

How basic need satisfaction and dispositional motives interact in predicting flow experience in sport

Julia Schüler, Veronika Brandstätter

University of Zurich

Correspondence concerning this article should be addressed to Julia Schüler, Department of Sport Sciences, University of Berne, Switzerland.
E-mail: julia.schueler@ispw.unibe.ch

Abstract

We have integrated the basic psychological needs approach from self-determination theory with motive disposition theory in order to enhance the prediction of flow experience in sports. We hypothesize that an environment that enables people to fulfill their basic psychological needs for competence and social relatedness results in flow. Additionally, we assume that the effect of competence need satisfaction is moderated by the achievement motive and that the effect of need-for-relatedness satisfaction is moderated by the affiliation motive. Four studies show the expected positive effects of need satisfaction on flow and further confirm that high achievement and affiliation-motivated individuals benefit more from competence and relatedness sports environments, respectively, than individuals low in these motives.

Engaging in sports and exercises has a range of positive consequences for physiological health (Bouchard, Shepard, Stephens, Sutton, & McPherson, 2000) as well as for psychological well-being (Biddle, Fox, & Boutcher, 2000). To name but a few of these, regular exercise is associated with reduced likelihood of coronary heart disease (Bouchard et al., 2000) and enhanced life expectancy (Katzmarzyk, 2006). Its psychological benefits include better cognitive functioning (Colcombe et al., 2003), higher self-esteem and satisfaction with life in older people (Fox, Stathi, McKenna, & Davis, 2006), and a positive influence on mental disorders such as anxiety and depression (Mutrie, 2000). However, although the beneficial effects of an active lifestyle are widely known, many individuals do not engage in health-related physical activities at all or else drop out of sports activities after a few weeks (Marcus et al., 2000). In order to identify the reasons for participating or not participating in sports and exercises, researchers and health professionals often consider approaches to motivation (e.g., Dishman & Sallis, 1994; Hagger & Chatzisarantis, 2005) with a special focus on intrinsic forms of motivation, which are a core predictor of exercise adherence (Hagger & Chatzisarantis, 2007).

In order to explain and accurately predict intrinsic motivation in sports, the present work integrates the basic psychological need approach within self-determination theory (SDT; Deci & Ryan, 1985, 2000) and the dispositional motive theory (MDT; McClelland, 1985; Schultheiss, 2008). In doing so, we hope to achieve synergies that enhance

the theoretical prediction of intrinsic motivation on the one hand, while on the other hand directly linking the theory with its practical implications, delivering more precise practical recommendations for practitioners in health and sports psychology.

Basic need satisfaction and intrinsic motivation

According to SDT (Deci & Ryan, 2002), intrinsic motivation results from the satisfaction of three innate psychological needs that are fundamental to all humans. Those needs are the need for autonomy, the need for competence, and the need for social relatedness. The need for autonomy is the desire to feel a sense of ownership of one's own behavior and to experience it as self-determined rather than controlled by others (Deci & Ryan, 2002); the need for competence reflects the desire to master challenging tasks effectively (Deci & Ryan, 2002; White, 1959); and the need for social relatedness is satisfied when people have a sense of meaningful interpersonal connection and belonging (Baumeister & Leary, 1995; Deci & Ryan, 2002).

Deci and Ryan (1985, 2000) believe that intrinsic motivation is promoted by environments that satisfy these innate psychological needs, whereas contexts that stifle psychological need satisfaction undermine intrinsic motivation. Consequently, this research approach focuses on the analysis and modification of situational characteristics (e.g., social

circumstances, task characteristics) in order to create environments that permit need satisfaction. The assumptions of SDT are backed by convincing empirical research. A multitude of laboratory experiments as well as studies in real-world settings (e.g., sports, school, work organizations) show that environments that support autonomy, enhance perceived competence, and are characterized by a sense of secure relatedness are associated with greater intrinsic motivation (see Deci & Ryan, 2000, for a summary).

SDT has been successfully applied especially in sports (Mullan, Markland, & Ingledew, 1997; Pelletier & Sarrazin, 2007; Vallerand, 2007; see Hagger & Chatzisarantis, 2007, for a summary). For example, the satisfaction of psychological needs has been found to be associated with more self-determined exercise motivation (Wilson, Mack, Muon, & LeBlanc, 2007), well-being (Edmunds, Ntoumanis, & Duda, 2007), and enhanced exercise-related affect (Parfitt, Rose, & Markland, 2000). Most research has focused on autonomy need satisfaction achieved through perceived autonomy-supportive interpersonal behavior (e.g., whether choices and options are provided), for example, by swimming coaches (Pelletier, Fortier, Vallerand, & Briere, 2001), physical education teachers (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003), and friends (Wilson & Rodgers, 2004), and promoting intrinsic motivation for exercising and sports (see also Markland & Hardy, 1993; Vansteenkiste, Simons, Soenens, & Lens, 2004). Other studies confirm the positive effects of need satisfaction in sports and exercises for all three psychological needs (Ntoumanis, 2005; Standage, Duda, & Ntoumanis, 2005; Wilson, Mack, Blanchard, & Gray, 2009).

In accordance with the assumption of SDT that the environmental context in which individuals are able to feel autonomous, competent, and socially related determines their intrinsic motivation, the studies cited above focus on the analysis and modification of situations, while so far neglecting individual differences. However, we argue that focusing on situational characteristics alone is too narrow when trying to predict intrinsic motivation in the applied domain of sports. We definitely agree with SDT that a “rich” environment—offering a high number of situational characteristics that can potentially satisfy important psychological needs—fosters intrinsic motivation. However, we would like to differentiate this perspective by positing that the effectiveness of those situational characteristics varies greatly depending on an individual’s motive strength. We will elaborate on this in the following paragraph.

Dispositional motives and intrinsic motivation

In motivation psychology, it is assumed that two central concepts determine human motivation (e.g., Lewin, 1931;

McClelland, 1985). One of these—called motive—is intrinsic to the person and conceptualized as a stable characteristic of that person (a kind of personality disposition). These motives are the achievement motive, the affiliation motive, and the power motive all of which energize, select, and direct behavior (McClelland, 1985). They differ in strength, as a result of differences in early childhood learning, and determine the sensitivity toward certain kinds of incentives (see Schultheiss & Hale, 2007, for a summary). The second central concept in motivation psychology is incentives,¹ which are an environmental characteristic with the potential to satisfy a motive (e.g., Atkinson, 1957; Beckmann & Heckhausen, 2008; Lewin, 1951; Tolman, 1932). Motives and incentives interact in the prediction of motivation: On the one hand, a motive is incited by corresponding environmental characteristics and as a consequence energizes behavior (McClelland, 1985). On the other hand, other things being equal, the stronger a motive, the higher the sensitivity for corresponding incentives in a particular situation.

In the present research, we transferred this postulated interaction between motives and the environment to the domain of sports and exercising, and focused on the achievement and affiliation motives because these are the most relevant in the sports context. Sports offer an excellent opportunity for testing and improving one’s skills and for socializing with other people. The achievement motive is the recurrent concern with surpassing standards of excellence (McClelland, Atkinson, Clark, & Lowell, 1953). A person with a high achievement motive has a high standard of excellence and a strong desire to improve his/her competence and learn new things (see Brunstein & Heckhausen, 2008, for a current review on the achievement motive). In sports, achievement incentives that trigger the achievement motive might be the opportunity to feel competent (e.g., by improving running time) and the opportunity to learn new things (e.g., by improving tennis technique). At the core of the affiliation motive is the capacity to derive satisfaction from establishing, maintaining, and restoring positive relationships with others (Atkinson, Heyns, & Veroff, 1958). Individuals with a high affiliation motive “want to be with individuals who are friendly and accepting, and distance themselves from people who are not” (Schultheiss, 2008, p. 605). They are incited by environmental characteristics in sports that allow them to spend time and harmonize with other people, and to share positive affective experiences with others (e.g., team spirit), as for example in team sports.

¹It is important to note that the term “incentive” is not used in the sense of an external reward here (as it is in research on the undermining of intrinsic motivation; e.g., Deci, 1971), but is defined as a situational characteristic that promises the satisfaction of a need. Incentives can either be learned (e.g., individuals’ positive experiences with a situation) or they can be independent of experiences (e.g., the nature of the situation itself for an overview of the incentive concept, see Beckmann & Heckhausen, 2008).

The interaction of basic need satisfaction and dispositional motives

When comparing the motive concept (dispositional motive approach) with the basic need satisfaction concept within self-determination theory, the parallels are obvious. The achievement and affiliation incentives that are assumed to incite the achievement and affiliation motives are phenomenologically closely related to the environmental characteristics that SDT researchers would assume to fulfill the psychological need for competence and social relatedness. The striking difference between these approaches, however, is that SDT researchers assume that individual differences in need strength “are not the most fruitful place to focus attention” (Deci & Ryan, 2000, p. 232), whereas the motive concept is inextricably linked to the notion of interindividual differences. This difference between the approaches is not only of theoretical significance but of great practical relevance. This is why we chose an integrative perspective on intrinsic motivation and aimed to analyze the interplay of psychological need satisfaction and motives in sports. We do so by analyzing the interaction between environmental characteristics and dispositional motives. It is assumed that individuals who differ in the strength of their achievement motives would also differ in their sensitivity for opportunities in sports that promise to satisfy a psychological need for competence. In more concrete terms, individuals with high achievement motives were assumed to respond more strongly to environmental characteristics associated with the experience of competence (e.g., opportunities for making progress, improving skills) than individuals with a low achievement motive. We also assumed that differences in the strength of the affiliation motive would lead to differences in the sensitivity toward opportunities in sports that might satisfy the need for social relatedness (e.g., opportunities to spend harmonious time with others), in the sense that individuals with high affiliation motives would benefit more from such situations in terms of their intrinsic motivations than individuals with low affiliation motives. If, on the other hand, an individual with a high achievement or affiliation motive does not experience corresponding situational characteristics in the sports environment (either competence or relatedness), the motive is frustrated and we would therefore expect no positive consequences or even negative consequences of motive frustration. To summarize our assumptions in statistical terms: We hypothesized that basic needs-satisfying environmental characteristics interact with dispositional motives to predict intrinsic motivation in sports.

Recent studies by Schüler, Sheldon, and Fröhlich (2010) have already made a start toward integrating the basic psychological need concept within SDT and the motive disposition approach. In a series of three studies, they confirmed their assumptions that in accordance with SDT, the satisfac-

tion of the need for competence predicted subsequent motivation (e.g., goal commitment, goal progress, intrinsic motivation) positively. Most interestingly, need for competence satisfaction had stronger effects on the motivational outcome variables for individuals with high achievement motives than for individuals with low achievement motives. The present research aims to transfer the theoretical integration of different approaches to human needs (SDT and MDT), which has been suggested by Schüler et al. (2010), to the applied domain of sports and exercises. The major objective is to use this theoretical integration to enhance the prediction of intrinsic motivation in sports and to suggest practical interventions aimed at promoting adherence to a regular exercise schedule. Furthermore, we extended the work of Schüler et al. by analyzing the interaction between achievement motive and competence satisfaction in more detail, using different operationalizations of competence satisfaction, and examining different kinds of sports. Additionally, we considered not only achievement but also affiliation as an important reason for human sports behavior and analyzed whether the affiliation motive moderates the effect of need-for-relatedness satisfaction on intrinsic motivation.

Present research

The theoretical considerations reported above led us to two central hypotheses that will be summed up briefly. First, in accordance with the central SDT assumption, we hypothesized that a high number of opportunities in the sports environment enabling the psychological need for competence and social relatedness to be fulfilled will facilitate intrinsic motivation (Hypothesis 1). For the sake of simplification, in this report we will use the terms *competence environments* and *relatedness environments* for environmental opportunities with the potential to fulfill the psychological need for competence and social relatedness.

The second hypothesis refers to the interaction between motive and environment (Hypothesis 2). We hypothesized that the positive effect of competence environments on intrinsic motivation will be stronger for individuals with a high rather than a low achievement motive. Similarly, the positive effect of relatedness environments on intrinsic motivation was expected to be stronger for individuals with a high than with a low affiliation motive.

In order to operationalize intrinsic motivation, we measured flow experience, which has been described as a prototype of intrinsic motivation, in which people feel totally involved in an activity and perform it for its own sake (Csikszentmihalyi, 1990; Rheinberg, 2008). The flow experience is defined as “a state that people report when they are completely involved in something to the point of forgetting time, fatigue, and everything else but the activity itself” (Csikszentmihalyi & Rathunde, 1992, p. 59). Flow is a

multifaceted phenomenon characterized by a perceived balance between the challenge of a task and one's skills, by the clarity of the goal, by clear and immediate feedback, by a high concentration on the task at hand, by a merging of action and awareness, by a high sense of control, and by an altered sense of time (Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005). Although the experience of flow seems, at first sight, to be more probable in an achievement context, the theoretical conceptualization of flow explicitly includes other domains of human life. For example, Csikszentmihalyi (1990) states that flow can also be experienced in affiliation contexts such as in the interaction with friends or within the family. The experience of flow in social relationships requires the same conditions that must be present in achievement contexts. Thus, it is necessary to have common goals (clear goals as a condition of flow), to experience mutual exchange in the relationship (immediate feedback as a condition of flow), "but also to find new challenges in each other's company" (Csikszentmihalyi, 1990, p. 188) (challenging activities as a condition for flow). Flow experience is of utmost interest for sports and exercise behavior because it is associated with performance in sports (Jackson, Kimiecik, Ford, & Marsh, 1998; Jackson & Roberts, 1992; Jackson, Thomas, Marsh, & Smethurst, 2001; McInman & Grove, 1991). Moreover, due to its rewarding quality, it contributes to the maintenance of sports and exercise behavior which, for example, is an exigence of health-related sports programs (e.g., Csikszentmihalyi et al., 2005).

We tested our hypotheses with four studies in different sports domains (badminton, fitness, volleyball) and used correlational as well as experimental study designs in order to demonstrate the stability of the effect. In Study 1 and Study 2, we focused on the achievement domain (achievement motive and competence environment), whereas Study 3 and Study 4 also considered the affiliation domain (affiliation motive and relatedness environment). Competence and relatedness environments were measured in different ways: by participants' self-reports and by an objective expert rating of the sports environment characteristics.

Study 1

Study 1 is designed as a field study in badminton and focuses on the interaction between a competence environment and the achievement motive. We hypothesized that individuals would generally experience more flow in a sports situation characterized by a large number of competence-satisfying characteristics, such as the opportunity to get feedback and experience progress, than in situations characterized by few such opportunities (Hypothesis 1: main effect of competence environment). Additionally, we hypothesized that the effect of the competence environment on flow would be stronger for individuals with high achievement motives than for indi-

viduals with low achievement motives (Hypothesis 2: interaction of achievement motive \times competence environment).

Method for Study 1

Participants and procedure

Sixty-one male and 33 female advanced badminton players (who had been playing badminton for more than 1 year) with a mean age of 20.6 ($SD = 1.1$) were recruited from different recreation-oriented badminton clubs. First, prior to a regular training session the participants were asked to complete the achievement motive measure and rate the extent of competence-satisfying characteristics in their sports. Then, in the middle of the training session, participants were interrupted and were asked to fill in the flow measure. After the training session, participants were debriefed in detail.

Measures

The Multi-Motive-Grid (MMG; Sokolowski, Schmalt, Langens, & Puca, 2000) is a highly valid measure (e.g., Gable, 2006; Kehr, 2004; Langens & Schmalt, 2002; Puca, 2005; Puca & Schmalt, 1999) to assess the achievement, affiliation, and power motives. It consists of 14 line drawings of everyday situations, which are presented along with statements describing various thoughts, feelings, and action tendencies. Participants had to rate the statements regarding whether or not they fitted the situation. With this procedure, the MMG combines the advantages of projective measures and questionnaires as follows. The presentation of motive-relevant pictures arouses the participant's motives similarly to classical implicit motive measures like the Thematic Apperception Test/Picture Story Exercise (Murray, 1938; Schultheiss & Pang, 2007). In contrast to the Picture Story Exercise, however, participants do not write down a story that later has to be coded by raters, but answer statements that can be analyzed objectively. Because participants project the motive-relevant statements upon the situation illustrated in the picture (rather than referring them to themselves), their unconscious implicit motives can be measured (e.g., Gable, Reis, & Elliot, 2003; Puca & Schmalt, 2001; Schmalt, 1999; Sokolowski et al., 2000). Theoretical arguments and empirical evidence that the MMG measures implicit motives are summarized in Kehr (2004). For example, correlations between MMG motive scores and explicit motives have been found to be low, which underlines its discriminant validity. Furthermore, the MMG predicts intrinsic motivation and task enjoyment (see Sokolowski et al., 2000), both of which are theoretically associated with implicit motives (Deci & Ryan, 2000). (Further evidence of the validity of the MMG can be found in Gable, 2006; Kehr, 2004; Puca & Schmalt, 1999; and Schöler, 2007.)

The MMG measures a hope and a fear component for each motive. In line with the current motive research tradition (e.g., Winter, 1994), which focuses on the approach component of motives and in order to optimally answer our theoretical research question, we considered the hope component of the achievement motive (hope of success; Cronbach's alpha in the present study: .66).

Competence environment was assessed using a 3-item scale developed by the authors. Participants rated the degree to which their sport is characterized by opportunities ("My sport is characterized by opportunities . . .") "to learn new things," "to figure out new techniques," and "to improve skills" using a 7-point scale (1: *not at all* to 7: *very much*). The reliability of this competence environment scale was sufficiently high, with Cronbach's $\alpha = .80$.

Flow experience

The *Flow Short-Scale* (Rheinberg, Vollmeyer, & Engeser, 2003), whose validity has often been demonstrated in the meantime (Engeser & Rheinberg, 2008; Rheinberg et al., 2003; Schtuler et al., 2010), measured participants' flow experience. It consists of ten items (e.g., "I am totally absorbed in what I am doing"; "I do not recognize that time is going by") and participants rated their agreement using a 7-point rating scale ranging from 1 (*no agreement*) to 7 (*full agreement*). The flow measure was sufficiently reliable, with Cronbach's $\alpha = .76$.

Results of Study 1

Preliminary analyses and descriptive statistics

Men and women did not differ in any of the assessed variables and neither sex nor the participants' ages influenced the results reported below. The achievement motive ($M = 7.64$, $SD = 2.44$) was positively associated with the competence environment rating ($M = 4.48$, $SD = 1.08$; $r = .23$, $p < .05$) and flow experience ($M = 4.69$, $SD = .84$; $r = .21$, $p < .05$). The competence environment was significantly related to flow experience, $r = .25$, $p < .001$.

Analysis of the competence environment main effect and the motive \times competence environment interaction

A hierarchical regression analysis with the z-standardized achievement motive (ACHmotive) and competence environment (COMenviron) entered into the regression equation at Step 1, and the ACHmotive \times COMenviron interaction (multiplication of the z-standardized ACHmotive and COMenviron) entered at Step 2 (see Table 1), and revealed a significant main effect of the competence environment, $b = .53$, $SE_b = .09$, $p < .001$, and a significant interaction effect, $b = .19$, $SE_b = .09$, $p < .05$. The interaction pattern was illus-

Table 1 Hierarchical Regression of Flow Experience on Achievement Motive (ACHmotive) and Competence Environment (COMenviron) (Study 1)

Step	Variable	ΔR^2	df	ΔF	β^a
1	Main effects	.27	2,91	19.93***	
	Achievement motive				.11
	Competence environment				.54***
3	ACHmotive \times COMenviron	.03	1,90	4.48*	.19*
	Cumulative R^2	.31	3,90	13.21***	

Note. β^a is the standardized regression coefficient in the regression equation.

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

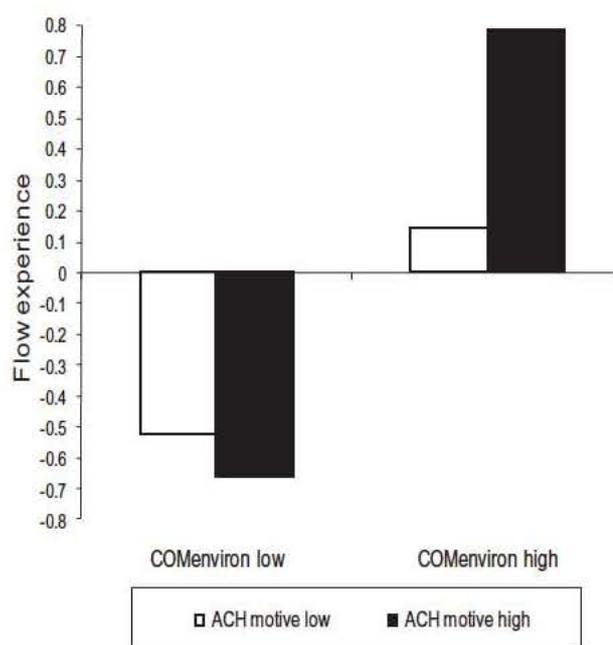


Figure 1 Flow experience of badminton players as a function of achievement motive (ACHmotive) and competence environment (COMenviron) (Study 1).

trated using a procedure proposed by Cohen, Cohen, West, and Aiken (2003) and is shown in Figure 1. All participants reported more flow when sports situations are characterized by a high number of opportunities to fulfill the need for competence than in low competence environments. However, the effect was stronger for individuals with high achievement motives. These benefited the most from being in a competence environment, but they also reported the lowest amount of flow when the sports situation lacked competence-satisfying opportunities. A supplementary post hoc analysis that employed a variant of the Johnson–Neyman technique (see Aiken & West, 1991, p. 132) showed that the difference between high and low competence environments was significant for individuals with high (1 SD above the mean)

achievement motives (comparison of the black bars, $\beta = .73$, $b = .72$, $SE_b = .14$, $p < .001$) and to a smaller degree also significant for individuals with low (1 *SD* below the mean) achievement motives (comparison of the white bars, $\beta = .34$, $b = .33$, $SE_b = .11$, $p < .01$). Individuals with high and low achievement motives differed significantly in high competence environments (comparison of the right bars, $\beta = .29$, $b = .32$, $SE_b = .14$, $p < .05$), but did not differ in low competence environments (comparison of the left bars, $\beta = -.06$, $b = -.07$, $SE_b = .13$).

Supplementary analysis

Because the MMG also measures the affiliation motive ($M = 7.16$, $SD = 2.38$) and the power motive ($M = 7.91$, $SD = 2.83$), in addition we were able to control for the effect of these motives (which were correlated with the achievement motive, with $r = .48$, $p < .001$ for affiliation and $r = .51$, $p < .001$ for power) and for alternative affiliation motive \times competence environment and power motive \times competence environment interactions. If the achievement motive (motive specific) rather than a general approach disposition (motive unspecific) plays a decisive role for the effects of the competence environment, the alternative interactions should at least account for a lower amount of the variance than the motive-specific interaction or at best should not predict flow at all. We therefore regressed flow experience on the achievement motive, the competence environment, and in addition on the affiliation and power motive (Step 1), and entered the ACHmotive \times COMenviron interaction, the AFFmotive \times COMenviron interaction, and the POWmotive \times COMenviron interaction as a second step in a hierarchical regression analysis. Competence environment significantly predicted flow ($b = .56$, $SE_b = .10$, $\beta = .57$, $p < .001$) and the ACHmotive \times COMenviron interaction marginally significantly predicted flow ($b = .17$, $SE_b = .10$, $\beta = .16$, $p = .09$). The AFFmotive \times COMenviron interaction ($b = .14$, $SE_b = .11$, $\beta = .14$, $p = .18$) and the POWmotive \times COMenviron interaction ($b = .06$, $SE_b = .10$, $\beta = .07$, $p = .52$) did not account for a significant amount of variance in flow experience (overall model: $R^2 = .34$, $F(7, 93) = 6.24$, $p < .001$).

Brief discussion of Study 1

In accordance with the SDT assumption and our first hypothesis, sports situations that enable the basic need for competence to be satisfied are positively associated with flow experience. However, this effect is moderated by the achievement motive in the expected direction: Individuals with high achievement motives experienced higher degrees of flow in sports when reporting that their sports situations are characterized by competence-related opportunities than individuals with low achievement motives. On the other hand, when

competence opportunities were lacking they experienced lower degrees of flow than individuals with low achievement motives.

A supplementary analysis revealed that, in accordance with our assumption of a motive-specific effect, the interaction of the achievement motive with the competence environment predicted flow better than the alternative interactions, including the affiliation and power motive, respectively. However, the motive specificity of the interaction effects was not as strong as we would have liked. A detailed explanation is given in the general discussion.

One further point of criticism might be that the competence environment in Study 1 was measured by the participants themselves rating the characteristics of their sports. In the following study, we used an experimental design in order to prevent methodological problems associated with self-report measures. This allows the independence of the effect from the methodological approach to be demonstrated.

Study 2

In Study 2, the competence environment was experimentally induced by means of competence-related instructions. We expected that participants in a competence environment instruction group would experience more flow than participants in a neutral instruction group (Hypothesis 1) when performing a volleyball exercise. Again, this effect was hypothesized to be stronger in individuals with high achievement motives than in those with low achievement motives (Hypothesis 2).

Method for Study 2

Participants and procedure

A total of 78 undergraduate students (60 female) with a mean age of 25.0 ($SD = 6.12$) participated in a study on "personality and sport preferences." They had no experience in volleyball and took part in single sessions in return for extra course credits. Forty-two participants were randomly assigned to a competence environment group and 36 to a control group. First, all participants filled in questionnaires asking them to state their age and gender, and containing the achievement motive measure. Then they were asked to perform an exercise that is often used as a warm-up exercise in volleyball training and that does not require any previous knowledge. Participants had to set a volleyball, bouncing it against a wall as often as possible in a given time period of 5 minutes. The experimenter demonstrated the volleyball exercise and answered any questions of the participants. Participants were then asked to read the following instructions carefully. Participants of the competence environment group were given the instructions: "Please pay attention to the way in which you are

continuously learning and improving your sports skills. Try to make use of the opportunity to feel competent and proud while you are performing the ball exercise." Participants of the control group received the following instructions: "Please pay attention to the way the ball behaves to changes that arise from the throwing distance. Try to focus on the way you feel and behave during the ball exercise."

Afterward, participants of both groups were asked about the amount of flow they had experienced while performing the volleyball exercise.

Measures

As in Study 1, the MMG (Sokolowski et al., 2000) was used to assess the achievement motive (again hope of success, Cronbach's α : .60) and the *Flow Short-Scale* (Rheinberg et al., 2003) measured participants' flow experiences (Cronbach's α : .81).

Results of Study 2

Preliminary analyses and descriptive statistics

Participants of the competence environment group did not differ from participants of the control group in terms of their achievement motives, age, and sex. Neither age nor sex influenced the analyses reported below. In the competence condition, the achievement motive ($M = 7.50$, $SD = 2.22$) was positively associated with flow ($r = .26$), whereas in the control group the achievement motive ($M = 7.30$, $SD = 2.13$) was negatively related to flow ($r = -.32$). However, both correlations were marginal ($p < .10$). This is in accordance with the motive disposition approach, according to which individuals with high achievement motives should experience flow in achievement contexts and might be less intrinsically motivated (low flow) when situational characteristics fail to arouse their motives.

Analysis of the competence environment main effect and the motive \times competence environment interaction

A hierarchical regression with the achievement motive (ACHmotive) and the experimental condition (COMenviron versus control) (Step 1) and the ACHmotive \times condition interaction (Step 2) revealed a significant main effect for the condition, $b = .34$, $SE_b = .10$, $p < .01$, indicating that participants in the competence environment group reported more flow than participants in the control group. In addition, the motive \times condition interaction accounted for a significant amount of variance in flow experience, $b = .27$, $SE_b = .11$, $p < .05$. The interaction pattern is illustrated in Table 2 and

Table 2 Hierarchical Regression of Flow Experience on Achievement Motive (ACHmotive) and Experimental Condition (Competence Environment versus Control) (Study 2)

Step	Variable	ΔR^2	df	ΔF	β^a
1	Main effects	.12	2,75	5.11**	
	Achievement motive				-.04
	Experimental condition				.35**
3	ACHmotive \times experimental condition	.07	1,74	6.69*	.27*
	Cumulative R^2	.19	3,74	5.89**	

Note. β^a is the standardized regression coefficient in the regression equation.

The experimental condition is coded as 0 for the control group and 1 for the competence environment group.

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

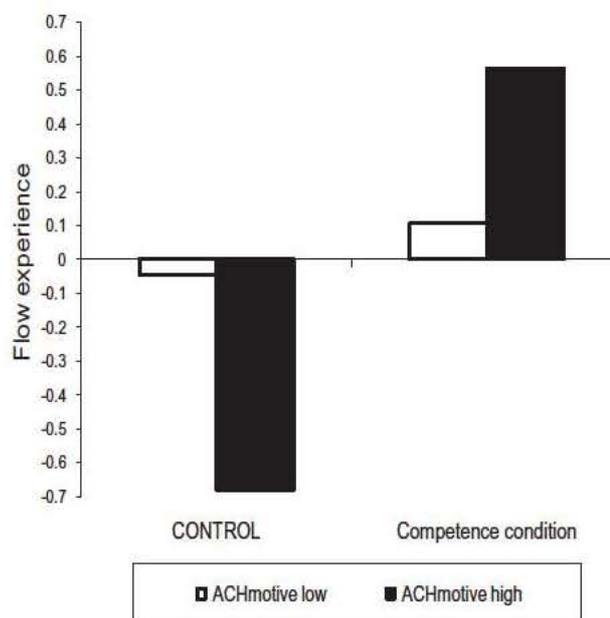


Figure 2 Flow experience of undergraduate students performing a volleyball exercise as a function of achievement motive (ACHmotive) and the experimental condition (competence environment versus control) (Study 2).

Figure 2, and shows that in accordance with our hypothesis, individuals with high achievement motives reacted stronger to the presence (more flow) and absence (less flow) of a high competence environment than participants with low achievement motives. Supplementary post hoc analyses, like those conducted in Study 1 (Johnson–Neyman), revealed that the difference between high and low competence environments was significant for individuals with high achievement motives (comparison of the black bars, $\beta = .62$, $b = .62$, $SE_b = .15$, $p < .001$), but not for individuals with low achievement motives (comparison of the white bars, $\beta = -.04$,

$b = -.04$, $SE_b = .10$). Individuals with high and low achievement motives differed marginally in high competence environments (comparison of the right bars, $\beta = .23$, $b = .23$, $SE_b = .14$, $p < .10$) and differed significantly in low competence environments (comparison of the left bars, $\beta = -.32$, $b = -.32$, $SE_b = .15$, $p < .05$).

Supplementary analysis

As in Study 1, we conducted a supplementary analysis that considered the affiliation motive ($M = 6.02$, $SD = 2.10$) and the power motive ($M = 8.18$, $SD = 2.17$). A hierarchical regression analysis with ACHmotive \times condition and AFFmotive and POWmotive (Step 1) and the ACHmotive \times condition, AFFmotive \times condition, and POWmotive \times condition interactions (Step 2) revealed a significant effect for condition ($b = .32$, $SE_b = .10$, $\beta = .32$, $p < .01$) and a marginal significant effect for the ACHmotive \times COMenviron interaction ($b = .23$, $SE_b = .12$, $\beta = .22$, $p = .06$). The AFFmotive \times COMenviron interaction ($b = .16$, $SE_b = .11$, $\beta = .17$, $p = .14$) and the POWmotive \times COMenviron interaction ($b = .20$, $SE_b = .12$, $\beta = .20$, $p = .11$) were not significant (overall model: $R^2 = .26$, $F(7, 77) = 3.48$, $p < .01$).

Brief discussion of Study 2

Study 2 added to the previous findings in two important ways. First, it replicated the competence environment main effect and the interaction between motive and environment of Study 1 in a different sports domain and with a different sample (Study 1: experienced badminton players; Study 2: inexperienced students performing a volleyball exercise). More importantly, it showed that the competence environment can be artificially created by instructing individuals to focus on competence-related aspects of their sports.

A supplementary analysis testing the motive-specific effects again confirmed that flow was predicted better by the interaction of the achievement motive and the competence environment than by the interactions with the affiliation and power motive. However, as in Study 1, the achievement motive \times competence environment interaction was weaker ($p < .10$) when the affiliation and power motive and their interactions with competence environments were additionally entered into the regression analysis than when considering the achievement motive alone ($p < .05$, see above).

A potential criticism of Study 1 and Study 2 could be that we only analyzed opportunities for fulfilling the basic need for competence and the moderating role of the achievement motive and have so far neglected another important need and motive in sports: the need for relatedness and the affiliation motive, respectively.

Study 3

Study 3 considered that individuals are not only motivated by opportunities to fulfill the need for competence but also by opportunities that promise to satisfy the need for social relatedness. Examples are the opportunity to make new friends, enjoying one's leisure time with others, and feeling socially related (Baumeister & Leary, 1995; Deci & Ryan, 2000; McClelland, 1985). Specifying this for the sports domain, an important reason for doing sports is the opportunity to spend time with others (Biddle, 1994; Markland & Hardy, 1993). In the present study, we aimed to test the effect of relatedness environments and the affiliation motive \times relatedness environment interaction on flow experience. Additionally, we tried to replicate the main effect and interaction effect in the achievement domain.

Study 3 is a correlative field study with fitness athletes. We assessed flow at the beginning and at the end of the semester in order to show that the motive \times environment interaction predicts the enhancement of flow over a time period of about 12 weeks. We hypothesized that competence and relatedness environments are positive predictors of the enhancement of flow during the time period of one semester (Hypothesis 1). This effect is assumed to be stronger for individuals with high achievement (/affiliation) motives than for individuals with low achievement (/affiliation) motives (Hypothesis 2).

Low commitment toward exercise behavior (Scanlan, Carpenter, Schmidt, Simons, & Keeler, 1993; Wilson et al., 2004) and physical well-being (Boothby, Tungatt, & Townsend, 1981) are important reasons for not maintaining sports and exercise behavior. We assume that these variables indicate a lack of motivation and might also impair the experience of flow in fitness sports. In the present study, we therefore controlled for commitment and physical well-being.

Method for Study 3

Participants and procedure

A total of 695 students and alumni (409 female) with a mean age of 32.0 ($SD = 9.97$) were recruited from university fitness courses and asked to complete a first questionnaire at the beginning of a semester (second week of semester, T1). The analyses reported below are based on 685 participants who also completed the second questionnaire at the end of the semester (T2; 12 weeks after T1). The ten participants who decided to quit the study did not differ from the remaining participants in any variable measured at the beginning of the semester. The first questionnaire comprised the achievement and affiliation motive assessment, the competence and relatedness environment measure, and the first flow measure, and asked participants about their commitments toward the sports activity and their physical complaints during the

sports sessions. In the second questionnaire, at the end of the semester, participants rated how much flow they had experienced during their fitness sports activities in the last few weeks.

Measures

Participants' achievement and affiliation motives were measured using the achievement (hope of success, Cronbach's $\alpha = .73$) and affiliation (hope of affiliation, Cronbach's $\alpha = .61$) scales from the MMG (Sokolowski et al., 2000).

The *Flow Short-Scale* (Rheinberg et al., 2003) was used to measure flow at the beginning (Cronbach's $\alpha = .89$) and at the end of the semester (Cronbach's $\alpha = .92$).

The competence and relatedness environment measure was developed by the authors for the purpose of this study. Participants were asked to what extent (7-point rating scale) their sports are characterized by the following opportunities. Examples of the seven competence environment items are "experience progress," "feel competent," and "enjoy perfect movements." Relatedness environment was measured with seven items such as "make friends," "experience team spirit," and "enjoy leisure time with others." The competence environment (COMenviron) and relatedness environment (RELenviron) measures were sufficiently reliable (Cronbach's $\alpha = .75$ for COMenviron and $.74$ for RELenviron).

Participants rated their commitments to the sports activities they were planning to perform in the ongoing semester using four items, which were designed by the authors (e.g., How committed are you to performing your sport in the ongoing semester? How strongly do you feel engaged with your sport in the ongoing semester?). The items had to be rated using a 7-point rating scale ranging from 1 (*not at all*) to 7 (*very much*) (Cronbach's $\alpha = .74$).

Physical well-being was assessed using the single item, "How did you feel physically the last time you performed your sport?"; which had to be rated using a 5-point rating scale ranging from 1 (*not good at all*) to 7 (*very good*).

Results of Study 3

Preliminary analyses and descriptive statistics

Men and women did not differ in their age, achievement, or affiliation motive, in the competence and relatedness environment rating, and in their commitment and physical well-being. The only significant difference was that women reported more relatedness characteristics in sports ($M = 3.02$, $SD = .99$) than did men ($M = 2.80$, $SD = 1.0$), $t(684) = 2.77$, $p < .05$. Participants' ages did not influence the results reported below.

Table 3 shows that the control variables commitment and physical well-being were significantly correlated with competence and relatedness environments in sports and flow at T1 and T2. Thus, it is necessary to control for these variables in all further analyses. The achievement motive was associated with the competence environment, and the affiliation motive was associated with the relatedness environment. Both motives as well as both environment ratings were significantly related to each other. In addition, the environment ratings were correlated with flow at T1 and T2, and both flow scores were strongly correlated.

Analyses of the competence and relatedness environment main effects and the motive \times environment interactions

To test whether the achievement motive \times competence environment interaction predicts the enhancement of flow, the control variables commitment and physical well-being, and the flow baseline measure (T1) were entered into the regression analysis in Step 1 (all variables were z-transformed). In Step 2, the achievement motive (ACHmotive) and competence environment (COMenviron) were entered, followed by the ACHmotive \times COMenviron interaction (Step 3, multiplication of the z-standardized ACHmotive and competence) (see Table 4). Flow at T1, $b = .39$, $SE_b = .03$, $p < .001$, and physical well-being, $b = .07$, $SE_b = .03$, $p < .05$, predicted flow

Table 3 Descriptive Statistics and Correlations (Pearson's Correlation) among Variables of Study 3

		1	2	3	4	5	6	7	8	M	SD
1	Commitment	1	.19***	.02	.06	.31***	.19***	.29***	.27***	5.28	1.23
2	Physical WB		1	-.01	-.01	.20***	.08*	.42***	.31***	4.16	0.7
3	ACH motive			1	.48***	.16***	.06	.05	.08*	7.23	2.65
4	AFF motive				1	.01	.15**	.07	.05	6.24	2.21
5	Competence					1	.53***	.41***	.52***	3.44	0.6
6	Relatedness						1	.17***	.24***	2.89	1.0
7	Flow at T1							1	.57***	5.22	1.1
8	Flow at T2								1	5.28	1.0

Note. Physical WB = physical well-being; ACH = achievement; AFF = affiliation; Competence = competence environment; Relatedness = relatedness environment; T1 = beginning of semester; T2 = end of semester. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4 Hierarchical Regression Analyses of Flow Experience on Control Variables, Motives and Environments, and the Motive \times Environment Interactions (Results for the Affiliation Domain in Brackets) (Study 3)

Step	Variable	ΔR^2	df	ΔF	β^a
1	Control variables	.34 (.34)	3, 681 (3, 681)	118.34*** (118.34***)	
	Flow at T1				.39*** (.49***)
	Commitment				.30* (.10**)
	Physical well-being				.07* (.07*)
2	Main effects	.09 (.02)	2, 679 (2, 679)	53.99*** (8.15***)	
	ACHmotive (AFFmotive)				.01 (-.01)
	COMenviron (RELenviron)				.34*** (.13***)
3	(AFF motive \times RELenviron)	.01 (.01)	1, 678 (1, 678)	2.92+ (3.76*)	.05+ (.06*)
	Cumulative R^2	.44 (.36)	6, 678 (6, 678)	87.11*** (64.01***)	

Note. β^a is the standardized regression coefficient in the regression equation.

+ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

at T2 significantly. In addition, the main effect of competence environment reached significance, $b = .34$, $SE_b = .03$, $p < .001$. The ACHmotive \times COMenviron interaction effect was marginal, with $b = .05$, $SE_b = .03$, $p = .09$. The interaction pattern was quite similar to the interaction revealed in Study 1 (see Figure 1). All participants experienced more flow enhancement in sports situations characterized by a high level as compared with a low level of competence characteristics. This effect was stronger for individuals with high achievement motives compared to those with low achievement motives. Supplementary post hoc analyses showed that the difference between high and low competence environments was significant for individuals with high achievement motives with a beta weight of .39 (comparison of the black bars, $b = .39$, $SE_b = .05$, $p < .001$) and for individuals with low achievement motives with a lower beta weight of .29 (comparison of the white bars, $b = .29$, $SE_b = .04$, $p < .001$). Individuals with high and low achievement motives did not differ either in high competence environments (comparison of the right bars, $\beta = .06$, $b = .06$, $SE_b = .04$) or in low competence environments (comparison of the left bars, $\beta = -.04$, $b = -.04$, $SE_b = .04$).

A similar analysis was conducted for the hypotheses in the affiliation domain. The regression analyses of flow enhancement on the control variables (Step 1: flow at T1, commitment, physical well-being), the affiliation motive and relatedness environment (Step 2), and the affiliation motive \times relatedness environment interaction (Step 3, multiplication of the z-standardized AFFmotive and RELenviron) (see Table 4) showed that the control variables flow at T1, $b = .49$, $SE_b = .03$, $p < .001$; commitment, $b = .10$, $SE_b = .03$, $p < .01$; and physical well-being, $b = .07$, $SE_b = .03$, $p < .05$, accounted for a significant amount of variance in flow at T2. Again, the environment main effect was found to be significant, $b = .13$, $SE_b = .03$, $p < .05$. The significant affiliation motive \times relatedness environment interaction, $b = .06$, $SE_b = .03$, $p < .05$, is illustrated in Figure 3. According to sup-

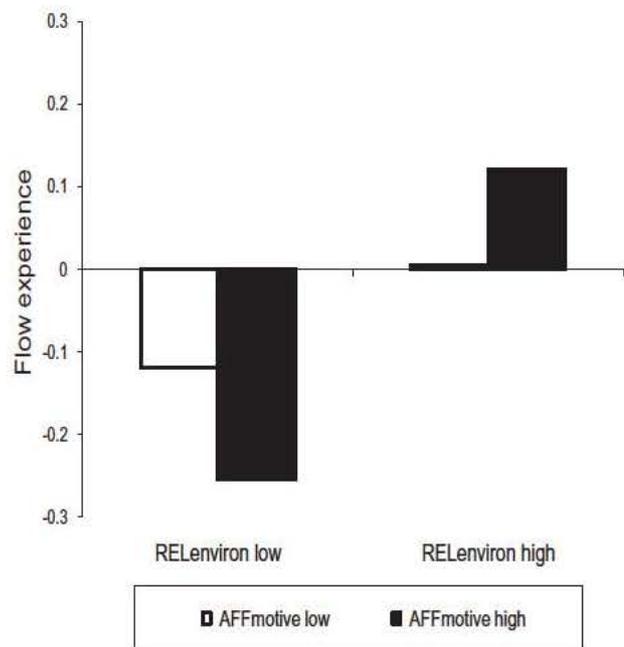


Figure 3 Flow experience of fitness athletes as a function of control variables, affiliation motive (AFFmotive) and relatedness environment (RELenviron) (Study 3).

plementary post hoc analyses, the difference between high and low relatedness environments was significant for individuals with high affiliation motives (comparison of the black bars, $\beta = .19$, $b = .19$, $SE_b = .04$, $p < .001$), but not for individuals with low affiliation motives (comparison of the white bars, $\beta = .07$, $b = .07$, $SE_b = .04$). Individuals with high and low affiliation motives did not differ either in high relatedness environments (comparison of the right bars, $\beta = .06$, $b = .06$, $SE_b = .04$) or in low relatedness environments (comparison of the left bars, $\beta = -.07$, $b = -.07$, $SE_b = .05$).

Supplementary analyses

Two supplementary analyses tested the motive specificity of the interaction effects. First, in the achievement domain, a hierarchical regression analysis of flow (Step 1: flow at T1, commitment, physical well-being; Step 2: ACHmotive, competence environment, AFFmotive, POWmotive; Step 3: ACHmotive \times COMenviron, AFFmotive \times COMenviron, POWmotive \times COMenviron) revealed flow at T1 ($b = .39$, $SE_b = .03$, $\beta = .39$, $p < .001$), physical well-being ($b = .07$, $SE_b = .03$, $\beta = .07$, $p < .05$), and competence environment ($b = .35$, $SE_b = .03$, $\beta = .35$, $p < .001$) as being significant predictors of flow. In addition, the ACHmotive \times COMenviron interaction predicted flow marginally significant ($b = .06$, $SE_b = .03$, $\beta = .06$, $p = .09$). Neither the AFFmotive \times COMenviron ($b = .04$, $SE_b = .04$, $\beta = .04$, $p = .33$) nor the POWmotive \times COMenviron interaction ($b = .02$, $SE_b = .04$, $\beta = .02$, $p = .52$) reached significance (overall model: $R^2 = .44$, $F(10, 684) = 53.11$, $p < .001$). A second supplementary analysis in the affiliation domain showed that flow at T1 ($b = .49$, $SE_b = .03$, $\beta = .49$, $p < .001$), commitment ($b = .10$, $SE_b = .03$, $\beta = .10$, $p < .01$), physical well-being ($b = .07$, $SE_b = .03$, $\beta = .07$, $p < .05$), and relatedness environment ($b = .13$, $SE_b = .03$, $\beta = .13$, $p < .001$) significantly predicted flow. However, although on a descriptive level the interaction pattern was clearer for the AFFmotive \times RELEnviron ($b = .05$, $SE_b = .04$, $\beta = .05$, $p = .20$) than for the ACHmotive \times RELEnviron ($b = .04$, $SE_b = .04$, $\beta = .04$, $p = .29$) and the POWmotive \times RELEnviron ($b = .03$, $SE_b = .03$, $\beta = .03$, $p = .44$), it failed to reach significance (overall model: $R^2 = .37$, $F(10, 684) = 39.06$, $p < .001$).

Brief discussion of Study 3

In accordance with SDT and our first hypothesis, the competence as well as the relatedness environments was able to predict flow enhancement across one semester. Again, the motive environment interaction effect was as hypothesized, this time for the achievement as well as the affiliation domain. The interaction between ACHmotive and the competence environment was only marginal rather than significant, yet we interpret the effect as meaningful because the previous studies have convincingly demonstrated the significance of the interaction effect (all $ps < .05$). In addition, it fits our theoretical considerations and the empirical pattern of our previous results perfectly. Hence, as recommended by Cohen (1994), we relied on replication and theoretical arguments rather than relying exclusively on testing the significance of the null hypothesis.

As already found in Study 1 and Study 2, the supplementary analyses supported the motive specificity of the interaction effects, but again revealed these to be weaker than expected (for an explanation, see General Discussion).

Another limitation of the study is the competence and relatedness environment rating by self-report. As in Study 1, the participants themselves rated the extent of competence and relatedness characteristics, and one might argue that motives and environment ratings have somehow been confounded. An environment rating is required that better represents an objective rather than a subjective perception of the sports environment.

Study 4

The aim of Study 4 was to replicate the competence and relatedness environment main effects on flow and to replicate the achievement and affiliation motive \times environment interaction effects using a more objective rating of the sports environment. The reason for using an objective rating is to disentangle the subjective environment ratings and the participants' motives measure by assessing the motives and the sports environment separately from each other.

In a pre-study of Study 4, we asked experts in different sports to rate the competence and relatedness environment of their sports. We intentionally chose sports (combat, fitness, cycling, running, rowing, volleyball) that vary in many characteristics (e.g., indoor versus outdoor, individual versus team sport) in order to cover a broad variety of sports. We then used this objective sports environment rating to test our hypotheses in Study 4. Again, we hypothesized that a high number of environmental characteristics capable of satisfying the psychological needs for competence and social relatedness (this time rated by experts) should predict participants' flow experiences (Hypothesis 1) and that participants' achievement and affiliation motives would interact with the sports environment in the prediction of flow (Hypothesis 2). As in Study 3, we assumed commitment and physical well-being to be correlated with flow and controlled for these variables in the following analyses.

Pre-study of Study 4

Experts and expert rating

Twenty-nine female and 40 male experts in different sports (combat: $n = 10$; fitness: $n = 18$; cycling: $n = 9$; running: $n = 9$; rowing: $n = 15$; volleyball: $n = 8$) with a mean age of 36.4 ($SD = 9.2$; range: 24–56) participated in the expert rating. They were experienced coaches of a college sports organization and had been coaching their sports for an average of 8.8 years ($SD = 8.2$; range: 1–35 years). The experts in the different sports did not differ significantly in terms of age or coaching experience.

We designed the following procedure to assess objectively the environmental characteristics of sports. First, we

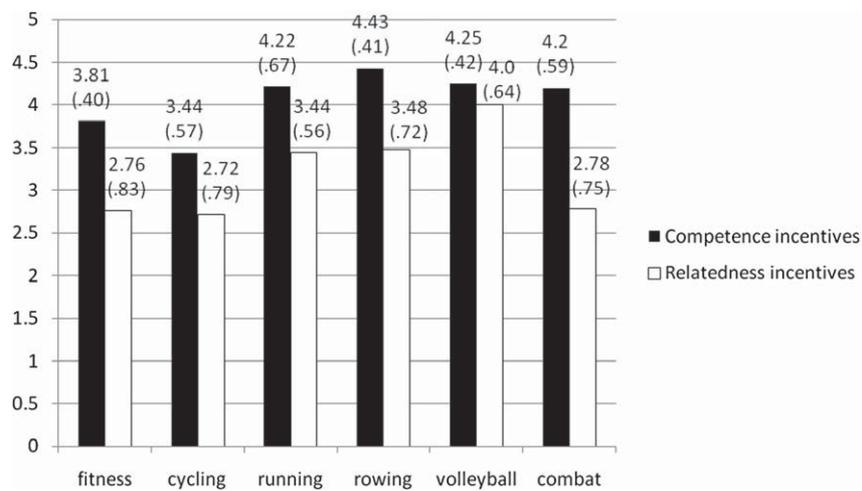


Figure 4 Means and standard deviations of expert's ratings of competence and relatedness characteristics for six different kinds of sport (pre-study of Study 4).

explained the concept of the need for competence and the need for relatedness in detail. Then we asked the experts to rate on a 7-point scale (1: *not at all* to 7: *very much*) to what degree their sports are characterized by each of four competence characteristics (opportunity to feel competent, enjoying perfect movements, enjoying performance, experiencing progress) and four relatedness characteristics (opportunity to enjoy leisure time with others, enjoying the sense of being popular, enjoying a feeling of belonging, experiencing team spirit) (items developed by the authors). To give them a point of reference, we asked them to compare their sports with a prototype of a “competence sport,” a 100 m sprint (i.e., running time as a concrete operationalization of progress), and a “relatedness sport,” fun-oriented bowling (i.e., the focus is on spending time with others).

Results of expert rating

The means of the four competence environment items ($M = 4.06$, $SD = .60$; Cronbach's $\alpha = .51$) and the four relatedness environment items ($M = 3.15$, $SD = .85$; Cronbach's $\alpha = .76$) across all sports were significantly correlated, $r = .40$, $p < .01$. Figure 4 shows the means and standard deviations for each sport separately. All sports got higher competence than relatedness environment ratings. However, the relation between competence and relatedness environments differed. For example, whereas in individualistic fitness sports (fitness, cycling, running, rowing) the competence characteristics were rated much higher (e.g., running: $M = 4.22$) than the relatedness characteristics (e.g., running: $M = 3.44$; difference to competence = -0.78), the relation between competence and relatedness characteristics was nearly balanced for team sports (volleyball: difference between competence and

relatedness = -0.25). For combat sports, the difference between the competence and relatedness characteristics was the highest (difference = -1.42). The competence and relatedness environment ratings for each sport were then used as the objective environment measure in the analyses reported below.

Method for Study 4

Participants and procedure

The participants were 262 members of sports clubs for students, alumni, and university staff with a mean age of 33.5 ($SD = 10.40$). They participated in one of the sports (combat: $n = 16$, fitness: $n = 67$, cycling: $n = 34$, running: $n = 89$, rowing: $n = 18$, volleyball: $n = 38$) for which we had obtained expert ratings (see pre-study of Study 4). In a web survey, they were asked to answer questions regarding their age, sex, and the sports they were going to take part in during the ongoing semester, and were asked to complete the motive measure. They were then asked to vividly imagine a typical sports session, rate their flow experiences, and fill in the commitment and physical well-being measures.

Measures

Again, the MMG (Sokolowski et al., 2000) was used to assess participants' achievement motive (hope of achievement, Cronbach's $\alpha = .71$) and affiliation motive (hope of affiliation, Cronbach's $\alpha = .60$). Flow was measured using the Flow Short-Scale (Rheinberg et al., 2003) (Cronbach's $\alpha = .92$). The competence and relatedness environment variables were obtained from the expert ratings reported in

Table 5 Descriptive Statistics and Correlations (Pearson's Correlation) among Variables of Study 4

		1	2	3	4	5	6	7	M	SD
1	Commitment	1	.18**	.05	.13*	.12+	.11+	.24***	5.28	1.26
2	Physical WB		1	-.02	-.04	.11+	.10+	.18**	4.12	0.73
3	ACH motive			1	.48***	-.02	.01	.10+	7.05	2.57
4	AFF motive				1	-.19*	-.09	.03	6.09	2.11
5	Competence					1	.78***	.37***	4.04	0.30
6	Relatedness						1	.43***	3.22	.46
7	Flow							1	5.22	.96

Note. Physical WB: physical well-being; ACH: achievement; AFF: affiliation; Competence: competence environment; Relatedness: relatedness environment

+ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6 Hierarchical Regression Analyses of Flow Experience on Control Variables, Motives and Environments, and the Motive \times Environment Interactions (Results for the Affiliation Domain in Brackets) (Study 4)

Step	Variable	ΔR^2	df	ΔF	β^a
1	Control variables	.08 (.08)	2, 259 (2, 259)	10.75*** (10.75***)	
	Commitment				.17** (.16**)
	Physical well-being at T1				.10+ (.10+)
2	Main effects	.12 (.15)	2, 257 (2, 257)	18.64*** (25.58**)	
	ACHmotive (AFFmotive)				.11* (.05)
	COMenviron (RELeviron)				.32*** (.38***)
3	ACHmotive \times COMenviron	.01 (.02)	1, 256 (1, 256)	4.40* (6.39*)	.12* (.14*)
	Cumulative R^2	.21 (.25)	5, 256 (5, 256)	13.39*** (16.95***)	

Note. β^a is the standardized regression coefficient in the regression equation.

+ $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

detail above. Commitment (Cronbach's $\alpha = .73$) and physical well-being were also measured as in Study 3.

Results of Study 4

Preliminary analyses and descriptive statistics

Neither age nor sex of participants influenced the results reported below. There were also no differences between participants of different types of sports in the main results presented in the following paragraphs. Table 5 shows the descriptive statistics and correlations among all variables. As in the previous study, commitment and physical well-being were marginally associated with competence and relatedness environments and with flow experience, and thus were controlled for in the hierarchical regression analyses reported below. As expected, competence and relatedness environments (expert ratings) were correlated with each other and with the participants' flow experiences. Participants' achievement and affiliation motives were correlated with each other but were not related to the corresponding environment ratings of the experts. The affiliation motive was negatively correlated with the competence environment.

Analysis of the competence and relatedness environment main effects and the motive \times environment interactions

A hierarchical regression of flow was conducted with the control variables (commitment, physical well-being as Step 1), participants' achievement motives and experts' ratings of competence environment (step 2), and the achievement motive \times competence environment interaction (Step 3) (variables were z-transformed; see also Table 6; the interaction term is calculated by multiplying the z-standardized ACHmotive and Competence environment scores). The control variables commitment, $b = .18$, $SE_b = .06$, $p < .01$, and physical well-being, $b = .10$, $SE_b = .06$, $p < .10$, proved to be related to flow. As hypothesized, the main effect of competence environment was significant, $b = .32$, $SE_b = .06$, $p < .001$. Furthermore, the achievement motive was able to predict flow, $b = .11$, $SE_b = .06$, $p < .05$. Most importantly, the ACHmotive \times COMenviron effect was significant, $b = .11$, $SE_b = .05$, $t(261) = 2.10$, $p < .05$. The interaction pattern was similar to the interactions found in Study 1 and Study 3 (the interaction pattern is illustrated in Study 1, Figure 1). As hypothesized, all individuals benefited more from high than from low competence environments and this is especially true

for participants with high achievement motives.² We again conducted a supplementary analysis that revealed that the difference between high and low competence environments was significant for individuals with high achievement motives (comparison of the black bars, $\beta = .44$, $b = .43$, $SE_b = .07$, $p < .001$) and to a smaller degree for individuals with low achievement motives (comparison of the white bars, $\beta = .21$, $b = .21$, $SE_b = .08$, $p < .01$). Individuals with high and low achievement motives differed significantly in high competence environments (comparison of the right bars, $\beta = .23$, $b = .22$, $SE_b = .08$, $p < .01$), but not in low competence environments (comparison of the left bars, $\beta = .002$, $b = .002$, $SE_b = .07$).

In order to test the hypotheses in the affiliation domain, a hierarchical regression analysis in three steps (Step 1: commitment, physical well-being; Step 2: affiliation motive and relatedness environment; Step 3: motive \times environment, interaction term calculated as described above; see Table 6) was again used to predict flow. The effects of commitment, $b = .17$, $SE_b = .06$, $p < .01$; physical well-being, $b = .19$, $SE_b = .06$, $p < .10$; and the relatedness environment, $b = .38$, $SE_b = .05$, $p < .001$, were significant. In addition, the AFFmotive \times RELEnviro interaction predicted flow significantly, $b = .13$, $SE_b = .05$, $p < .05$, revealing a similar interaction pattern as in the previous studies (for an illustration of the pattern of the interaction, see Study 3, Figure 3).³ Supplementary analyses revealed that the difference between high and low relatedness environments was significant for individuals with high affiliation motives (comparison of the black bars, $\beta = .48$, $b = .48$, $SE_b = .07$, $p < .001$) and to a smaller degree for individuals with low affiliation motives (comparison of the white bars, $\beta = .30$, $b = .30$, $SE_b = .08$, $p < .01$). Individuals with high and low affiliation motives differed significantly in high relatedness environments (comparison of the right bars, $\beta = .15$, $b = .15$, $SE_b = .07$, $p < .05$), but not in low relatedness environments (comparison of the left bars, $\beta = -.06$, $b = -.06$, $SE_b = .08$).

Supplementary analyses

Again, two additional hierarchical regression analyses were conducted to test the motive specificity of the interaction effects. First, an analysis of flow (Step 1: commitment, physical well-being; Step 2: ACHmotive, competence environment, AFFmotive, POWmotive; Step 3: ACHmotive \times COMenviro, AFFmotive \times COMenviro, POWmotive \times COMenviro) revealed commitment ($b = .18$, $SE_b = .06$,

^{2,3}In order to test whether type of sport affects the results, we conducted hierarchical regression analyses for each sport separately. As expected, all interaction patterns were descriptively very similar to the interaction patterns presented in the text for the whole sample. However, due to variations in sample sizes, the effects were more or less strong and failed to reach significance in case of small sample sizes (e.g., combat: $n = 16$, rowing: $n = 18$).

$\beta = .17$, $p < .01$) as being a significant predictor of flow, and physical well-being ($b = .10$, $SE_b = .06$, $\beta = .10$, $p = .07$) as being a marginally significant predictor of flow. The effect of the competence environment was significant ($b = .31$, $SE_b = .06$, $\beta = .31$, $p < .001$). Neither the ACHmotive \times COMenviro interaction ($b = .08$, $SE_b = .07$, $\beta = .08$, $p = .26$) nor the AFFmotive \times COMenviro ($b = .07$, $SE_b = .06$, $\beta = .07$, $p = .30$) and POWmotive \times COMenviro interactions ($b = .01$, $SE_b = .07$, $\beta = .01$, $p = .86$) were significant (overall model: $R^2 = .18$, $F(9, 261) = 7.56$, $p < .001$). The supplementary analysis in the affiliation domain revealed commitment ($b = .17$, $SE_b = .06$, $\beta = .16$, $p < .01$) as being a significant predictor of flow, and physical well-being ($b = .10$, $SE_b = .05$, $\beta = .10$, $p = .07$) as being a marginally significant predictor of flow. Relatedness environment predicted flow significantly ($b = .37$, $SE_b = .06$, $\beta = .38$, $p < .001$). None of the interaction effects were significant (AFFmotive \times RELEnviro: $b = .10$, $SE_b = .06$, $\beta = .11$, $p = .11$; ACHmotive \times RELEnviro: $b = .07$, $SE_b = .07$, $\beta = .07$, $p = .36$; POWmotive \times RELEnviro: $b = .01$, $SE_b = .07$, $\beta = .01$, $p = .84$) (overall model: $R^2 = .23$, $F(9, 261) = 9.67$, $p < .001$).

Brief discussion of Study 4

Study 4 fully replicated the environment main effect (Hypothesis 1) and the motive \times environment effect (Hypothesis 2) in the achievement as well as in the affiliation domain. However, as in the previous study, the motive specificity of the interaction effects was weaker than expected. Using an objective rating of sports environments (expert rating), we were able to disentangle the confounding of participants' motives and the environment ratings. A potential limitation is that Study 4 mainly tested participants with high-school-leaving qualifications (students; alumni; also most of the university staff had a high school degree). Although no plausible reason occurs to us why the results should not be true for other populations, only future empirical studies with different samples can confirm the generalizability of the results.

Aside from the methodological contribution mentioned above, an objective environment rating has important practical implications. Objectively measured sports environments could be compared with the motives of individuals seeking a sport that fits them personally. As will be outlined in more detail in the general discussion, the fit between motives and sports environments could be used as a sports counseling strategy that facilitates flow, and thereby might help individuals maintain their sports activities.

General discussion

With the present research, we tried to integrate perspectives from SDT (Deci & Ryan, 2002) and motive disposition

approach (e.g., McClelland, 1985) with the aim of enhancing the predictability of flow experience in sports. Three correlational field studies and one experiment in different sports, using different samples and partly different measures of need-satisfying environments, strongly supported our assumption that opportunities to satisfy psychological needs are not sufficient to predict flow experience in sports. As expected from the SDT perspective, sports environments with a high level of competence and relatedness characteristics predicted flow experience in all studies. However, as expected from the dispositional motive approach, the interaction of environments and motives further enhanced the prediction of flow. The results of all four studies consistently showed that individuals with high achievement/affiliation motives benefited most from being in sports situations that can potentially fulfill the psychological need for competence/relatedness. They also reported the lowest amount of flow experience in situations that did not provide the opportunity to satisfy these psychological needs.

The data also show that a motive main effect occurred in only one out of six analyses. In five analyses, neither the achievement motive nor the affiliation motive predicted flow experience significantly. This supports the assumption of the dispositional motive approach that motives are incited by corresponding characteristics in the environment (McClelland, 1985). In unfavorable situations (in terms of a small number of need-satisfying opportunities), few differences appear between individuals.

Apart from the strengths of the present studies, we would also like to note some limitations. First, in Study 3 flow was assessed retrospectively, and in Study 4 we asked participants to imagine a typical sports session and then rate their presumed flow experiences. However, measuring flow after the flow-evoking event has been criticized by some authors (see Rheinberg, 2008; for a discussion about retrospective and online flow measure in sports, see Schüler & Brunner, 2009). Aside from memory effects that decrease the validity of the retrospective measure, another criticism concerns conceptual reasons. Because individuals are totally involved in the action during flow, there should be no room left in their awareness for introspection. This makes it difficult to report about flow experience afterward. In future studies addressing the research question of the present studies, flow could be measured directly during the performance of an activity, for example, using the experience-sampling method (Csikszentmihalyi, Larson, & Prescott, 1977; Csikszentmihalyi & LeFevre, 1989), which has been successfully employed in the domain of sport (Schüler & Brunner, 2009). It would also be interesting to analyze the conditions and characteristics of flow more objectively, for example, by an expert rating of the balance of participant's sports skills and the demands of the sports situation. The deep involvement in the activity could be operationalized by participants

with fewer distractions by ascertaining information not relevant to the task.

Another potential limitation is the age range of our participants. We analyzed participants with a mean age between 20.6 years (Study 1) and 33.5 years (Study 4). It would be interesting to conduct future studies with younger (e.g., adolescent) or older (e.g., elderly) participants who exercise for other reasons than the satisfaction of competence or relatedness needs (e.g., as in compulsory sports activities at school or in physical exercise upon medical prescription).

The third limitation of the present studies concerns the issue of the motive specificity of the interaction effects. Supplementary analyses that controlled for potential alternative motive–environment interactions showed, for example, that the interaction of the achievement motive with the competence environment consistently predicts flow better than the alternative interaction of the affiliation motive and power motive, respectively, and the competence environment in all four studies. In addition, flow was also better predicted by the motive-specific interaction of affiliation motive \times relatedness environment than by the motive-unspecific interactions with the achievement and power motive. However, the effects were only marginally significant or even not significant and therefore weaker than in the analyses in which we did not control for the alternative interactions. We believe that the overlap of the achievement, affiliation, and power motive scores as measured by the MMG was responsible for these less clear results. The mean correlations among the achievement, affiliation, and power motive scores indicate that both share some common variance, which might represent a general approach disposition. In order to fully exclude the interpretation that a general approach disposition accounts for parts of the results, future studies must employ a motive measure without a methodological overlap among the achievement, affiliation, and power motives.

The present results lead to some future research issues. A theoretical research issue is the examination of further positive consequences of the match between an individual's motives and the basic need-fulfilling sports environment that go beyond the experience of flow. According to Csikszentmihalyi et al. (2005), the deep involvement during flow is accompanied by a positive experience, which in turn is a powerful source of motivation and functions as a reward for the activity that has been performed. Because rewarded activities are more likely to be performed again and thereby indirectly lead to an enhancement of performance, further effects of flow experience in sports should be the longer term maintenance of sports activities and high performance. An open research question that has to be addressed by an empirical future study is whether a motive–environment fit leads directly to maintenance of sports behavior and performance, or whether this relation is mediated by flow experience or other kinds of intrinsic motivation.

A further theoretical research issue is the third basic psychological need, namely autonomy. However, need for autonomy does not have a clear analogue in the dispositional motive approach, in which the power motive is conceptualized as the desire to influence others (Langan-Fox & Grant, 2007; McClelland, 1975) which does not map cleanly onto the need for autonomy, which is conceptualized as the desire to determine one's own behavior (Deci & Ryan, 2000). Further research is needed to theoretically and empirically examine the interaction between the autonomy environment and the power motive in intrinsic motivation.

A methodological issue for future research is to test whether the interaction between basic psychological need satisfaction and implicit motives also holds true when different measures of the two concepts are applied. For example, although the discriminant and predictive validity of the MMG has been convincingly demonstrated (Sokolowski et al., 2000), evidence for its convergent validity is still missing. Future research could, for example, examine the Picture Story Exercise (Schultheiss & Pang, 2007) as an alternative measure for implicit motives.

The results of the present studies have interesting practical implications. First of all, our research implies that modifying situations alone—for example, by enhancing the competence and autonomy characteristics of a sports situation, as has been done by SDT approaches to intrinsic sports motivation (Hagger & Chatzisarantis, 2007)—is not particularly fruitful for certain individuals, for example, for individuals with low motives. In these cases, it might be a more successful strategy to find a sport that matches the individual's motive profile better (e.g., sport with relatedness characteristics). According to our theorizing and empirical results, tailored interventions that consider personality characteristics in addition to environmental characteristics are much more effective in the prediction of flow in sports.

Another practical intervention is based on the fact that the need for a competence-satisfying character of a

situation can be artificially induced, as shown in Study 2. This could be used for health-related sports programs in which the high dropout rate of participants is a serious problem. Providing individuals with the right environments by giving them simple (e.g., competence-related) instructions prior to their sports lessons might facilitate their flow experiences, which is known to be a powerful motivating force. Flow has a rewarding quality (Csikszentmihalyi et al., 2005) that is expected to have a positive influence on maintaining long-term sports behavior (Schüler & Brunner, 2009).

Study 4 also reveals interesting links to practical interventions. The expert rating of the sports environments showed that the sports differed regarding their potentials to fulfill psychological needs. Although the experts rated more competence than relatedness characteristics in all investigated sports, the relationship between these characteristics differed. This suggests that it might be possible to generate profiles of the need satisfaction characteristics of sports and use them for sports counseling with a view to matching individuals' motives with the corresponding sports environments. Thus, achievement-motivated individuals would be better served by competence environments (individualistic sports, e.g., athletics) and affiliation-motivated individuals would be better off in relatedness sports environments (team sports, e.g., volleyball). This is in line with broader approaches for the fit between person and environment (Caplan, 1987; Davis & Lofquist, 1984; Holland, 1997; Pervin, 1968), proposing that the fit between characteristics of a person and environmental characteristics has important effects for various positive outcomes, such as psychological and physiological well-being and motivation. According to our results, a special kind of person \times environment fit, namely the motive \times need-satisfying environment fit, can be expected to enhance flow experience which in turn results to greater well-being and a long-term maintenance of sports and exercise behavior.

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.
- Atkinson, J. W. (1957). Motivational determinants of risk-taking behavior. *Psychological Review*, *64*, 359–372.
- Atkinson, J. W., Heyns, R. W., & Veroff, J. (1958). The effect of experimental arousal of the affiliation motive on thematic apperception. In J. W. Atkinson (Ed.), *Motives in fantasy, action, and society: A method of assessment and study* (pp. 95–104). Princeton, NJ: Van Nostrand.
- Baumeister, R., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529.
- Beckmann, J., & Heckhausen, H. (2008). Motivation as a function of expectancy and incentives. In J. Heckhausen & H. Heckhausen (Eds.), *Motivation and action* (pp. 99–136). Cambridge, UK: Cambridge University Press.
- Biddle, S. (1994). Exercise motivation: Theory and practice. In F. I. Bell & G. H. Van Gyn (Eds.), *Access to active living. Proceedings for the 10th Commonwealth & International Scientific Congress* (pp. 12–38). Victoria, Canada: University of Victoria Press.
- Biddle, S., Fox, K. R., & Boutcher, S. H. (2000). *Physical activity and*

- psychological well-being*. London, UK: Routledge.
- Boothby, J., Tungatt, M. F., & Townsend, A. R. (1981). Ceasing participation in sports activity: Reported reasons and their implications. *Journal of Leisure Research, 13*, 1–14.
- Bouchard, C., Shepard, R. J., Stephens, T., Sutton, J. R., & McPherson, B. D. (2000). *Exercise, fitness, and health*. (pp. 187–204). Champaign, IL: Human Kinetics Books.
- Brunstein, J. C., & Heckhausen, H. (2008). Achievement motivation. In J. Heckhausen & H. Heckhausen (Eds.), *Motivation and action* (pp. 137–183). Cambridge, UK: Cambridge University Press.
- Caplan, R. D. (1987). Person-environment fit theory and organization: Commensurate dimensions, time perspectives, and mechanisms. *Journal of Vocational Psychology, 31*, 248–267.
- Cohen, J. (1994). The earth is round ($p < .05$). *American Psychologist, 49*, 997–1003.
- Cohen, P., Cohen, J., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Hillsdale, NJ: Lawrence Erlbaum.
- Colcombe, S., Erickson, K. I., Raz, N., Webb, A. G., Cohen, N. J., McAuley, E., et al. (2003). Aerobic fitness reduces brain tissue loss in aging humans. *Journal of Gerontology: Medical Sciences, 58*, 176–180.
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row.
- Csikszentmihalyi, M., Abuhamdeh, S., & Nakamura, J. (2005). Flow. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 598–608). New York: Guilford Publications.
- Csikszentmihalyi, M., Larson, R., & Prescott, S. (1977). The ecology of adolescence activity and experience. *Journal of Youth and Adolescence, 6*, 281–294.
- Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. *Journal of Personality and Social Psychology, 56*, 815–822.
- Csikszentmihalyi, M., & Rathunde, K. (1992). The measurement of flow in everyday life: Toward a theory of emergent motivation. In R. Dienstbier & J. E. Jacobs (Eds.), *Developmental perspectives on motivation. Nebraska Symposium on motivation* (pp. 57–97). Lincoln and London: University of Nebraska Press.
- Davis, R. V., & Lofquist, L. H. (1984). *A psychological theory of work adjustment*. Minneapolis, MN: University of Minnesota Press.
- Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*, 105–115.
- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227–268.
- Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research*. Rochester, NY: University of Rochester Press.
- Dishman, R. K., & Sallis, J. F. (1994). Determinants and interventions for physical activity and exercise. In C. Bouchard, R. J. Shephard & T. Stephens (Eds.), *Physical activity, fitness, and health* (pp. 214–238). Champaign, IL: Human Kinetics Books.
- Edmunds, J., Ntoumanis, N., & Duda, J. L. D. (2007). Understanding exercise adherence and psychological well-being from a self-determination theory perspective among a cohort of obese patients referred to an exercise on prescription scheme. *Psychology of Sport & Exercise, 8*, 722–740.
- Engeser, S., & Rheinberg, F. (2008). Flow, performance and moderators of challenge-skill-balance. *Motivation and Emotion, 3*, 158–172.
- Fox, K. R., Stathi, A., McKenna, J., & Davis, M. G. (2006). Physical activity and mental well-being in older people participating in the Better Ageing Project. *European Journal of Applied Physiology, 100*, 591–602.
- Gable, S. L. (2006). Approach and avoidance social motives and goals. *Journal of Personality, 74*, 175–222.
- Gable, S. L., Reis, H. T., & Elliot, A. J. (2003). Evidence for bivariate systems: An empirical test of appetition and aversion across domains. *Journal of Research in Personality, 37*, 349–372.
- Hagger, M. S., & Chatzisarantis, N. L. D. (2005). *The social psychology of exercise and sport*. Buckingham, UK: Open University Press.
- Hagger, M. S., & Chatzisarantis, N. L. D. (2007). *Intrinsic motivation and self-determination in exercise and sport*. Leeds, UK: Human Kinetics Europe.
- Hagger, M. S., Chatzisarantis, N. L. D., Culverhouse, T., & Biddle, S. J. H. (2003). The process by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behavior: A trans-contextual model. *Journal of Educational Psychology, 95*, 784–795.
- Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environment* (3rd ed.). Odessa, FL: Psychological Assessment Resources.
- Jackson, S. A., Kimiecik, J., Ford, S., & Marsh, H. W. (1998). Psychological correlates of flow in sport. *Journal of Sport & Exercise Psychology, 20*, 358–378.
- Jackson, S. A., & Roberts, G. C. (1992). Positive performance states of athletes: Toward a conceptual understanding of peak performance. *The Sport Psychologist, 6*, 156–171.
- Jackson, S. A., Thomas, P. R., Marsh, H. W., & Smethurst, C. J. (2001). Relationship between flow, self-concept, psychological skills, and performance. *Journal of Applied Sport Psychology, 13*, 129–153.
- Katzmarzyk, P. T. (2006). Physical inactivity and life expectancy in Canada. *Journal of Physical Activity & Health, 3*, 381–389.
- Kehr, H. M. (2004). Implicit/explicit motive discrepancies and volitional depletion among managers. *Personality and Social Psychology Bulletin, 30*, 315–327.
- Langan-Fox, J., & Grant, S. (2007). The effectiveness of sentence cues in measuring the big three motives. *Journal of Personality Assessment, 89*, 105–115.
- Langens, T. A., & Schmalt, H.-D. (2002). Emotional consequences of positive daydreaming: The moderating role of fear-of-failure. *Personality and Social Psychology Bulletin, 12*, 1725–1735.

- Lewin, K. (1931). *Die psychologische Situation bei Lohn und Strafe [The psychological situation in reward and punishment]*. Leipzig: Hirzel.
- Lewin, K. (1951). *Field theory in social science*. Chicago, IL: University of Chicago Press.
- Marcus, B. H., Dubbert, P. M., Forsyth, L. H., McKenzie, T. L., Stone, E. J., Dunn, A. L., et al. (2000). Physical activity behaviour change: Issues in adoption and maintenance. *Health Psychology, 19*, 32–41.
- Markland, D., & Hardy, L. (1993). The exercise motivations inventory: Preliminary development and validity of a measure of individuals' reasons for participation in regular physical exercise. *Personality and Individual Differences, 15*, 289–296.
- McClelland, D. C. (1975). *Power: The inner experience*. New York: Irvington.
- McClelland, D. C. (1985). *Human motivation*. Glenview, IL: Scott Foresman.
- McClelland, D. C., Atkinson, J. W., Clark, R. A., & Lowell, E. L. (1953). *The achievement motive*. New York: Appleton-Century-Crofts.
- McInman, A. D., & Grove, J. R. (1991). Peak moments in sport: A literature review. *Quest, 43*, 333–351.
- Mullan, E., Markland, D., & Ingledew, D. K. (1997). A graded conceptualization of self-determination in the regulation of exercise behavior: Development of measure using confirmatory factor analysis procedures. *Personality and Individual Differences, 23*, 745–752.
- Murray, H. A. (1938). *Explorations in personality*. New York: Wiley.
- Mutrie, N. (2000). The relationship between physical activity and clinically defined depression. In S. J. H. Biddle, K. Fox & S. H. Boutcher (Eds.), *Physical activity and psychological well-being* (pp. 46–62). London: Routledge.
- Ntoumanis, N. (2005). A prospective study on participation in optional school physical education based on self-determination theory. *Journal of Educational Psychology, 97*, 444–453.
- Parfitt, G., Rose, E. A., & Markland, D. (2000). The effect of prescribed and preferred intensity exercise on psychological affect and the influence of baseline measures of affect. *Journal of Health Psychology, 5*, 231–240.
- Pelletier, L. C., & Sarrazin, P. (2007). Measurement issues in self-determination theory and sport. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 143–152). Champaign, IL: Human Kinetics.
- Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Briere, N. M. (2001). Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion, 25*, 279–306.
- Pervin, L. A. (1968). Performance and satisfaction as a function of individual-environment fit. *Psychological Bulletin, 69*, 56–68.
- Puca, R. M. (2005). The influence of the achievement motive on probability estimates in pre- and post-decisional action phases. *Journal of Research in Personality, 39*, 245–262.
- Puca, R. M., & Schmalt, H. D. (1999). Task enjoyment: A mediator between achievement motives and performance. *Motivation and Emotion, 23*, 15–29.
- Puca, R. M., & Schmalt, H. D. (2001). The influence of the achievement motive on spontaneous thoughts in pre- and post-decisional action phases. *Personality and Social Psychology Bulletin, 27*, 302–308.
- Rheinberg, F. (2008). Intrinsic motivation and flow-experience. In J. Heckhausen & H. Heckhausen (Eds.), *Motivation and action* (pp. 323–348). Cambridge, UK: Cambridge University Press.
- Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die Erfassung des Flow Erlebens [Measuring flow experience]. In J. Stiensmeier-Pelster & F. Rheinberg (Hrsg.) (Eds.), *Diagnostik von Motivation und Selbstkonzept* (pp. 261–279). Göttingen: Hogrefe.
- Scanlan, T. K., Carpenter, P. J., Schmidt, G. W., Simons, J. P., & Keeler, B. (1993). An introduction to the sport commitment model. *Journal of Sport & Exercise Psychology, 15*, 1–15.
- Schmalt, H. D. (1999). Assessing the achievement motive using the grid technique. *Journal of Research in Personality, 33*, 109–130.
- Schüler, J. (2007). Arousal of flow-experience in a learning setting and its effects on exam-performance and affect. *Zeitschrift für Pädagogische Psychologie, 21*, 217–227.
- Schüler, J., & Brunner, S. (2009). The rewarding effect of flow experience on performance in a marathon race. *Psychology of Sport and Exercise, 10*, 168–174.
- Schüler, J., Sheldon, K. M., & Fröhlich, S. M. (2010). Implicit need for achievement moderates the relationship between felt competence and subsequent motivation. *Journal of Research in Personality, 44*, 1–12.
- Schultheiss, O. C. (2008). Implicit motives. In O. John, R. W. Robins & L. A. Pervin (Eds.), *Handbook of personality: Theory and research*. (3rd ed., pp. 603–633). New York: Guilford.
- Schultheiss, O. C., & Hale, J. A. (2007). Implicit motives modulate attentional orienting to facial expression of emotion. *Motivation and Emotion, 31*, 13–24.
- Schultheiss, O. C., & Pang, J. S. (2007). Measuring implicit motives. In R. W. Robins, R. C. Fraley & R. Krueger (Eds.), *Handbook of research methods in personality psychology* (pp. 322–344). New York: Guilford.
- Sokolowski, K., Schmalt, H.-D., Langens, T. A., & Puca, R. M. (2000). Assessing achievement, affiliation, and power motives all at once—The Multi-Motive Grid (MMG). *Journal of Personality Assessment, 74*, 126–145.
- Standage, M., Duda, J. L., & Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *British Journal of Educational Psychology, 75*, 411–433.
- Tolman, E. C. (1932). *Purposive behaviour in animals and men*. New York: Appleton Century.
- Vallerand, R. J. (2007). A hierarchical model of intrinsic and extrinsic motivation for sport and physical activity. In M. D. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 255–280). Champaign, IL: Human Kinetics.
- Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004). How to become a

- persevering exerciser? Providing a clear, future intrinsic goal in an autonomy supportive way. *Journal of Sport & Exercise Psychology*, 26, 232–249.
- White, R. W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review*, 66, 297–333.
- Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology*, 6, 183–206.
- Wilson, P. M., Mack, D. E., Muon, S., & LeBlanc, M. E. (2007). What role does psychological need satisfaction play in motivating exercise participation? In L. A. Chiang (Ed.), *Motivation for exercise and physical activity* (pp. 35–52). Hauppauge, NY: Nova Science.
- Wilson, P. M., & Rodgers, W. M. (2004). The relationship between perceived autonomy support, exercise regulations and behavioral intentions in women. *Psychology of Sport & Exercise*, 5, 229–242.
- Wilson, P. M., Rodgers, W. M., Carpenter, P. J., Hall, C., Hardy, J., & Fraser, S. N. (2004). The relationship between commitment and exercise behavior. *Psychology of Sport and Exercise*, 5, 405–421.
- Winter, D. G. (1994). *Manual for scoring motive imagery in running text* (4th ed). Ann Arbor, MI: Department of Psychology, University of Michigan, Unpublished manuscript.