

## Does Flow Experience Lead to Risk? How and for Whom

Julia Schüler\*

*University of Bern, Switzerland*

Jeanne Nakamura

*Claremont Graduate University, USA*

**Background:** Previous research has focused on the positive consequences of flow, an intrinsically rewarding state of deep absorption. In contrast, the present research links flow to impaired risk awareness and to risky behaviour. We expected flow to enhance self-efficacy beliefs, which in turn were hypothesised to result in low risk awareness and risky behaviour in sports. In addition, we predicted that individuals' level of experience in the activity would moderate the expected effects. **Methods:** One study with kayakers (Study 1) and two studies with rock climbers (Studies 2 and 3) were conducted. Kayakers completed a survey while still on the river; climbers responded during and upon completion of a climb. **Results:** In all studies flow was related to risk awareness. Study 2 additionally showed its association with risky behaviour. Studies 2 and 3 revealed that these relationships were mediated by self-efficacy. The mediations were moderated by level of experience (Study 3). **Conclusions:** The results indicated that inexperienced but not experienced participants respond to self-efficacy beliefs evoked by flow with impaired risk awareness and with risky behaviour. Theoretical implications for flow and risk research as well as practical implications for risk prevention are discussed.

Keywords: experience in sport, flow, risk, self-efficacy

### INTRODUCTION

Previous research has focused on flow as a highly desirable state associated with a wide variety of positive outcomes (Csikszentmihalyi, 1990; Csikszentmihalyi, Abuhamedh, & Nakamura, 2005). For example, flow is highly motivating, helping people to adopt and particularly maintain sports involvement, which in turn is important for health benefits (Rothman, 2000) and is a necessary condition for high performance. In addition to this view of

\* Address for correspondence: Julia Schüler, University of Bern, Department of Sport Science, Bremgartenstrasse 145, 3012 Bern, Switzerland. Email: [julia.schueler@ispw.unibe.ch](mailto:julia.schueler@ispw.unibe.ch)

flow, we addressed a possible “dark side” (Partington, Partington, & Olivier, 2009) of flow in the present research. We examined the role of flow experience in impaired risk awareness and risk taking in sport. Furthermore, we analysed whether self-efficacy beliefs are the mechanism through which flow is linked to risk and tested level of experience in the sport as a moderator of the direct relationship between flow and risk. Finally, we suggest that the level of experience moderates the expected flow–self-efficacy–risk-taking relationship.

### The Flow Experience and its Dark and Bright Sides

Flow is defined as a state of optimal functioning in which one is deeply involved in an activity (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009) and the feeling of immersion in the activity is accompanied by a “sense of effortless ease and fluency in one’s movements and thoughts” (adapted from Jackson & Wrigley, 2004, p. 430). The intense experiential involvement is associated with several additional characteristics. The “merging of action and awareness” means that during flow, attentional resources are fully invested in pursuing the current task. All other objects fail to enter one’s awareness. This includes the awareness of oneself. A “high sense of control” means that during flow, one experiences a lack of anxiety about losing control. Flow is also characterised by an “altered sense of time” (time seems to pass quickly) and is more probable with clear goals, a balance between high challenge and skills and clear, immediate feedback (Csikszentmihalyi, 1990; Delle Fave, Massimini, & Bassi, 2011).

Consistent with its roots in the study of intrinsically motivated, skill-stretching activity, research has focused almost exclusively on exploring the flow state’s “bright sides”. The above-mentioned characteristics suggest that flow is an “optimal motivational state” (Csikszentmihalyi, 1990) in which all resources are focused on realising the intended action. For example, previous research has found flow to be predictive of persistence (Csikszentmihalyi, Rathunde, & Whalen, 1993) and motivation in learning contexts (Engeser, Rheinberg, Vollmeyer, & Bischoff, 2005). Flow is also associated with positive outcomes regarding experience, well-being, and mood (Asakawa, 2010; Peterson, Park, & Seligman, 2005; Schmidt, 2003; Csikszentmihalyi & LeFevre, 1989).

Flow is also conducive to “peak performance” (Csatari & Antheil, 1996). It is predictive of positive performance in academic work (Csikszentmihalyi et al., 1993; Engeser et al., 2005; Schüler, 2007), in sports (Jackson, Thomas, Marsh, & Smethurst, 2001), and in the workplace (Eisenberger, Jones, Stinglhamber, Shanock, & Randall, 2005).

Flow’s “bright sides” make it highly relevant to physical and psychological health promotion, particularly as sedentary lifestyles become an increasingly

serious risk factor in many societies. A large body of research shows that flow is experienced in individual and team sports and in activities such as yoga (e.g. Jackson et al., 2001), even by previously inactive individuals (Elbe, Strahler, Krustrup, Wikman, & Stelter, 2010). It may motivate participation, development of skills, and sustained pursuit.

However, the first hints of a dark side of flow come from Csikszentmihalyi himself. He characterised flow as a state “in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it” (Csikszentmihalyi, 1990, p. 4). What could be meant by “great cost”? One example is that the positive rewarding quality of the flow experience may lead to an addiction to the flow-producing activity. From the outset, Csikszentmihalyi (1975) noted the “addictive properties” of flow (p. 139) and attendant risk of becoming dependent on it. This observation has been confirmed in different life domains, such as exercise addiction (Partington et al., 2009) and cyber-gaming (Chou & Ting, 2003).

Are there other costs of the flow experience? Would people endanger even their own physical integrity, for example in risky sports, for the sake of experiencing flow? Does flow lead to risk taking? Although some research has suggested that sports like climbing may be motivated by flow *rather than* by risk (e.g. Csikszentmihalyi, 1975; Ewert, 1994), the study by Rheinberg (1991) would answer “Yes” to this question. Using interviews he found flow to be an important reason for motorcycling which might be associated with risk (“I am so gone that I feel that I don’t exist”; “In this condition I feel absolutely safe”; cf. Sato, 1988). Quantitative analyses revealed that the more intense was the flow experienced by motorcyclists, the less afraid they were when riding a motorcycle, and the more dangerous their self-reported driving style was. For example, they preferred higher speeds and reported a larger number of crashes and accidents. If flow contributes to risky behaviour in physical activities more generally, its bright sides for health promotion may be accompanied by a dark side that needs to be understood.

## The Present Research

Our present research aims to test the relationship of the flow experience to risk awareness and risky behaviour in more detail. Based on Rheinberg’s (1991) research, it is hypothesised that flow leads to reduced risk awareness and to risky behaviour (Hypothesis 1).

In addition, we aim to identify a mediator that is responsible for this relationship. We therefore looked at predictors of risky behaviour that were also likely to be influenced by flow experience. We suggest self-efficacy beliefs as a candidate for the following reasons. Whereas research has shown that individuals with higher task self-efficacy are higher on a number of positive

health and other outcomes (Schwarzer & Luszczynska, 2005), Bandura (1997) himself suggested a relationship between self-efficacy and risk (see also Krueger & Dickson, 1994). He assumed that low self-efficacy is associated with the anticipation of failure whereas high self-efficacy is associated with the anticipation of success. Failure and success anticipation in turn encourage individuals such as athletes to either avoid or engage in risk taking. In accordance with Bandura's (1997) assertions, Llewellyn, Sanchez, Asghar, and Jones (2008) identified self-efficacy as a predictor of risk taking in rock climbers.

The flow to self-efficacy hypothesis is based on the following rationale. According to Bandura (1997), self-efficacy beliefs are known to emerge by processing information derived directly from activity-related mastery experiences. We suggest that the experience of effortless fluency of action and high sense of control during the experience of flow should foster self-efficacy beliefs. Supporting this account, Salanova, Bakker, and Llorens (2006) found that in the workplace, flow builds self-efficacy over time (and, slightly less strongly, the opposite also occurs). Linking the two relationships, we hypothesise that self-efficacy beliefs mediate the relationship between flow and risk (Hypothesis 2).

However, we do not expect that flow leads to risk taking (through self-efficacy) for everybody. We examined level of experience in the (sports) activity as a potential moderator of the predicted mediation effects. Being experienced in a sport enables evaluating situational features based on greater knowledge of one's own or others' past risk behaviour and its consequences. This is likely to influence whether or not one takes risks (Ewert, 1994). In contrast, being inexperienced with a sport often means overestimating one's abilities when things go well. Overestimation of ability in turn has been found to predict risk taking and injuries in sports (Kontos, 2004). In the present research it is hypothesised that for experienced kayakers and rock climbers the link between flow and risk taking is weaker than for individuals who are not experienced in the sport (Hypothesis 3).

Finally, we integrated the hypothesised mediation and hypothesised moderation into a single model and tested sports experience as a moderator of the flow–self-efficacy–risk relationship (Hypothesis 4).

Risk taking in sport has mainly been operationalised by sport-specific risk behaviours (Llewellyn & Sanchez, 2008) measured by observation of risk behaviour by others or by risk-taking behaviour questionnaires (e.g. Kontos, 2004) as well as by asking participants for their risk awareness (e.g. Cook, Peterson, & DiLillo, 1999). The present research aims to use a variety of risk operationalisations by measuring risk awareness, self-reported risk behaviour, and objective observation of risk behaviour during sports.

Three field studies in the domain of sport were conducted to test the above-mentioned hypotheses. Study 1 examined the association between flow

and risk awareness in kayakers and whether this relationship is moderated by level of experience in the activity. Study 2 tested self-efficacy as a mediator of the flow–risk relationship in rock climbers, using multiple operationalisations of risk. In Study 3 we tested all hypotheses simultaneously by examining the direct link between flow and risk in rock climbing, analysing self-efficacy as a mediator, and testing the role of experience level in the flow–self-efficacy–risk relationship using moderated mediation analyses.

In all studies we measured flow “online”, while the activity was being performed. Thus, kayakers responded to the flow items while sitting in their kayaks. Rock climbers wore headsets and were asked about their flow experience while hanging from the rock face. The risk operationalisations differed because they were optimally adapted to the respective sport. For example, in kayaking we asked about the experienced risk of capsizing, whereas in rock climbing we asked about the risk of falling and measured concrete risk behaviour (omitting security hooks).

## STUDY 1: FLOW AND RISK IN KAYAKING

Study 1 tested the hypothesised link between flow and risk in kayakers and whether this relationship was moderated by level of experience in kayaking.<sup>1</sup>

### Method

*Participants and Procedure.* Sixty-one kayakers (40 men) with a mean age of 21.7 years ( $SD = 2.2$ ) participated in Study 1. They were taking either a sports course offered to beginners ( $n = 30$ ) or one for advanced kayakers ( $n = 31$ ). Participants declared their informed consent to participate before the study started. They completed a brief questionnaire including questions regarding age and level of kayaking experience and then performed a kayak route. Here, while sitting in their kayaks they filled in the flow measure with respect to the experience they were having on the river. They then rated the risk they perceived on the river route. In addition, experts in kayaking (kayaking trainers) rated the river route on the same risk factors.

*Measurement.* We measured *kayaking experience* by asking participants whether they had no experience, average experience, or a lot of experience in kayaking. Thirty participants indicated that they had no experience and 31 participants classified themselves as having average experience. We will refer to these categories as “no experience” and “experience”.

---

<sup>1</sup> Please note that parts of the data from Study 1 have already been reported in a book chapter by Schüler and Pfenninger (2011).

In order to assess *flow* we used the Flow Short Scale (Engeser & Rheinberg, 2008; Rheinberg, Vollmeyer, & Engeser, 2003). Participants rated their experience on 10 items (e.g. “I am totally absorbed in what I am doing”, “I don’t notice time passing”) using a 7-point scale (1: *not at all*—7: *very much*). An average score of flow was computed. The scale was reliable ( $\alpha = .81$ ).

In addition, in order to control for an important variable associated with the flow state, we assessed participants’ *perceived balance between their skills and the challenge* of the task using Rheinberg et al.’s item “For me personally, the current demands are . . .”. Participants indicated their response using a scale ranging from 1 (*too low*) through 4 (*just right*) to 7 (*too high*). The item was recoded so that higher scores reflect a better challenge/skill balance (1: *too high*, and *too low*—4: *just right*).

We assessed the *underestimation of risk* by first identifying typical risks in kayaking through interviews with experts in a pre-study. We asked participants to rate three items on a scale from 1 (*very low*) to 7 (*very high*), with reference to the present kayaking route: “How high do you consider the risk of having an accident while kayaking?”; “How high do you consider the risk of capsizing on the river route?”; “How high do you consider the risk of hurting yourself on the river route?” ( $M = 2.60$ ,  $SD = 1.01$ ,  $\alpha = .80$ ). To get a more objective risk rating of the kayaking route, five experts (kayaking trainers) rated the route on the same three items. We averaged their ratings ( $M = 1.33$ ,  $SD = .01$ ) and computed an index of underestimation of risk by subtracting participants’ risk rating from the experts’ risk rating.

## Results and Brief Discussion

*Preliminary Analyses, Descriptive Statistics, and Correlations.* Neither participants’ age nor gender influenced the results reported below. As expected, the more intense the experience of flow ( $M = 5.25$ ,  $SD = .70$ ) while kayaking, the significantly higher the underestimation of risk ( $M = -1.27$ ,  $SD = 1.00$ ),  $r = .32$ ,  $p < .05$  (Pearson correlation). Level of kayaking experience was positively but not significantly related to flow,  $r = .14$ ,  $p = .29$ , and non-significantly related to underestimation of risk,  $r = .21$ ,  $p = .11$  (Spearman correlation). The perceived challenge–skill balance ( $M = 3.40$ ,  $SD = .70$ ) was related to flow with  $r = .25$  ( $p = .051$ ).

*Test of Experience in Kayaking as a Moderator.* We tested the expected moderation effect by probing the flow–experience in kayaking interaction in OLS logistic regression. Flow and experience in kayaking as well as the product of flow and kayaking experience were entered into the regression equation (Hayes & Matthes, 2009). As illustrated in Table 1, flow interacts with kayaking experience ( $b = -0.74$ ,  $se = .35$ ,  $t = -2.14$ ,  $p < .05$ ) to predict participants’ underestimation of risk. As recommended by Hayes and

TABLE 1  
Underestimation of Risk as a Function of Flow and Level of Experience  
(Study 1)

	B	SE	t	p
Constant	-9.92	2.92	-3.40	0.01
Flow	1.56	0.56	2.80	0.01
Experience	4.23	1.84	2.30	0.02
Flow × Experience	-0.74	0.35	-2.14	0.04

Note:  $R^2 = .19$ ,  $F(3, 57) = 4.54$ ,  $p < .001$ .  
Experience: level of kayaking experience.

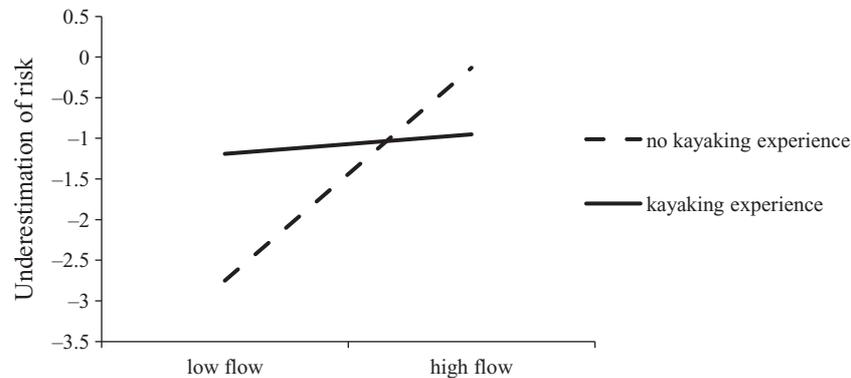


FIGURE 1. Illustration of the interaction of flow state and experience level on underestimation of risk in kayaking (Study 1).

Matthes (2009), we additionally analysed the simple slopes. The conditional effects of flow are estimated at the sample mean of experience in kayaking (further called average experience) as well as one standard deviation below (low experience) and one standard deviation above the sample mean (high experience).

As shown in Figure 1, flow predicted risk perception in individuals without kayaking experience ( $b = .81$ ,  $t = 3.24$ ,  $p < .05$ , 95% CI [.31, 1.32]) but not in individuals with kayaking experience ( $b = .07$ ,  $t = .31$ ,  $p = .76$ , 95% CI [-.41, .55]).

This confirms our assumption that because experienced athletes have more information at their disposal when evaluating sports situations, they are less easily seduced into responding to flow with an underestimation of risk. In contrast, kayaking beginners who are in flow perceive much less risk than

those not in flow, suggesting that novices are prone to respond to the flow experience by displaying a risk underestimation that may endanger them.

The flow–experience-level interaction was very similar to the interaction reported above when controlling for participants’ perceived challenge–skill balance (individuals without kayaking experience:  $b = .82$ ,  $t = 3.14$ ,  $p < .01$ , 95% CI [.29, 1.33]); individuals with kayaking experience:  $b = .07$ ,  $t = .29$ ,  $p = .78$ , 95% CI [−.42, .56]).<sup>2</sup>

## STUDY 2: FLOW AND RISK IN OUTDOOR ROCK CLIMBERS

A study of outdoor rock climbers aimed to replicate the relationship between flow and risk and introduced self-efficacy as a possible mediator of this relationship. In addition, openness to risk, perceived risk, and risky behaviour were assessed, in order to broaden the range of outcome variables in a single context.

### Method

*Participants and Procedure.* We recruited 79 outdoor rock climbers (64 men; age:  $M = 31.2$  years,  $SD = 8.7$ ) in a famous Swiss outdoor climbing region. Prior to their climb, we asked participants for their age, and informed them about the study procedure and about how to use the headset and microphone. They signed an informed consent form. While rock climbing, about half-way along the route the researcher contacted the climber via the headset, asking them to find a firm hold and to answer the flow items. Participants also rated their openness to risk while on the rock face (openness assessed online). They then finished the route and after returning to the ground they rated perceived self-efficacy and perceived risk (retrospective risk awareness). In addition, the researcher recorded how many safety hooks the climber omitted (risky behaviour).

*Measurement.* We again measured *flow* while climbing with the Flow Short Scale (Rheinberg et al., 2003;  $\alpha = .85$ ). The *challenge–skill balance* was measured as in Study 1.

*Risk variables:* We assessed the currently experienced *openness to risk* while participants were hanging from the rock face (“Would you omit the next

---

<sup>2</sup> In order to consider challenge–skill balance as a possible non-linear variable (e.g. too high and too low challenge–skill balance having different effects), we calculated the square of the challenge–skill balance item and conducted all analyses (in which we originally controlled for the continuous challenge–skill balance variable) with this squared variable. The results in all analyses were very similar and in one analysis weaker (moderation analysis in Study 1) while in other analyses stronger (mediation analyses, moderated mediation analysis in Study 3).

security hook?"; 1: *very unlikely*—7: *very likely*). *Retrospective risk awareness* was measured by asking participants after climbing to rate to what extent the possibility of falling was ever-present in their mind (1: *not at all*—7: *very much*). We assessed *risk behaviour* by counting participants' omission of safety hooks while climbing. Omitting a safety hook means having a several-metre free fall before the rope tautens again. Participants omitted none ( $n = 64$ ), one ( $n = 8$ ), or two ( $n = 7$ ) safety hooks. Because participants who omitted two hooks did not differ in any of the assessed variables from those omitting one hook, we simplified the variable and treated it as a dichotomous variable (omission: 0,  $n = 15$ ; no omission: 1,  $n = 64$ ).<sup>3</sup>

To assess *self-efficacy* we asked how the climbers felt during rock-climbing using an adapted version of Schwarzer and Jerusalem's (2004) 10-item self-efficacy scale. Some items remained in their original version (e.g. "I can remain calm when facing difficulties because I can rely on my coping abilities"), whereas others had to be adapted to the rock-climbing situation. For example, we replaced general descriptions with more specific words related to rock-climbing (e.g. original item in German scale version: "When a problem occurs I can handle it using my own resources"; adaptation: "When a difficult part of the route occurs I can handle it using my own resources"; original item in German scale version: "In the case of resistance, I can find the means and ways to get what I want"; adaptation: "In the case of difficulties during climbing, I can find the means and ways to get what I want"). Because we aimed to measure self-efficacy in a specific situation, we omitted words such as "usually" (e.g. original item: "If I am in trouble, I can usually think of a solution"; adaptation: "If I am in trouble, I can think of a solution").

Participants indicated how much they agreed with each statement using a 4-point rating scale (1: *not at all true*, 2: *hardly true*, 3: *moderately true*, 4: *completely true*). The scale was reliable, with  $\alpha = .92$ .

## Results and Brief Discussion

*Preliminary Analyses, Descriptive Statistics, and Correlations.* Neither participants' age nor gender influenced the results reported below.

Flow ( $M = 5.40$ ,  $SD = .86$ ) was significantly related to self-efficacy ( $M = 3.52$ ,  $SD = .53$ ),  $r = .51$ ,  $p < .001$ , and to openness to risk assessed online

---

<sup>3</sup> We also asked the climbing partner who was securing the climber how riskily the climber had behaved. However, this partner rating of risk lacked convergent validity (low correlations with the other risk variables) although the hypothesised mediation model (flow  $\rightarrow$  self-efficacy  $\rightarrow$  risk) was also supported using this risk variable. An explanation for the lack of convergent validity might be that the skill level of the partners varied broadly from advanced rock climbers to experts in rock climbing. Furthermore, the climbing partners were not trained to make this risk assessment. In sum, we question the raters' "expertise" to rate the risk behaviour.

TABLE 2  
 Indirect Effects for the Flow–Self-Efficacy–Risk Perception and Risky Behaviour  
 Model Using Normal Distribution (Sobel Test) and Bootstrapping (Study 2)

	<i>Indirect effect</i>		<i>Sobel test</i>		<i>Bootstrapping</i>
	b	seb	z	p	95% CI
Openness to risk	.48	.17	2.89	.004	[.19, .90]
Retrospective risk awareness	–.26	.09	–2.75	.006	[–.59, –.07]
Risky behaviour	.89	.44	2.00	.046	[.34, 1.81]

( $M = 5.32$ ,  $SD = 1.92$ ),  $r = .30$ ,  $p < .01$ , and risk behaviour ( $M = 0.19$ ,  $SD = .40$ ),  $r = .43$ ,  $p < .001$ , and marginally related to retrospective risk awareness ( $M = 1.75$ ,  $SD = 1.11$ ),  $r = -.21$ ,  $p < .10$ . Self-efficacy was also related to the risk variables (openness to risk assessed online,  $r = .47$ ,  $p < .001$ ; risk behaviour,  $r = .36$ ,  $p < .01$ ; retrospective risk awareness,  $r = -.41$ ,  $p < .001$ ). The risk variables significantly correlated with each other. Openness to risk assessed online was related with risk behaviour,  $r = .29$ ,  $p < .01$ , and marginally associated with retrospective risk awareness,  $r = -.21$ ,  $p < .10$ . The correlation between risk behaviour and retrospective risk awareness was  $r = -.27$ ,  $p < .01$ . Participants' perceived challenge–skill balance ( $M = 3.00$ ,  $SD = .91$ ) was not correlated with any of the other variables.

*Test of Self-Efficacy as a Mediator.* In order to clarify the process by which flow affects risk taking, we conducted Sobel tests and also applied a bootstrapping procedure (5,000 bootstraps) which estimates effect sizes independent of the non-normality of the sampling distribution (Preacher & Hayes, 2004) separately for each dependent variable. As presented in Table 2, self-efficacy was revealed to be a significant mediator of all flow–risk relationships<sup>4</sup> (openness to risk assessed online, retrospective risk awareness, risk behaviour). All Sobel tests were significant ( $ps$  between .004 and .05) and none of the 95% confidence intervals derived by bootstrapping included zero. The nature of the mediation analyses is presented for the example of openness to risk assessed online in Figure 2.

Summing up the study results, the assumed flow–self-efficacy–risk relationship was found for all operationalisations of risk—the online-measured openness to risk, the retrospectively rated risk awareness, and the risky behaviour.

<sup>4</sup> The mediation models remained stable when controlling for participants' perceived challenge–skill balance. The bootstrap results for indirect effects are 95% CI [.19, .93] for openness to risk, 95% CI [–.58, –.07] for retrospective risk awareness, and 95% CI [.28, 1.85] for risky behaviour.

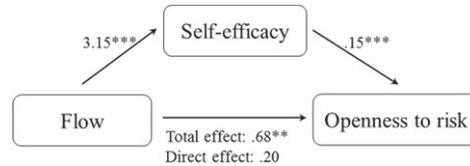


FIGURE 2. Results of mediation analyses in the example of openness to risk (Study 2).

Because participants indicated that making ratings while hanging from the rock face was very exhausting, we decided in the following study to measure only flow online and to enquire about the other variables retrospectively.

### STUDY 3: FLOW AND RISK IN ROCK CLIMBING

In addition to analysing self-efficacy as a mediator, Study 3 probed the moderation effect supported by Study 1. That is, we conducted moderated mediation analyses to identify the specific point at which the level of experience in a sport operates in the flow–self-efficacy–risk relationship (Hypothesis 3).

### Method

*Participants and Procedure.* One hundred and two indoor rock climbers (75 men) with a mean age of 32.1 years ( $SD = 10.8$ ) with securing partners took part in the study. Participants declared their informed consent to participate before the data collection started. In a brief questionnaire prior to rock climbing, participants were asked for their age and their rock-climbing experience. Then, after having climbed half of the route we asked them about their flow experience using the same headset and microphone procedure as in Study 2. We measured risk awareness and self-efficacy while climbing as soon as participants were on terra firma again.

*Measurement.* We again used the Flow Short Scale (Rheinberg et al., 2003; Cronbach's  $\alpha = .86$ ) to assess *flow*. The *perceived balance* between participants' skills and the challenge of the task was measured as in Study 1.

We assessed *experience in rock climbing* by asking participants to indicate how long they had been rock climbing. The responses ranged from one month to more than 10 years, with a mean of 5.00 years ( $SD = 3.45$ ).

We gained data about participants' *retrospective risk awareness* by asking them to rate the typical risks of rock climbing with reference to the climb they had just completed. We asked them to remember the situation and imagine

the activity vividly. The items were “How often did you think of the risk of falling?”, “How often did you think about the negative consequences of climbing this route?” (both items, 1: *never*—7: *very often*), and “The possibility of hurting myself was ever-present in my mind” (1: *not at all*—7: *very much*),  $\alpha = .70$ .

We measured *self-efficacy* using Llewellyn et al.’s (2008) 10-item self-efficacy scale for rock climbers. Asking participants to indicate as a percentage (0–100%) how much they trusted their climbing abilities “at the moment” while rock climbing, this scale captures participants’ state self-efficacy. Examples of items are “capable of maintaining my concentration”, “adopting an appropriate climbing technique”, and “dealing with the unexpected”. The scale was reliable, with  $\alpha = .85$ .

## Results and Brief Discussion

*Preliminary Analyses, Descriptive Statistics, and Correlations.* Again, neither participants’ age nor gender influenced the results reported in the following sections. As expected, flow ( $M = 5.15$ ,  $SD = .91$ ) was negatively related to risk awareness ( $M = 2.60$ ,  $SD = 1.35$ ),  $r = -.36$ ,  $p < .01$ . In addition, flow correlated positively with self-efficacy ( $M = 70.68$ ,  $SD = 14.17$ ),  $r = .56$ ,  $p < .001$ , and perceived challenge–skill balance ( $M = 3.10$ ,  $SD = 1.38$ ),  $r = .39$ ,  $p < .001$ . Self-efficacy was negatively related to risk awareness,  $r = -.43$ ,  $p < .001$ . Experience in rock climbing was not significantly correlated with any of the assessed variables.

*Analyses of Mediation.* Again we employed Sobel tests and nonparametric bootstrapping (5,000 bootstraps) to test the expected mediation effect (Preacher & Hayes, 2004). Self-efficacy emerged as a mediator of the relationship between flow and risk awareness using Sobel tests (indirect effect:  $b = -.31$ ,  $seb = .10$ ,  $z = -3.07$ ,  $p < .01$ ) and the bootstrapping procedure (95% CI  $[-.56, -.08]$ ). As expected, flow fostered self-efficacy beliefs ( $b = 8.58$ ,  $seb = 1.31$ ,  $t = 6.53$ ,  $p < .001$ ) and self-efficacy influenced risk awareness negatively ( $b = -.04$ ,  $seb = .01$ ,  $t = -3.51$ ,  $p < .001$ ) (total effect:  $b = -.51$ ,  $seb = .14$ ,  $t = -3.37$ ,  $p < .001$ ; direct effect:  $b = -.19$ ,  $seb = .16$ ,  $t = -1.23$ , *ns*).

*Test of Moderated Mediation.* In order to test whether the mediation effect is moderated by experience in rock climbing, we used the procedure recommended by Preacher, Rucker, and Hayes (2007). Because we were interested in where exactly experience in rock climbing unfolds its moderating effect, we conducted separate analyses in which we specified experience in rock climbing either as a moderator of the predictor–mediator (flow–self-efficacy) link or of the mediator–criterion (self-efficacy–risk awareness) link.

TABLE 3  
Moderation of the Flow–Self-Efficacy–Risk Awareness Relationship (Study 3)

	B	SE	t	p
Constant	12.12	2.81	4.31	.001
Flow	-.18	.18	-.98	.33
SE	-.75	.27	-2.78	.01
Experience	-1.35	.55	-2.44	.02
SE × Experience	.11	.05	2.04	.04

Note: SE: Self-efficacy (mediator); Experience: Level of climbing experience (moderator).

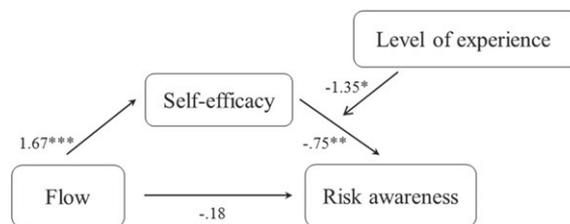


FIGURE 3. The moderated mediation model tested in Study 3. Path values are unstandardised coefficients. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

In a first analysis, we specified the path from self-efficacy to risk perception as being moderated by rock-climbing experience. As illustrated in Table 3 and Figure 3, the statistically significant interaction implies that the indirect effect of self-efficacy on risk awareness is indeed moderated by rock-climbing experience.<sup>5</sup>

Table 4 shows the conditional indirect effects at the mean and at the values one standard deviation above and one standard deviation below the mean for rock-climbing experience. The table also includes bootstrapping confidence intervals for the conditional indirect effects (5,000 bootstraps). As can be seen, the conditional effects for individuals with low and average rock-climbing experience were non-zero and the bootstrap intervals do not contain zero, whereas the conditional indirect effect was not significant for individuals with high rock-climbing experience. That is, whereas individuals with

<sup>5</sup> Controlling for participants' perceived challenge–skill balance changed neither the interaction ( $b = .11$ ,  $seb = .05$ ,  $p < .05$ ) nor the direction of moderation. Again, the conditional indirect effect was significant for participants with low level of experience ( $z = -3.21$ ,  $p < .05$ ) and average level of experience ( $z = -2.70$ ,  $p < .01$ ) in rock climbing.

TABLE 4  
 Conditional Indirect Effect at Low, Average, and High Levels of Rock-Climbing Experience (Moderator) for the Flow–Self-Efficacy–Risk Awareness Model (Study 3)

<i>Experience</i>	<i>Indirect effect</i>		<i>Sobel test</i>		<i>Bootstrapping</i>
	<i>b</i>	<i>SE</i>	<i>z</i>	<i>p</i>	<i>95% CI</i>
Low	–.58	.18	–3.30	.001	[–.93, –.17]
Average	–.37	.13	–2.79	.001	[–.64, –.10]
High	–.16	.16	–1.00	.320	[–.48, .19]

*Note:* Low: one standard deviation below the mean; Average: sample mean; High: one standard deviation above the mean.

low/average experience have low risk awareness when they feel self-efficacy, this relationship does not exist for experienced rock climbers.

In a second moderated mediation analysis we specified the path from flow to self-efficacy as being moderated by level of rock-climbing experience. However, as expected, no significant interaction effect occurred. Inexperienced and experienced rock climbers did not differ in how much self-efficacy results from the experience of flow.

Thus, in addition to the replication of previous results, Study 3 showed that inexperienced and experienced rock climbers benefited equally from the experience of flow in terms of feeling self-efficacy. However, level of rock-climbing experience moderated the effect of self-efficacy on risk awareness. Thus, the direct positive consequences of flow (high self-efficacy) impaired risk only for inexperienced rock climbers. By contrast, experienced rock climbers seem to get the most out of flow. They feel self-efficacy, but without reduced risk awareness. It seems that their experience in the sport protects them from this negative consequence of self-efficacy.

## GENERAL DISCUSSION

The present research suggests that the highly desirable state of flow associated with highly effective actions and a positive quality of experience may also have a dark side. This is in accordance with Csikszentmihalyi's (1990) findings that "enjoyable activities that produce flow have a potential negative aspect: while they are capable of improving the quality of existence by creating order in the mind, they can become addictive, at which point the self becomes captive of a certain kind of order, and is then unwilling to cope with the ambiguities of life" (Csikszentmihalyi, 1990, p. 62). What the present paper has added to Csikszentmihalyi's observation is that flow can also lead

to low risk awareness and to risk-taking behaviour which might even endanger one's physical integrity. We hypothesised that positive flow consequences can have negative effects, and analysed self-efficacy as a mediator. But what does "can" mean here? For whom is flow associated with risk through self-efficacy? We suggested that inexperience plays a crucial role and analysed level of experience in an activity as a moderator.

In a study with kayakers and two studies of rock climbing—an activity closely associated with flow and optimal experience (Csikszentmihalyi, 1969, 1975)—we showed that flow is indeed associated with low risk awareness (Studies 1, 2, and 3) and actual risky behaviour (Study 2). Furthermore, this association can be explained by high self-efficacy beliefs (Studies 2 and 3). However, the link between flow and risk exists for inexperienced but not for experienced athletes (Study 3). A detailed analysis of the moderation effect reveals that experience influences the effects of the mediator on risk rather than the effect of flow on the mediator. Thus experienced athletes can get the most out of flow. They feel effective, but their experience in the sport situation does not lead them to underestimate risk or engage in risky behaviour. In short, their expertise protects them from risks. Inexperienced persons lack such protection. They too may experience flow while engaging in their sport and enjoy self-efficacy. However, having less information that could help them to judge the situation (in particular, knowledge about which situations are potentially dangerous) they are mostly guided by these feelings, which may betray them into underestimating and taking risks.

Our results contribute to previous research about flow by recognising risk perception and risk taking as factors influenced by experiencing flow. Furthermore, our research contributes to the understanding of risk-taking behaviours that can adversely affect health, such as gambling, drug consumption, dangerous driving style, and most directly the pursuit of high-risk sports. Sports participation is of great importance as a potential health-promoting factor. Experiencing flow may encourage this participation. However, high-risk sports, which are increasingly popular, at the same time carry potential for significant injury and even death (Llewellyn & Sanchez, 2008). Moreover, contemporary cultural influences encourage risky behaviour across multiple domains, as shown by Fischer, Greitemeyer, Kastenmüller, Vogrincic, and Sauer's (2011) meta-analysis linking risk-taking inclinations to exposure to "risk-glorifying" media (e.g. video games, TV, music).

In the past, researchers have explained risk-taking behaviours by stable aspects of personality, in particular by individual differences in sensation seeking (Bouter, Knipschild, Feij, & Volovics, 1988; Nicholson, Soane, Fenton-O'Creevy, & Willman, 2005; Zuckerman & Kuhlman, 2000). Subsequently, researchers have associated risk taking with other traits, including extraversion, openness to experience, low neuroticism, low conscientiousness (Tok, 2011), and emotional difficulties leading to escape into high-risk sports

(Castanier, Le Scanff, & Woodman, 2010; Woodman, Hardy, Barlow, & Le Scanff, 2010). Our research departed from this personality perspective, building on studies of self-efficacy and risk (e.g. Krueger & Dickson, 1994; Lewellyn & Sanchez, 2008) by showing that a specific positive state experienced during the activity itself and enhancing self-efficacy–flow experience may impair (novice) sports participants' risk awareness and foster risk taking.

A theoretical issue regarding the causal relationship between flow and self-efficacy warrants discussion. We assumed that the characteristics of flow lead to high state self-efficacy feelings which in turn increase risk taking. However, there are also arguments for the reverse causal relationship between optimal motivation and self-efficacy. Focusing on dispositional self-efficacy beliefs in academic learning contexts, Bassi, Steca, Delle Fave, and Caprara (2007) found that students high in academic self-efficacy showed more optimal motivation than individuals with low scores. The authors' explanation is that high self-efficacy students perceive learning activities as challenging and feel that they can manage them with their perceived high skills. Because the challenge–skill balance is an important condition of flow, these students more often experience optimal motivation than students with low dispositional self-efficacy (who perceive their skills as being low).

We suggest that both relationships between flow and self-efficacy may hold when considering the state and trait character of self-efficacy. As assumed in this paper, flow leads to state experiences of being effective. Repeated experiences of self-efficacy in turn over time lead to stable self-efficacy beliefs (Bandura, 1997). Dispositional self-efficacy, for example in rock climbing, will then lead to realistic sport goal setting in which challenges and high skills match closely. As a consequence, the experience of flow occurs more often. In order to address whether the *state* self-efficacy is a consequence rather than a condition of flow, we empirically tested the alternative mediation model (state self-efficacy → flow → risk) with additional Sobel tests for the four risk variables in Studies 2 and 3. Only one out of four indirect effects was significant,<sup>6</sup> whereas the predicted mediation model (flow → state self-efficacy → risk) revealed four significant indirect effects.

Our studies also contributed to the methodological question raised in flow research of whether flow is best measured online or can be assessed retrospectively (Csikszentmihalyi & Larson, 1987; Jackson & Marsh, 1996; Schüller & Brunner, 2009). Csikszentmihalyi and Larson (1987), for example, have criticised retrospective measurement mainly for the conceptual reason

---

<sup>6</sup> Sobel tests examining the alternative mediation model (state self-efficacy → flow → risk) revealed three non-significant mediation models (Openness to risk assessed online in Study 2:  $z = .72, p > .47, 95\% \text{ CI } [-.03, .06]$ ; retrospective risk awareness in Study 2:  $z = -.03, p > .97, 95\% \text{ CI } [-.03, .04]$ ; retrospective risk awareness in Study 3:  $z = -1.20, p > .23, 95\% \text{ CI } [-.02, .004]$ ) and one significant mediation model (risk behaviour in Study 2:  $z = 2.54, p < .05, 95\% \text{ CI } [.07, .39]$ ).

that the deep involvement in an activity is believed to exclude introspection and thus to hamper the accurate reporting of flow afterwards. Furthermore, memory effects are likely to decrease the validity of retrospective flow measures. On the other hand, online flow measures such as the Experience Sampling Method (ESM; Csikszentmihalyi & Larson, 1987; Csikszentmihalyi & LeFevre, 1989; Delle Fave & Bassi, 2000; Delle Fave, Bassi, & Massimini, 2003) also have disadvantages. One example is that online measurement often requires technical equipment and expertise (beepers in ESM research; headset and microphone in the present studies) and is associated with a high degree of effort and time on the part of the participants and researchers. Thus, studies are needed which directly compare the online and retrospective measure of flow. This is what we did in our second study. The online risk measure was found to be superior to the retrospective measure, in terms of a stronger direct relationship with flow. However, measuring risk online is more complicated and sometimes even impossible. For example, the participants in Study 2 mentioned that making ratings while hanging from the rock face was very exhausting. Thus, long questionnaires measuring all relevant variables online might be methodologically desirable, but at odds with the practical situation. In addition, the less complicated retrospective risk measures also revealed the expected mediation, perhaps because we asked participants to remember the situation and imagine the activity vividly. In sum, the decision of how to measure flow in one's studies mainly depends on weighing accuracy (usage of online rather than retrospective measure) and feasibility (usage of retrospective rather than online measure).

Future research is needed to extend the present research and to overcome certain limitations. The current results are based on cross-sectional data which could be complemented by longitudinal research. Showing that the same person responds to flow with high risk taking (through efficacy beliefs) when beginning a sport, but not when he/she becomes advanced in that sport, would provide further support for the proposed account.

In order to enhance the generalisability of the study results, further flow–risk relationships in other domains of human life have to be examined in detail. Examples include flow and risky decisions in the workplace, in road transport, at the stock exchange, and in health-related behaviour. Furthermore, future studies could control for variables which are linked to both flow and risk (such as anxiety and sensation seeking) and thus may function as third variables.

In relation to health promotion through sport participation, these studies have suggested that at least for beginners flow may be a double-edged sword. One might argue that a useful practical implication derived from the present research results would be to prevent beginners from experiencing flow in order to prevent them from taking risks. However, this seems inappropriate due to flow's rewards and its positive effect on sport and exercise

maintenance. Furthermore, flow occurs when high environmental challenges match with equally high levels of personal skills which is an important precondition for the development of skills. Thus, preventing flow is not an option. As Csikszentmihalyi (1990, p. 70) said: “It would be senseless, however, to ignore a source of energy because it can be misused.” To prevent beginners from being led into risky behaviour by flow and the sense of self-efficacy that it creates, they must be helped to become “experienced” quickly, for example by knowledge transfer concerning risk, practical risk training courses, and safety rules (“Never omit a safety hook!”).

To conclude in Csikszentmihalyi’s (1990) words: “the flow experience, like everything else, is not ‘good’ in an absolute sense” (p. 70). It is the aim of future research to learn to “distinguish the useful and the harmful forms of flow, and then make the most of the former while placing limits on the latter” (p. 70).

#### ACKNOWLEDGEMENTS

We would like to thank Tabea Schwab, Marc Albrecht, and Mirjam Pfenninger for their great help with data collection.

#### REFERENCES

- Asakawa, K. (2010). Flow experience, culture, and well-being: How do autotelic Japanese college students feel, behave, and think in their daily lives? *Journal of Happiness Studies, 11*, 205–223.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bassi, M., Steca, P., Delle Fave, A., & Caprara, G.V. (2007). Academic self-efficacy beliefs and quality of experience in learning. *Journal of Youth and Adolescence, 36*, 301–312.
- Bouter, L.M., Knipschild, P.G., Feij, J.A., & Volovics, A. (1988). Sensation seeking and injury risk in downhill skiing. *Personality and Individual Differences, 9*, 667–673.
- Castanier, C., Le Scanff, C., & Woodman, T. (2010). Beyond sensation seeking: Affect regulation as a framework for predicting risk-taking behaviors in high-risk sport. *Journal of Sport & Exercise Psychology, 32*, 731–738.
- Chou, T.-J., & Ting, C.-C. (2003). The role of flow experience in cyber-game addiction. *CyberPsychology & Behavior, 6*, 663–675.
- Cook, S., Peterson, L., & DiLillo, D. (1999). Fear and exhilaration in response to risk: An extension of a model of injury risk in a real world context. *Behavior Therapy, 30*, 5–15.
- Csatari, J., & Antheil, K. (1996). The secret of peak performance. *Men’s Health, 11*, 58–59.
- Csikszentmihalyi, M. (1969). The Americanization of rock-climbing. *The University of Chicago Magazine, 61*, 20–26.

- Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. San Francisco, CA: Jossey-Bass.
- Csikszentmihalyi, M. (1990). *Flow*. 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.
- Csikszentmihalyi, M., & Larson, R. (1987). Validity and reliability of the Experience Sampling Method. *Journal of Nervous and Mental Disease*, *175*, 529–536.
- Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. *Journal of Personality and Social Psychology*, *56*, 815–822.
- Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1993). *Talented teenagers: A longitudinal study of their development*. New York: Cambridge University Press.
- Delle Fave, A., & Bassi, M. (2000). The quality of experience in adolescents' daily lives: Developmental perspectives. *Genetic, Social, and General Psychology Monographs*, *126*, 347–367.
- Delle Fave, A., Bassi, M., & Massimini, F. (2003). Quality of experience and risk perception in high-altitude rock climbing. *Journal of Applied Sport Psychology*, *15*, 82–98.
- Delle Fave, A., Massimini, F., & Bassi, M. (2011). *Psychological selection and optimal experience across cultures*. Dordrecht, Netherlands: Springer.
- Eisenberger, R., Jones, J.R., Stinglhamber, F., Shanock, L., & Randall, A.T. (2005). Flow experiences at work: For high need achievers alone? *Journal of Organizational Behavior*, *26*, 755–775.
- Elbe, A.-M., Strahler, K., Krusturup, P., Wikman, J., & Stelter, R. (2010). Experiencing flow in different types of physical activity programs: Three randomized studies. *Scandinavian Journal of Medicine and Science in Sports*, *20*, 111–117.
- Engeser, S., & Rheinberg, F. (2008). Flow, moderators of challenge–skill balance and performance. *Motivation and Emotion*, *32*, 158–172.
- Engeser, S., Rheinberg, F., Vollmeyer, R., & Bischoff, J. (2005). Motivation, Flow-Erleben und Lernleistung in universitären Lernsettings [Motivation, flow experience and performance in learning settings at university]. *Zeitschrift für Pädagogische Psychologie*, *19*, 159–172.
- Ewert, A.W. (1994). Playing the edge: Motivation and risk taking in a high-altitude wildernesslike environment. *Environment and Behavior*, *26*, 3–24.
- Fischer, P., Greitemeyer, T., Kastenmüller, A., Vogrincic, C., & Sauer, A. (2011). The effects of risk-glorifying media exposure on risk-positive cognitions, emotions, and behaviors: A meta-analytic review. *Psychological Bulletin*, *137*(3), 367–390.
- Hayes, A.J., & Matthes, J. (2009). Computational procedures for probing interactions in OLS and logistic regression: SPSS and SAS implementations. *Behavior Research Methods*, *41*, 924–936.
- Jackson, S.A., & Marsh, H.W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport & Exercise Psychology*, *18*, 17–35.
- 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.

- Jackson, S.A., & Wrigley, W.J. (2004). Optimal experience in sport: Current issues and future directions. In T. Morris & J. Summers (Eds.), *Sport psychology* (pp. 423–451). Milton: Wiley.
- Kontos, A.P. (2004). Perceived risk, risk taking, estimation of ability and injury among adolescent sport participants. *Journal of Pediatric Psychology, 29*, 447–455.
- Krueger, N., & Dickson, P.R. (1994). How believing in ourselves increases risk taking: Perceived self-efficacy and opportunity recognition. *Decision Sciences, 25*, 385–400.
- Llewellyn, D.J., & Sanchez, X. (2008). Individual differences and risk taking in rock climbing. *Psychology of Sport and Exercise, 9*, 413–426.
- Llewellyn, D.J., Sanchez, X., Asghar, A., & Jones, G. (2008). Self-efficacy, risk taking and performance in rock climbing. *Personality and Individual Differences, 45*, 75–81.
- Nakamura, J., & Csikszentmihalyi, M. (2009). Flow theory and research. In S.J. Lopez & C.R. Snyder (Eds.), *Oxford handbook of positive psychology* (2nd edn., pp. 195–206). New York: Oxford University Press.
- Nicholson, N., Soane, E., Fenton-O’Creevy, M., & Willman, P. (2005). Personality and domain-specific risk taking. *Journal of Risk Research, 8*, 157–176.
- Partington, S., Partington, E., & Olivier, S. (2009). The dark side of flow: A qualitative study of dependence in big wave surfing. *Sport Psychologist, 23*, 170–186.
- Peterson, C., Park, N., & Seligman, M.E.P. (2005). Orientations to happiness and life satisfaction: The full life versus the empty life. *Journal of Happiness Studies, 6*, 25–41.
- Preacher, K.J., & Hayes, A.F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behaviour Research Methods, Instruments & Computers, 36*, 717–731.
- Preacher, K.J., Rucker, D.D., & Hayes, A.F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*, 185–227.
- Rheinberg, F. (1991). Flow-experience when motorcycling: A study of a special human condition. In R. Brendicke (Ed.), *Safety, environment, future* (pp. 349–362). Bochum, Germany: Institut für Zweiradsicherheit (ifZ).
- Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die Erfassung des Flow-Erlebens [The assessment of flow experience]. In J. Stiensmeier-Pelster & F. Rheinberg (Eds.), *Diagnostik von Selbstkonzept, Lernmotivation und Selbstregulation* (pp. 261–279). Göttingen, Germany: Hogrefe.
- Rothman, A.J. (2000). Toward a theory-based analysis of behavioral maintenance. *Health Psychology, 19*, 64–69.
- Salanova, M., Bakker, A.B., & Llorens, S. (2006). Flow at work. *Journal of Happiness Studies, 7*, 1–22.
- Sato, I. (1988). Bosozoku: Flow in Japanese motorcycle gangs. In M. Csikszentmihalyi & I. Csikszentmihalyi (Eds.), *Optimal experience* (pp. 92–117). New York: Cambridge University Press.
- Schmidt, J. (2003). Correlates of reduced misconduct among adolescents facing adversity. *Journal of Youth and Adolescence, 32*, 439–452.

- 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., & Pfenninger, M. (2011). Flow impairs risk perception in kayakers. In B.D. Geranto (Ed.), *Sport psychology* (pp. 237–246). New York: Nova Publishers.
- Schwarzer, R., & Jerusalem, M. (2004). General self-efficacy scale. In S. Salek (Ed.), *Compendium of quality of life instruments* (Vol. 6, Section 2A:1) [CD-ROM]. Cardiff, Wales: Centre for Socioeconomic Research, Cardiff University. Haslemere, England: Euromed Communications [CD-ROM publication, without page numbers].
- Schwarzer, R., & Luszczynska, A. (2005). Self-efficacy, adolescents' risk-taking behaviors, and health. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents: Adolescence and education* (Vol. 5, pp. 139–159). Greenwich, CT: Information Age Publishing.
- Tok, S. (2011). The big five personality traits and risky sport participation. *Social Behavior and Personality, 39*, 1105–1112.
- Woodman, T., Hardy, L., Barlow, M., & Le Scanff, C. (2010). Motives for participation in prolonged engagement high-risk sports: An agentic emotion regulation perspective. *Psychology of Sport and Exercise, 11*, 345–352.
- Zuckerman, M., & Kuhlman, D.M. (2000). Personality and risk-taking: Common biosocial factors. *Journal of Personality, 68*, 999–1029.