gradually during the match, and that the consistency of his performance was important for him to get into flow. Similarly, Participant 2 stated that a more intense experience of flow occurred rather automatically and was not triggered by a key situation.

With regard to competition performance, all participants reported an increase in their performance following the intervention. Participants accentuated different aspects in the performance when working with the imagery script. Participant 3 reported that his emphasis of the performance images was on the process of performing, such as how to accurately hit the ball, whereas Participant 1 reported that he focused his imagery on the performance results, such as playing winners. The performance increase was not only related to playing winners, as found in the quantitative data analysis, but participants noted that they played more consistently (Participants 2 and 3) and it was easier to adjust to tough match situations (Participant 1). Participant 4 reported that he perceived having more control over his service than his groundstroke performance. Following the intervention, Participant 3 was on a winning streak from Match 5 to Match 7, which was played at the National Championships. After three straight-set wins he described himself as having been overly confident in Match 8. In Match 8, he believed that his ability to make fast and accurate decisions was not optimal and somewhat “clouded”, which he thought caused him to lose the match.

With regard to confidence, all participants noticed an increase in confidence in their competition following the intervention. Participant 4 described the increase in level of confidence as minor, whereas Participants 1, 2, and 3 reported a substantial increase in their confidence. A particularly strong increase in confidence was stated by Participant 1, outlining that, after the intervention, his confidence level was considerably higher in the time leading up to and throughout the competition matches. The level of confidence that was experienced during competition was evident in Participant 1’s statement that he believed he could “make the shots when it was important”.

With regard to action control, the script contained imagery and self-talk parts that aimed at increasing action-oriented thoughts. Participant 1 noted that before the intervention he was repeatedly dwelling on lost points. Following the intervention he reported that he was less preoccupied with the outcome of the last point and, instead, he was more focused on the upcoming point. In addition, he described his thoughts as “more proactive towards being positive”. Having won all of his post-intervention matches in two sets, Participant 1 reported that he had a strong focus on the next point. Similar to Participant 1, Participant 2 stated that prior to the intervention he was preoccupied when he had just lost big points. After the intervention, Participant 2 frequently used self-talk in the form of “positive comments” to keep his mind up and focused on the task. Participant 1 reported that he used self-talk before the study, but not to the extent he did after the intervention. Thereafter, the way he employed self-talk was more positive, and, in contrast to Participant 2, he used self-talk more frequently after the rally finished (e.g., making him aware what he needed to do to refine his shot selection).

Overall, in the social validation interviews participants expressed that working with the imagery script was a useful addition to their normal training routine and helpful in preparation for competition matches. Most participants perceived that using imagery facilitated flow, confidence, and action control. Crucial flow aspects that increased after the intervention were reported as concentration, being in control, and having clear goals in mind.

In summary, the study's findings on the influence of the imagery intervention on flow and performance in tennis competition indicated that three participants increased in flow state and all participants increased in service and groundstroke performance. After the intervention, quantitative results indicated a substantial and sustained increase in flow for Participant 1. Participants 2 and 3 also increased in flow, but some data points showed overlaps with baseline scores. Participant 4 showed a decrease in mean flow across phases. All participants enhanced their performance with regard to direct winners and ranking-list position. The social validation interviews supported the quantitative findings. In addition, participants perceived an increase in their confidence and more action-oriented thoughts during the competitions.

Discussion

The present study investigated the effectiveness of an imagery intervention for enhancing flow state and competition performance among advanced, junior tennis players. The results showed that the intervention had a positive effect on flow and performance, with three participants displaying a mean increase in flow state and all participants improving their mean performance from baseline to post-intervention phase. These results are consistent with previous research, employing hypnosis (e.g., Lindsay et al., 2005; Pates et al., 2001) and imagery (Pates et al., 2003) to increase flow and performance in sport. In this study, intervention effects were assessed in ecologically-valid conditions of official ranking list tournaments and by tracking participants' development in the national junior ranking list over a period of six months.

The study made original contributions to the knowledge base in relation to methodology and instruments used. In contrast to previous imagery interventions, the imagery script was developed based on regression results in Study 1 to increase flow state. Instead of focusing on all flow dimensions, the script focused on the strongest links between flow subscales and personality variables of confidence and action control. To get more accurate results on flow experiences in tennis competition, I adjusted the FSS-2, so that flow could be assessed for each set separately.

The results suggested that the imagery intervention was a valuable and effective addition to the participants' off-court training routine and competition preparation. None of the participants had systematically used imagery or worked with an imagery script before this study. The assessment of imagery ability demonstrated that participants varied broadly among imagery subscales. On the vividness and control subscales, which are considered particularly important for imagery ability (Morris et al., 2005; Watt, 2003), all participants scored above 250 points. This result on participants' eligibility to effectively use the imagery script was supported by findings from Fogarty and Morris (2003). Assessing internal and external imagery perspectives of junior tennis players in open and closed skills, Fogarty and Morris selected players with scores of above 200 points on all SIAM subscales to ensure an appropriately high level of imagery ability among participants. Although participants reported relatively high imagery ability scores, there appeared to be qualitative difference in participants' imagery ability. For instance, Participants 1 and 3 reported substantially higher scores for particularly important subscales of control, vividness, and visual imagery sense than Participant 4. Imagery ability seemed to be particularly strong for Participants 1 and 3, which was also supported by participants' self-assessment on vividness and clarity in the adherence log used in the intervention phase. Consequently, the effectiveness of an imagery intervention could be partly influenced by athletes' imagery ability.

Even though there was evidence for the effectiveness of imagery increasing flow, some of the participants' flow scores strongly deviated from the overall trend. Deviations of single flow scores could be mainly due to the tennis competition settings (e.g., facing different opponents, competing in various tournaments) and to the tennis performance demands (e.g., self-paced and externally-paced performance characteristics). With regard to the competition setting, Lindsay et al. (2005) found similarly strong deviations, when assessing flow in cycling competitions. This could indicate that the outer conditions of the competition setting had a strong influence on participants' flow experience. Employing similar hypnosis interventions, as did Lindsay et al., Pates and colleagues (2001, 2002) found only little overlap between flow scores in baseline and post-intervention phases that were analysed in controlled training tasks. Therefore, facing different opponents at various stages of the tournament competitions could have had a strong influence on the participants' flow intensity.

The variation of flow scores could be related to the performance characteristics of tennis. In previous intervention studies on flow, flow was mainly assessed in self-paced, closed-skill performances within a training setting (e.g., Pates et al., 2002, 2003). All participants in the Pates et al. studies showed an immediate increase in flow scores after the intervention, with most participants revealing a sustained increase with little overlap between baseline and post-intervention scores. Lindsay et al. (2005), on the other hand, found considerable overlap for flow scores in cycling competitions before and after the hypnosis intervention. Compared to the continuous cycling performance, tennis is frequently interrupted by breaks, which could make it more difficult to maintain flow. Similar to the performance task in the studies conducted by Pates and colleagues (2001, 2002, 2003), service shots reflect self-paced performances. In a tennis competition, however, service performance marks the start of an interactive performance situation. A good service can tip the groundstroke dominance in a servers' direction, whereas a bad service can give the edge to the receiver. In addition, once the ball is in play, the externally-paced groundstroke rally makes the athlete even more dependent on the opponent's ability. Therefore, facing highly interactive competition situations that may shift swiftly and requiring mainly open skills can have a great influence on athletes' flow intensity. This may partly account for the variability of flow scores in tennis competition as found in this study.

Taking the effects of the competition settings and the performance characteristics into consideration, Participant 1 provided quantitative evidence that a noteworthy treatment effect occurred, showing a sustained increase in flow. Participant 2 revealed a mean increase in flow state following the intervention. The final three treatment scores of the post-intervention phase showed a decrease, overlapping with two baseline scores. Therefore, Participant 2 appeared to have had a positive intervention effect, but the present data is not conclusive. The treatment effect for Participant 3 could have been clouded by a ceiling effect. Participant 3 reported relatively high flow scores within the baseline phase, leaving little room to gain a substantial increase in flow intensity.

The selection of flow dimensions addressed in the imagery script appeared to be effective for enhancing flow state. The emphasis on the connection between personality variables of confidence and action control and flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task, sense of control, and autotelic experience seemed to facilitate flow in tennis competition. According to participants' reports, concentration, clear goals, and feelings of control were particularly enhanced through the intervention. These qualitative findings have been confirmed through qualitative data, showing a general increase for Participant 1 and 2. This provides further evidence that the six flow dimensions emphasised in the script are valuable antecedents for the experience of flow state. Along with the increase of flow subscale scores, performance scores also improved from baseline to post-intervention phase. Concentration is an important variable with regard to performance and as a dimension of flow. Similarly, clear goals were addressed as a performance characteristic, in terms of a specific target area, which could have positively influenced the experience of clear goals as a flow dimension. Selecting flow dimensions that reflect important aspects of flow and performance appeared to be crucial for the effectiveness of the intervention.

The effectiveness of imagery as a vehicle to increase flow has been underpinned by a previous intervention study. Pates et al. (2003) asked participants to recreate an image and feelings associated with flow. Participants then self-selected a music track that would facilitate similar experiences as in flow. The intervention was complete when participants confirmed that listening to music triggered similar experience to the previous flow experience. The Pates et al. study provided evidence for a direct link between imagery and flow, suggesting that imagery can be effective for inducing flow, without physically performing. Morris et al. (2005) underlined the importance of imagery as a mental warm-up to achieve optimal readiness at the start of the performance. According to Morris et al., athletes imaging challenging match situations immediately before performing “will go into competition much more mentally alert and in the right mood state” (p. 220) than athletes who are *mentally cold*. Possibly, a similar effect could have occurred for participants using imagery in preparation for the tennis performance. Participant 1 specifically reported being more alert and more aware before stepping out on court than before the imagery intervention. Therefore, participants who effectively used imagery before the competition (Participant 1) might have achieved a positive pre-performance state through a physical and, equally important, mental warm-up that led to a state resembling flow. The achievement of a high pre-performance state of flow may be important to experience high flow from the onset of and throughout the competition.

A positive effect of imagery on performance was found for all participants. The effectiveness of imagery in enhancing performance was examined through changes in self-paced and externally-paced competition performance, measured through direct winners. In addition, performance was measured through participants' development in the junior rankings, reflecting strong external validity of the performance results. All participants increased in self-paced and externally-paced performance from baseline to post-intervention phase, indicating a positive effect of the intervention on performance winners. Following the intervention, the group of four participants showed an increase in service performance with a combined score of 37.16 points and an increase in groundstroke performance of 35.44 points. There were no substantial differences in participants' increase of hitting winners in self-paced and externally-paced performance, indicating that the imagery intervention was equally effective for improving service and groundstroke performance in competition.

Suinn (1994) provided qualitative evidence from former professional tennis players as to why pre-match imagery could be effective for increasing performance. Suinn outlined that athletes' successful pre-match preparation included two steps. First, players tried to identify opponents' strategies. Then, in a second step, the players imagined how to counterattack those strategies in the specific situation. A similar effect could have occurred for participants in this study when participants were asked to imagine common performance situations. Participant 1 reported that he perceived an increase in awareness following the intervention that made him more aware of his actions, as well as his opponent's tactics and actions. This type of awareness appears to be less related to the aspect of action-awareness merging than to the aspect of heightened self-awareness to identify critical performance cues. Jackson and Csikszentmihalyi (1999) asserted that "without self-awareness an athlete misses important cues that can lead to a positive change in performance" (p. 105). In addition, Jackson and Csikszentmihalyi emphasised that athletes who are aware of what a high-quality performance feels like can effectively use imagery to visualise their performance and desired performance outcomes. The effect of imagery on Participant 1's increased awareness appears to have been critical for the increase in performance that, following the intervention, allowed him to win all competition matches in straight sets against mainly higher-ranked opponents.

Inconsistent patterns of the associations between flow state and service and groundstroke performance were found for all participants. That is, changes in flow state did not always correspond with changes in competition performance. Participant 1 reported the strongest increase in flow, but showed the smallest increases in service and groundstroke performance. Moderate increases in flow for Participants 2 and 3 were associated with a strong increase in service performance (Participant 2) or groundstroke performance (Participant 3). Participant 4 showed increases in service and groundstroke performance, whereas flow decreased. A possible explanation is that imagery had a direct effect on performance, as measured through direct winners, as well as a direct, but separate, effect on flow.

With regard to ranking-list position, all participants improved in their ranking from the beginning to the end of the study. Advancement in the junior rankings was a rather crude and general indicator of performance development. Interpretation of flow intensity and ranking-list improvement, however, is an interesting aspect because the four participants were ranked at a similarly high level, between position 200 and 245 at the onset of the study. The improvement in the rankings varied between 27 and 145 positions. Participant 3, who showed the smallest increase in mean flow from baseline to post-intervention phase, strongly improved in his ranking by 82 positions. This result further supports the proposition that the rather minor increase in flow state after the intervention was mainly due to a ceiling effect, with exceptionally high flow scores during the baseline phase. Out of all participants, Participant 1 showed the largest improvement in ranking-list position and reported the strongest increase in mean flow. The joint and substantial increase of flow state and ranking-list position appeared to be particularly meaningful for Participant 1. With regard to flow state and performance winners, Participant 1's self-paced and externally-paced performance scores reflected relatively small improvements after the intervention compared to the other participants. The quantitative results for Participant 1 indicated that the connection between flow state and specific performance outcomes was not particularly strong. The qualitative reports by Participant 1 and the overall ranking-list improvement suggested that flow state had a substantial influence on performance. This, however, puts into question the meaningfulness of the various performance measures when interpreting the connection between flow state and performance.

The association between flow and performance outcomes reflects how the findings provide evidence for different conclusions. Depending on the performance measure, results of Participant 1 indicated that flow state either shared a very strong connection with performance, regarding ranking list development, or a very weak relationship with performance improvements, regarding direct winners. This aspect makes it more difficult to be confident as to which connection between flow state and performance outcome reflects a meaningful relationship. An adequate assessment of the association between flow and performance needs to address most relevant performance aspects in the particular sport. With regard to tennis performance in advanced junior athletes, the assessment of direct winners and ranking-list development appeared to be appropriate, because participants reported that they were motivated to improve their rankings and their advanced skill-level allowed them to be successful by hitting direct winners. Another performance measure that could be an important indicator for the relationship between flow and performance in tennis is the measurement of shot consistency or the ability to avoid errors.

The way participants experienced flow state and competition performance was also addressed in the social validation interview. Participant 1, who scored substantially lower on flow when losing in Match 5, reported a poor performance for that match. Participant 1 also emphasised that, even if he had won Match 5, he believed that that would not have changed his perception on flow during the match, because his actual on-court performance remained well below his performance expectations. Participant 2 expressed his displeasure about losing Matches 2, 4, and 7, but he also reported that he felt some contentedness about his competition performance in Match 7. The flow score in Match 7 was the third highest score out of eleven competition matches and above the flow baseline scores. Participant 3 reported his lowest flow scores for Matches 4 and 8, whereas the service and groundstroke performance scores remained on a comparably high level. Participant 3 stated that he believed that he could have won these matches, highlighting his disappointment in losing both matches. This indicates that the match outcome was more important for Participant 3 than the quality of performance, which might have had a direct negative influence on flow. From an organisational point of view, filling out the flow questionnaire immediately after losing these competitions could have led to a lower flow assessment. In a study on potential risks of retrospective introspection, Brewer et al. (1991) reported that the retrospective evaluation of confidence and task focus, which are also important characteristics of flow state, was confounded by performance outcome. Losing narrowly in Matches 4 and 8 and filling out the flow state scale immediately after the competition may have contributed to the unusually low flow assessments made by Participant 3 on these occasions. The relationship between winning and losing in regard to flow state needs further investigation. Those examinations should address a) under which circumstance has the performance outcome, such as winning or losing, a positive effect on flow, and b) which aspects of the performance have a positive effect on flow state, particularly when there is a negative performance outcome.

In the social validation interviews, participants reported an increase in confidence and action control in tennis competitions following the intervention. Confidence was the main personality variable that participants noticed to have changed between baseline and post-intervention competitions. After the intervention, all the participants mentioned that confidence was higher at least at the onset of the competition. Participant 1 said that he felt more confident throughout the match and he reported that he was able to maintain a high level of confidence during match-deciding situations. Action control also appeared to have increased, because participants reported that they had more action-oriented thoughts and stated they felt less affected by distractions during the competition. Participants mentioned that, in the baseline phase, several competition-related aspects influenced their mental state. Participant 3 reported that he lost focus when the opponent tried to distract him with "mind games". Another source of distraction was losing points, especially in critical match situations (Participant 2). Participants 1, 2, and 3 made similar comments on the point that the intervention had a facilitative effect on focusing their concentration. Participant 1 and 3 reported that imagery use was crucial to obtain focused attention and to be less distracted. Participant 2 stated that the use of self-talk was paramount to keep his mind and concentration channelled. The increase of confidence and aspects of action control during the competitions, as reported by participants in this study, could have shielded the experience of flow from distractions and facilitated the sustained, increase in flow levels throughout the post-intervention phase.

Regarding qualitative assessments of interventions on flow, Pates and colleagues (2000, 2001, 2002) found that the hypnosis interventions generally improved athletes' perception of confidence, relaxation, control, and composure, and decreased worries and concerns. This is an interesting finding that provides evidence that interventions have a direct effect on flow state and an effect on other variables that emerged as by-products of the intervention. In addition, the Pates et al. (2001) study employed suggestions that were directed towards a polysensory experience of participants' best performance, but not towards flow. Following the intervention, participants also reported an increase in confidence, positive thoughts, and periods of feeling less distracted. Future research needs to isolate which intervention effects influence flow or performance. The intervention design of this study, with imagery directly aiming at increasing confidence and action control, would suggest that personality variables of confidence and action control had a mediating effect on flow, whereas the Pates et al. (2001) study provided evidence for confidence being a by-product of flow.

The effects of the intervention underlined the importance of the influence of imagery on personality variables of confidence and action control. Confidence and action control were directly addressed in the imagery script, which was perceived as helpful by most of the participants. In contrast to this study, previous intervention studies (e.g., Pates et al., 2001, 2002) aimed at increasing flow and performance without making an emphasis on confidence. Athletes in the Pates et al. studies frequently reported that they felt more confident following the intervention, supporting the suggestion that confidence is one of the main personality variables associated with the experience of flow. So far, it is unclear whether confidence is a possible mediator or by-product of flow. More research is needed to examine the relationship between critical personality variables, like confidence, and flow.

The relationship between flow and performance is not conclusive at this point. Participants' comments indicated that flow is not solely dependent on performance outcome, such as winning or losing. This was confirmed by the visual inspection of the quantitative data, showing that increases in flow state were not consistent with increases in objective performance results. All participants lost at least one match during the baseline or post-intervention phase. Flow scores varied considerably for lost matches between 92.5 and 160 points on the FSS-2. The issue for the interpretation of effects linking flow and performance was that the flow measure was administered only once after participants knew about the competition result. Firstly, the overall assessment of flow at one point provided broad information on flow state during competition, which can only be interpreted with regard to the overall result, such as winning or losing. The association between flow and performance, as measured by direct winners, cannot be determined, because of the absence of frequently administering a flow measure during the competitions. Multiple flow measurements during performance are necessary to detect meaningful patterns between flow state and performance, such as hitting winners, than one-off flow assessments. Secondly, the flow measure was completed following the competition. Even though this study measured flow separately for each competition set, the flow measure was completed retrospectively, that is, participants knew about the performance result. Brewer et al. (1991) found that knowledge about the performance outcome can influence the evaluation of people's experience after having received performance feedback. To avoid this measurement bias and to shed more light on the connection between flow and performance, a different research approach is required, investigating the flow-performance link by frequently measuring flow and performance during competition to detect the timely sequence of changes in flow and performance. This way, athletes do not know about the overall performance outcome and, therefore, are less biased in their flow assessment and reflect more genuinely about their competition flow state. This research approach would provide more conclusive results on the association between flow and performance.

Methodological Issues

The effect of the imagery intervention on flow state and performance could have been limited by several factors. I identified three general limitations of this study. The limitations are related a) to the use of a single-case design, b) to the participants' characteristics, and c) to the competition setting.

Using a Single-Case Design

The first limitation of this study was related to the influence that the single-case design had on the results. I identified four noteworthy design-related issues, regarding the relationship between researcher and participants, the flow measure, the measurement of personality variables, and the flow-performance link.

Researcher-participant relationship. Throughout the study, I followed each tennis match courtside to collect performance data during, and flow data following, the competition. Because I was at the venue before, during, and after the competitions, this led to a closer relationship between me and the participants. For the collection of the performance data, it was necessary that I was permanently present during participants' matches. Some participants could have gained more confidence through my presence, especially when there was no other support available from friends or family who could not spend time at the venue. Participants and participants' parents thanked me for being there during the competition. Even though I did not give any obvious or tangible support of any kind before, during, or after the matches, my mere presence could have been perceived by participants as emotional support. This connection could have influenced the results on flow. Rees and Hardy (2004) found that emotional support was one of the support variables that advanced tennis athletes reported positively influenced their flow experiences during tennis competitions.

Flow measure. Using all dimensions of the FSS-2 could have compromised the sensitivity of the flow measure. In Study 1, action-awareness merging, loss of self-consciousness, and time transformation were poor discriminators of flow. Because the imagery script addressed six specific flow dimensions, a flow scale that focused on the measurement of these specific scales could be more sensitive than measuring flow on all dimensions, as employed in this study. Further advancements to increase the sensitivity of measuring flow in competition are warranted. In tennis competitions, there are several situational and match-related conditions that might have strong influences on flow, which cannot be identified by the flow questionnaire. Situational conditions, such as a tight match schedule or exhausting competitions, could have a lasting negative effect on flow (Participant 4). Also, there is a possibility that flow differs in intensity before and after key situations that have a positive or negative effect on flow, which cannot be picked up by a broad, quantitative measure of flow. Therefore, to obtain a more detailed understanding and more specific information on the development of flow within the competition and throughout the study, a multi-method approach of qualitative data should support the quantitative assessment of flow. In addition, with regard to quantitative flow measures, a short version of the FSS-2 that can be completed quickly during a match, addressing the most crucial aspects of flow, would provide more specific information on key flow dimensions at different stages of the match.

Measurement of personality variables. In this study, the assessment of the influence of confidence and action control on flow was part of the social validation interview. No quantitative measures of confidence or action control were used. With regard to action control, as far as I am aware, there was no state measure of action control available at the start of the study. Even though the study did not include a quantitative measure of action control, the qualitative assessment provided evidence for the effectiveness of the intervention to facilitate a shift from state-oriented towards action-oriented thoughts, as indicated by reports from Participants 1 and 2. I did not include a state confidence measure in this study to assess changes in confidence following the intervention. In the social validation interviews, all participants reported an increase in confidence after the intervention. Confidence appears to be a key variable for the experience of flow, which was supported by qualitative assessments of previous interventions aiming to increase flow state (e.g., Lindsay et al., 2005; Pates et al., 2003). Future intervention studies that address the relationship between flow and confidence should include a state measure of confidence to detect changes in confidence from pre-match to post-match. Similar to the Stavrou and Zervas (2004) study, measuring confidence repeatedly before and during tennis competition would provide important information on the development of confidence in regard to flow state.

Flow-performance link. The single-case design does not allow a causal examination of the imagery-flow-performance relationship. Based on the results, a tentative observation indicates that imagery had a direct effect on both flow and performance. Because Participant 4 decreased in flow, but improved in performance, the imagery intervention appeared to separately impact on flow and performance. Participant 4 reported that he preferred more specific performance situations in the imagery script that are tailored towards his game. Even though there were no signs of an insufficient adherence to the intervention, the commitment and conviction to using the imagery script could have been lower for Participant 4, which, in turn, impacted on flow.

Assessing the flow-performance relationship, I used two performance measures that included direct winners hit in each match and long-term ranking-list development to assess the relationship with flow state. With regard to Participant 1, the data provided contradictory results between the two performance measures and flow state. Future studies need to assess performance outcomes that are most important to the athlete, which could produce more conclusive results concerning the relationship between flow and performance. Additional performance measures for tennis competitions could include athletes' consistency regarding number of unforced errors or ratio of direct winners and unforced errors. As Participants 2 and 3 reported, their flow experiences appeared to increase rather gradually in conjunction with a consistent performance.

Participants' Characteristics

The second general limitation of the study related to the influence of participants' characteristics on flow. I identified two noteworthy limitations in this study regarding participants' attitudes towards the use of imagery, and working with the imagery script.

Attitudes towards imagery. Participants revealed different attitudes towards the use of imagery, which could have affected their commitment and conviction in the intervention. Participant 1 reported immediate improvement in flow and performance early in the intervention phase, which he attributed to the use of the imagery script. This seemed to have positively influenced his attitude and commitment about using imagery extensively and thoroughly for the remainder of the intervention phase. Participant 4, on the other hand, reported that he preferred imagery situations that better suited his game, which could have affected his attitude of using imagery. Future studies would benefit from the development of individualised imagery scripts. Individual imagery scripts would be more beneficial than standardised scripts, promoting a positive attitude and commitment towards the frequent and constructive use of imagery. One of the advantages of an individualised imagery script was outlined by Callow and Hardy (2005), who explained that the meaning of the image could vary immensely between individuals, which, subsequently, could influence the effectiveness of the intervention. In addition, selecting athletes with positive attitudes towards imagery would also increase the effectiveness of imagery interventions. Further research should take these suggestions into account, regarding individualised scripts and targeting situations that are specifically meaningful to the athlete.

Working with the imagery script. During the testing of imagery ability and the introduction of the imagery script, one participant took a relatively long time to read through the imagery scenes to get familiar with the contents. The imagery script required more concentrated and repeated reading at the beginning of the intervention, before participants were able to remember key aspects of the performance situations. Providing written information of the imagery contents could have posed a challenge for this participant. Two participants mentioned that it took them some time to familiarise themselves with the structure and contents of the script. Having completed several imagery sessions with the script, participants reported that the sequence of relaxation, imagery on serves, and imagery on groundstrokes had become smoother. Future studies that employ imagery interventions with young athletes should consider whether it is more effective to provide the imagery content in script form or as an audiotape. Previous hypnosis interventions that aimed at increasing flow and performance (e.g., Pates et al., 2001, 2002) successfully used audiotapes for participants aged between 19 and 23 years. The use of audiotapes, rather than written scripts, might make it easier for young athletes to get used to the intervention. Using a script takes more effort to get started, which might strain athletes' motivation to work effectively during the intervention phase. Using audiotapes could provide a practical alternative for younger athletes to develop a routine that they can follow more easily from the beginning of the intervention. Another alternative would be to include a learning phase at the commencement of the intervention phase. The practitioner could introduce imagery in an easier step by step way that also provides rewards for athletes to help to stay motivated.

Real-World Competitions

The third general limitation of this study related to characteristics of the real-world competition setting, in which participants' were evaluated on flow and performance. Csikszentmihalyi (1975) proposed that the type of competition setting could influence the rewards and enjoyment individuals experience in the activity. Given that all participants had tight competition schedules, which culminated during the school holidays, this could have negatively influenced participants' commitment towards some of the competitions. Therefore, I identified two noteworthy limitations regarding the influence of direct competitions on flow and the influence of participants' commitment towards competitions.

Direct competition settings. Participants played in direct competitions, facing opponents of various skill levels in a one-on-one situation. Csikszentmihalyi (1975) proposed that the reward structure in direct competitions is based on evaluations in comparison to the opponent, so enjoyment in direct competition could depend more on outperforming others than on the activity itself. From this point of view, competing against higher-ranked players may be a limiting factor for experiencing flow. In addition, a general practice in junior tournaments is that the players have to referee on their side of the court. A recurrent incident during the competitions of this study was that, particularly during close matches, participants and opponents argued about line calls. Being treated unfairly, or the mere perception of receiving unfair treatment, could have negatively influenced flow. In addition, facing the opponent on the other side of the net could be an emotional experience in itself that may also limit the experience of flow. Researchers investigating flow in ecologically-valid conditions, such as tennis competitions, should consider and be aware of possible disadvantages of direct competitions and sport-specific situations that influence the experience of flow.

Commitment towards competitions. Compared to reports of the other participants, Participant 4 stated a lower level of commitment towards and importance of several post-intervention competitions, which included competing at the national championships (Matches 5 to 7). Particularly strong commitment was reported by Participant 1, competing in a quarterfinal, semi-final, and final match (Matches 8 to 10). Even though Participant 4 showed a larger increase in service and groundstroke performance than Participant 1, opposite results were found for flow state. Participant 4 reported that he played long and exhausting competition matches one week prior to the national championships. A lack of physical readiness and commitment to the competition in the post-intervention phase could have had a strong influence on the participant's low flow experience. Another contributing factor that I discussed to explain results in Study 2, and, that also could relate to the results in Study 3, is lack of ego-involvement. The low level of physical fitness of Participant 4 towards the end of the post-intervention phase could have led to a decrease in commitment and ego-involvement for some competitions. In a study with recreational tennis players, Siegenthaler and Lam (1992) found strong positive correlations between commitment and ego-involvement in tennis competition. Perceiving a lack of meaningful involvement and commitment in the activity, which relates to, or is caused by, low physical condition as indicated by Participant 4, could have had a joint effect leading to lower levels of flow. The findings of Study 3 provide further evidence supporting the proposition that task-related commitment and perceived importance are crucial variables to experience flow (Kimiecik & Stein, 1992). Future research on flow in competition should also consider ego-involvement as a critical variable influencing the experience of flow state. Consequently, individual differences in competition commitment, ego-involvement, and competition importance could have had a positive (Participant 1) or negative (Participant 4) influence on participants' flow experience.

Implications for Practice

The findings of the present study have demonstrated the effectiveness of imagery interventions for increasing flow state and performance in competition among junior athletes. The results could be valuable for younger athletes of an advanced skill level, such as state or national training squads, providing support for the increase of positive experience and performance. Developing and using tailored off-court imagery routines would be a constructive addition to players' competition preparation. Depending on the athlete, imagery-guided interventions could be further individualised on flow-related factors by highlighting specific aspects of confidence and action control. In general, aiming to enhance flow over a longer period of time should increase athletes' intrinsic motivation and enjoyment for training and competition. Additionally, from a long-term perspective, increasing flow in competition may benefit athletes who aim to perform on higher levels of competition, including the facilitation of career transitions from junior to senior level. This study has several implications that regard the delivery of imagery, the development of personality variables of confidence and action control, and the enhancement of flow and performance.

Imagery Delivery

The study showed that the imagery intervention was a successful addition to the physical training routines young athletes use to prepare themselves for competition. Imagery delivery as part of the competition preparation could be critical for athletes to get into an optimal pre-performance state. Jackson and Csikszentmihalyi (1999) asserted that the development of a pre-competition routine to achieve a level of physical and mental readiness facilitates flow and performance. In particular, the use of an imagery routine before the onset of a competition could have important implications for athletes' flow experience, because "familiar stimuli often do facilitate immersion in the activity and help to bring about flow" (Jackson & Csikszentmihalyi, 1999, p. 89). Teenage athletes who would like to achieve optimal preparation for competition should make an imagery routine part of their regular pre-competition warm-up. Imagery delivery before a competition could be a critical aspect for the achievement of positive competition experience, such as flow, facilitating confidence, action orientation, and successful performance outcomes.

Developing Confidence

In this study, I found that confidence is an important variable for both flow and performance. Bandura (1986) noted a reciprocal relationship between confidence and performance. According to Jackson and Csikszentmihalyi (1999), flow experiences assist in building confidence and help to diminish self-consciousness, which restricts athletes' confidence. As found in this study, a constructive approach to develop confidence is the use of imagery. Morris et al. (2005) advocated imagery to be particularly effective with younger individuals, including children and adolescents, because of their generally positive attitude to frequently using their imagination. Csikszentmihalyi (1975) proposed that children can "make order in the environment through images … these are skills he already has, and so he can experience flow while building his self-confidence" (p. 205). With regard to sport activities, Jackson and Csikszentmihalyi (1999) repeatedly emphasised that recalling previous successful performances can assist in developing confidence. In addition, confidence grows when athletes master challenging situations by taking risks, such as taking the opponent by surprise through unorthodox performance. Using imagery as a match preparation technique would facilitate building confidence prior to the event. This is particularly important when high-challenge situations require exceptional individual performances to win against a strong opponent.

Developing Action Control

The social validation interview provided support for imagery being a possible technique to shift athletes' thoughts from state towards action orientation in tennis competition. To break dysfunctional thoughts and behaviour that lead to negative performance results (e.g., giving up prematurely after failure performance early in the competition), athletes' should aim to replace unconstructive thoughts by positive and productive cognitions. The combination of imagery with self-talk components appears to be a fruitful way of decreasing state orientation and developing action orientation. A package of imagery and self-talk should be used more specifically to address aspects of action control that are related to athletes' individual needs to constructively deal with failure, to implement action plans, and to get immersed into the activity.

Enhancing Flow and Performance

The results of this study supported the proposition that players between 13 and 15 years of age would benefit from the imagery intervention to increase flow state and performance. The results of this study are particularly important for the long-term development of younger athletes. Interventions to increase flow can provide athletes with the motivation and confidence to aim for higher performances and simultaneously facilitate positive experiences. In the long-term, the enhancement of flow could help the development of the individual on a personal and a performance level. With regard to performance, Carney (1986) examined male artists on intrinsic and extrinsic motivation in their early adulthood and again in their middle age. Carney found that those artists with a preference for extrinsic rewards in early adulthood gradually distanced themselves from the activity and finally relinquished it. Those artists high in intrinsic motivation were still involved in the same activity after a period of 20 years. Given the close relationship between flow and intrinsic motivation, the aspect of increasing flow might be even more important for sports where athletes are able to perform on a high level at a very young age. By fostering young athletes' flow experiences in sports like tennis, gymnastics, and swimming, these athletes would gain particular value to enjoy, motivate, and commit themselves to the effort required to be successful in training and competition, helping to prevent premature burnout.

In summary, I suggest that it would be valuable to include imagery interventions designed to enhance flow and performance as an off-court and pre-competition routine for junior athletes preparing for tennis competitions. Several studies have underpinned the importance of competition preparation for the attainment of flow (Jackson, 1995; Young, 2000). A careful screening of athletes' eligibility for and commitment to the intervention, as well as a guided and athlete-centred introduction to the use of imagery, employing an individualised imagery script, would assist with the successful implementation of imagery interventions. Imagery appears to be an effective tool that can be used to increase flow and important psychological variables related to flow, such as confidence and action control, in younger athletes. Fostering and enhancing flow state in adolescent athletes through imagery would benefit their competition experience and performance on court.

Future Research Specific to this Study

This study produced some encouraging results related to the influence of imagery on flow and performance. Generally, the effects and underlying mechanisms of how and why imagery is effective in increasing flow warrant further investigations. More specifically to this study, future research should investigate in greater detail a) the influence and function of flow dimensions in the experience of flow state, b) the influence of situational factors on flow in competition settings, and c) the relationship of flow and performance.

With regard to flow dimensions, greater emphasis needs to be put on the importance of specific flow dimensions to be conducive of flow state. More research should investigate the functions of flow dimensions, that is, whether flow dimensions are antecedents or concomitants of flow state. Research should examine which flow dimensions relate to functional processes inducing flow, and which flow dimensions are part of the phenomenological experience of flow. This direction of such research studies would provide more insight into the chronological emergence of flow dimensions during performance, indicating the key dimensions that are pivotal in the development of interventions aiming to increase flow state.

In addition, the functioning of key flow dimensions should be further assessed. The dimension of challenge-skills balance needs further investigation as a main antecedent to get into flow. Jackson and Csikszentmihalyi (1999) stated that the skill factor, or, more specifically, athletes' confidence in their skills, is an important factor in the challenge-skills balance. With regard to the challenge factor, as noted in Study 2, there appears to be a crucial difference between task difficulty and challenge, with ego-involvement being the key for this distinction. In the post-intervention phase, Participants 3 and 4 both competed in several matches in the national championships. The highest flow-state score for a winning match was 170 for Participant 3, whereas Participant 4 did not exceed a point score of 114 on the FSS-2 for winning performances. Qualitative analysis suggested that ego-involvement for Participant 3 was much stronger than for Participant 4. Research could be done on this by experimentally manipulating ego-involvement, while keeping task difficulty constant and monitoring challenge and flow. Therefore, an individualised challenge-skills balance, taking into account the specific interplay between personal skills including athletes' confidence in their skills, and environmental challenges, that athletes consider worthy to psychologically engage in, could be a more appropriate indicator of why and how athletes get into flow.

More research is warranted to examine the influence of situational factors, particularly differences in task type, on flow state in a competition setting. Unlike Study 2, I found no substantial differences in this study between performances of self-paced and externally-paced tasks. Participants scored similarly high on both tasks. In Study 2, flow state could be assessed separately for each task type, whereas in Study 3 the real competition situation integrated both tasks in the performance situation. Therefore, it was not possible to separate self- and externally-paced aspects in relation to flow state. In a sport like tennis, flow seems to be experienced as a non-momentary phenomenon, that is, the experience of flow extends over different task types, such as serves and groundstroke tasks. For example, if flow was measured after one point, when a player is serving, it is going to reflect the serve and other aspects of the point. Actually, given the nature of flow, at any time we probably measure the build-up, or not, of flow over a longer period of time than for just a point or a game. Even if flow was more momentary, it is hard to measure as such, because the situational variables of task type are intertwined, as they are in a service game in tennis. In tennis and similar games, there appears to be no valid approach to measure flow separately for each task type, except when artificially setting up two separate performance situations, as I conducted Study 2. This way it was feasible to measure and distinguish flow on those separate occasions, with the downside of setting up an artificial task that lacked ecological validity. To examine flow state in self- and externally-paced tasks in a real competition, future studies should examine differences in flow state between sports that consist of self-paced tasks, like golf and javelin, and sports that consist of externally-paced tasks, such as marathon and cycling.

The results found for the relationship between flow and performance are not conclusive at this point. In the present study, I examined the effectiveness of imagery for increasing flow and performance. Based on the approach and design of the study, there is no way to know whether the relationship between flow and performance is causal or not causal, or whether there is no consistent relationship between these variables. Qualitative findings indicated different propositions for the connection between flow and performance. Participant 1 reported that he perceived a state of flow during the warm-up before competing. It could be that there is a directional causal relationship, that is, different intensities in athletes' pre-performance flow state influence competition performance, or at least the opening stages of the competition performance. Future research should test this proposition by assessing flow state before and during performance.

During the competition, the reports of Participants 2 and 3 indicated that flow increased alongside a consistent performance. There are two possible explanations for this finding. Flow and performance are a) linked by a reciprocal relationship, in which flow enhances performances and vice versa, or b) flow and performance were affected by another variable that could increase both independently. Following the intervention, Participant 4 showed an increase in flow and a decrease in performance, which reflects an inconsistent relationship. To get a more complete understanding of the nature of the relationship between flow and performance, more detailed examination of flow and competition performance is needed. A fruitful approach would be to investigate flow state during competition. This could be achieved by the completion of flow scales during break times that are inherent in sports like tennis or golf, as was previously proposed by Kimiecik and Stein (1992). The connection of flow and performance should be investigated in a more detailed way in which tennis athletes complete multiple measures of flow during the competition breaks. The flow measurement could consist of a short form of the FSS-2, including one to two items of the major flow subscales, to reduce the FSS-2 to a one-minute flow measure. Filling out a short version of the flow state measure every four or six games would provide important information on the development of flow state for different stages of the match. Performance during these four or six games would be readily available, so the causal relationship between flow and performance could be tracked over time by examining the time 1 performance to time 2 flow relationship, and the time 2 flow to time 3 performance relationship.

In summary, the results of this intervention study were especially valuable, because of the administration of a targeted intervention, which was based on findings in Studies 1 and 2, and implemented in ecologically-valid conditions. In this study, I found that an imagery intervention designed to target key personality variables, confidence and action control, and critical dimensions of flow, was an effective means to increase flow state in tennis competitions. In addition, using imagery in competition contexts also effectively increased service and groundstroke performance. Future studies would benefit from examining key flow dimensions in the particular sport before commencing an intervention to increase flow. This study adds further evidence supporting the proposition that imagery can be used to enhance flow state and performance in sport (e.g., Morris et al., 2005; Pates et al., 2003). The findings on the relationship between flow and performance are inconclusive at this point, but future studies should increase efforts to further investigate possible causal links between flow intensity and quality of performance.

CHAPTER 6: GENERAL DISCUSSION

Introduction

The general purpose of this thesis was to examine the influence of stable personal and situational factors underlying flow state in order to enhance flow. I employed propositions from Kimiecik and Stein's (1992) flow model as the theoretical basis for the intervention to increase athletes' flow state during competition. Although the sport-specific flow framework has not been used systematically to implement interventions, the proposition of the interaction between personality and situation factors to attain flow was in line with Csikszentmihalyi's (1975, 1988b) general theory of flow and appeared to be crucial for flow experiences in sport.

Kimiecik and Stein (1992) distinguished between dispositional and state personal variables that affect flow. I decided to examine the effect of dispositional, rather than state, variables because personality traits predispose individuals to perceive flow in a wide range of situations. Csikszentmihalyi (1975, 1988c) argued that stable personality dispositions are important in whether individuals have the capacity to experience flow independent of the situational characteristics. Csikszentmihalyi (1975) termed individuals' capacity to experience flow the autotelic personality, representing a cluster of personality traits that signify the ability to restructure the situation and facilitate transforming a general experience into flow. Research has supported the idea of an autotelic personality influencing flow, but few studies have undertaken a comprehensive investigation on the influence of personality variables on flow (Jackson et al., 1998, 2001). Based on theoretical and research findings, I proposed that personality dispositions of confidence, imagery, action control, and absorption are critical for athletes' propensity to experience flow.

With regard to situational factors, I theorised that differences between task characteristics in tennis, that is self-paced service and externally-paced groundstroke shots, would influence athletes' flow experience. According to Singer (1998, 2000), different cognitive processes underlie self- and externally-paced tasks to achieve successful performances. With regard to flow, Kimiecik and Stein (1992) hypothesised that self-paced performances are more likely to induce flow because athletes mark the beginning of the performance, whereas externally-paced performances depend on opponents' actions. In agreement with Kimiecik and Stein, I argued that interventions need to take into account differences in performance characteristics related to increase in flow. Therefore, I developed an intervention that specifically addressed flow attributes in tennis service and groundstroke situations.

Another critical factor influencing the experience of flow is performance. Even though performance factors are not part of the flow model, in line with Jackson and Csikszentmihalyi (1999) and Privette and Bundrick (1997), I argued that the attainment of flow state could be affected by the current performance. In their performance-experience model, Privette and Bundrick (1997) described a positive connection between experience and performance. That is, the experience during failure performance is more closely related to worry, whereas athletes during a peak performance state experience joy and ecstasy. In addition, Jackson and Csikszentmihalyi (1999) described a positive connection between the experience of flow and performance in sport, and Jackson (2000) found several attributes that describe similar experiences during peak performance and flow. Consequently, for the intervention, I aimed to increase both flow and performance.

To attain flow in competition, I argued that the main flow dimensions in the specific sport should be targeted to enhance flow state. Similarly, Csikszentmihalyi (2000a) argued that flow dimensions can be distinguished in their function of either inducing flow or being characteristics of flow. From a theoretical perspective, Csikszentmihalyi proposed flow dimensions of challenge-skills balance, clear goals, and unambiguous feedback to be conducive of flow, whereas action-awareness merging, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation, and autotelic experience are characteristics of flow. From an applied perspective, Morris et al. (2005) proposed that interventions directly targeting flow antecedents are critical to enhance flow state. In accordance with propositions by Csikszentmihalyi (2000a) and Morris et al. (2005), I aimed to increase the most crucial flow dimensions to increase flow state in tennis competition.

Therefore, I proposed that an effective intervention needs to focus on personality variables and situational characteristics to increase the main flow dimensions to enhance flow state and performance in tennis competition. In this thesis, I conducted three independent studies and incorporated the findings of Studies 1 and 2 into the development of the intervention in Study 3. In the first study, I investigated the influence of dispositional variables on flow in tennis to gain a better understanding of which variables predict flow. Testing propositions of the flow model (Kimiecik & Stein, 1992) in the second study, I investigated interaction effects between personal and situational variables related to flow state and performance. I integrated the findings of these two studies into the third study, which examined an intervention designed to increase flow in tennis competition. To enhance flow, I designed an imagery-based intervention to target the most common flow dimensions identified in Study 1 to increase flow state. In this chapter, I discuss the general results and conclusions drawn from each study. I further address implications for theory and research, methodological issues, directions for future research, and practical implications that emerge from the results, before I present final comments.

General Results

The major finding of this thesis was that person and situation factors influence the experience of flow in tennis, generally supporting theoretical propositions of Kimiecik and Stein's (1992) flow model. The thesis consisted of three studies. The results of the studies examining the influence of personality variables on flow (Study 1) and the influence of situational self-paced and externally-paced tasks on flow (Study 2) were incorporated into an intervention procedure to increase flow state and performance (Study 3). In the following subsections, I discuss the conclusions drawn from the studies regarding athletes' propensity to experience flow and factors influencing the attainment of flow state. The results showed general support for Kimiecik and Stein's flow model, but some findings were unexpected, going beyond the scope of the current flow model, so they require more specific explanations.

Propensity of Flow in Junior Tennis Athletes

In Study 1, I aimed to investigate the relationship between flow and personality variables of action control, imagery use, absorption, and trait sport confidence. I found that athletes, who were high in confidence, often used imagery, and had a tendency toward action orientation, rather than state orientation, frequently experienced flow in tennis competition. The results provided evidence that an intervention to increase flow needs to emphasise and enhance athletes' characteristics of confidence, imagery use, and action control. As expected, trait confidence was the strongest predictor of global flow and flow dimensions of challenge-skills balance and sense of control, which confirms previous theoretical propositions (Jackson & Csikszentmihalyi, 1999) and research findings (Stavrou & Zervas, 2004). Interestingly, imagery use showed substantial connections with flow, being the strongest predictor of most flow dimensions, including concentration on the task, clear goals, unambiguous feedback, and autotelic experience. This finding was important because imagery use was a crucial variable underlying flow and imagery functions can also be employed as intervention techniques, with imagery serving as a vehicle, targeting the central dimensions of flow to increase flow state. More importantly than the finding of imagery use being a main personality variable underlying flow, I concluded that imagery would be a valuable procedure to form the basis of the intervention in Study 3. The results of Study 1 pinpointed that cognitive and motivational imagery functions are significant predictors of flow dimensions. That is, motivational general-mastery was a crucial imagery function for clear goals, autotelic experience, and challenge-skills balance. With regard to cognitive functions, cognitive general imagery was a strong predictor of challenge-skills balance, sense of control, and concentration of the task at hand. Therefore, results provided evidence that both cognitive and motivational imagery functions would be beneficial for the development of the contents of the intervention in Study 3. In addition, imagery use can be employed as a vehicle to target both key personality variables underlying flow (confidence, action control) and specific flow dimensions to increase flow in tennis competition.

I found action control to be a substantial variable affecting flow on a global and subscale level. The various aspects of action and state orientation appear to address key aspects of the flow experience in sport. That is, the way athletes' deal with failure, initiate action plans, and keep their minds on the current performance are crucial for their experience and performance. The result of this study underlines the importance of active and constructive involvement in the present situation and being able to adjust the focus on the task at hand to experience flow. I found, on the other hand, that state orientation was counterproductive for the experience of flow. The results suggested that athletes' extended fixation on situational aspects does not facilitate flow in tennis competition. Consequently, the intervention in Study 3 included statements that specifically addressed action-oriented cognitions during tennis performance to facilitate flow in competition.

Absorption did not show any significant associations with dispositional or state flow. This finding was unexpected, because several researchers have supported the conceptual connection and phenomenological similarity between flow and absorption (Jackson & Csikszentmihalyi, 1999; Jackson et al., 1998). Research findings on flow and hypnotic susceptibility, which was found to be a correlate of absorption (Tellegen & Atkinson, 1974), indicated that hypnotic susceptibility facilitated the experience of flow state in a training situation (Grove & Lewis, 1996). Stavrou and Zervas (2004) proposed that absorption is reflected by characteristics of flow dimensions. Investigating the contribution of flow dimensions to the experience of flow state, Stavrou and Zervas found statistical support for three higher-order factors. One factor is termed *absorption of the performance*, including action-awareness merging, loss of self-consciousness, time-transformation, and autotelic experience. According to Stavrou and Zervas, flow dimensions of challenge-skills balance and clear goals are critical to get into flow, whereas flow dimensions constituting the higher-order factor absorption of the performance reflect consequences of the precedent stage, which generally supports conclusions of Study 1.

From a methodological point of view, I argued that the generic, non-sport specific measure of absorption was not an adequate reflection of absorptive experiences in tennis competition. Therefore, methodological issues, rather than conceptual issues, could have contributed to these results. Future research should re-examine the connection between flow and absorption, employing a standardised and sport-specific measure of absorption.

From a personality point of view, the findings of Study 1, as illustrated in Figure 6.1, strongly indicated that imagery use should form the basis of the intervention aimed at enhancing confidence and action control, and flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience, which were operationalised as antecedents of flow, to induce flow state.

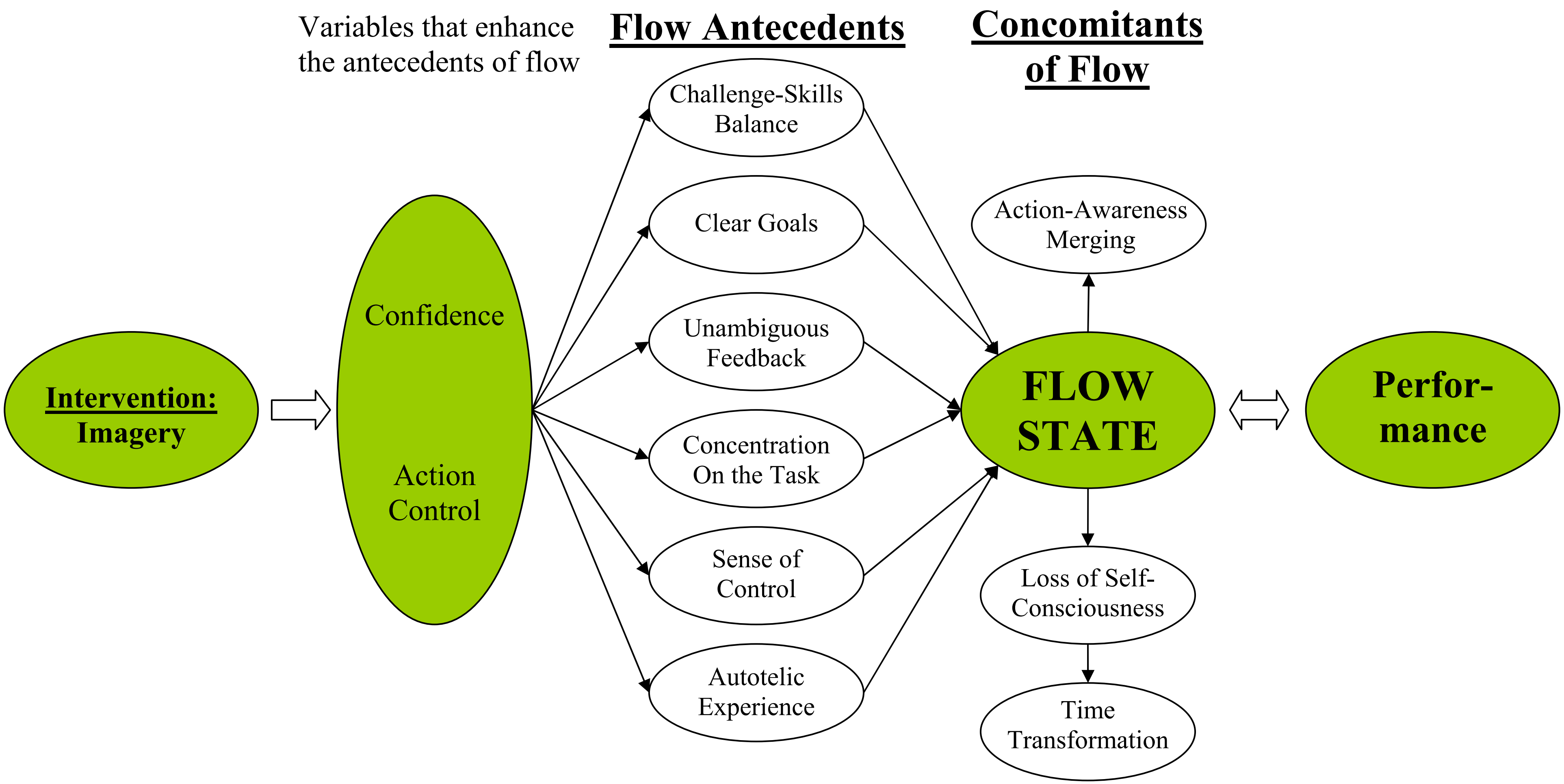

Figure 6.1. Flow model delineating the effect of imagery, personality variables, and performance on flow state.

Attainment of Flow State

Studies 2 and 3 had the aim to examine factors facilitating the attainment of flow state. The flow model (Kimiecik & Stein, 1992) proposed that interactions between personal and situational factors influence flow state. In Study 2, I investigated the interaction between personality variables, confidence and action control, and the task type, self- and externally-paced tasks, on flow state and performance. The results of Studies 1 and 2 were then incorporated into Study 3 to maximise the effect of an imagery intervention on flow state and performance in tennis competition.

Person and Situation Interactions

In Study 2, I found that person and situation factors influenced flow state. A trend towards an ordinal interaction effect emerged between confidence and task types on flow. As expected, confidence was a critical variable for the flow experience in the self-paced service and the externally-paced groundstroke task, with high-confident participants scoring higher on flow in both tasks than low-confident participants. Also, I found a trend towards an interaction effect between confidence and task type on flow state. The particular effect of self- and externally-paced tasks on flow state was examined for the first time, so that no direct comparisons can be made to the existing literature. Previous studies investigating person and situation interactions on flow underlined the importance of activity characteristics in the experience of flow state. Grove and Lewis (1996) concluded that the task type, circuit training, had a positive effect on flow state because exercisers follow a closed-skill and repetitive activity that includes various levels of difficulty and lasts for over 30 minutes. In contrast to circuit training, the execution of tennis shots in training or competition is characterised, not only by a repetitive routine, but also through mainly open skills and an interactive performance, including a return player on the other side of the net. In Study 2, changing important characteristics of the task by reducing the activity from interaction to repetition could have taken away the excitement that is generally part of the tennis experience. Compared to the activity in the Grove and Lewis (1996) study, the tennis tasks lasted for several minutes, which indicated that the duration of the activity could have been too short to experience flow. As Grove and Lewis reported, circuit trainers showed a significant increase in flow from early to late in the sessions, pointing out that the duration of the task is crucial for flow.

The task duration also appears to be important when examining differences in the relationship between action control and flow. Action orientation addresses individuals' capacity to get immersed into the performance, whereas state-oriented individuals are more volatile, which makes it difficult to keep their minds focused on one task over a long period of time. Finding no significant differences between action- and state-oriented participants and flow further supported the proposition that the duration of the task may not have been long enough. In addition, the task characteristics did not put an emphasis on participants' ability to deal with failure or to initiate action plans. Preoccupation after failure and hesitation are the other two aspects that reflect differences in action control. Finding no significant differences in flow between action and state orientation in the training task suggested that the task characteristics in Study 2 were not optimally suited to assess effects of action control on flow state. Therefore, the modification of the field-study task by which it deviated from the actual tennis training or competition performance seemed to be pivotal. The field task showed strong differences from general performance tasks in tennis training and competition and was very different in duration to the task characteristics in the Grove and Lewis (1996) study. In conclusion, the task characteristics of the activity appear to have strongly affected the results of the interaction with personality variables on flow state. Therefore, the intervention needed to address the specific task characteristics to increase flow in tennis competition.

Enhancing Flow State in Competition

Results of Studies 1 and 2 demonstrated that personal and situational factors need to be considered in the development of treatments to enhance flow in tennis competition. Consequently, I developed an intervention program with imagery as a vehicle, targeting key personality variables of confidence and action control and key dimensions of flow, including challenge-skills balance, clear goals, unambiguous feedback, concentration on the task, sense of control, and autotelic experience, in self- and externally-paced competition situations, to increase flow state and performance. The imagery script separately addressed service and groundstroke situations to amplify the effect of the intervention on flow and performance.

Study 3 showed that the intervention was generally effective in increasing both flow state and performance. The examination of flow in a competition context generated flow scores that ranged widely, showing some overlapping data points before and after the intervention. This result confirms previous findings by Lindsay et al. (2005), using hypnosis as the intervention technique to increase flow state in competition. The variety of flow scores in competition suggests that flow is a much more volatile state and susceptible to distractions in competition compared to a training setting. Interventions applied to increase flow state in training settings have generally shown a sustained increase in flow and performance after the hypnosis (e.g., Pates et al., 2001, 2002) or imagery (Pates et al., 2003) treatment with little overlap to pre-intervention measurements. My research showed that a volatile and ephemeral state like flow can be increased during tennis competition by using imagery and targeting personality variables of confidence and action control to enhance flow state.

As shown in Figure 6.1, I employed imagery to enhance action control as personality variable to increase antecedents of flow. I chose self-talk in combination with imagery to shift state-oriented to action-oriented cognitions. Action control theory suggests that a personal disposition towards action orientation would facilitate flow, with action-oriented athletes having a stronger capacity to get immersed into the performance and keep their focus on the task than state-oriented athletes, who are more volatile during performance and ponder more excessively after failure (Beckmann & Kazén, 1994). Previous research indicated that self-talk and self-instructions were successful treatments to shift individuals from state to action orientation (Brunstein, 1994). In addition, self-talk was found to be effective as part of an imagery intervention to increase competition performance (Kendall et al., 1990) or as part of a mental training program targeting confidence and anxiety in competitive tennis players (Mamassis & Doganis, 2004). In Study 3, self-talk was integrated in the imagery script. Participants reported that after the intervention they had more positive thoughts, felt less affected by distractions, and perceived an increase in focused concentration. More specifically, some participants reported that they used self-talk more constructively and perceived more action-oriented thoughts of what-to-do and to keep their focus on the task. Therefore, the results of Study 3 corroborated that imagery, in combination with self-talk components, was effective in facilitating action orientation and flow antecedents, such as concentration.

In addition, I employed imagery to target confidence as a personality variable that can increase antecedents of flow, which, in turn, aimed to increase flow state. The mean flow state increased and participants reported a noticeably higher confidence level after the intervention, which supported the intended effect. A main reason for the effectiveness of the intervention was targeting confidence as a critical variable underlying flow. The imagery script emphasised the motivational general-mastery imagery function in connection with confidence that related to flow dimensions of challenge-skills balance, unambiguous feedback, sense of control, and autotelic experience.

Research has indicated that motivational general-mastery imagery has a positive effect on confidence, which supports my research findings. Callow et al. (2001) found that an intervention using motivational general-mastery facilitated the confidence level of advanced badminton players in competition. Moritz, Hall, Martin, and Vadocz (1996) reported that confidence was more strongly affected by motivational mastery functions than by cognitive functions of imagery. Vealey's (2001) model of sport confidence provided theoretical support for the effectiveness of imagery functions. Vealey advocated that imagery interventions that enhance confidence have a motivational effect on behaviour, thoughts, and emotions. Providing theoretical support for the connection between imagery, confidence, and flow aspects, Vealey proposed that imagery can enhance confidence through its motivational function by "creating a productive task focus of what to do" (p. 560). In Study 3, all participants reported an increase of confidence and flow state after the intervention. Out of the four participants, Participants 1 showed the strongest increase in flow, which indicated that confidence had a mediating effect between motivational functions of imagery and flow antecedents.

An unexpected result in Study 3 was that three participants increased in flow state and four participants increased in performance. Correlational results of Study 1 and previous research (e.g., Jackson et al., 2001; Stavrou & Zervas, 2004) suggested a positive association between flow and competition performance. For the intervention, I expected an outcome that provides further evidence that flow and performance develop in the same direction, with both variables either increasing or decreasing, as indicated by previous intervention results related to flow and performance (e.g., Pates et al., 2001, 2002 2003).

The diverse outcomes could be explained by Vealey's (2001) model of sport confidence. Vealey advocated that imagery interventions enhance confidence in two ways with regard to cognitive and motivational imagery functions. On the one hand, imagery has a motivational effect on how athletes feel, think, and behave. On the other hand, imaging oneself performing successfully increases confidence through vicarious experience that provides an ideal mental model or blueprint for performance. This aspect of imagery emphasises a cognitive function to adjust or improve performance skills and strategies. In a meta-analysis on imagery, Feltz and Landers (1983) found that cognitive functions of imagery, as reflected in skills and strategies, were more critical for performance, whereas motivational functions of imagery were more effective for increasing confidence and reducing anxiety. The single-case design does not allow for the interpretation of causal effects, but the differences between flow state and performance could be explained by the impact of motivational and cognitive functions of imagery on flow and performance. Confidence appeared to be a key variable by mediating the effect of imagery on flow state and by mediating the relationship between imagery and performance. Therefore, the imagery intervention, including confidence enhancement, could have had a direct impact on flow and a direct, but separate, impact on performance.

Another variable that could have influenced the attainment of flow state is ego-involvement. Ego-involvement relates to athletes' interest and commitment in the task, which reflects individuals' interest and engagement in an activity that is perceived as personally important and meaningful. Csikszentmihalyi (1975) termed this type of flow engagement *autotelic involvement*. In a recent study, Havitz and Mannell (2005) investigated the relationship between flow, ego-involvement, and situational involvement in leisure and non-leisure contexts. The study examined the hypothesis that the relationship between ego-involvement, also referred to as “enduring involvement” (p. 153), and flow is mediated by situational involvement. Situational involvement is temporally distinct from enduring involvement, addressing temporary feelings that could be “evoked by a particular stimulus or situation” (Rothschild, 1984, p. 216). The results showed that high enduring (ego) involvement was positively related with flow experiences in leisure and non-leisure activities. In addition, structural equation modeling showed that situational involvement was a mediator between enduring involvement and flow.

Similar to dispositional and state flow, the distinction between enduring and situational involvement, as examined by Havitz and Mannell (2005), indicates that the long-term, enduring involvement in an activity is relatively unswayable, whereas situational involvement can underlie stronger fluctuations. Therefore, the level of situational involvement can have important and direct consequences for flow state. Individuals who are highly autotelically involved in the task at hand might perceive a fusion between the task performance and the task experience, which would reflect results for Participant 1. Situational involvement could also account for individual differences in the experience of flow state. That is, low situational involvement could still lead to moderate or even high performance outcomes. In particular, skilled athletes, as in Study 3, would be able to achieve a reasonable performance level under either facilitative or detrimental performance conditions, but the experience during performance would be less emotionally intense than for athletes with high ego-involvement. This reflects the results of Participant 4, who showed a higher performance, but a lower flow state level, than before the intervention. Therefore, ego-involvement appears to be another important antecedent of flow, providing more evidence that flow experiences, in some instances, are detached from competition performance, whereas in other events flow and performance share a positive connection.

Flow State and Performance

In this thesis, I found evidence for a positive relationship between flow and performance. I measured flow state consistently with the FSS-2 and various aspects of performance across the three studies. In Study 1, I tested the association between flow state and self-ratings of performance and objective performance outcomes. In Study 2, I assessed flow state and performance outcome that involved the accuracy of service and groundstroke shots. In Study 3, I examined the effect of an imagery intervention on flow state and performance, as measured through service and groundstroke winners.

In Study 1, I found that the connection between flow and performance was substantially higher for subjective performance, with ratings comparing the last competition performance to performances in similar competitions in general, than objective performance, as measured by number of games won. Stavrou and Zervas (2004) found moderate to strong connections between dimensions of flow state and subjective performance, confirming a substantial link between flow and self-assessed performance. The results of Study 1 indicated that flow experiences were more related to being content about the performance process than the actual outcome. This finding is supported by previous results from Jackson and Roberts (1992), concluding that task orientation, e.g., mastering the performance task, would be facilitative of flow, whereas competition orientation, which prioritises performance outcomes and outperforming others, could be debilitative of flow. Csikszentmihalyi (2002) described the purpose of flow to be self-contained, to experience flow for its own sake and to stay in flow, which will be disrupted by thoughts of instrumental rewards, such as winning.

Study 2 was a field study examining flow and specific aspects of tennis performance in a training setting, whereas Study 1 employed pen-and-paper scores to assess the connection between flow state and competition performance. In Study 2, I found moderate correlations between flow state and performance outcome for the service task and between flow state and performance for the groundstroke task, which confirms the findings of Study 1, indicating a positive connection between flow state and performance outcome.

In Study 3, I measured flow state and performance in a competition setting, providing more ecological validity than the previous study. In this study, I examined the influence of an imagery intervention on flow state and performance in official ranking-list tournaments. I found inconsistent patterns between flow state and performance winners. That is, an increase in performance was not necessarily accompanied by an increase in flow state. The results showed that after the intervention all participants increased in performance, but only three of the four participants increased in flow state, whereas flow state decreased for one participant. These findings indicated that flow could have mediated performance results. One explanation for the diversity of flow and performance scores could be that the competition setting has a positive or negative influence on athletes' flow experience. In competition, athletes have to deal with more factors influencing their experience, such as competition pressure or expectations, than in training. Employing hypnosis interventions in a competition setting, Lindsay et al. (2005) also found deviations between flow state and performance following the intervention, whereas studies examining intervention effects on flow and performance in training tasks have reported more consistency in the increase of flow and performance from baseline to intervention phase (Pates et al., 2001, 2002, 2003). These results were supported by Young (2000), who reported that elite tennis players experience flow more often in training than in competition situations.

Study 3 also showed that the development of flow state during competition was perceived differently among the participants. Participant 1 noted that the use of imagery was a helpful addition to his competition preparation, which resulted in a strong pre-performance state. The impact of an optimal pre-performance state as a facilitator of flow has been widely supported by previous research, indicating that optimal physical and mental competition preparation was the most influential factor producing flow in college and elite sports (Jackson, 1995; Russel, 2001; Young, 2000). It is possible that the intensity of the pre-performance state, for instance, during warm-up, as reported by Participant 1, positively affected performance from the start of the competition. In contrast to Participant 1, Participants 2 and 3 reported that their flow experiences were not triggered by one specific event, but developed gradually within the match, which both participants attributed to a consistent performance. In conclusion, Study 3 provided evidence that flow and performance could be connected by a reciprocal (Participants 2 and 3) relationship or a one-directional relationship (Participant 1) with flow influencing performance. More specific measurements are needed that allow for the assessment of flow state before and during performance (e.g., during natural competition breaks, which are part of tennis matches) to examine the link between flow and performance on a detailed level to be able to draw more conclusive inferences on the flow-performance link

Overall Conclusions

In summary, this thesis illustrated a coherent approach to the examination of flow in sport, providing general support that stable person and situation factors influence flow state, as proposed by the flow model (Kimiecik & Stein, 1992). Confidence was the most critical personality variable for the experience of flow across the three studies. Specific flow dimensions appear to be more important than others to get into flow in tennis competition, which provided important information in constructing the intervention script. The results in Study 3 on flow and performance provided evidence about the effectiveness of an imagery intervention aiming to increase flow dimensions to increase flow state. Consequently, tennis specific imagery interventions that aim at increasing crucial personality variables (confidence and action control), in combination with the most important antecedents of flow, appear to be a most appropriate intervention technique to increase flow state and performance in competition.

Implications for Theory and Research

Jackson and Csikszentmihalyi (1999) characterised flow in sport as a complex psychological state. Kimiecik and Stein (1992) addressed the complexity of flow in a sport-specific model of flow, proposing a number of personal and situational factors that interplay in the generation of global state flow. The findings of this thesis have two important implications for the further development of a more specific model of flow in sport with regard to a) flow dimensions facilitating the experience of flow in sport, and b) the relationship between flow and performance and its effect on the experience of flow.

Flow Dimensions

A key aspect of Study 1 was the examination of the importance of flow dimensions in the experience of flow. Jackson et al. (1998) proposed that flow dimensions might vary in the way certain dimensions contribute to flow, which could depend on individual and sport characteristics. With regard to the frequency of flow in junior tennis players, Study 1 showed that several flow dimensions were strongly connected with personality variables of confidence, imagery use, and action control. As illustrated in Figure 6.1, flow dimensions of challenge-skills balance, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, and autotelic experience, which I termed antecedents of flow, appeared to be particularly important for the occurrence of flow. Small correlations between personality variables and flow dimensions of action-awareness merging, loss of self-consciousness, and time transformation indicated that these dimensions, which I called concomitants of flow, played a different role in the experience of flow. Research examining flow on a subscale level would provide more detailed information of critical processes underlying flow state. Discriminating between functions of flow dimensions would provide a *parsimonious way* (Stavrou & Zervas, 2004) to investigate characteristics conducive of flow.

The distinction between functions of flow dimensions has been suggested recently by several researchers, proposing revised models of flow that take into account functions of flow dimensions that vary in their contribution to flow state. The revised models emerged from theoretical notions of flow (Csikszentmihalyi, 2000a), from qualitative results (Sugiyama & Inomata, 2005), and from quantitative analysis (Stavrou & Zervas, 2004). Similar to the distinction made in this thesis between antecedents and concomitants of flow, Csikszentmihalyi (2000a) divided flow dimensions into *flow conditions*, which are crucial to get into flow, and *flow characteristics*, which reflect the experience during flow. According to Csikszentmihalyi, general conditions facilitating flow are based on dimensions of challenge-skills balance, clear goals, and unambiguous feedback. Characteristics of flow that are experienced while being in flow are dimensions of concentration on the task at hand, action-awareness merging, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. Csikszentmihalyi's distinction between flow conditions and flow characteristics is based on theory-based findings. Even though the model is not specifically directed to flow experiences in sport, the model reflects several dimensions of dispositional flow that I found related to personality variables in Study 1. That is, challenge-skills balance, clear goals, and unambiguous feedback were significantly predicted by personality variables of confidence, imagery use, and action control.

Sugiyama and Inomata (2005) proposed a sport-specific *advanced flow model*, in which they distinguished between flow dimensions that are critical for the intensity of flow experiences on a low, moderate, or high level. The assessment of flow on a continuum between low and high experiences bears conceptual similarities to Csikszentmihalyi's (1975, 1988b) proposition of flow varying on a continuum between microflow experiences that occur frequently in everyday life and macroflow experiences that occur rarely and reflect deep flow experiences. Sugiyama and Inomata (2005) based their flow model on qualitative findings in sports. Athletes reported to frequently experience flow dimensions of unambiguous feedback, concentration on the task at hand, and autotelic experience, which, according to Sugiyama and Inomata, represent basic flow states. To experience deeper flow states, concentration on the task at hand has a key function influencing dimensions of action-awareness merging and sense of control, which, in turn, are conducive for high-level flow, represented by loss of self-consciousness, and time transformation. Sugiyama and Inomata found that athletes rarely referred to the challenge-skills balance as part of their flow experience, which indicates that this dimension, along with loss of self-consciousness and time transformation, could signify deeper flow states. The finding regarding the challenge-skills balance is contrary to theoretical propositions that a balance between challenges and skills is a precondition to get into flow (Csikszentmihalyi, 1975, 1988b). Sugiyama and Inomata's flow model, on the other hand, fits qualitative results by Jackson (1996), who found that athletes from a range of sports reported flow dimensions in a similar way. With regard to quantitative findings, partial support for this model was found in Study 1, showing that loss of self-consciousness and time transformation were rarely part of the tennis players' flow experiences.

Stavrou and Zervas (2004) proposed a fruitful approach to examine flow dimensions in a more parsimonious way using a quantitative approach. Investigating common characteristics of flow dimensions contributing to flow, Stavrou and Zervas tested higher-order models of flow and found statistical support for three higher-order factors of flow that were termed *clearness of the state*, including challenge-skills balance and clear goals, *control of the situation*, including unambiguous feedback, concentration on the task at hand, and sense of control, and *absorption of the performance*, including action-awareness merging, loss of self-consciousness, time-transformation, and autotelic experience. According to Stavrou and Zervas, flow dimensions regarding clearness of the state are important to get into flow, whereas control of the situation and absorption of the performance, respectively, reflect consequences of the precedent stage. The flow model by Stavrou and Zervas is based on quantitative data, whereas the Sugiyama and Inomata (2005) advanced flow model emerged from qualitative findings. Both models outline that deep flow states are represented by the experience of specific flow dimensions of loss of self-consciousness and time transformation, which was generally supported by the results of Study 1. Differences between models were apparent for the function of the flow dimension of challenge-skills balance, which Stavrou and Zervas (2004) addressed as an important dimension to get into flow, whereas Sugiyama and Inomata (2005) advocated that the challenge-skills balance would be part of particularly deep flow experiences.

Future research would benefit from propositions of a more parsimonious flow model. Csikszentmihalyi's (2000a) proposition of making a general distinction between flow dimensions relevant as either conditions or characteristics of flow warrants further examination in a sport context. Figure 6.1 illustrates the way the imagery intervention targeted personality variables and specific flow dimensions, which were termed antecedents of flow, because of their proposed function to increase flow state, whereas flow dimensions that were not directly targeted in the intervention were termed concomitants of flow. Similar to Csikszentmihalyi's differentiation between conditions and characteristics of flow, the distinction made in this thesis between flow antecedents and concomitants of flow was based on results in Study 1 and assisted in targeting specific flow dimensions in Study 3 to increase flow state in tennis competition. The sport-specific advanced flow model, as proposed by Sugiyama and Inomata (2005), fits previous qualitative results on flow in sport (Jackson, 1996) and is partly supported by quantitative results in Study 1 of this thesis. Results on flow that deviate from the advanced flow model might be due to the examination of flow dimensions in junior athletes in one specific sport, namely tennis, whereas Sugiyama and Inomata (2005) and Jackson (1996) interviewed elite athletes from a range of sports. Both models by Csikszentmihalyi (2000a) and Sugiyama and Inomata (2005) are partly supported by the results in this thesis.

There are efforts by researchers to conceptualise functions of flow dimensions to improve research in the generation of flow state. Previous conceptualisations of the effect of flow dimensions on flow state originated from the general theoretical perspective (Csikszentmihalyi, 2000a), or reflected propositions that stemmed from qualitative (Sugiyama & Inomata, 2005) or quantitative (Stavrou & Zervas, 2004) research. Based on research findings, Stavrou and Zervas (2004) proposed a distinction between "conceptual, chronological, and cognitive concepts" (p. 170) of flow dimensions, which led to the grouping of first-order factors of flow into three higher-order factors. Csikszentmihalyi (2000a) and Sugiyama and Inomata (2005), on the other hand, based their proposed flow models on their interpretation of interview data. To thoroughly assess the impact of functional aspects of flow dimensions on flow state, a more controlled research approach is necessary. Theoretical and research advancements on flow in sport should be guided by the influence of key flow dimensions in the experience of flow within the specific activity. This approach would provide a deeper understanding of the mechanisms involved in the experience of flow. Therefore, conceptualising flow aspects as antecedents and concomitants of flow in a particular sport situation, such as tennis competitions, and applying the results to the development of interventions to increase flow state represents a valid and fruitful approach to test functions of specific flow dimensions. Based on the results in this thesis, Studies 1 and 3 provided strong evidence that aspects of sense of control and concentration on the task at hand are antecedents of flow, which can be targeted in interventions to enhance flow. These antecedents should be further tested in future research. Dimensions that have been shown to relate to flow state as antecedents should undergo further examination to enhance flow state. Only one or two flow dimensions should be manipulated at a time to closely examine the specific effect on flow state. Alternatively, examinations regarding the function of flow dimensions could focus on antecedents that are agreed to relate to flow, such as sense of control, to examine the predictions that manipulation of this antecedent does affect flow state, whereas manipulating concomitants of flow, such as loss of self-consciousness, does not affect flow state.

Flow-Performance Relationship

Across the three studies, I found positive associations between flow state and performance quality and performance outcome. In general, the intensity of the association between flow and performance varied with regard to the performance measure and the performance situation. Flow state was continuously assessed by the FSS-2, whereas performance was measured by competition score (Study 1), service and groundstroke accuracy (Study 2), and service and groundstroke winners (Study 3). Beside the various measures of performance in this thesis, one important aspect in the examination of the flow-performance relationship was that, similar to most previous research, flow state was reported retrospectively following performance with no continuation or repetition of performance or flow measurements. Single measurements of flow on one occasion put a substantial limitation on assessment of the direction of the flow-performance relationship. Overall, in this thesis, the connection between flow state and the various performance outcome measures provided evidence for a positive connection between flow and performance outcome. Therefore, the conclusion can be drawn that there is a positive relationship between flow and performance outcome. The positive connection between flow and performance should be considered as another factor that adds to the interaction of personal and situational interactions.

The positive connection between athletes' experience and performance was proposed by Privette and Bundrick (1997) in their feeling-performance model. Privette and Bundrick distinguished between two components in the model, namely, a feeling dimension and a performance process dimension. The model received research support showing that specific feelings and processes underlie peak, average, and failure performance. Feeling factors tested with regard to performance levels were fulfilment, significance, spirituality, and play, whereas performance processes were assessed including two factors, termed focus and self in process. Discriminant analysis showed a linear relationship between feeling levels of fulfilment and performance, that is, the stronger the performance the higher the level of fulfilment about the performance. Fulfilment, with intrinsic rewards also being part of the fulfilment factor, was the strongest discriminator between performance outcomes. With regard to performance processes, Privette and Bundrick found that focus and self in progress significantly differentiated peak performance from other performance levels. Interestingly, the two performance-process factors consist of aspects reflecting flow dimensions, which include awareness and clear focus of attention. Depending on the theoretical viewpoint, awareness and focus represent feeling states, as proposed by flow theory, or aspects of performance processes as proposed by the feeling-performance model. Jackson (2000) provided additional support for the proposition that similarities existing between flow dimensions and peak performance attributes. More attention is warranted on processes that are related to flow and performance, such as awareness and focus, to determine what triggers these processes and whether these processes are related to athletes' flow experiences or to athletes' performance. Examining variables critical for flow and performance could provide more insight into whether flow and performance are connected by a reciprocal or a one-directional relationship, depending on whether these processes are triggered by athletes' experience or by athletes' performance. Theoretical and research developments would benefit by considering propositions from both Kimiecik and Stein's (1992) flow model, regarding personal and situational interactions on flow, and Privette and Bundrick's (1997) feeling-performance model, addressing the connection between experience and performance states. Consequently, based on the findings of this thesis and theoretical propositions, the generation of flow state should be more comprehensively examined by investigating possible three-way effects between personal, situational, and performance factors on flow state.

Methodological Issues

Several methodological issues arise from the research on flow as presented in this thesis. I identified three noteworthy methodological issues related to this thesis, which regard a) flow measurement, b) participants' age, and c) the competition setting.

Flow Measurement

With regard to flow measurement, a general concern for all studies on flow is that a self-report questionnaire has been used to retrospectively measure flow. Brewer et al. (1991) found that psychological states, namely confidence and task focus, which are important aspects of flow, were biased by performance outcome. Consequently, the subjectivity of participants' flow experience could have been affected by performance results. That was particularly important in Study 3 for the assessment of the effectiveness of the application of an imagery program designed to enhance flow. Particularly after unsuccessful competitions, participants commenting in the social validation interview on flow indicated that the overall performance outcomes could have distorted their assessment of flow state.

In addition, measuring flow on a global level might not be sensitive enough to reflect flow state during an activity or performance. Several studies have suggested that flow dimensions of action-awareness merging, loss of self-consciousness, and time transformation appeared to be less effective discriminators of flow (e.g., Jackson et al., 1998, 2001). This finding was supported by Study 1, suggesting that flow dimensions can be differentiated as more and less effective discriminators of flow. As illustrated in Figure 6.1, the results of Study 1 demonstrated that several flow dimensions, including challenge-skills balance, clear goals, unambiguous feedback, concentration on the task, sense of control, and autotelic experience had a strong connection with personality variables, supporting the proposition that they are primary variables in the induction of flow state, which I termed antecedents of flow. Flow dimensions showing a weaker connection with predictor variables, including action-awareness merging, loss of self-consciousness, and time transformation, I categorised as concomitants of flow, which are more important during flow. A similar proposition was put forward by Jackson et al. (1998) and Sugiyama and Inomata (2005), who advocated that flow dimensions of loss of self-consciousness and time transformation could indicate the experience of particularly deep flow. Therefore, a more sensitive measure of flow that addresses the main constituents of flow would increase the validity of measuring flow on a global level, which more accurately reflects the general experience of flow, than through the inclusion of dimensions that rarely occur during an activity or performance. Furthermore, the use of advanced analysis techniques, such as structural equation modeling, would be beneficial to shed more light into the relationship between flow dimensions and global state flow.

Finally, flow state, as measured by the FSS-2, reflects an athlete-centred measure, whose items more strongly address flow aspects in self-paced or closed-skill tasks than situations that are characterised by externally-paced or open skill tasks. This bias of flow items towards self-paced situations is apparent for key flow dimensions of clear goals (Item 3, "I knew clearly what I wanted to do"), unambiguous feedback (Item 4, "It was clear to me how my performance was going"), concentration on the task at hand (Item 5, "My attention was focused entirely on what I was doing"), and sense of control (Item 6, "I had a sense of control over what I was doing"). These examples address flow in self-paced, closed-skill tasks, leaving out environmental aspects, such as the influence of a direct opponent that may prevent or disrupt the experience of flow. The measurement of flow dimensions in mainly externally-paced, open-skill situations, such as tennis competitions, would be more accurately addressed by qualifying flow items in regard to the opponent. The influence of the opponent on athletes' flow could be reflected by rewording items to "I knew clearly what I and my opponent wanted to do" or "It was clear how my performance was going in comparison to my opponent's performance", or "My attention was focused entirely on what I and my opponent were doing", or "I had a sense of control over what I and my opponent were doing". These items partly reflect what Participant 1 described in the social validation interview by experiencing increased flow and awareness that included his opponents' actions. Further psychometric developments should evaluate flow items in reflection to externally-paced, open-skill situations, which would take into account environmental influences on flow state. For sports like tennis, soccer, and volleyball that consist of combinations of self-paced and externally-paced tasks in direct competition situations, a modified FSS-2, with half the items addressing athlete-centred flow and half the items addressing flow in regard to the opponents' influence, would more accurately assess flow in sports with open- and closed-skill performances.

Participants' Age

With regard to participants' age, Studies 1 to 3 examined flow and personality variables in participants between 11 and 18 years of age. This particular age group was chosen to examine the flow experience in junior tennis. The issue is that some of the younger participants of this sample might not have fully understood some of the items and this influenced the results, especially on flow. Jackson and Eklund (2004) advocated that participants completing the FSS-2 should be at least 15 years of age. Several previous studies employed participants between 10 and 19 years of age to examine flow (Jackson & Marsh, 1996; Doganis et al., 2000) and personality variables that were found important predictors of flow in Study 1, such as imagery use (Moritz et al., 1996), action control (Seidel, 2005), and confidence (Moritz et al., 1996). These studies did not report possible negative age-related effects on the results. In a long-term study of flow with teenagers, Patton (1998) found that the amount of time spent in flow decreased from 12 to 17 years of age. Consequently, younger individuals appear to have a strong capacity to experience flow. This is an important research area on flow and will be addressed in the future research section. Fostering flow, especially in sports where athletes are able to perform at high levels at a young age, will be beneficial for athletes' personal and performance development. Future research, however, should examine whether there are age-related limitations in the measurement of flow. Difficulties in understanding and rating the dimensions of flow should be overcome with age-specific measures of flow. The results on flow in this thesis have not indicated apparent age-related limitations in rating flow.

Competition Setting

With regard to the competition setting, there are several potentially confounding variables in a competition environment. Situational factors like different opponents, venues, weather, and time of match play vary between competitions. Therefore, situational factors can affect athletes' flow experience, which was supported by qualitative results on factors disrupting or preventing flow (Jackson, 1995; Russel, 2001; Young, 2000). Previous intervention studies aiming at increasing flow and performance found that the treatment effect in a training environment was stronger on flow state and performance (e.g., Pates et al., 2002, 2003) than in a competition environment (Lindsay et al., 2005). Csikszentmihalyi (1975) asserted that direct competitions, in which athletes compare their performance against others, could have a stronger negative effect on flow than indirect competitions, because of the immediate impact of the opponent's behaviour on the athlete. Intervention studies assessing flow state and performance in direct competitions should ensure the collection of enough data to allow for fluctuations due to opponents, weather conditions, and crowd. Extended baseline and post-intervention phases could be accounted for by varying external conditions, so, decisions about a stable baseline criterion or intervention effects can be made with more confidence. As found in Study 3, baseline and post-intervention phases that include few data points were strongly affected by one measurement. With regard to Participant 3, a deviation in the final measurement point of both phases can give a distorted image of the overall trend. Future intervention studies, in direct competition, should consist of extended baseline and post-intervention phases with a sufficient amount of data points to account for uncontrollable effects of external variables. Following this approach, more accurate conclusions can be drawn about the intervention effect on flow state. Even though intervention studies in real-world settings involve a number of variables that are subject to change, future intervention research examining flow and performance should be applied in competitions because they are more ecologically-valid than training or field-study conditions, which will benefit practitioners and further applied research.

Future Research

The present thesis offers many possible avenues to conduct further research. In this subsection, I will address noteworthy future research that emerged from each study. This involves more in-depth studies addressing the influence of personality variables, situational variables, and performance on flow, as well as long-term effects of intervention studies on flow in competition

Flow and Personality Variables

In Study 1, one of the most fruitful findings for future research was the significant connections between flow dimensions and functions of imagery use. Cognitive functions of imagery significantly predicted dispositional flow dimensions of challenge-skills balance, sense of control, concentration on the task at hand, and unambiguous feedback, and motivational functions of imagery most strongly predicted flow dimensions of clear goals and autotelic experience. It appears plausible that the experience of flow in highly technical sports, such as tennis, could involve the use of mainly cognitive functions of imagery, as found in Study 1. The examination of athletes' imagery use in tennis allowed for designing sport-specific imagery interventions targeting certain flow dimensions to increase flow state and performance. Future studies should a) test for significant associations between the personality variable of imagery use and flow dimensions, which will provide specific information for the development of imagery scripts targeting the most relevant dimensions of flow in the specific sport, and b) examine the use of imagery as a vehicle to deliver interventions, including content based on other variables thought to affect flow, in the way that I delivered material to enhance confidence and action control in Study 3. Also, pinpointing connections between imagery and flow might shed more light on the mechanisms underlying flow. For instance, further testing between functions of imagery use and dimensions of flow could clarify whether flow dimensions have a cognitive or motivational function contributing to flow in sport. The result that cognitive and motivational imagery functions significantly predicted dimensions of flow could indicate that each flow dimension might contribute to flow primarily as a cognitive or motivational antecedent. Further research is needed to more fully understand the connection between imagery functions and flow dimensions.

Flow State and Task Type

The results of Study 2 provided encouraging results supporting the proposition that personal and situational factors interplay in the generation of flow state. These results further support previous findings by Grove and Lewis (1996), providing more evidence for the usefulness of propositions of the flow model in a training setting. In Study 2, the trend towards significant interactions indicated that the situational conditions were not pure enough to provide distinctly different conditions that significantly affect flow state. Therefore, future studies should investigate interaction effects on flow in competition settings. Singer (1998, 2000) proposed specific cognitive processes that are part of self-paced and externally-paced performances. Based on the results of Study 2, an authentic competition setting, rather than a modified training setting, might be more appropriate to activate these processes, and would provide more insight and ecologically-valid results on the impact of interaction effects on flow state. Sports, like tennis, include self-paced and externally-paced performance situations that are intertwined with a combination of open and closed skills, whereas flow is an ongoing experience. Thus, a real competition situation cannot separate the effects of self- and externally-paced task components on flow. Therefore, investigations of self-paced and externally-paced situational effects on flow should be more closely examined by comparing flow between purely self- or externally-paced sports, such as jump versus running disciplines in athletics. Researchers should also examine other situational variables that are important for the experience of flow state. Key situational variables that might influence flow state are open versus closed skills, competition versus training settings, athletes’ skills, opponents’ and crowd responses

Flow State and Performance

Another aspect of future research should focus on the relationship between flow and performance to increase the understanding of possible links between these variables. More specifically, it is important for future studies to examine the association between flow and various aspects of subjective and objective performance outcomes to more fully understand processes that separately or jointly underlie flow and performance. Furthermore, more research should investigate whether there is a causal relationship, which could be one-directional or reciprocal, between flow and performance, as opposed to a coincidental association because flow and performance are independently affected by the same antecedents.

One research approach could be to investigate the connection between flow state and performance that is directed to untangle the relationship between flow and subjective and objective performance. In Study 1, I found strong connections between flow and subjective performance, whereas less strong associations emerged between flow and objective performance outcomes. These results were generally supported by previous studies on flow and subjective performance (Jackson et al., 2001; Stavrou & Zervas, 2004) and flow and performance outcomes (Jackson et al., 2001). To shed more light on the connection between flow experience and performance outcome, further analysis should be directed towards the examination of performance by separate testing of flow and subjective performance, and flow and objective performance. This can be achieved, in a field-study setting, by testing flow twice after the end of the performance, once without athletes' knowledge of the performance results, and, again, after knowing the objective performance outcome. To investigate differences in flow and subjective and objective performance in tennis, the same set-up as employed in Study 2 can be used. The only difference would be that athletes do not receive visual feedback about the performance result. This could be achieved including a cover that hangs over the net that occludes the performance outcome. Participants would report on flow once before they know about the performance outcome and a second time after they have received the results of their performance. The first flow score would reflect athletes' flow experience with regard to subjective performance, whereas the second flow score would indicate flow state that includes the impact of the objective performance outcome. Differences between the first and the second flow score would indicate the influence of the performance outcome on flow. A more ecologically-valid approach can be taken with sports that include performances that are rated by judges, such as dance, diving, trampolining, and surfing. Flow, with regard to subjective performance, could be assessed before the performance outcome is known to the athlete. Subsequently, the performer would be informed about the actual performance result and flow is assessed again. This would provide more evidence on differences in flow with regard to quality of performance experience and performance outcome in a real-world competition setting.

Another research approach could be directed to examine the link between flow state and objective performance outcome. In this thesis, objective performance was measured in different ways by overall match outcome (Study 1), shot accuracy (Study 2), and winning shots (Study 3). Previous studies generally measured flow once after the event, assessing flow for the entire event. In Study 3, I employed a modified version of the FSS-2, assessing flow for each set played in tennis competition. Future research should include more frequent flow assessments during performance to more thoroughly examine relationships between flow experience and performance. In tennis, one way to gather more information would be to apply a shortened flow measure that could be filled out during the breaks when swapping sides. Kimiecik and Stein (1992) proposed a two-part experience form to measure flow in golf, with the first questionnaire assessing possible antecedents of flow, such as confidence, concentration, expectations, and competency before playing the hole, whereas the second questionnaire examines key flow dimensions, such as challenges and skills, goals, concentration, and control to be filled out after the completion of the hole. A similar approach in sports that offer time for athletes to complete flow measures during performance, such as tennis, would more clearly pinpoint antecedents of flow and provide more detailed information on the connection and interaction of flow and performance.

Multiple measurements of flow and performance are needed to test for causal relationships between flow state and performance. In a tennis match, a shortened flow scale could be completed before the onset of the match and after three, five, and seven games played, and so on, and after the conclusion of each set. Patterns in which performance increased after flow increased would provide evidence for a one-directional connection in which flow state directly affects performance. The opposite pattern would suggest a one-directional link with performance influencing flow. A pattern, in which both flow and performance jointly increase or decrease, could emerge, indicating reciprocal effects between flow and performance.

Long-Term Effects of Flow

Overall, the thesis provided evidence of employing a valuable approach to increase flow and performance in tennis competition. One of the most important future research directions should be centred on the enhancement of flow state and competition performance over a longer period of time. Study 3 demonstrated that imagery is a viable intervention technique to enhance flow state and performance in a competition setting. In contrast to previous studies that examined short-term intervention effects (e.g., Pates et al., 2002, 2003), this study provided evidence for the successful implementation of an imagery intervention to increase flow and performance with a post-intervention phase lasting over a longer period of four to six weeks. The results of Study 3 indicated that, as found with Participant 1, the effect of the intervention positively influenced flow state and had far reaching effects on the overall on-court experience and competition performance, regarding confidence, awareness, and performance winners. Furthermore, the long-term effect of the intervention showed an increase in ranking-list development. Interventions, like the one in Study 3, that aim to increase flow occurrence and intensity in most competition events over a longer period of time, for instance, six or twelve months, would also positively affect dispositional flow. Frequency of attaining flow does not appear to be a fixed capacity. Future studies should aim to increase flow state in a competition setting for the examination of long-term effects on flow and performance.

The intervention effect of imagery on personality variables and flow could be described as having a proximal or short-term influence. More research is needed to evaluate distal or long-term influences of interventions on flow that last for a substantial period of time. Mamassis and Doganis (2004) found positive influences of a continuous season-long mental training program with elite junior tennis players on performance were tested by. The mental training program consisted of imagery, self-talk, goal setting, concentration, and arousal regulation techniques. Mamassis and Doganis compared the effects of the program between an intervention and a control group, finding that confidence and performance increased more strongly for the intervention group. A similar intervention approach to the one conducted in this thesis, in combination with an extended intervention and post-intervention phase, could provide important long-term effects for young athletes. In a first step, a thorough pre-intervention examination needs to be conducted to pinpoint the most critical personality and situational factors that impact on athletes' experience and performance in competition. In a second step, an intervention procedure with imagery, hypnosis, self-talk, or other effective techniques, as the vehicle could be established to target the main personality variables and flow antecedents. Two social validation interviews would be required to examine the effect of the intervention immediately after the end of the study and on a follow-up session after a longer period of time to check whether the treatment is still working. Positive long-term effects of interventions on flow and performance would be expected for confidence and action control, as well as for other psychological variables, such as intrinsic motivation and anxiety.

Implications of possible long-term effects of flow on behaviour have been indicated by Carney (1986), who examined intrinsic and extrinsic motivation in the early adulthood of artists and, 20 years later, in their middle age. The results showed that only artists high in intrinsic motivation were still involved in the same activity after the 20-year period. Given the close relationship between flow and intrinsic motivation, the long-term effects of increasing flow could be particularly important for sports where athletes are able to perform on a high level at a very young age. Fostering flow in young athletes would have collateral effects on their enjoyment, motivation, and commitment to the task and the effort required to be successful over years of training and competition. Another long-term effect of flow could be to assist in preventing premature burnout and drop-out.

Consequently, research designs with interventions that aim for effects over a longer period of time, including more in-depth investigations through follow-up interviews, should be developed for flow and performance, in combination with the development of personality variables, such as confidence, action control, intrinsic motivation, or anxiety that are most conducive for the athlete. For instance, longitudinal research should focus more intensely on the relationship between flow and confidence, and whether there is a positive effect of flow on confidence, or vice versa, or if confidence is linked to performance. To develop flow, positive personality characteristics, and performance, the effects of such long-range interventions would be beneficial for several target groups. This type of intervention would be particularly helpful for young athletes who have long-term goals aiming for a career transition from junior to senior level, or even to professional level, as well as for individuals who would like maintain to increase their level of physical activity.

Practical Implications

The main practical implications can be derived from Study 3, and the development of interventions based on findings in Studies 1 and 2, employing intervention programs to increase athletes' flow experience and performance. The results of Study 3 can be important for athletes, coaches, and sport psychology practitioners. Athletes would benefit from an increase in flow in various ways, that is, increasing enjoyment and intrinsic motivation will enhance athletes' effort and persistence in training and competition. Based on athletes' individual prerequisites, variables closely related to flow, such as confidence, action control, intrinsic motivation, or anxiety, could also be targeted within the flow intervention. The effectiveness of imagery interventions, as assessed in Study 3, is not limited to older athletes, but younger participants can also benefit from imagery interventions. The full potential of the imagery intervention may depend on athletes' imagery ability, as well as on the athletes' conviction to employ imagery frequently and intensely. Based on initial assessments of imagery ability, junior athletes should be encouraged, under professional guidance, to more frequently engage in systematic and deliberate imagery to improve flow and performance in sport.

Study 3 provided evidence for the effectiveness of an imagery intervention that was not customised to individuals, but based on results of Studies 1 and 2 and applied to all four participants in Study 3. Sport psychology practitioners should aim for more effective interventions, based on specific personal and situational characteristics, using individualised intervention packages. For instance, individualised imagery interventions should address individual key factors, such as confidence or action control, and key situational factors, such as critical parts of the performance that, depending on the athlete, could relate to technical, tactical, or mental aspects of performance. The flow model (Kimiecik & Stein, 1992) offers a general guideline of potentially important variables for the development of sport-specific interventions. Interventions that are athlete-centred, taking into account personal prerequisites and situational demands, are essential to enhance the effectiveness of interventions for increasing flow and performance.

With regard to personality variables, building confidence in conjunction with flow would be beneficial for athletes' flow state and performance. In the integrated model of sport confidence, Vealey (2001) proposed that self-regulation, as employed through imagery, is an important part for interventions to influence confidence. The results of Study 3 underlined that imagery is a valuable intervention technique to increase both athletes' confidence and flow state. Practitioners should improve their intervention approaches by aiming to increase flow and personality variables closely related to flow, such as confidence. In addition, Bandura (1986) noted a reciprocal relationship between confidence and performance. Coaches and practitioners should take the connection between confidence, flow, and performance into consideration when preparing athletes for competitions. Qualitative findings of interventions aiming to increase flow and performance (e.g., Pates et al., 2002, 2003) or just performance (Pates et al., 2001) showed that confidence was a key personality variable that was enhanced alongside flow and performance. Therefore, confidence should become a main focus for practitioners and coaches who aim to increase flow state and performance.

In addition, action control appears to be another important personality variable that should be included in practical applications. Qualitative findings of Study 3 provided support for the usefulness of interventions aiming to shift athletes from state to action orientation. The various aspects of action control, dealing with failure, implementing action plans, and getting immersed in the activity, are important parts of tennis competitions. Practitioners and coaches could use athlete-centred intervention packages, based on imagery and self-talk, to specifically address aspects of action control that are related to athletes' individual needs to constructively deal with various competition situations.

Flow should not only be addressed in competition, but also in the training context. The use of imagery interventions should include practice sessions, so athletes try to attain flow more frequently and develop a sense of controllability of flow. For instance, aiming to control flow in training would be an easier task than aiming to increase flow in competition, given that the training setting usually has less distractions and need for familiarisation, with regard to varying opponents and competition environments. Because there are more training sessions than competitions, athletes would have the opportunity to practice imagery more often to attain more control over their mental processes and, eventually, over flow. Developing a stronger sense of control over flow state in training would help athletes to experience flow more frequently in competition. As results in Study 3 indicated, the controllability of flow could be enhanced by using imagery as a pre-performance routine and mental warm-up to gain a high flow state early in performance. In addition, a mental warm-up using imagery could aim to increase confidence, motivation, and focus (Morris, Spittle, & Perry, 2004). Sport psychologists could assist coaches in developing individual imagery scripts to facilitate athletes' flow experience in training and competition settings.

With regard to flow measurement, flow should be assessed more regularly in and after training and competition matches to pinpoint the connection between flow and performance. This would assist practitioners and trainers in gaining a better understanding of how changes in flow affect performance or vice versa. In addition, monitoring the performance situation would provide more detailed information, in combination with quantitative flow-performance data, about which personal and situational factors facilitate, prevent, or disrupt athletes' flow. Therefore, practitioners and coaches would gain more insight into the processes underlying flow and performance and could adjust behaviour, for instance, by giving instructions that direct athletes' focus to crucial performance aspects or by assisting athletes in interpreting and dealing with feedback or by providing specific feedback, that helps athletes' to attain flow (Kimiecik & Stein, 1992).

Measuring flow during performance should include the use of shorter flow scales. The current version of the FSS-2 provides a thorough assessment of flow state, measuring each flow dimension with four items. The in-depth assessment of flow state limits its application to investigations of measuring flow state following performance. An adjusted flow measure that can be used during performance would be valuable for practitioners and coaches. A short version of the flow state scale could consist of one or two items per subscale, or could focus on flow dimensions that appear to be most important to attain flow, such as flow antecedents. A short form of the FSS-2, which could be completed within a minute, should initially be employed in tennis training matches to have athletes get used to working with the scales when having a break or changing ends. Training matches that are important to the athletes, like an officially-scheduled training match playing a team mate, could be set up first, before using short flow scales in a competition setting.

Final Comments

The main purpose of this thesis was to develop an intervention to increase flow state and performance by taking into account personal and situational factors. Study 1 examined the athletes’ propensity of flow, investigating proposed personality variables underlying flow. Study 2 assessed the interaction of stable personal and situational factors on flow state and performance in self- and externally-paced tasks. Study 3 monitored the attainment of flow state in self- and externally-paced performance. Because self- and externally-paced performances are intertwined in tennis competition, the results showed that the intervention had a similar impact on flow and performance outcomes. That is, three players went up in flow and in service and groundstroke performance, whereas one player decreased in flow and increased in service and groundstroke performance. Results of the present thesis supported the Kimiecik and Stein (1992) model of flow in sport, providing evidence for person and situation factors interacting in the experience of flow. Confidence appeared to be a key personality variable in the experience of flow across all three studies. Even though a number of person and situation factors' seemed to influence flow, the results of the intervention showed that a tailored imagery program, targeting key flow dimensions, helped increase flow and performance in self-paced and externally-paced tasks in a competition setting. Understanding the mechanism that makes the link between athletes' propensity to flow and variables underlying flow state will help practitioners on an applied level to facilitate flow and enhance athletes' performance. Moreover, flow as an enjoyable experience makes it worthwhile to increase the experience for its own sake, and for its impact on intrinsic motivation, leading to more effort in training and performance. This has important and far-reaching implications for athletes' development in their area of sport. With regard to future research, it is hoped that the results of this thesis stimulate researchers to further examine person and situation factors in the flow model (Kimiecik & Stein, 1992), as they apply in training and competition settings, and to develop targeted interventions for increasing flow and performance. Interventions to increase flow should be based on a deeper understanding of key personal factors and the influence of various training and performance variables that can be employed to implement effective intervention procedures that induce a substantial and sustained increase in flow state and performance.

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APPENDICES

Appendix A: Study 1 Information Statement

Victoria University of Technology

School of Human Movement, Recreation and Performance

Information Statement

Personality Variables and the Experience of

Dispositional Flow and Flow State

STATEMENT OF PROJECT

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To examine and promote the occurrence of flow in sport situations, it is important to identify variables that are related to flow. This study will explore the principal personality variables underlying flow experiences in adolescent tennis players using pen and paper questionnaires.

PROCEDURES

As a participant of this study, you will be requested to complete eight questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics such as your history of involvement in tennis (demographic information), your experience of flow in tennis, as well as specific topics such as absorption, confidence, imagery, and your orientation towards action. There are no right or wrong answers to any of these measures; they just reflect your own experience on the various topics. The demographic questionnaire, the Dispositional Flow Scale, the Social Desirability Scale, and the Trait Sport Confidence Inventory will be followed by the Flow State Scale, the Action

Control Scale, the Tellegen Absorption Scale, and the Sport Imagery Questionnaire. The questionnaires will be completed on two separate occasions at your training venue, so, the first session will take 20-30 minutes and the second session will take around 30 minutes, with a total examination time of 50-60 minutes.

IMPORTANT ISSUES

Should you or your parents have any questions at any time prior to, during, or after participation in the project, please do not hesitate to ask any of the researchers. Contact details are provided at the bottom of this page. Furthermore, contact details for the Victoria University Ethics Committee are also provided in case there is a need to address any ethical concerns you have about the procedures or any other aspect of the research project.

Please be aware that the strictest confidentiality will be upheld; all information will only be used for the purpose of the investigation; it will be stored under lock and key, will only be accessed by the investigators. It will be coded such that individuals cannot be identified – your name will not be associated with any information provided by you, and any personally identifying information, such as your signature on the consent form, will be stored separately from the data. To ensure confidentiality, you will be instructed not to disclose names or other personally identifiable information about others. Please also note that if anything is upsetting you to the point that you do not wish to continue at any time during completion of the questionnaires, you may end the session and postpone it until a time convenient for you or you may withdraw completely.

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4270). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix B: Study 1 Consent Form – Parent/Guardian

Victoria University of Technology

School of Human Movement, Recreation and Performance

Consent Form (Parent/Guardian)

Personality Variables and the Experience of Dispositional Flow and Flow State

INFORMATION TO PARTICIPANTS

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To examine and promote the occurrence of flow in sport situations, it is important to identify variables that are related to flow. This study will explore the principal personality variables underlying flow experiences in adolescent tennis players using pen and paper questionnaires.

CERTIFICATION BY PARENT/GUARDIAN

I, ____________________________________ certify that I am the parent or guardian

of ____________________________________ for whom I give permission and consent to participate, in the study entitled: Personality Variables and the Experience of Dispositional Flow and Flow State, being conducted at Victoria University of Technology by Professor Tony Morris, Dr. Anthony Watt, and student Stefan Koehn. I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the study, have been fully explained to me.

PROCEDURES

As a participant of this study, you will be requested to complete eight questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics, such as history of involvement in tennis (demographic information), experience of dispositional flow and flow state in tennis, as well as specific topics, such as absorption, confidence, imagery, and your orientation towards action. There are no right or wrong answers to these measures; they just reflect your own experience on the various topics.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardize me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: …………………………………….. Date: ……………………………

Witness other than the researcher: …………………………….……………...

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 7207). If you have any queries or complaints about the way you have treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix C: Study 1 Consent Form – Participant

Victoria University of Technology

School of Human Movement, Recreation and Performance

Consent Form (Participants)

Personality Variables and the Experience of Dispositional Flow and Flow State

INFORMATION TO PARTICIPANTS

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To examine and promote the occurrence of flow in sport situations, it is important to identify variables that are related to flow. This study will explore the principal personality variables underlying flow experiences in adolescent tennis players using pen and paper questionnaires.

CERTIFICATION BY PARTICIPANT

I, ____

certify that I am at least 18 years old, and that I am voluntarily giving my consent to participate, in the study entitled: Personality Variables and the Experience of Dispositional Flow and Flow State, being conducted at Victoria University of Technology by Professor Tony Morris, Dr. Anthony Watt, and student Stefan Koehn. I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the study, have been fully explained to me.

PROCEDURES

As a participant of this study, you will be requested to complete eight questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics, such as history of involvement in tennis (demographic information), experience of dispositional flow and flow state in tennis, as well as specific topics, such as absorption, confidence, imagery, and your orientation towards action. There are no right or wrong answers to these measures; they just reflect your own experience on the various topics.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardize me in any way.

I have been informed that the information I provide will be kept confidential.

Signed: ……………..……………………… Date: …………………………..

Witness other than the researcher: …………………………………………...…

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4270). If you have any queries or complaints about the way you have treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix D: Demographic Information

Please write an answer in the space provided or circle the answer that is appropriate for you.

Gender: M F (please circle) Age: ....

For how long have you been playing tennis? ……………..... (in years)

For how long have you been playing tennis competitively? ………….. (in years)

How many hours of tennis do you play per week in general? ....

In how many tournaments do you compete each year?

1 – 5 / 6 – 10 / 11 – 15 / 16 – 20 / 21 – 25 / more

Are you currently listed in a ranking list? Yes No

If yes, what was your most recent ranking list position? ………………....................

Do you participate in other sport than tennis? If yes, please name these:

..............……………………………………………………………………….……

……………………………………………………………………………………………

What is/are the main reason(s) why you participate in tennis in general?

....

……………………………………………………………………………………………

Why do you participate in tennis competitions? Please, list up to three points (The reasons you quote here might be similar as listed before. Please think about and compare the last two questions and consider differences that apply to you).

....

....…………...

Appendix E: Marlowe-Crowne Social Desirability Scale-Short Form (MCSDS-SF)

Instructions: Read each of the items below and circle whether it applies to you (true) or not (false).

true	false	1.	It is sometimes hard for me to go on with my work if I am not encouraged.
true	false	2.	I sometimes feel resentful when I don't get my way.
true	false	3.	On a few occasions I have given up doing something because I thought too little of my ability.
true	false	4.	There have been times when I felt like rebelling against people in authority even though I knew they were right.
true	false	5.	No matter who I'm talking to, I'm always a good listener.
true	false	6.	There have been occasions when I took advantage of someone.
true	false	7.	I'm always willing to admit it when I make a mistake.
true	false	8.	I sometimes try to get even rather than forgive and forget.
true	false	9.	I am always courteous, even to people who are disagreeable.
true	false	10.	I have never been irked when people expressed ideas very different from my own.
true	false	11.	There have been times when I was quite jealous of the good fortune of others.
true	false	12.	I am sometimes irritated by people who ask favours of me.
true	false	13.	I have never deliberately said something that hurt someone's feelings.

Appendix F: Dispositional Flow Scale-2 (DFS-2)

Please answer the following questions in relation to your experience in your chosen activity. These questions relate to the thoughts and feelings you may experience during participation in your activity. You may experience these characteristics some of the time, all of the time, or none of the time. There are no right or wrong answers. Think about how often you experience each characteristic **DURING YOUR TENNIS COMPETITIONS IN GENERAL** and circle the number that best matches your experience.

For each question circle the number that best matches your experiences.

Rating Scale:				
Never	Rarely	Sometimes	Frequently	Always
1	**2**	**3**	**4**	**5**

1.	I am challenged, but I believe my skills allow me to meet the challenge.	1	2	3	4	5
2.	I make the correct movements without thinking about trying to do so.	1	2	3	4	5
3.	I know clearly what I want to do.	1	2	3	4	5
4.	It is really clear to me how my performance is going.	1	2	3	4	5
5.	My attention is focused entirely on what I am doing.	1	2	3	4	5
6.	I have a sense of control over what I am doing.	1	2	3	4	5
7.	I am not concerned with what others may be thinking of me.	1	2	3	4	5
8.	Time seems to alter (either slows down or speeds up).	1	2	3	4	5
9.	I really enjoy the experience.	1	2	3	4	5
10.	My abilities match the high challenge of the situation.	1	2	3	4	5
11.	Things just seem to happen automatically.	1	2	3	4	5
12.	I have a strong sense of what I want to do.	1	2	3	4	5
13.	I am aware of how well I am performing.	1	2	3	4	5
14.	It is no effort to keep my mind on what is happening.	1	2	3	4	5
15.	I feel like I can control what I am doing.	1	2	3	4	5
16.	I am not concerned with how others may be evaluating me.	1	2	3	4	5

There are no right or wrong answers. Think about how often you experience each characteristic **DURING YOUR TENNIS COMPETITIONS IN GENERAL** and circle the number that best matches your experiences.

For each question circle the number that best matches your experiences.

Rating Scale:				
Never /	Rarely /	Sometimes /	Frequently /	Always
1	**2**	**3**	**4**	**5**

17.	The way time passes seems to be different from normal.	1	2	3	4	5
18.	I love the feeling of the performance and want to capture it again.	1	2	3	4	5
19.	I feel I am competent enough to meet the high demands of the situation.	1	2	3	4	5
20.	I perform automatically, without thinking too much.	1	2	3	4	5
21.	I know what I want to achieve.	1	2	3	4	5
22.	I have a good idea while I am performing abut how well I am doing.	1	2	3	4	5
23.	I have total concentration.	1	2	3	4	5
24.	I have a feeling of total control.	1	2	3	4	5
25.	I am not concerned with how I am presenting myself.	1	2	3	4	5
26.	It feels like time goes by quickly.	1	2	3	4	5
27.	The experience leaves me feeling great.	1	2	3	4	5
28.	The challenge and my skills are at an equally high level.	1	2	3	4	5
29.	I do things spontaneously and automatically without having to think.	1	2	3	4	5
30.	My goals are clearly defined.	1	2	3	4	5
31.	I can tell by the way I am performing how well I am doing.	1	2	3	4	5
32.	I am completely focused on the task at hand.	1	2	3	4	5
33.	I feel in total control of my body.	1	2	3	4	5
34.	I am not worried about what others nay be thinking of me.	1	2	3	4	5
35.	I lose my normal awareness of time.	1	2	3	4	5
36.	The experience is extremely rewarding.	1	2	3	4	5

Appendix G: Action Control Scale-Sport (ACS-S)

Please answer the following questions **spontaneously** by circling the response that **applies best to you**. It is possible that either both answers apply to you or that neither answer applies to you, but you should choose the answer that is best.

There are no right or wrong answers in this questionnaire. We are interested in your immediate reaction. Please answer promptly. Do not think for a long time, but decide spontaneously for one of the two response possibilities. Please answer all questions. We can evaluate the questionnaire only if you answer all questions.

Example:
When I am really thirsty after a match,
A. I like to drink a glass of beer.
B. I quench my thirst with mineral water.

Answer by circling either A or B. If you circled A in the above example you are more likely to drink a glass of beer than mineral water when you are thirsty after a match.

For each question please circle the answer that best applies to you.

1. When I have prepared many weeks for a competition and then cannot compete because of an injury,
   A. it takes a long time before I can accept that.
   B. I can quickly direct my attention toward the next competition.

2. When several mistakes during a competition cause me to lose,
   A. I don't let myself be bothered by losing.
   B. my mind keeps coming back to the mistakes.

3. When I have only one attempt to demonstrate my ability during a qualification and I fail,

A. I accept that quickly.

B. I do not get over it quickly.

4. When during a competition I miss a clear chance to win,

A. the missed chance goes through my head during the rest of the competition.

B. I can block it out and concentrate on the next chance.

5. When I lose a competition because I was not in the right frame of mind,

A. I do not get over losing quickly.

B. I quickly manage to overcome the defeat.

6. When I have set myself a specific goal for my training and I do not succeed in reaching it,

A. then I gradually lose courage.

B. then I forget about it for a while and occupy myself with other things.

7. When I am disappointed about my performance in a competition,

A. it is difficult for me to do anything else.

B. it is easy for me to distract myself with other things.

8. When everything goes wrong during practice on one day,

A. I sometimes do not know what to do with myself.

B. I remain almost as energetic as I would have if it had not happened.

9. When I achieve less than I had expected during an important competition,

A. I can let it be and turn to other things.

B. it is difficult for me to do anything at all.

10. When I have several invalid attempts during a competition,
    A. I do not get over them quickly.
    B. I get over them quickly.

11. When, despite a good season preparation, I have a bad start and lose the first competition,
    A. this losing takes away my self-confidence.
    B. it does not bother me.

12. When the coach repeatedly criticizes my behaviour as tactically stupid,
    A. the criticism occupies my thoughts for a long time.
    B. the criticism does not bother me.

13. When I do not have anything planned in between two training units and am bored,
    A. I sometimes cannot decide what to do.
    B. I usually quickly find something to occupy myself with.

14. When I have to inform my sports club that I want to change to another club,
    A. doing so seems like an insurmountable task.
    B. I think about how I can get it done in a somewhat pleasant way.

15. When I have to decide whether to participate in a competition or not,
    A. I think for a while until I make a decision.
    B. I usually make a decision without difficulty.

16. When I am supposed to complete conditioning training in the late afternoon,
    A. it is difficult for me to get started.
    B. I usually get started easily.

17. When I have to get a lot of important things done in preparation for a competition,
    A. I think carefully about where to begin.
    B. it is easy for me to make a plan and follow it.

18. When I must decide between two different strategies in a competition,
    A. I quickly choose one of the alternatives and do not think about the other.
    B. it is not easy for me to decide for one or the other alternative.

19. When I have to do something important but unpleasant,
    A. I usually get going immediately.
    B. it can take a while for me to get started.

20. When there are many things to prepare for a competition,
    A. I spend too much time thinking about what I should start with.
    B. I have no problems getting started.

21. When I have to begin a training unit, and I do not feel like it at all,
    A. I have no problem getting started.
    B. I sometimes feel virtually paralysed.

22. When I must complete a training unit that is annoying and unpleasant for me,
    A. I complete it without difficulty.
    B. it is difficult for me to get started.

23. When I have the choice between two promising qualification competitions,
    A. I can immediately decide on one.
    B. I think over the choices thoroughly before I decide on one or the other.

24. When I do not feel fit before an important competition,

    A. I quickly decide whether to compete or not.

    B. I am often torn between competing or not.

25. When I learn a new, interesting sport,

    A. I soon have enough of it and do something else.

    B. I stay with it for a long time.

26. When preparing for a competition,

    A. I am happy to interrupt my preparation occasionally to do something else.

    B. I get so involved in my preparation that I stay with it for a long time.

27. When doing my sport,

    A. I am so involved that I do not even think about interrupting this activity.

    B. I occasionally want to interrupt this activity to do something else.

28. When I spend a lot of time with a new technique in my sport,

    A. I sometimes think about whether this new technique is really useful.

    B. I am so involved that I do not even question how useful it is.

29. When doing my training program,

    A. I am so involved that I complete it without interruption.

    B. I interrupt it occasionally to chat with other athletes.

30. In a training camp that I really enjoy,

    A. I nevertheless want to do something else after a while.

    B. the thought of doing something else never crosses my mind.

31. When I talk to other athletes about our sport,
    A. an elaborate discussion develops quite easily.
    B. I soon have the desire to do something else.

32. When a training unit goes really well,
    A. I occasionally enjoy a change.
    B. I could continue forever.

33. When I speak with my coach about an improvement in my technique,
    A. I can really get into the topic.
    B. I like to change the topic after some time.

34. When the atmosphere during a competition is great,
    A. then many hours can pass without my thinking about other things.
    B. I soon have the desire to do something completely different.

35. During endurance training
    A. I occupy myself with other things now and then to distract myself.
    B. I often stay with it for a very long time.

36. When I try to learn a new technique that I am very interested in,
    A. I stay involved with the new technique for long time.
    B. I like to do something different after some time.

Appendix H: Sport Imagery Questionnaire (SIQ)

This questionnaire was designed to assess the extent to which you incorporate imagery into your sport. Any statement depicting a function of imagery that you rarely use should be given a low rating. In contrast, any statement describing a function of imagery which you use frequently should be given a high rating. Your ratings will be made on a seven-point scale, where one is the rarely or never engage in that kind of imagery end of the scale and seven is the often engage in that kind of imagery end of the scale. Statements that fall within these two extremes should be rated accordingly along the rest of the scale. Read each statement below and fill in the blank the appropriate number from the scale provided to indicate the degree to which the statement applies to you when you are competing in your sport. Don't be concerned about using the same numbers repeatedly if you feel they represent your true feelings. Remember, there are no right or wrong answers, so please answer as accurately as possible.

Rating Scale:						
Rarely						**Often**
1	**2**	**3**	**4**	**5**	**6**	**7**

1.	I image the atmosphere of winning a championship (e.g., the excitement that follows winning, etc.).	1	2	3	4	5	6	7
2.	I imagine other athletes congratulating me on a good performance.	1	2	3	4	5	6	7
3.	I image the atmosphere of receiving a medal (e.g., the pride, the excitement, etc.).	1	2	3	4	5	6	7
4.	I image the audience applauding my performance.	1	2	3	4	5	6	7
5.	I image myself winning a medal.	1	2	3	4	5	6	7
6.	I image myself being interviewed as a champion.	1	2	3	4	5	6	7
7.	I can re-create in my head the emotions I feel before I compete.	1	2	3	4	5	6	7
8.	I imagine myself handling the stress and excitement of competitions and remaining calm.	1	2	3	4	5	6	7
9.	I imagine the stress and anxiety associated with competing.	1	2	3	4	5	6	7
10.	When I image a competition, I feel myself getting emotionally excited.	1	2	3	4	5	6	7

Rating Scale:						
Rarely						**Often**
1	**2**	**3**	**4**	**5**	**6**	**7**

11.	When I image an event/game that I am to participate in, I feel anxious.	1	2	3	4	5	6	7
12.	I image the excitement associated with competing.	1	2	3	4	5	6	7
13.	I can easily change an image of a skill.	1	2	3	4	5	6	7
14.	When imaging a particular skill, I can consistently perform it perfectly in my mind.	1	2	3	4	5	6	7
15.	I can mentally make corrections to physical skills.	1	2	3	4	5	6	7
16.	Before attempting a particular skill, I imagine myself performing it perfectly.	1	2	3	4	5	6	7
17.	When learning a new skill, I imagine myself performing it perfectly.	1	2	3	4	5	6	7
18.	I can consistently control the image of a physical skill.	1	2	3	4	5	6	7
19.	I make up new plans/strategies in my head.	1	2	3	4	5	6	7
20.	I image alternative strategies in case my event/game plan fails.	1	2	3	4	5	6	7
21.	I image each section of an event/game (e.g., offence vs. defence, fast vs. slow)	1	2	3	4	5	6	7
22.	I image myself continuing with my event/game plan even when performing poorly.	1	2	3	4	5	6	7
23.	I imagine executing entire plays/programs/sections just the way I want them to happen in an event/game.	1	2	3	4	5	6	7
24.	I imagine myself successfully following my event/game plan.	1	2	3	4	5	6	7
25.	I image giving 100% during an event/game.	1	2	3	4	5	6	7
26.	I image myself being mentally tough.	1	2	3	4	5	6	7
27.	I image myself appearing self-confident in front of my opponents.	1	2	3	4	5	6	7
28.	I image myself to be focused during a challenging situation.	1	2	3	4	5	6	7
29.	I imagine myself being in control in difficult situations.	1	2	3	4	5	6	7
30.	I image myself working successfully through tough situations (e.g., a power play, sore ankle, etc.).	1	2	3	4	5	6	7

Appendix I: Tellegen Absorption Scale (TAS)

PERSONAL ATTITUDES AND EXPERIENCES

This questionnaire consists of questions about experiences that you may have had in your life. I am interested in how often you have these experiences. It is important, however, that your answers show how often these experiences happen to you when you are not under the influence of alcohol or drugs. To answer the questions, please indicate approximately what percentage of the time each experience happens to you by choosing the appropriate number in the scale given below and entering it to the left of the item.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Never |____|____|____|____|____|____|____|____|____|____| Always

___	1.	Sometimes I feel and experience things as I did when I was a child.
___	2.	I can be greatly moved by eloquent or poetic language.
___	3.	When watching a movie, a TV show, or a play, I may become so involved that I forget about myself and my surroundings and experience the story as if it were real and as if I were taking part in it.
___	4.	If I stare at a picture and then look away from it, I can sometimes "see" an image of the picture, almost as if I were still looking at it.
___	5.	Sometimes I feel as if my mind could envelop the whole world.
___	6.	I like to watch cloud shapes change in the sky.
___	7.	If I wish, I can imagine (or daydream) some things so vividly that they hold my attention as a good movie or story does.
___	8.	I think I really know what some people mean when they talk about mystical experiences.
___	9.	I sometimes "step outside" my usual self and experience an entirely different state of being.
___	10.	Textures -- such as wool, sand, wood -- sometimes remind me of colours or music.
___	11.	Sometimes I experience things as if they were doubly real.
___	12.	When I listen to music, I can get so caught up in it that I don't notice anything else.
___	13.	If I wish, I can imagine that my body is so heavy that I could not move it if I wanted to.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Never |____|____|____|____|____|____|____|____|____|____| Always

___	14.	I can somehow sense the presence of another person before I actually see or hear her/him.
___	15.	The crackle and flames of a wood fire stimulate my imagination.
___	16.	It is sometimes possible for me to be completely immersed in nature or in art and to feel as if my whole state of consciousness has somehow been temporarily altered.
___	17.	Different colours have distinctive and special meanings for me.
___	18.	I am able to wander off into my own thoughts while I am doing a routine task, and then find a few minutes later that I have completed it.
___	19.	I can sometimes recollect certain past experiences in my life with such clarity and vividness that it is like living them again or almost so.
___	20.	Things that might seem meaningless to others often make sense to me.
___	21.	While acting in a play, I think I could really feel the emotions of the character and "become" her/him for the time being, forgetting both myself and the audience.
___	22.	My thoughts often don't occur as words, but as visual images.
___	23.	I often take delight in small things (like the five-pointed star shape that appears when you cut an apple across the core or the colours in soap bubbles).
___	24.	When listening to organ music or other powerful music, I sometimes feel as if I am being lifted into the air.
___	25.	Sometimes I can change noise into music by the way I listen to it.
___	26.	Some of my most vivid memories are called up by scents and smells.
___	27.	Some music reminds me of pictures or changing colour patterns.
___	28.	I often know what someone is going to say before he/she says it.
___	29.	I often have "physical memories"; for example, after I've been swimming, I may still feel as if I'm in the water.
___	30.	The sound of a voice can be so fascinating to me that I can just go on listening to it.
___	31.	At times I somehow feel the presence of someone who is not physically there.
___	32.	Sometimes thoughts and images come to me without the slightest effort on my part.
___	33.	I find that different odours have different colours.
___	34.	I can be deeply moved by a sunset.

Appendix J: Trait Sport Confidence Inventory (TSCI)

Think about how self-confident you are when you compete in sport.
Answer the questions below based on how confident you generally feel when you compete in your sport.

Compare your self-confidence to the *most self-confident athlete* you know. Please answer as you really feel, not how you would like to feel. Your answers will be kept completely confidential.

When you compete, how confident do you *generally feel*? (Circle number)

1.	Compare your confidence in *your ability to execute the skills necessary to be successful* to the most confident athlete you know.	Low 1	2	3	Medium 4	5	6	7	8	High 9
2.	Compare your confidence in *your ability to make critical decisions during competition* to the most confident athlete you know.	Low 1	2	3	Medium 4	5	6	7	8	High 9
3.	Compare your confidence in *your ability to perform under pressure* to the most confident athlete you know.	Low 1	2	3	Medium 4	5	6	7	8	High 9
4.	Compare your confidence in *your ability to execute successful strategy* to the most confident athlete you know	Low 1	2	3	Medium 4	5	6	7	8	High 9
5.	Compare your confidence in *your ability to concentrate well enough to be successful* to the most confident athlete you know.	Low 1	2	3	Medium 4	5	6	7	8	High 9
6.	Compare your confidence in *your ability to adapt to different game situations and still be successful* to the most confident athlete you know.	Low 1	2	3	Medium 4	5	6	7	8	High 9

When you compete, how confident do you *generally feel*? (Circle number)

7.	Compare your confidence in *your ability to achieve your competitive goals* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
8.	Compare your confidence in *your ability to be successful* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
9.	Compare your confidence in *your ability to consistently be successful* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
10.	Compare your confidence in *your ability to think and respond successfully during competition* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
11.	Compare your confidence in *your ability meet the challenge of competition* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
12.	Compare your confidence in *your ability to be successful even when the odds are against you* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9
13.	Compare the confidence in *your ability to bounce back from performing poorly and be successful* to the most confident athlete you know.	Low 1	2	3	4	Medium 5	6	7	8	High 9

Appendix K: Flow State Scale-2 (FSS-2)

Please answer the following questions in relation to your experience in the event or activity you have just completed. These questions relate to the thoughts and feelings you may have experienced while taking part. There are no right or wrong answers. Think about how you felt **DURING YOUR LAST COMPETITION MATCH** and answer the questions using the rating scale below.

For each question circle the number that best matches your experience.

Rating Scale:				
Strongly Disagree /	Disagree /	Neither agree nor disagree /	Agree /	Strongly Agree
1	**2**	**3**	**4**	**5**

1.	I was challenged, but I believed my skills would allow me to meet the challenge.	1	2	3	4	5
2.	I made the correct movements without thinking about trying to do so.	1	2	3	4	5
3.	I knew clearly what I wanted to do.	1	2	3	4	5
4.	It was really clear to me how my performance was going.	1	2	3	4	5
5.	My attention was focused entirely on what I was doing.	1	2	3	4	5
6.	I had a sense of control over what I was doing.	1	2	3	4	5
7.	I was not concerned with what others may have been thinking of me.	1	2	3	4	5
8.	Time seemed to alter (either slowed down or speeded up).	1	2	3	4	5
9.	I really enjoyed the experience.	1	2	3	4	5
10.	My abilities matched the high challenge of the situation.	1	2	3	4	5
11.	Things just seemed to be happening automatically.	1	2	3	4	5
12.	I had a strong sense of what I wanted to do.	1	2	3	4	5
13.	I was aware of how well I was performing.	1	2	3	4	5
14.	It was no effort to keep my mind on what was happening.	1	2	3	4	5
15.	I felt like I could control what I was doing.	1	2	3	4	5
16.	I was not concerned with how others may have been evaluating me.	1	2	3	4	5
17.	The way time passed seemed to be different from normal.	1	2	3	4	5
18.	I loved the feeling of the performance and want to capture it again.	1	2	3	4	5

There are no right or wrong answers. Think about how you felt **DURING YOUR LAST COMPETITION MATCH** and answer the questions using the rating scale below. For each question circle the number that best matches your experience.

Rating Scale:				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**

19.	I felt I was competent enough to meet the high demands of the situation.	1	2	3	4	5
20.	I performed automatically, without thinking too much.	1	2	3	4	5
21.	I knew what I wanted to achieve.	1	2	3	4	5
22.	I had a good idea while I was performing about how well I was doing.	1	2	3	4	5
23.	I had total concentration.	1	2	3	4	5
24.	I had a feeling of total control.	1	2	3	4	5
25.	I was not concerned with how I was presenting myself.	1	2	3	4	5
26.	It felt like time went by quickly.	1	2	3	4	5
27.	The experience left me feeling great.	1	2	3	4	5
28.	The challenge and my skills were at an equally high level.	1	2	3	4	5
29.	I did things spontaneously and automatically without having to think.	1	2	3	4	5
30.	My goals were clearly defined.	1	2	3	4	5
31.	I could tell by the way I was performing how well I was doing.	1	2	3	4	5
32.	I was completely focused on the task at hand.	1	2	3	4	5
33.	I felt in total control of my body.	1	2	3	4	5
34.	I was not worried about what others may have been thinking of me.	1	2	3	4	5
35.	I lost my normal awareness of time.	1	2	3	4	5
36.	I found the experience extremely rewarding.	1	2	3	4	5

Appendix L: Subjective Performance Assessment

Compare your performance of the competition you have just completed to your competitive performance in general in similar competitions. Please **circle** the answer that is appropriate to you.

Rating scale:
–5 = very poor   0 = average   +5 = excellent

1.	How would you rate your competition performance of first serves?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
2.	How would you rate your competition performance of second serves?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
3.	How would you rate your competition performance of forehand strokes?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
4.	How would you rate your competition performance of backhand strokes?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
5.	How would you rate your technical performance overall?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
6.	How would you rate your tactical performance overall?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
7.	How would you rate your mental performance overall?	–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5

Please answer each question with reference to how you felt and what you thought before the competition? Please **circle** the answer that is appropriate to you.

Before the competition:												
1.	How important was this competition for you in comparison to the competitions you play in general?	**–5 = not important at all extremely important = +5**										
		–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
2.	How would you rate your commitment towards the competition?	**–5 = very low very high = +5**										
		–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
3.	How certain did you feel about the competition outcome?	**–5 = very uncertain very certain = +5**										
		–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5
4.	Did you prepare yourself mentally (e.g., match plan) and physically (e.g., warm up) for this match?	**–5 = not at all very much so = +5**										
		–5	–4	–3	–2	–1	0	+1	+2	+3	+4	+5

Appendix M: Study 2 Information Statement

Victoria University of Technology
School of Human Movement, Recreation and Performance
Information Statement

The Influence of Person and Situation Factors on Flow and Performance

STATEMENT OF PROJECT

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To investigate and promote the occurrence of flow in sport, it is important to examine the experience of flow in different sport situations. This study will explore the influence of imagery use and flow, using pen and paper questionnaires, on tennis performance tasks in adolescent tennis players.

PROCEDURES

As a participant of this study, you will be requested to complete four questionnaires, taking about 5-10 minutes each. The questionnaires will cover your flow experience in tennis, factual information about you, like your age and tennis background, as well as specific topics on your imagery use. There are no right or wrong answers to any of these measures; they just reflect your own experience on the various topics. The flow and the imagery measures will be completed at the onset of the study. A different flow measure will be completed twice immediately after the serving and the ground-stroke task. To complete the performance tasks will take 10 to 15 minutes each, both taking place at your training venue.

IMPORTANT ISSUES

Should you or your parents have any questions at any time prior to, during, or after participation in the project, please do not hesitate to ask any of the researchers. Contact details are provided at the bottom of this page. Furthermore, contact details for the Victoria University Ethics Committee are also provided in case there is a need to address any ethical concerns you have about the procedures or any other aspect of the research project.

Please be aware that the strictest confidentiality will be upheld; all information will only be used for the purpose of the investigation; it will be stored under lock and key and will only be accessed by the investigators. It will be coded, so that individuals cannot be identified – your name will not be associated with any information provided by you, and any personally identifying information, such as your signature on the consent form, will be stored separately from the data. To ensure confidentiality, you will be instructed not to disclose names or other personally identifiable information about others.

Please also note that if anything is upsetting you to the point that you do not wish to continue at any time during completion of the questionnaires, you may end the session and postpone it until a time convenient for you or you may withdraw completely without any reflection on you.

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4207). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix N: Study 2 Consent Form – Parent/Guardian

Victoria University of Technology
School of Human Movement, Recreation and Performance
Consent Form (Parent/Guardian)

The Influence of Person and Situation Factors on Flow and Performance

INFORMATION TO PARTICIPANTS

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To investigate and promote the occurrence of flow in sport, it is important to examine the experience of flow in different sport situations. This study will explore the influence of imagery use and flow, using pen and paper questionnaires, on tennis performance tasks in adolescent tennis players.

CERTIFICATION BY PARENT/GUARDIAN

I, ____________________________________ certify that I am the parent or

guardian of ____________________________________ for whom I give permission and consent to participate, in the study entitled: The Influence of Person and Situation Factors on Flow and Performance, being conducted at Victoria University of Technology by Professor Tony Morris, Dr. Anthony Watt, and student Stefan Koehn. I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the study, have been fully explained to me.

PROCEDURES

As a participant of this study, your son/daughter will be requested to complete four questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics your flow experience in tennis and factual information about age and tennis background, as well as specific topics on imagery use. There are no right or wrong answers to these measures; they just reflect your own experience on the various topics. The performance measures include a self-paced serving task and an externally paced ground-stroke task.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw my son/daughter from this study at any time and that this withdrawal will not jeopardize them in any way.

I have been informed that the information my son/daughter provides will be kept confidential.

Signed: ……………………………………… Date: ……..……………………

Witness other than the researcher: ………………………………….......................

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4207). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix O: Study 2 Consent Form – Participant

Victoria University of Technology
School of Human Movement, Recreation and Performance
Consent Form (Participants)

The Influence of Person and Situation Factors on Flow and Performance

INFORMATION TO PARTICIPANTS

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To investigate and promote the occurrence of flow in sport, it is important to examine the experience of flow in different sport situations. This study will explore the influence of imagery use and flow, using pen and paper questionnaires, on tennis performance tasks in adolescent tennis players.

CERTIFICATION BY PARTICIPANT

I, ____ certify that I am at least 18 years old, and that I am voluntarily giving my consent to participate, in the study entitled: The Influence of Person and Situation Factors on Flow and Performance, being conducted at Victoria University of Technology by Professor Tony Morris, Dr. Anthony Watt, and student Stefan Koehn. I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the study, have been fully explained to me.

PROCEDURES

As a participant of this study, you will be requested to complete four questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics of your flow experience in tennis and factual information about your age and tennis background, as well as specific topics on imagery use. There are no right or wrong answers to these measures; they just reflect your own experience on the various topics. The performance measures include a self-paced serving task and an externally paced ground-stroke task.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time and that this withdrawal will not jeopardize me in any way.

I have been informed that the information I provide will be kept confidential.

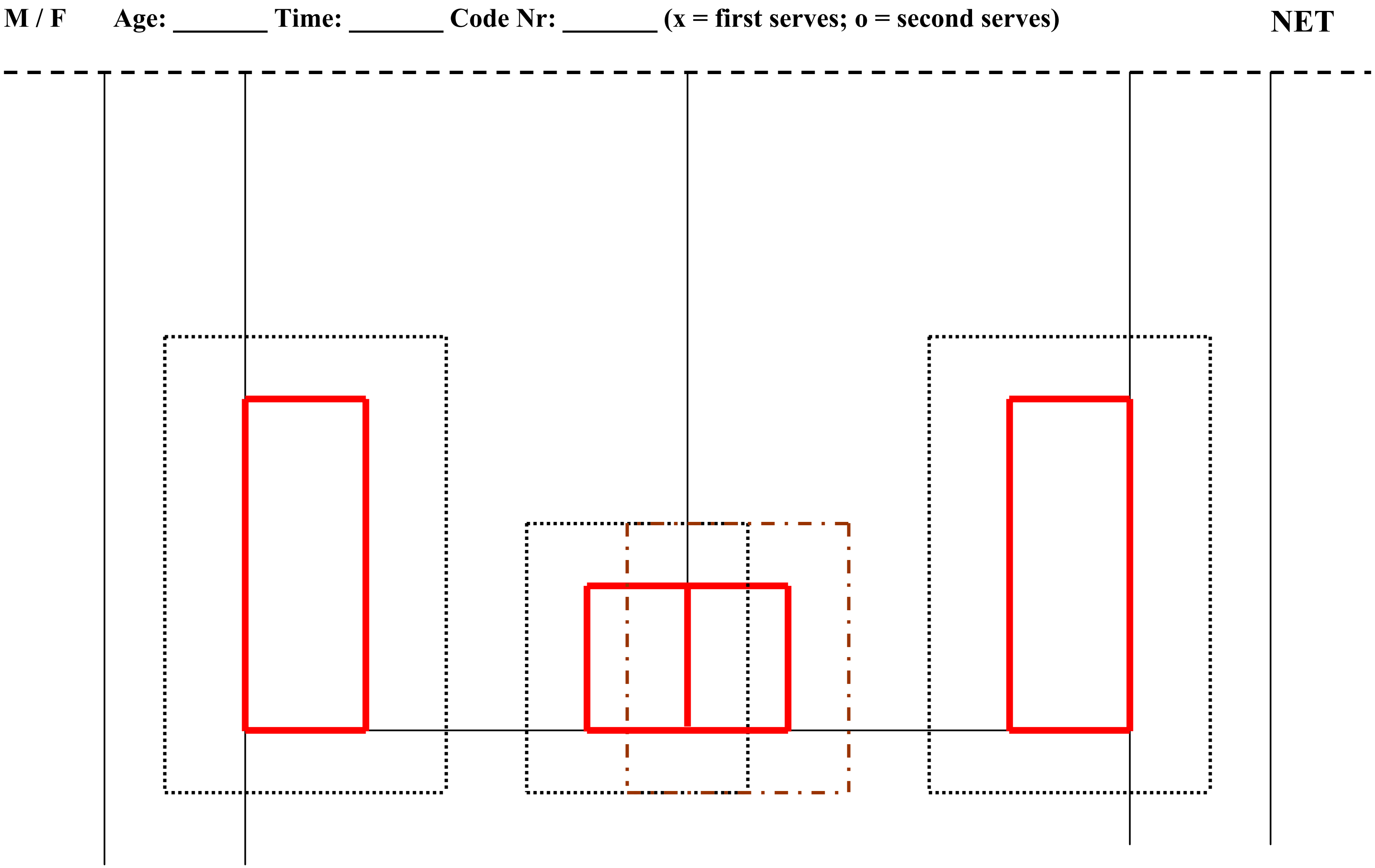
Signed: ………………………………………… Date: …..……………………

Witness other than the researcher: …..………………………………......................

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4207). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

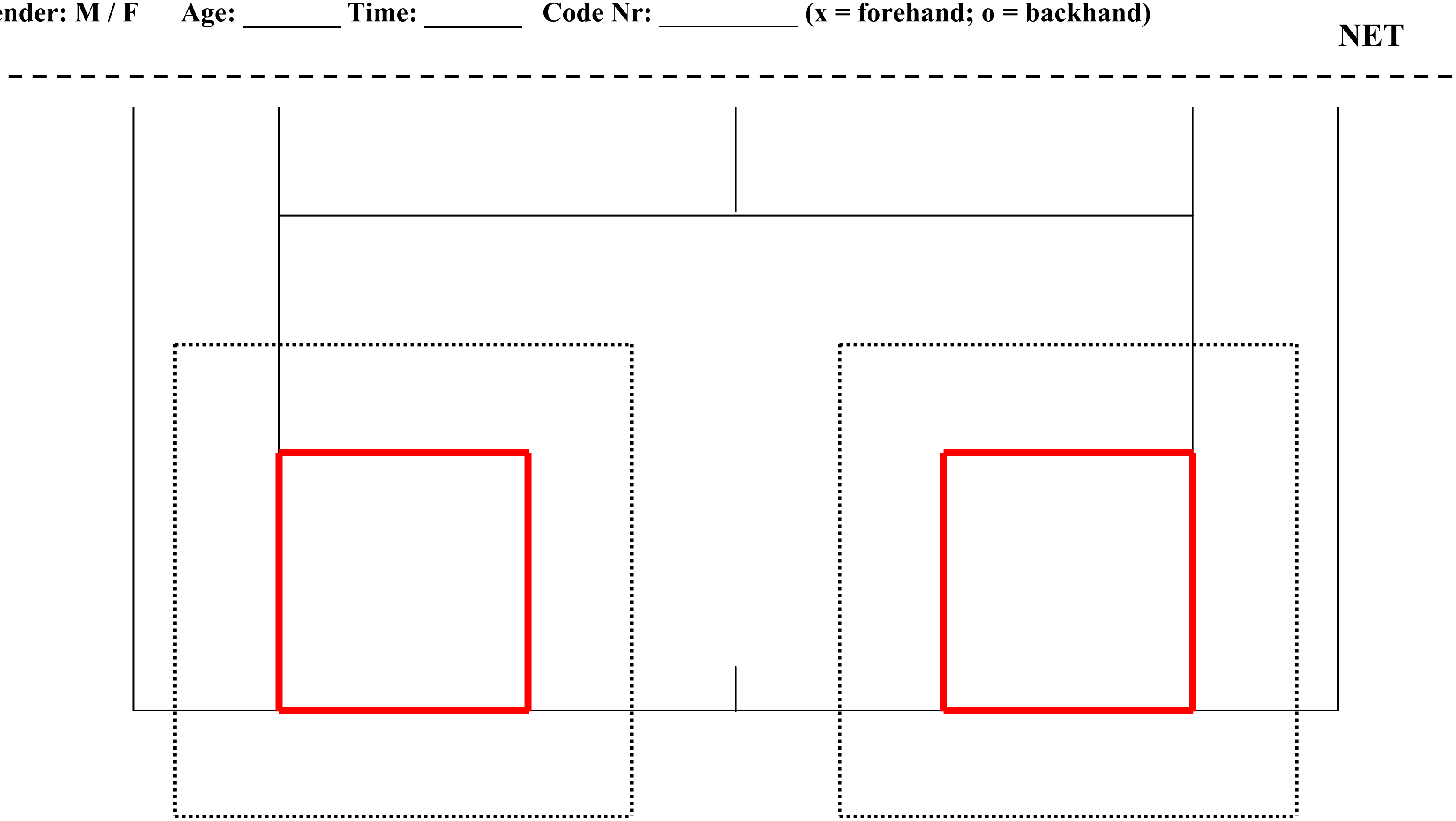
Appendix P: Paper Documentation Service Performance

Gender: M / F Age: _______ Time: _______ Code Nr: _______ (x = first serves; o = second serves)



Appendix Q: Paper Documentation Groundstroke Performance

Gender: M / F Age: _______ Time: _______ Code Nr: __________ (x = forehand; o = backhand)



Appendix R: Study 3 Information Statement

Victoria University of Technology

School of Human Movement, Recreation and Performance

Information Statement

The Effect of an Imagery Use Intervention on Flow and Performance in Tennis

STATEMENT OF PROJECT

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To investigate and promote the occurrence of flow in sport, it is important to examine the experience of flow in sport and variables underlying flow. This study will explore the influence of imagery use on flow, using a tailored script and pen and paper questionnaires. The aim of the study is to examine the effect of imagery on flow state and performance in tennis competition.

PROCEDURES

As a participant of this study, you will be requested to complete four questionnaires, taking about 5-10 minutes each. The questionnaires will cover your flow experience in tennis, factual information about you, like your age and tennis background, as well as specific topics on your imagery use. There are no right or wrong answers to any of these measures; they just reflect your own experience on the various topics. Measures on frequency of flow and imagery will be completed at the onset of the study. The state measure of flow will be completed after each tennis performance. To assess competition performance, some of the competition matches will be videotaped. For a period of four weeks, participants will work with the imagery script, outlining tennis specific match situations to use imagery more in ways that relate to flow. You will read through the imagery script three times per week, between 10 and 15 minutes per session. After the three-week period, the effect of the imagery script will be assessed by measuring flow state and performance in competition.

IMPORTANT ISSUES

Should you or your parents have any questions at any time prior to, during, or after participation in the project, please do not hesitate to ask any of the researchers. Contact details are provided at the bottom of this page, which includes details of the Victoria University Ethics Committee, in case there is a need to address any ethical concerns you have about the procedures or any other aspect of the research project.

Please be aware that the strictest confidentiality will be upheld; this includes:

a) Information given by you will only be used for the purpose of the investigation

b) Information will be stored under lock and key and only be accessed by the investigators

c) Your name and personally identifying information will be stored separately

d) Videotapes of your performance will be erased as soon as the data has been extracted

e) You will be instructed not to disclose names or information about others.

Please also note that if anything is upsetting you to the point that you do not wish to continue at any time during completion of the questionnaires, you may end the session and postpone it until a time convenient for you or you may withdraw completely without any reflection on you.

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4207). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix S: Study 3 Consent Form – Parent/Guardian

Victoria University of Technology
School of Human Movement, Recreation and Performance
Consent Form (Parent/Guardian)

The Effect of an Imagery Use Intervention on Flow and Performance in Tennis

INFORMATION TO PARTICIPANTS

Flow is an optimal state of mind. Athletes experiencing flow have described flow as a state of total concentration on the task at hand, body and mind working as one unit, which results in an effortless and outstanding performance. Enjoyment is an inherent aspect of the flow experience, that is, the activity appears rewarding in itself and worth doing for its own sake.

To investigate and promote the occurrence of flow in sport, it is important to examine the experience of flow in sport and variables underlying flow. This study will explore the influence of imagery use on flow, using a tailored script and pen and paper questionnaires. The aim of the study is to examine the effect of imagery on flow state and performance in tennis competition.

CERTIFICATION BY PARENT/GUARDIAN

I, ____________________________________ certify that I am the parent or

guardian of ____________________________________ for whom I give permission and consent to participate in the study entitled: The Effect of an Imagery Use Intervention on Flow and Performance in Tennis, being conducted at Victoria University of Technology by Professor Tony Morris, Dr. Anthony Watt, and student Stefan Koehn. I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the study, have been fully explained to me.

PROCEDURES

As a participant of this study, your child will be requested to complete four questionnaires, taking about 5-10 minutes each. The questionnaires will cover general topics on the flow experience in tennis and factual information about your child's age and tennis background, as well as specific topics on imagery use. There are no right or wrong answers to these measures; they just reflect your child's experience on the various topics. In addition, your child will be requested to work with an imagery script three times per week for a duration of four weeks to increase the imagery use in tennis competitions. To assess tennis performance, some of your child's competition matches will be videotaped.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw my son/daughter from this study at any time and that this withdrawal will not jeopardize them in any way.

I have been informed that the information my son/daughter provides will be kept confidential.

Signed: ………………………………………… Date: …...……………………

Witness other than the researcher: ………………………………….....................

Any queries about your participation in this project may be directed to the researchers (Name: Professor Tony Morris, telephone 03-9919 5353; Stefan Koehn, telephone 03-9919 4207). If you have any queries or complaints about the way you have been treated, you, or your parents, may contact the Secretary, University Human Research Ethics Committee, Victoria University of Technology, PO Box 14428 MCMC, Melbourne, 8001 (telephone: 03-9919 4710).

Appendix T: Flow State Scale-2 (Modified for Assessment in Tennis Competition)

Please answer the following questions in relation to your experience during the tennis competition you have just completed. These questions relate to the thoughts and feelings you may have experienced while competing. There are no right or wrong answers. Think about how you felt **DURING YOUR LAST COMPETITION MATCH** and answer the questions using the rating scale below.

For each question circle the number that best matches your experience for each set you have played.

Rating Scale:				
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
1	**2**	**3**	**4**	**5**

		Set 1	Set 2	Set 3
1.	I was challenged, but I believed my skills would allow me to meet the challenge.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
2.	I made the correct movements without thinking about trying to do so.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
3.	I knew clearly what I wanted to do.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
4.	It was really clear to me how my performance was going.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
5.	My attention was focused entirely on what I was doing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
6.	I had a sense of control over what I was doing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
7.	I was not concerned with what others may have been thinking of me.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
8.	Time seemed to alter (either slowed down or speeded up).	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
9.	I really enjoyed the experience.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
10.	My abilities matched the high challenge of the situation.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
11.	Things just seemed to be happening automatically.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

For each question circle the number that best matches your experience for each set you have played.

Rating Scale:				
Strongly Disagree	/ Disagree	/ Neither agree nor disagree /	Agree /	Strongly Agree
1	**2**	**3**	**4**	**5**

		Set 1	**Set 2**	**Set 3**
12.	I had a strong sense of what I wanted to do.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
13.	I was aware of how well I was performing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
14.	It was no effort to keep my mind on what was happening.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
15.	I felt like I could control what I was doing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
16.	I was not concerned with how others may have been evaluating me.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
17.	The way time passed seemed to be different from normal.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
18.	I loved the feeling of the performance and want to capture it again.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
19.	I felt I was competent enough to meet the high demands of the situation.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
20.	I performed automatically, without thinking too much.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
21.	I knew what I wanted to achieve.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
22.	I had a good idea while I was performing about how well I was doing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
23.	I had total concentration.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
24.	I had a feeling of total control.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
25.	I was not concerned with how I was presenting myself.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

For each question circle the number that best matches your experience for each set you have played.

Rating Scale:				
Strongly Disagree /	Disagree /	Neither agree nor disagree /	Agree /	Strongly Agree
1	**2**	**3**	**4**	**5**

		Set 1	Set 2	Set 3
26.	It felt like time went by quickly.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
27.	The experience left me feeling great.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
28.	The challenge and my skills were at an equally high level.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
29.	I did things spontaneously and automatically without having to think.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
30.	My goals were clearly defined.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
31.	I could tell by the way I was performing how well I was doing.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
32.	I was completely focused on the task at hand.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
33.	I felt in total control of my body.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
34.	I was not worried about what others may have been thinking of me.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
35.	I lost my normal awareness of time.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
36.	I found the experience extremely rewarding.	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Appendix U: Sport Imagery Ability Measure (SIAM)

INTRODUCTION

This questionnaire involves creating images of four situations in sport. After you image each scene, you will rate the imagery on twelve scales. For each rating, place a cross on the line at the point you feel best represents the image you produced. The left end of the line represents no image or sensation or feeling at all and the right end represents a very clear or strong image or feeling or sensation.

Ensure the ***intersection*** of the cross is on the line as shown in the examples below.

Correct X

Incorrect X X

An **example** of the style of scene to be created is as follows:
You are at a carnival, holding a bright yellow, brand new tennis ball in your right hand. You are about to throw it at a pyramid of six blue and red painted cans. A hit will send the cans flying and win you a prize. You grip the ball with both hands to help release the tension, raise the ball to your lips and kiss it for luck, noticing its soft new wool texture and rubber smell. You loosen your throwing arm with a shake and, with one more look at the cans, you throw the ball. Down they all go with a loud “crash” and you feel great.

Below are some possible ratings and what they represent to give you the idea.
1. How **clear** was the image ?

no image X perfectly clear image

This example shows an image was experienced but was quite unclear

6. How well did you **feel the muscular movements** within the image?

no feeling X very strong feeling

This example indicates very strong imagery of the feel of muscular movements

7. How well did you **hear** the image?

no hearing X very clear hearing

This example reflects the strongest possible image, like hearing the real sound

12. How strong was your **experience of the emotions** generated by the image?

no emotion X very strong emotion

This example reflects a degree of emotion which is moderate

Do you have any questions regarding the imagery activity or the way you should respond using the rating scales? Please feel free to ask now.

<u>DO NOT TURN THE PAGE</u> UNTIL YOU ARE ASKED TO DO SO.

Fitness Activity
Imagine yourself doing an activity to improve your fitness for your sport. Get a clear picture of what you are doing, where you are, and who you are with. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you get the sensation of **taste** within the image?

no taste ______________________________ very clear taste

2. How **long** was the image held?

image held for a very short time ______________________________ image held for the whole time

3. How well did you **feel the texture** of objects within the image?

no feeling ______________________________ very clear feeling

4. How **clear** was the image?

no image ______________________________ perfectly clear

5. How well did you **hear** the image?

no hearing ______________________________ very clear hearing

6. How **easily** was an image created?

image difficult to create ______________________________ image easy to create

7. How well did you **see** the image?

no seeing ______________________________ very clear seeing

8. How **quickly** was an image created?

image slow to create ______________________________ image created quickly

9. How strong was your **experience of the emotions** generated by the image?

no emotion ______________________________ very strong emotion

10. How well did you **feel** the muscular movements within the image?

no feeling ______________________________ very strong feeling

11. How well could you **control** the image?

unable to control image ______________________________ completely able to control image

12. How well did you get the sensation of **smell** within the image?

no smell ______________________________ very clear smell

Check that you have placed a cross on all 12 lines.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

Your "Home" Venue

Imagine that you have just got changed and made your final preparations for a competition at your "home" venue, where you usually practice and compete. You move out into the playing area and loosen up while you look around and tune in to the familiar place. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel the texture** of objects within the image?

no feeling ______________________ very clear feeling

2. How **clear** was the image?

no image ______________________ perfectly clear

3. How well did you get the sensation of **taste** within the image?

no taste ______________________ very clear taste

4. How **long** was the image held?

image held for a very short time ______________________ image held for the whole time

5. How well did you **hear** the image?

no hearing ______________________ very clear hearing

6. How **easily** was an image created?

image difficult to create ______________________ image easy to create

7. How strong was your **experience of the emotions** generated by the image?

no emotion ______________________ very strong emotion

8. How well did you **see** the image?

no seeing ______________________ very clear seeing

9. How well did you **feel** the muscular movements within the image?

no feeling ______________________ very strong feeling

10. How well could you **control** the image?

unable to control image ______________________ completely able to control image

11. How well did you get the sensation of **smell** within the image?

no smell ______________________ very clear smell

12. How **quickly** was an image created?

image slow to create ______________________ image created quickly

Check that you have placed a cross on all 12 lines.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

Successful Competition
Imagine you are competing in a specific event or match for your sport. Imagine that you are at the very end of the competition and the result is going to be close. You pull out a sensational move, shot, or effort to win the competition. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **see** the image?

no seeing ______________________________ very clear seeing

2. How **quickly** was an image created?

image slow to create ______________________________ image created quickly

3. How strong was your **experience of the emotions** generated by the image?

no emotion ______________________________ very strong emotion

4. How **clear** was the image?

no image ______________________________ perfectly clear

5. How well did you get the sensation of **taste** within the image?

no taste ______________________________ very clear taste

6. How well could you **control** the image?

unable to control image ______________________________ completely able to control image

7. How well did you get the sensation of **smell** within the image?

no smell ______________________________ very clear smell

8. How **easily** was an image created?

image difficult to create ______________________________ image easy to create

9. How well did you **feel the texture** of objects within the image?

no feeling ______________________________ very clear feeling

10. How **long** was the image held?

image held for a very short time ______________________________ image held for the whole time

11. How well did you **feel** the muscular movements within the image?

no feeling ______________________________ very strong feeling

12. How well did you **hear** the image?

no hearing ______________________________ very clear hearing

Check that you have placed a cross on all 12 lines.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

A Slow Start

Imagine that the competition has been under way for a few minutes. You are having difficulty concentrating and have made some errors. You want to get back on track before it shows on the scoreboard. During a break in play, you take several deep breaths and really focus on a spot just in front of you. Now you switch back to the game much more alert and tuned in. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How strong was your **experience of the emotions** generated by the image?

no emotion ________________ very strong emotion

2. How **easily** was an image created?

image difficult to create ________________ image easy to create

3. How well did you **feel the texture** of objects within the image?

no feeling ________________ very clear feeling

4. How well could you **control** the image?

unable to control image ________________ completely able to control image

5. How well did you get the sensation of **smell** within the image?

no smell ________________ very clear smell

6. How **clear** was the image?

no image ________________ perfectly clear

7. How well did you **hear** the image?

no hearing ________________ very clear hearing

8. How **quickly** was an image created?

image slow to create ________________ image created quickly

9. How well did you get the sensation of **taste** within the image?

no taste ________________ very clear taste

10. How **long** was the image held?

image held for a very short time ________________ image held for the whole time

11. How well did you **see** the image?

no seeing ________________ very clear seeing

12. How well did you **feel** the muscular movements within the image?

no feeling ________________ very strong feeling

Check that you have placed a cross on all 12 lines.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

Training Session
Think of a drill you do in training that is really tough. Now imagine yourself doing the drill. As you get a picture of yourself performing the skill in practice, try to complete an entire routine or drill. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel** the muscular movements within the image?

no feeling ____________________ very strong feeling

2. How well could you **control** the image?

unable to control image ____________________ completely able to control image

3. How well did you **hear** the image?

no hearing ____________________ very clear hearing

4. How **long** was the image held?

image held for a very short time ____________________ image held for the whole time

5. How well did you get the sensation of **taste** within the image?

no taste ____________________ very clear taste

6. How well did you **see** the image?

no seeing ____________________ very clear seeing

7. How **easily** was an image created?

image difficult to create ____________________ image easy to create

8. How strong was your **experience of the emotions** generated by the image?

no emotion ____________________ very strong emotion

9. How **quickly** was an image created?

image slow to create ____________________ image created quickly

10. How well did you get the sensation of **smell** within the image?

no smell ____________________ very clear smell

11. How **clear** was the image?

no image ____________________ perfectly clear

12. How well did you **feel the texture** of objects within the image?

no feeling ____________________ very clear feeling

Check that you have placed a cross on all 12 lines.

Appendix V: Competition Outcome Assessment

DATE:								**FINAL SCORE:**												
	1st SERVE				**2nd SERVE**				**Service Point**			**NET**		**BASELINE**				**RALLY OVERALL**		**SCORE OVERALL**
N	WON	IN	NET	OUT	WON	IN	DF		WON	LOST		WON	LOST	WON	UF	LOST		WON	LOST	SCORE
1																				
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Appendix W: Imagery Script

Imagery Script to Increase Flow Experience and Performance in Tennis Competition

GENERAL INSTRUCTIONS

For this activity, you need to generate images of two common performance situations in tennis competition, serving and groundstroke performance. This script can be used as a guide to generate images, which you can use in preparation for your training sessions, competition matches, and during the competition breaks, e.g., swapping sides or getting ready to serve. You don't have to remember every line of the script, but pay attention to *italicised* sentences and *italicised* cue words. In competition, saying those lines to yourself out loud or in your mind will help you stay focused on and confident about the task at hand. You should do three imagery sessions per week for a period of four consecutive weeks. Performing the imagery tasks on Mondays, Wednesdays, and Fridays would ensure an optimal addition between imagery sessions and tennis training sessions. On the day, you can choose the time that suits you best to do the imagery training. Each session will take approximately 10 minutes and the imagery training can be done at home in a comfortable environment. A session consists of three parts: (1) relaxation, (2) imagery of service performance, and (3) imagery of groundstroke performance. During the session, try to image in as much detail as you can. For instance:

- **imagine vividly**, as if you actually were in this particular situation, and use all your senses within your images, that is, imagine what you see, hear, feel (within your muscles), touch (tennis ball & racquet), and even what you smell on court, such as the aroma of new balls or the smell of the court surface.
- **imagine clearly** and in detail what this situation and your performance is like
- try to **control your images**, e.g., seeing yourself being successful

Once you have obtained a comfortable, relaxed state, read part 2 of the script. Read slowly through the instructions on 1^{st} and 2^{nd} serves and start the imagery session on serves. After you have completed the imagery on serves, proceed with the imagery instructions on groundstrokes (part 3 of the script). You can imagine the different aspects of the performance as they are being described to get an idea of what each involves. Each aspect of the performance ends with a quotation and a sentence in parentheses, for example, (Imagine this element of the groundstroke routine NOW).

This is when you follow the instructions, when you perform the imagery. Then, after you have finished reading the whole part 2 of the script, imagine your 1^{st} and 2^{nd} serves in real time, that is, imagine the speed of your shots and your movements, at the speed that they actually happen.

The sequence (e.g., 1^{st} serve, 2^{nd} serve, 2^{nd} serve, 1^{st} serve, and so on) and placement (see target areas in *Figure 1* – a, b, c, and d) of serves should be similar to a typical service game in a competition match, e.g., you would like to vary serves into different target areas and you would need to hit 1^{st} and 2^{nd} serves as the game goes on. In each service imagery session, imagine at least five of your 1^{st} and five of your 2^{nd} serves. Beyond that, you can imagine as many 1^{st} and 2^{nd} service performances per session as you like.

After the completion of the imagery session on serves (part 2) and groundstrokes (part 3), use the adherence log to make notes of your experiences. After having completed several sessions, you will find that you will need to look at the script less and less. Nonetheless, you should check the script periodically to ensure an important element has not dropped out of your imagery.

1. RELAXATION

Make yourself comfortable in a relaxing sitting or resting position. You can choose, whether you feel more comfortable with your eyes open or closed at any time during the imagery session. Now, focus on the centre of your body. Take several slow deep breaths. With each inhalation, imagine that you are pulling all of the tension from your body into your lungs. With each exhalation, imagine that you are releasing all of your body tension and negative thoughts from your body. Continue this slow, focused breathing, until your body becomes relaxed and your mind is alert and open for productive thoughts.

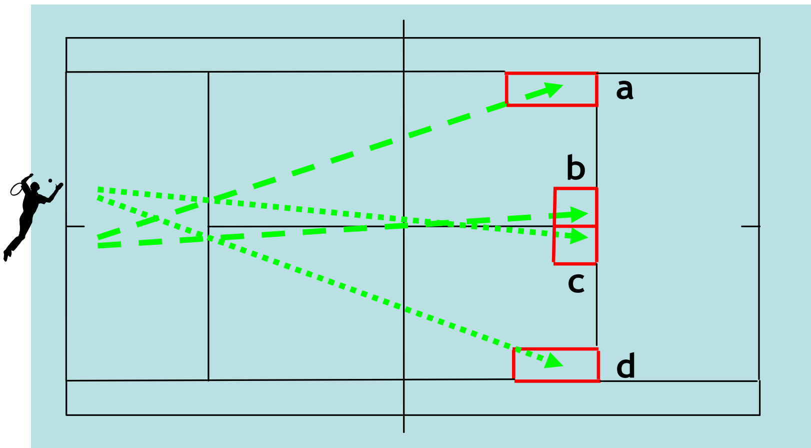

Figure 1. Target areas (a, b, c, d) and possible ball flights (cross court, down-the-centre line) for 1st and 2nd serves

2. IMAGERY OF SERVICE PERFORMANCE IN TENNIS

Imagine preparing for your first/second serve in a competition match. You are aware that you are relaxed and also excited to perform in the competition. The audience, the people around you, and your opponent don't bother you, because you know you have the skills and confidence to hit successful serves, which gives you a feeling of control, concentrating distinctly on the task at hand. You can feel how confident and relaxed you are, because you know clearly what you want to do next and you are up to the task. In your mind's eye, imagine yourself performing perfectly; you are hitting winning serves while feeling confident and having fun. It is fun to compete, because you are totally in control of your service action. Your serve gives you the confidence to win the upcoming rally.

Go through your regular routine before you imagine hitting first and second serves. You know, no matter how challenging the situation is you stay calm, focused, and confident about your serves. Now, you are standing at the baseline, seeing your opponent waiting for you to serve on the other side of the net. You are confident in your skills, even in tough match situations, knowing that you have the ability to meet the challenge. It is hard to serve right in this corner of the service box, but you know you can hit the spot with a really fast and heavily spun ball. Based on your opponent's position, you know instantly which target area is best to hit a winning serve (see target areas a, b, c, or d in *Figure 1*). Notice the arrangement of the lines and focus particularly on the part of the service box, which you want to serve to. Assessing the service situation, you know that your skills, the clear strategy and the clear goal in your mind will enable you to win the point. You say to yourself:

"I am up to the serving task!"

"I am concentrating fully and in control!"

(Imagine this element of the service routine NOW).

You are about to hit now. You can feel the grip of your racquet in your hand. The grip is very familiar to you. With your other hand you can feel the tennis ball, its round shape and soft material. You can even smell the scent of the new tennis ball. Feel how confident and concentrated you are with the racquet in one hand and the ball in the other hand. This feeling is very familiar, which makes you feel in control and focused on the task at hand, knowing that you can master this situation. You have a clear service strategy in mind, which provides you with the confidence, focus, and sense of control to successfully hit the ball into the exact target area. Your posture conveys the notion of a confident server. You think to yourself:

"I am confident about my serve!"

"Serving is fun!"

"My concentration focuses entirely on the next serve!"

(Imagine this element of the service routine NOW).

Now, you bounce the ball as part of your routine. You can even hear the ball bouncing on the ground. You recognise the feeling of the ball when you release it and when you catch it again. At this moment, your concentration is focused on the ball and its seam. You slightly swing your racquet backwards. When you bring together ball and racquet, you are completely focused on your serve. Your muscles in your arms feel smooth. You know, you have the skills to hit the ball into the anticipated target area, which makes you feel in control and concentrating fully on the task at hand.

Now, you are ready to hit the serve. You toss the ball; you can feel how the ball lifts off your hand, describing a line, which is perfect for your serve. Simultaneously, you are swinging your racquet backwards and upwards. You can feel the positive muscle tension in your back, which is forming a slight arch, like a bow before launching the arrow. You are in a side-on position, one hand pointing to the ball, one hand holding the racquet confidently. Like watching a videotape, you can see the position you are in when you are about to hit the ball. You are feeling relaxed and the muscles in your arms, shoulders, and legs are smooth. You can feel the positive tension in your muscles and you are just about to explode. The only thing you think of before hitting the serve is:

"I am in control; this ball goes into that corner!"

(Imagine this element of the service routine NOW).

Now, you hit the ball and it feels fast, relaxed, and smooth. You can see yourself, your body is fully stretched and your muscles are smooth. You hear the sound of the ball on the racquet strings. It is the sound of a ball that has been hit in the "sweet spot", just as you intended. You move into the court with determination and confidence in achieving your goal. When you pursue the trajectory of your serve, it looks like being on a perfect line, going directly to the service box that you anticipated beforehand. The visual feedback about the service performance gives your confidence an extra boost. The ball moves quickly, while you feel energised and relaxed, enjoying the great performance and being excited about winning the point.

The ball exactly hits the corner of the service box, difficult to receive for your opponent on the other side of the court. You feel in control and confident about the winning serve and look forward to the next serve.

Now, that you have finished reading part 2 of the script, imagine the whole service routine. You should imagine your 1st and 2nd serves in real time, that is, do the imagery of your preparation and execution of serves at the speed that they actually happen. The sequence (e.g., 1st serve, 2nd serve, 2nd serve, 1st serve, and so on) and placement (see target areas in Figure 1 – a, b, c, and d) of serves should be similar to a typical service game in a competition match, e.g., you would like to vary serves into different target areas and you would need to hit 1st and 2nd serves as the game goes on. In each service imagery session, imagine at least five of your 1st and five of your 2nd serves. Beyond that, you can imagine as many 1st and 2nd service performances per session as you like.

3. IMAGERY OF FOREHAND AND BACKHAND GROUNDSTROKE PERFORMANCE IN TENNIS

Read slowly through the instructions on forehand and backhand groundstrokes. You can imagine the different aspects of the groundstroke performance as they are being described to get an idea of what each involves. Each aspect ends with a quotation and a sentence in parentheses, for example, (Imagine this element of the groundstroke routine NOW). This is when you follow the instructions, when you perform the imagery. Then, after you have finished reading the whole part 3 of the script, imagine your forehand and backhand groundstrokes in real time, that is, imagine the speed of your shots, your movements, and your opponent's shots and movements at the speed that they actually happen. During the imagery session, you can choose the corner to which you want to hit your forehand (F) and backhand (B) shots. The sequence (e.g., F, B, B, F, B, F) and placement (see target areas a and b in Figure 2) of groundstrokes should be similar to a typical baseline rally in a competition match, e.g., you would like to vary your forehand and backhand shots and you would need to hit cross-court and down-the-line shots as the rally goes on.

The imagery session will consist of 10 groundstroke rallies. In each of these rallies, you imagine yourself hitting 4 to 6 shots, with the last shot imagined being a clean forehand or backhand winner down the line or crosscourt (see Figure 2). As in a normal competition situation, the rally you imagine should include forehand and backhand strokes. The sequence of shots can be chosen by you. It is important that the final shot of the rally will be a clean winner with your forehand or backhand, respectively. Beyond the 5 forehand and five backhand winners per session, you can imagine as many groundstroke winners as you like. After the completion of the imagery sessions on groundstrokes and serves, use the adherence log to make notes of your experiences.

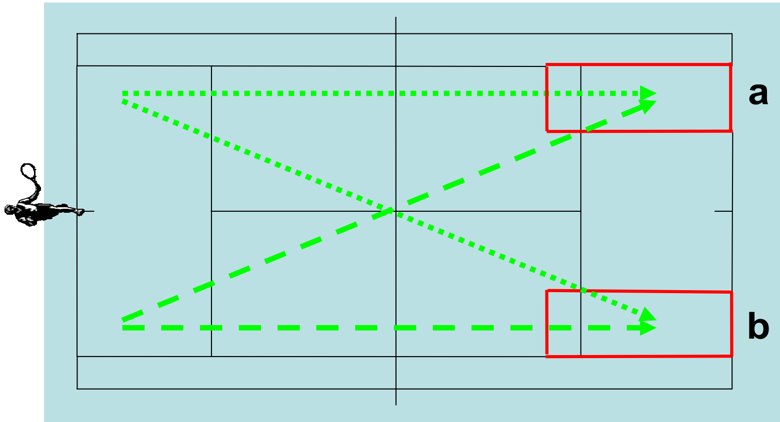

Figure 2. Target areas (a, b) and possible ball flight (cross court, down-the-line) for forehand and backhand groundstrokes

Go through this part of the script, imagining you are in a tough competition match and hitting successful forehand and backhand shots from the baseline into the cross-court or down-the-line corner. The audience, the people around you, and your opponent don't bother you, because you know you have the skills and confidence to hit winning baseline shots, which puts you in a state of control, focusing on the task at hand. You can feel how confident, relaxed, and composed you are, because you know clearly what you want to do next and you are up to the task. In your mind's eye, imagine yourself performing perfectly; you are confidently hitting forehand and backhand winners while having fun. It is fun to play baseline winners, being totally in control of and immersed in what happens on court. You realise that you are relaxed and also excited to perform in the competition, being totally focused on what happens here and now, switching off all distractions. No matter how long the rally goes, you know that you can win each rally. You think:

"I am confident in my groundstroke abilities!"

"I am concentrating fully and up to the task until the rally is over!"

(Imagine this element of the groundstroke routine NOW.)

Then you see the ball being hit by your opponent, setting you up for a baseline shot near the singles sideline. You are completely focused on what is happening on court, giving you a good sense of anticipation and the will to hit each ball in an optimal position. Now, imagine going through your regular routine before hitting a groundstroke. You always stay calm, focused, and confident about your baseline strokes. Now, you approach the ball. Even though it is a tough shot, you know exactly where to place your shot to win the rally, being confident in your skills. Based on the upcoming ball, your hitting position, and your opponent's baseline position, you know instantly that you will go for the winning shot (see target areas a and b in Figure 2). Notice the arrangement of the lines and focus particularly on the part of the target area, which you want to go for.

Assessing the groundstroke situation, you know that you are able to master this situation; having set a clear goal in your mind will enable you to win the point. You say to yourself:

"I have total control over my baseline shots!"

(Imagine this element of the groundstroke routine NOW).

You can see yourself moving sideways; being focused on the ball. You start the back swing. You can feel the grip of your racquet and the rotation of your shoulders and your back, while your head is still and you are fully concentrated on the ball. Now, you release the tension that built up through your backswing rotation. You swing your racquet towards the ball, feeling the fast and smooth movement of your shoulder and arm muscles. The closer the ball comes the more focused you are, knowing that you will hit the ball into a specific target area. Exactly when you hit the ball you can see yourself as in a video. The video shows you the dynamic movement, rotating your upper body towards the ball and your racquet hitting the ball in a perfect spot in front of your body, while your head is still and you are completely focused on the ball. You know:

"I am in control; this ball goes into that corner!"

(Imagine this element of the groundstroke routine NOW).

Your wrist action is exactly right for the winning shot. The contact with the ball feels fast, controlled, relaxed, and smooth. You hear the sound of the ball on the racquet strings. It is the sound of a ball that has been hit by the "sweet spot" on the racquet, just as you intended. You can feel the powerful impact and the positive tension of your arm muscles when you go through the ball. You are at the peak of being focused, confident, and in control of your actions.

When you pursue the trajectory of your baseline shot, it looks like being on a perfect line, going directly into the anticipated corner of court. The visual feedback about the winning shot enhances your confidence even more. The ball moves quickly, while you feel energised and relaxed, enjoying the great performance and being excited about winning the point. You feel confident about the winning shot, while moving sideways back to the middle of the court, looking forward to hitting the next shot.

Now, that you have finished reading the whole part 3 of the script, imagine your forehand and backhand groundstrokes in real time, that is, imagine the speed of your shots, your movements, and your opponent's shots and movements at the speed that they actually happen. During the imagery session, you can choose the corner to which you want to hit your forehand (F) and backhand (B) shots. The sequence (e.g., F, B, B, F, B, F) and placement (see target areas a and b in *Figure 2*) of groundstrokes should be similar to a typical baseline rally in a competition match, e.g., you would like to vary your forehand and backhand shots and you would need to hit cross-court and down-the-line shots as the rally goes on.

The imagery session will consist of 10 groundstroke rallies. In each of these rallies, you imagine yourself hitting 4 to 6 shots, with the last shot imagined being a clean forehand or backhand winner down the line or crosscourt (see Figure 2). As in a normal competition situation, the rally you imagine should include forehand and backhand strokes. The sequence of shots can be chosen by you. It is important that the final shot of the rally will be a clean winner with your forehand or backhand, respectively. Beyond the 5 forehand and five backhand winners per session, you can imagine as many groundstroke winners as you like.

At the end of the imagery session, you feel relaxed, energised, and calm. Focus on your breathing again before you slowly become aware of your environment. You feel alert and refreshed. During your training sessions and competition matches, remember the italicised sentences. Use the italicised sentences in your self-talk or as self-instructions to stay focused and confident on your service and groundstroke shots.

After the completion of the imagery sessions on groundstrokes and serves, use the adherence log to make notes of your experiences.

Appendix X: Imagery Adherence Log

Adherence Log

Dear Tennis Player,

Please use this log booklet in conjunction with your imagery sessions. After having completed the imagery session on serves and groundstrokes, please fill in the **date**, **starting time**, and **duration of the imagery session**. The booklet also provides space to comment on the imagery experience, e.g., how strongly and vividly you could experience the various images or how you felt while imaging 1st and 2nd serve and groundstroke performances. In addition to these comments, please rate your experience of imaging serves and groundstrokes on the scales that measure vividness and clarity of your images.

SESSION DATE	START TIME	SESSION DURATION
		(minutes)

Comments on your imagery experience:

………………………………………………………………………………

………………………………………………………………………………

………………………………………………………………………………

How would you rate the vividness and clarity of the images you had in the imagery session **today**? Place a cross in <u>one</u> box only:

-5 = much weaker					0 = alike				much stronger = +5	
-5	-4	-3	-2	-1	-0	+1	+2	+3	+4	+5

SESSION DATE	START TIME	SESSION DURATION
		(minutes)

Comments on your imagery experience:

…………………………………………………………………………………

…………………………………………………………………………………

……………………………………………...…………………………

How would you rate the vividness and clarity of the images you had today with your **previous** imagery session, how would you rate it? Place a cross in <u>one</u> box only:

-5 = much weaker					0 = alike					much stronger = +5
-5	-4	-3	-2	-1	-0	+1	+2	+3	+4	+5

Appendix Y: Transcription Social Validation Interview (Participant 1)

S: Thank you for your time to meet and talk about your competition experiences over the last three to four months. What is it about competition that you like?
P: It's a good question, em, I am not really sure. I'd say … I think I just like competing against the people. Like in training it's how many times you missed, Jesus, big deal. I really enjoy being under that high pressure. Like even at six all in the third and stuff, I still enjoy. I still, kind of, like the atmosphere.
S: Let's have a look at the figures (service and groundstroke performances), this is the pre-intervention phase, then we did the intervention for four weeks, and this is the post-intervention. Out of the all the competition matches, which match do you think was your best in terms of performance?
P: My best performance was in Match 8 and 9.
S: What was exceptionally good about these matches?
P: Both matches were really good, because I didn't make many mistakes and still managed to hit winners. So, I was just solid and still managed to win the point.
S: Do you think you played pretty tough players regarding Matches 6 to 11?
P: Yeah.
S: What do you think, what was the biggest difference between the pre- and post-intervention phase?
P: Em, I just sort of feel more confident in these ones (pointing to Matches 6 to 11), like through other matches I was just … I just felt more faithful in my shots (pointing to Matches 6 to 11 again). I just seem to be able to make my shots a bit more when it was important. Like up here (Matches 7, 8, and 9) it was much more difficult to win the points, and here (pointing at Matches 1 to 4) it was a lot more easier.
S: The reason why you played better here (post-intervention matches), has it something to do with the training sessions?
P: No, maybe it had a little bit to do with my health, cause I was still sick (pointing to Matches 4 and 5) and I got a lot better here (post-intervention matches). But also I think it was a lot of what we did with the psychology. It just helped me with my confidence. So, I think that was good.
S: How often did you use the imagery script?
P: Three to four times a week.
S: How long did a session last for?
P: 15 (minutes) to half an hour.
S: Did you feel it was easy for you to get adjusted to this routine?
P: Yeah … it was easy as I did it, the first time was a bit harder, but then it got really good. It was a good experience.
S: Throughout the intervention and post-intervention phase you mentioned to use the imagery script in preparation for your competition matches. What was the biggest difference you experience when you didn't use it, as in the pre-intervention matches, compared to the matches when you did use imagery? Did you experience a difference at the start of the match or throughout the match, or …?

P: Throughout the match, yeah, throughout the match was a lot better. It's just confident, more confident in general, cos I felt like I could win.
S: Do you think it had something to with your opponent's performance, or was it more like you living up to your own expectations?
P: I think it was also a bit more that I was focused on what I was doing, a bit less on what my opponent was doing. I think that helped as well.
S: When we have a look at your reports on flow throughout the competition matches, do you think it strongly depended on winning or losing?
P: Ah, in this match (Match 5) I didn't particularly feel very well. I went out there and I ... I wasn't playing very well. That match wasn't very good body wise, and I think I could get back into the match, so kept getting worse and worse. That wasn't one of my best standard matches.
S: If you had won Match 5 against your opponent and you played a similar standard as did then, would you have felt differently?
P: No.
S: What was your preparation like for the competition matches?
P: I was just imagining winning points against my opposition … and winning the way I wanted to win it, that make me feel the best. So, like off rallies and then hitting winners and putting pressure and forced errors. Yeah, so I focused on imagining that, and then tried to do it again in the actual match.
S: Did you also imagine the opponent's actions?
P: Yeah, who I was gonna play.
S: You have completed several questionnaires on flow experience. How would you describe in your own words, what is the flow experience for you like?
P: I'd say that I was a bit more aware of what was going on from up here, after the intervention, I was a bit more aware of what they (the opponents) were doing and of what I could do to fix it, and thinks like that … and I would say that my confidence and my feeling to be able to fix the game – that felt really good. And that changed mainly from the intervention, like I felt a lot more confident that I could win the next crucial point that I didn't do beforehand.
S: So, when you were facing a tough situation, it was a bit easier to adjust to the situation and do something about it?
P: Yeah, yeah.
S: What happened, what did you feel when you lost a big point, or a point that really hurt - how would you react? When you compare between before and after the intervention?
P: I think, before, I would have been affected a little bit more, I think I dwelled on the points a bit more before the intervention. I think here (post-intervention phase) I was a bit more aware and conscious of the next point, instead of the previous one. So, in general, I think I was a bit more positive here, not so much that before I was negative in that "Oh god, I missed it again – I am getting angry", but here it was more proactive towards being positive. Before I was a bit more neutral and, maybe, a bit more dwelling on the points before, whereas then (post-intervention phase) I was a lot more confident and positive.
S: All the matches following the intervention you played really well and won all of them in two straight sets. You mentioned the imagery helped you to get into the

matches. Was there sometimes a situation when you got out of the flow experience, and didn't go that well and wanted to get back into the match, did you use some imagery to achieve that?
P: To be honest, ever since I started doing the thing, I found that I didn't really have that problem where I couldn't get back into the match, it seemed to me that I automatically was able to get into it when I wanted, and I think that was one of the big things that changed. So, I actually didn't struggle with that problem. Here (after the intervention) it was much more controlled.
S: So, you were in flow state when you entered the court, or was it more like that depending on your performance you experienced flow?
P: It seemed it started in the warm up, in the warm up, I … I think in general I was just more aware of what was going on. Like I be sitting there and I be "he is doing this, this, this" and "I be doing this, this, this". I think, yeah, I was, like, kind of, more awake, but … it is hard to describe, I was just a bit more alert and aware of what I could do, and what he (the opponent) was doing and how to stop him.
S: Being aware of some things doesn't mean that you think about it consciously. What things do you think were more conscious for you than before, that you really thought about actively? Like skills or tactics.
P: Tactics was much better. I don't think it was so much that I was thinking of tactics that I wasn't before, I was just recognising them earlier. So, as you may have noticed, like in both these first two (Matches 1 and 2) I lost the first set and then I played three setters. And, I mean, after the intervention no three sets. I think I was just able to pick up tactics and pick up errors and mistakes earlier and stopping myself from losing that first set and then realising it. And that's why one of the things that I am surprised about that I didn't drop a set; I usually always drop a set. So, it was … was really good. Just shows something has changed.
S: I noticed the serve changed from this phase to that. How would you rate the service performance before and after the intervention?
P: This was tons better (after the intervention), this is holding serves. The matches here (before the intervention) was a lot more dogfight, break – break back, much more erratic, whereas here (after the intervention) was a lot more quality serving.
S: Did you do much in training sessions to improve the serve?
P: I had worked a bit on technique, but nothing that would change it as much as I think it did. Cos I look back and now I think there was a difference, so I get so many more free points, and short returns and stuff like that. So, I think it is what made the difference.
S: So, the technical side …
P: Basically, stayed the same, not much changed.
S: When you were thinking about yourself preparing for the matches, guide me through your imagery sessions when you were focusing on your serves.
P: Em, I was really just imagining … for some reason I always started imagining myself outside of myself, like I was watching. Just so I could see what it looks like on the outside of my serves and stuff. At the start I was just imagining like in a training, without someone there, and then I put someone in there, and then I did first serves and then I played out full points. One thing I didn't do was that I

didn't imagine the actual venue, I, for some reason, kept imagining Yarraville (the usual training venue), part of the Yarraville courts. I don't know why.
S: Do you focus on the area where you want to hit your serve?
P: Yeah, yeah.
S: Is it always pretty close to the lines?
P: It was always … not on the line, but very close. With a bit of margin. Because from experience, when you try to hit the lines, sometimes it is out. You know what I mean.
S: Yeah, yeah. Did you do some imagery during the breaks, when swapping sides?
P: No, no (imagery when) changing sides.
S: Do you think when you play well, has it anything to do that you are really certain about the opponent and the environment and these kind of things?
P: It seems to be that, I think, ever since I started playing that I play according to my confidence. It is all about confidence for some reason.
S: Have you done a similar program before with regard to imagery?
P: I did a bit myself, but not to this extent or someone was guiding me. So, it was really good.
S: Beside your confidence, do you think you play better when you know the person or when you play someone you haven't played before?
P: Certainly, when I didn't know (my opponent) I would play better. I'd think I have a problem when I know the person, it always carries expectation and I … I … I play really bad or really well, but since this (intervention) it's more playing well.
S: Before the intervention, did you do lots of self-talk, when you think something or say something to yourself during the matches?
P: Never to the extent like after the intervention. Like I'd be sitting there I'll be saying "next time don't go down the line on the backhand", but never to this extent.
S: What changed? Do you use it more often or …?
P: I use it more often, and I use it more positively. So, it is not like … it is not like "You didn't move your feet", it's "Move your feet more next time". So, switched it to positive.
S: In what situations would you use self-talk?
P: Em, in key point where I made bad shot selection.
S: Any final thoughts about these things we discussed today?
P: Eh, no, just glad I did it, definitely.
S: Thank you so much for your time during the study and for this interview and sharing your experiences here. All the best and good luck with the upcoming competitions.