

# Contribution to the Special Section

# Arousal of Flow Experience in a Learning Setting and Its Effects on Exam Performance and Affect

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**Abstract.** Flow experience is associated with learning motivation, performance and positive affect. Therefore it is important to analyze its antecedents. An important antecedent for experiencing flow is the balance between the person's skill and how challenging the situation is (Csikszentmihalyi, 1990). According to Atkinson's (1957) risk-taking model, only individuals with high hope-of-success prefer situations in which a balance of challenge and skill is given while individuals with high fear-of-failure try to avoid such situations. Integration of these two lines of research leads to the suggestion that the achievement motive might moderate the relationship between the challenge-skill balance and flow experience. This notion could be confirmed in two studies with undergraduate students ( $N = 57/N = 395$ ). Additionally, flow experience was found to be a significant predictor of affect (Study 1 and 2) and exam performance (Study 2). I discuss these findings and their practical implications for academic learning settings.

**Keywords:** flow experience, challenge-skill balance, achievement motive, performance

## Die Anregung des Flow-Erlebens im Lernkontext und dessen Auswirkung auf Lernleistung und Affekt

**Zusammenfassung.** Das Flow-Erleben hängt mit Lernmotivation, Leistung und positivem Affekt zusammen. Darum ist es wichtig, seine Entstehungsbedingungen zu untersuchen. Eine wichtige Bedingung für das Flow-Erleben ist die Passung zwischen den Fähigkeiten der Person und den Anforderungen der Situation (Csikszentmihalyi, 1990). Gemäß dem Risikowahl-Modell von Atkinson (1957) bevorzugen jedoch nur Hoffnung-auf-Erfolg-Motivierte Situationen, in denen ihre Fähigkeiten mit den Anforderungen übereinstimmen, während Furcht-vor-Misserfolg-Motivierte solche Situationen gerade vermeiden. Die Integration dieser beiden theoretischen Ansätze (Flow-Theorie, Risikowahl-Modell) führt zur Formulierung der Annahme, dass das Leistungsmotiv den Zusammenhang zwischen der Anforderungs-Fähigkeitspassung und dem Flow-Erleben moderiert. Dies konnte in zwei Studien mit Studierenden bestätigt werden ( $N = 57 / N = 395$ ). Zusätzlich sagte das Flow-Erleben den Affekt (Studie 1 und 2) und die Examensleistung (Studie 2) vorher. Die Befunde und ihre praktischen Implikationen für den akademischen Lernkontext werden diskutiert.

**Schlüsselwörter:** Flow-Erleben, Anforderungs-Fähigkeitspassung, Leistungsmotiv, Lernleistung

## 1 Introduction

In the present work I aim to extend research on flow experience (e.g., Csikszentmihalyi, 1990) by integrating Atkinson's (1957) risk-taking model. Atkinson's (1957) model helps to explain the relationship between flow experience and the balance between the skill of a person and the challenge of a task, which is the most important antecedent of flow experience (e.g., Csikszentmihalyi & LeFevre, 1989). After introducing the flow phenomenon in the first paragraph, the second paragraph explains why the risk-taking model suggests a relationship between the challenge-skill balance and flow experience which is

moderated by the achievement motive. Because a further aim of the present research is to scrutinize whether flow experience predicts performance and affect in an academic learning setting, research on flow consequences is also briefly summed up.

### 1.1 The Flow Phenomenon and the Challenge-Skill Balance

Flow experience is an optimal motivational state that drives human behavior. Csikszentmihalyi described it as

“[. . .] a subjective 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). The author could show by interviewing individuals who strive for challenging goals, that most of his interview partners knew the flow phenomenon (Csikszentmihalyi, 1990). Although the activities were obviously totally different (e.g., working on a challenging job task, rock climbing or playing music), he managed to identify seven common characteristic dimensions of the flow experience. One characteristic is the clarity of the goals (clear goals). Another characteristic is an unambiguous and immediate feedback as to how well one is doing (immediate feedback). The third characteristic is a balance between the challenge of the situation and the skill of the person (challenge-skill balance). The person is absolutely focused on and involved in the action (concentration on the task at hand), so that the separation between actor and action fades. Action and awareness seem to merge (action and awareness merge). Individuals feel a sense of potential control (sense of control) and some kind of self-transcendence, for example experiencing a sense of being part of some greater entity (loss of self awareness). Often, the awareness of time passing is disturbed (distortion of the sense of time).

Csikszentmihalyi (1975, 1999) theorized that the challenge-skill balance is the most important dimension in his model, describing it as an antecedent of flow experience. He assumed that individuals always experience flow, when the skills of an individual and the challenge of a task are balanced (Csikszentmihalyi, 1975). Later he extended this assumption by postulating that flow can only be experienced when the skills and the challenges are both on a high level. When challenge and skills are imbalanced, individuals feel either bored (i.e., when the skills are higher than the challenges), or they feel anxious (i.e., when the challenges are higher than the skills; Csikszentmihalyi, 1997). It is important to note that for Csikszentmihalyi (1997) the challenge-skill balance was a *sufficient precondition* for flow experience. Likewise, challenge-skill imbalance was a *sufficient precondition* for boredom or anxiety. However, he did not consider individual differences.

Research scrutinizing the relationship between the challenge-skill balance and flow experience revealed inconsistencies in Csikszentmihalyi's (1997) assumption. For example, Stoll and Lau (2005) found that the challenge-skill balance is not an urgently necessary precondition of flow experience. The authors asked marathon-runners about their flow experience during a race and found that flow experience was independent of the challenge-skill balance. In another study, on the other hand, the authors found a positive relationship between the challenge-skill balance and flow experience. The authors suggested that these inconsistencies might be explained by a moderating variable (c.f., Rheinberg, 2006; Rheinberg, Vollmeyer & Engeser, 2003).

## 1.2 The Achievement Motive as a Moderator of the Relationship Between Challenge-Skill Balance and Flow Experience

It is the translation of the term “challenge-skill balance” into the terminology of another theory that links the challenge-skill balance with the achievement motive. A task where challenge and individual skills are matched can be described as a challenging task of average difficulty. For tasks of average difficulty Atkinson's (1957) risk-taking model makes differential predictions for hope-of-success motivated individuals and fear-of-failure motivated individuals. Hope-of-success and fear-of-failure are two components of the achievement motive that Murray (1938, p. 80–81) described as the desire “to overcome obstacles, to exercise power, to strive to do something difficult as well and as quickly as possible” and that McClelland characterized as the desire to surpass personal standards of excellence (e.g., McClelland, Atkinson, Clark, & Lowell, 1953). Hope-of-success motivated individuals believe that they can succeed in challenging tasks, they enjoy competing with standards of excellence, call for information about their level of competence and attempt to attain the positive emotional consequences connected with success. On the other hand, fear-of-failure motivated individuals expect to fail and thus try to avoid the negative emotional consequences of failure. They dislike competing with standards of excellence and avoid feedback about their personal competences (for the distinction of hope-of-success and fear-of-failure see e.g., Elliot & Harackiewicz, 1996; McClelland et al., 1953).

Hope-of-success and fear-of-failure are assumed to work like personality attributes that influence behavior among different achievement contexts. One achievement context is the choice of different task difficulties, which is the core of Atkinson's (1957) risk-taking model. Herein it is assumed that the achievement motivation is determined by the probability of success at a task and by the incentive of being successful (i.e., feeling proud, being satisfied). For individuals high in hope-of-success these variables are linked as follows. Tasks with a low difficulty have a high probability of success, but because being successful in an easy task does not lead to feeling proud, such tasks lack the incentive of success. Thus, easy tasks do not stimulate achievement motivation. Achievement motivation is also not aroused by very difficult tasks. Indeed, such tasks have a high incentive, but the probability to succeed in them is low. Instead, achievement motivation is maximally aroused by tasks of mean difficulty. Here, the probability of success as well as the incentive of success is well-balanced, enabling both failure and success. With this, the exact level of ability (At which point do I succeed? When do I fail?) and the increase of competence can be measured optimally. However, not all individuals prefer situations in which they get a realistic feedback about their level of competence (e.g., McClelland et al., 1953). According to the achieve-

ment-motivation research mentioned above, only individuals with high hope-of-success prefer tasks of medium difficulty, where they can compare their current performance with others or with their own past performance. In contrast, people who are high in fear-of-failure expect to fail. Because they tend to attribute failure to their own lacking ability, they experience a negative self-evaluation. As a consequence, they try to avoid tasks that are of average difficulty. Such individuals either prefer easy tasks with a high probability of success, or they prefer very difficult tasks, where they can attribute failure on the difficulty of the tasks instead of attributing it on their lacking ability. To sum up, according to Atkinson (1957), individuals high in hope-of-success prefer tasks of average difficulty, whereas people high in fear-of-failure prefer either very easy or very difficult tasks.

Integrating the terminology of Csikszentmihalyi (1990) and the assumption of Atkinson's (1957) model, a challenge-skill balance should lead to higher motivation only for people who are high in hope-of-success. In contrast, for participants who are high in fear-of-failure, being in a challenge-skill balance does not arouse high motivation. On the contrary, being in a challenge-skill balance is a very unpleasant state for fear-of-failure motivated individuals, because fear is maximally aroused. In Csikszentmihalyi's flow model (1990) fear is the antithesis of flow. Also Jackson (1995) mentioned that fear, worry and avoiding thoughts disrupt concentration and self-assuredness. In line with this, other researchers confirmed the negative consequences of fear on positive motivational states (Hagtvet & Johnson, 1992; Spielberger & Vagg, 1995). Fear seems to prevent people from becoming totally involved in the action. Flow cannot arise when experiencing fear, and thus, participants with high fear-of-failure will not experience flow, even when they are in a challenge-skill balance. In contrast, participants who are high in hope-of-success and who are in a challenge-skill balance are likely to experience flow.

### 1.3 Consequences of Flow Experience: Performance and Affect

By assuming flow to be a peak performance state (Csikszentmihalyi, 1999), it is expected that it correlates with high performance. Supporting evidence for this assumption comes from research in sport psychology. For example, Jackson and colleagues found a relationship between flow experience and perceived success (Jackson & Roberts, 1992) suggesting that flow can explain a moderate amount of variance in an objective measure of performance (finishing position) across different kinds of sports (Jackson, Thomas, Marsh, & 2001). Pates and colleagues (Pates, Karageorghis, Freyer, & Maynard, 2003) found that self-selected music could trigger flow which again enhanced the shooting performance among netball players.

Also in academic learning settings flow experience was found to predict performance (Engeser, Rheinberg, Vollmeyer, & Bischoff, 2005; Nakamura, 1991). In a longitudinal study with talented teenagers Csikszentmihalyi and colleagues found that students who reported enjoying talent-related activities and experiencing flow were more likely to further develop their talents (Csikszentmihalyi, Rathunde, & Whalen, 1993). The authors concluded that flow experience is a strong motivator for developing difficult personal skills and thus to enhance performance. Engeser et al. (2005) convincingly demonstrated that flow experience predicted performance in a learning setting at university. At the beginning of the semester they measured flow experience during a lesson of a foreign language course and an elementary statistics course, and found that it predicted exam performance at the end of the semester, even when they controlled for ability. The present research aims at replicating the positive effects of flow experience on exam performance and additionally considers a further flow consequence, namely positive affect.

Csikszentmihalyi (1999, Csikszentmihalyi et al., 1993) suggested that repeated experience of flow might have a pervasive incremental effect on positive mood. Findings showing that flow experience during the working day was associated with positive affect support this notion (Csikszentmihalyi & LeFevre, 1989). In his research on flow deprivation, Csikszentmihalyi (1999) found that not only the presence of flow experience resulted in positive affect, but that also the absence of flow experience resulted in negative affect. Participants, who were asked to force themselves to avoid activities that normally were associated with flow experience, reported more negative affect (e.g., feeling more depressed, less active) than in times when they were allowed to experience flow. Flow experience therefore seems to positively influence well-being. In the present research this relationship is demonstrated in academic learning settings.

### 1.4 Present Research and Hypotheses

In the present study the flow experience in learning settings at university is analyzed in dependence of the challenge-skill balance, by integrating the flow theory (Csikszentmihalyi, 1990) and the risk-taking model (Atkinson, 1957). According to these models the relationship between challenge-skill balance and flow experience should only exist for individuals that score high in hope-of-success but not for individuals who score high in fear-of-failure. Further, flow was expected to be associated with performance and that it can predict affect on a short-term and long-term basis.

To test these hypotheses, two studies in academic learning settings were conducted. Study 1 was a cross-sectional study where challenge-skill balance and the achievement motive was measured in fifty-seven students of an elementary course of psychology. The aim was to scrutinize how

the interaction of challenge – skill balance and achievement motive predicts flow experience. Students rated the fit between their own skills and the challenge of the academic situation (challenge-skill balance). The achievement motive and the flow experience were measured using the Multi-Motive Grid (Sokolowski, Schmalt, Langens, & Puca, 2000) and the Flow Short-Scale (Rheinberg et al., 2003), which both have been proved to be reliable and valid measures. The second aim of Study 1 was to analyze the relationship between flow experience and affect during a course lecture, measured by the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988).

In Study 2 a larger number of students ( $N = 395$ ) was analyzed in a longitudinal design. The first aim of Study 2 was to replicate the interaction of challenge-skill balance and the achievement motive in a bigger sample of students. The same measures as in Study 1 were used. Another aim was to examine whether flow experienced at the beginning of a semester predicts the exam grades at the end of the semester. Additionally, the effects of flow experience on affect could be examined on a long-term basis.

## 2 Study 1

The first study was designed to test the antecedents of flow experience among undergraduate students in a learning setting. In contrast to other researchers who assumed the challenge-skill balance as a direct predictor of flow experience (i.e., Csikszentmihalyi, 1999), the present research takes the theoretical framework of achievement motivation into account (Atkinson, 1957). According to his theory only participants high in hope-of-success experience flow, as only they are comfortable when challenge and skill are in balance. In contrast, individuals with high fear-of-failure usually try to avoid situations where challenge and skill are balanced, because they expect failure. Such situations rather arouse fear and thus should hinder the experience of flow. Additionally, positive affect was hypothesized to be associated with flow.

### 2.1 Method

#### Participants and Procedure

Fifty-seven undergraduate students (42 women, 15 men) ranging in age between 20 and 46 years ( $M = 25$ ,  $SD = 6.13$ ) took part in the study in return for course credit. Data were collected in two successive sessions of an elementary course in psychology with one week in between. In the first session participants filled in the achievement-motive questionnaire and rated their positive and negative affect. In the second session flow, challenge-skill balance and again the positive and negative affect were assessed.

## Measures

### Achievement Motive

The Multi-Motive Grid (MMG; Sokolowski et al., 2000) assessed the hope and fear components of the achievement motive (hope-of-success and fear-of-failure). The MMG also allows measuring the affiliation motive (hope-for-affiliation and fear-of-rejection) and the power motive (hope-of-control and fear-of-power), which were used as control variables in the present research. The Multi-Motive Grid consists of 14 pictures showing everyday situations which are presented along with a set of statements representing motivational tendencies in terms of emotions, cognitions, goal anticipation and instrumental actions. For example, situations arousing the achievement motive are portrayed by pictures showing a badminton game or a person taking an exam. Together with these situations written statements are given, such as “Feeling confident to succeed at this task” (hope-of-success) and “Thinking about lacking abilities at this task” (fear-of-failure). Sokolowski et al. (2000) reported reliability data for the MMG that satisfy traditional standards. Thus internal consistencies (Cronbach  $\alpha$ ) are sufficiently high for the MMG scores (range from  $\alpha = .78$  for hope-of-affiliation to  $\alpha = .90$  for hope-of-power;  $\alpha = .84$  for hope-of-success and  $\alpha = .84$  for fear-of-failure; see Sokolowski et al., 2000). Also the validity of the MMG has been repeatedly demonstrated (e.g., Gable, Reis, & Elliot, 2003; Langens & Schmalt, 2002; see Sokolowski et al., 2000). Like in studies conducted by the test authors, the hope and fear scores in the present study were combined into a single netto-index by subtracting the z-transformed fear-scores from the z-transformed hope-scores (e.g., netto-achievement index = hope-of-success – fear-of-failure; Puca, 2004; Puca & Schmalt, 2001). Thus, high scores represent the tendency to be hope-of-success motivated, whereas low scores represent fear-of-failure.

### Challenge-Skill Balance

In order to assess the challenge-skill balance, a single item measure was used (see also Stoll & Lau, 2005). Participants were asked to continue the beginning of the sentence “For me, personally, the current challenge is . . .” by marking a 9-point-scale with 1 indicating that the current challenge is too low for ones’ skills, 5 indicating that the current challenge fit exactly to ones’ skills and 9 indicating that the current challenge is too high for ones’ skills (Rheinberg et al., 2003). Participants experiencing a challenge-skill balance and participants that do not were assigned to two different groups. Participants who marked the 5 at the 9-point were assigned to the “challenge-skill balance” group, whereas participants who marked one of the other answers were assigned to the “no challenge-skill balance” group. Additionally, a more differentiated index was computed separating the “no chal-

“challenge-skill balance” group into participants that felt too much challenged (marking 6–9) and participants that felt too less challenged (marking 1–4).

### Flow Experience

To measure flow experience the *Flow Short-Scale* (Rheinberg et al., 2003) was administered. It consists of two subscales that represent main characteristics of the flow experience. The subscale *being-absorbed-by-action* (4 items) consists of items such as “I do not recognize that time is going by,” and the subscale *automaticity-in-action* (6 items) is measured with items like “I feel that everything is under control.” Participants were asked to rate whether they agree with each item concerning the current and previous course session using a 7-point scale from 1 (no agreement) to 7 (agreement). Both subscales were highly reliable (Cronbach  $\alpha = .71/.87$ ). Because of high inter-correlations, an average score of flow experience was computed (Cronbach  $\alpha = .89$ ; for this procedure see also Rheinberg & Vollmeyer, 2003). The mean of 4.4 is comparable to scores that the test authors reported for academic learning settings (e.g., Engeser et al., 2005; Rheinberg et al., 2003).

### Measure of Affect

The German version of Watson, Clark, and Tellegen’s (1988) Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996) was used to assess positive affect (i.e., *excited, active*) and negative affect (i.e., *upset, distressed*) with 10 items each. Participants were asked to indicate how they felt at the moment, and they rated each adjective on a 5-point response scale (1 = *very slightly or not at all* and 5 = *extremely*). In accordance with prior research assessing the reliability and validity of the PANAS (e.g., Watson et al., 1988), the present research revealed adequate reliability for the positive as well as the negative affect scale at Time 1 and Time 2 (internal consistencies between .71 and .82). Positive and negative affects were highly negatively correlated (T1,  $r = -.66$ ; T2,  $r = -.62$ ), allowing to compute a general affect score by subtracting positive from negative affect.

## 2.2 Results

### Participant Attrition and Preliminary Analyses

All fifty-seven participants took part in both data collections. Exploratory analyses showed that neither gender, nor age of participants had a significant impact on the results reported below.

### Descriptive Statistics and Intercorrelations

Table 1 shows that flow experience was uncorrelated with the challenge-skill balance and that also the association between flow experience and the achievement motive marginally failed the 5% level of significance. Instead, flow was positively correlated with affect measured simultaneously (Affect T2), but uncorrelated with affect measured one week before (Affect T1). Both affect measures were positively correlated. The achievement motive was correlated with Affect T2 and was independent of the challenge-skill balance.

### Consequence of Flow Experience for Affect

A hierarchical regression analysis was conducted to test the effect of flow experience on affect at T2. Therefore, after controlling for affect at T1 (Step 1), we entered flow experience into the regression equation (Step 2). As expected, flow experience accounted for a significant amount of additional variance ( $\Delta R^2 = .12$ ,  $p < .01$ ) indicating that it is a strong positive predictor of affect at T2 ( $\beta = .35$ ), even when the influence of affect at T1 was controlled ( $\beta = .31$ ,  $p < .05$ ; overall model:  $F(2, 56) = 7.49$ ,  $p = .001$ ,  $R^2 = .22$ ).

### Moderation Analysis

To test our moderator hypothesis, a 2 (challenge-skill balance vs. no challenge-skill balance)  $\times$  2 (hope-of-success vs. fear-of-failure) ANOVA on flow experience was conducted. The groups of hope-of-success and fear-of-failure were created by a median split of the netto-achievement

Table 1  
Intercorrelations (Pearson, two-tailed) and descriptive statistics of variables of Study 1

	1	2	3	4	5	<i>M</i>	<i>SD</i>
1 Flow Experience	1	.11 <sup>1</sup>	.24+	-.02	.34**	4.40	0.72
2 Challenge-Skill Balance		1	-.19 <sup>1</sup>	-.09 <sup>1</sup>	-.09 <sup>1</sup>	–	–
3 Achievement Motive			1	.23+	.34*	5.44	3.25
4 Affect T1				1	.31*	1.69	.69
5 Affect T2					1	1.62	.65

Note. + $p < .10$ , \* $p < .05$ , \*\* $p < .01$ . <sup>1</sup> Because challenge-skill balance is a dichotomous variable (challenge-skill balance = 0, no challenge-skill balance = 1), Spearman’s Rho instead of Pearson’s correlation was computed. When using challenge-skill balance as a continuous variable (recoding the 9-point-scale as follows: 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 4, 7 = 3, 8 = 2, 9 = 1) the Pearson’s correlation with flow experience was  $r = .05$ , ns; with the achievement motive  $r = -.14$ , ns; with affect T1  $r = -.08$ , ns and affect at T2  $r = -.02$ , ns.



Figure 1. The achievement motive as a moderator of the challenge-skill-balance and flow-experience relationship (Study 1). Note. The mean flow experience in the sample ranged from 2.7 to 6.4.

index<sup>1</sup>. Results revealed that neither the main effect of challenge-skill balance,  $F(1, 53) = 1.00$ , nor the achievement motive,  $F(1, 53) = 2.26$ ,  $p = .139$ , was significant. As expected, the challenge-skill balance  $\times$  achievement motive interaction reached significance,  $F(1, 53) = 8.30$ ,  $p = .006$ ,  $\eta^2 = .13$ . Figure 1 depicts that participants who reported a high amount of flow experience were both in challenge-skill balance and high in hope-of-success. In contrast, participants who reported a challenge-skill balance but were high in fear-of-failure experienced the lowest amount of flow.

Additional analyses with the subscales of flow experience showed that the interaction effect occurred for flow automaticity-in-action,  $F(1, 52) = 6.81$ ,  $p = .012$ ,  $\eta^2 = .16$ , and marginally for flow being-absorbed-by-action,  $F(1, 52) = 3.76$ ,  $p = .058$ ,  $\eta^2 = .09$ .

### Supplemental Analyses

Three supplemental analyses were conducted to exclude alternative explanations for the moderator-effect reported above. First, the possibility has to be excluded that affect at T2 could have influenced the moderator effect, because the moderator as well as the dependent measure of the moderator analysis was correlated with affect at T2 (see Table 1). Therefore, an additional  $2 \times 2$  analysis of variance was conducted on flow experience, this time with affect at T2 controlled as a covariate. Results revealed that the challenge-skill balance  $\times$  achievement motive interaction remained significant,  $F(1, 52) = 5.78$ ,  $p = .020$ . Additionally, a marginally significant effect for the covariate Affect T2,  $F(1, 52) = 3.95$ ,  $p = .052$ , was found.

Second, in order to test whether the moderator effect was specific for the achievement-motive and does not occur for motives in general, the ANOVA reported above was repeated with the affiliation motive instead of the achievement

motive. The analysis revealed no significant effect for the affiliation motive ( $F(1, 52) < 1$ ) or the affiliation  $\times$  challenge-skill balance interaction,  $F(1, 52) = 2.29$ ,  $p = .136$ . A second analysis including the power motive instead of the achievement motive revealed no effect of power motive ( $F(1, 52) < 1$ ) and a marginally significant power  $\times$  challenge-skill balance interaction,  $F(1, 52) = 3.31$ ,  $p = .075$ .

Finally, the moderator effect might be different for participants who felt too much challenged compared to participant that felt not enough challenged. In the moderator analysis reported above these two groups were simply aggregated into the “no challenge-skill group.” To disentangle the effect for both subgroups, two additional analyses were conducted. The first analysis of variance compared the challenge-skill group ( $N = 26$ ) with the group of participants that felt too much challenged ( $N = 21$ ), and the second analysis compared the challenge-skill group with the participants that felt too less challenged ( $N = 10$ ). Both analyses revealed the same pattern of interaction as the analyses with the aggregated “no challenge-skill group,” indicating that only hope-of-success motivated, but not fear-of-failure motivated individuals reported more flow experience when in a challenge-skill balance compared to when they are not in a challenge-skill balance. The type of no-challenge-skill balance did not matter (too much challenged:  $F(1, 43) = 4.13$ ,  $p = .048$ ; too low challenged:  $F(1, 32) = 7.09$ ,  $p = .012$ ).

### 2.3 Brief Discussion

The interaction effect indicated that only hope-of-success motivated individuals but not fear-of-failure motivated individuals reported flow experience when they are in a challenge-skill balance. This is in accordance with Atkinson’s (1957) risk-taking model, predicting that only hope-of-success motivated individuals but not fear-of-failure motivated individuals prefer mean task difficulties. However, the marginally significant challenge-skill balance  $\times$  power interaction, which was descriptively similar to the challenge-skill balance  $\times$  achievement interaction, indicates that parts of the interaction effect could be ascribed to a kind of superordinate or general hope motive that underlies these motives.

In contrast to results reported by Csikszentmihalyi (1990) our study revealed no significant direct association between the challenge-skill balance and flow experience. At least two reasons could be responsible for this. First, it could be argued that our measures might not be reliable or that they might lack validity. Findings of previous studies demonstrating a good reliability and validity of these measures speak against such an interpretation (i.e., Engeser et al., 2005; Stoll & Lau,

1 An alternative method to test the moderator hypothesis is to consider the hope-of-success and fear-of-failure components of the achievement motive separately, rather than using the netto-achievement index. An analysis of variance with hope-of-success (high vs. low) as well as the analysis with fear-of-failure (high vs. low) as moderators of the relationship between the challenge-skill balance and flow experience also revealed, as expected, significant moderator effects (hope-of-success:  $F(1, 53) = 3.63$ ,  $p(\text{one-tailed}) = 0.31$ ; fear-of-failure:  $F(1, 53) = 3.31$ ,  $p(\text{one-tailed}) = .038$ ).

2005). Indeed, more likely the challenge-skill balance is not directly associated with flow experience, but can only be discovered when taking the achievement motive into account. The significant interaction between the challenge-skill balance and the achievement motive strongly supports this explanation. Study 1 also confirmed the postulated relationship between flow experience and affect as one of its most important consequences.

### 3 Study 2

The purpose of Study 2 was to replicate the findings of Study 1, suggesting that the achievement motive moderates the relationship between challenge-skill balance and flow experience with a larger number of students. An additional purpose of Study 2 was to extend the examination of flow consequences by additionally measuring affect and exam performance. Comparable to Study 1, participants were recruited in an elementary course of psychology. At the beginning and after the semester they were asked to answer questionnaires. Additionally, after the semester exam performance and affect were measured.

#### 3.1 Method

##### Participants and Procedure

Data were collected in three phases. At the beginning of the semester, 395 undergraduate students were recruited in a psychology course. They were told that the study was on "Motivation, Emotion and Goals" and that it consisted of two parts at the beginning of the semester for which they received extra course credits (Time 1, Time 2). They were further told that they could participate in a third part which would take place after their intermediate examination in the following vacations (Time 3). In the first week of the semester (Time 1) participants filled in the achievement motive and affect questionnaire. In the second week of the semester (Time 2) they were given a take-home booklet consisting of the flow and challenge-skill balance measure, and they were asked to fill in this questionnaire at home the same day and send it back immediately. The questionnaire contained the invitation to participate in the third part of the study. Fifty-two participants decided to take part in the whole study. The exam grades of these students and the ratings of how they felt during the last weeks before the exams were registered. The exams took place four weeks after the end of the semester (Time 3; 18 weeks after T1).

##### Measures

The variables of Study 2 were measured using the same questionnaires as in Study 1. Only the internal consistencies and the aggregations of the variables are reported here.

##### Measures at Time 1

The internal consistency coefficients at Time 1 were adequately high for positive and negative affect (Cronbach  $\alpha = .82/.84$ ) (PANAS, Krohne et al., 1996) and acceptable for the achievement motive subscales hope-of-success and for fear-of-failure (Cronbach's  $\alpha = .62/.58$ ) (MMG, Sokolowski et al., 2000). As in Study 1, participants were asked how they felt during the last weeks and the scores of both affect scales were aggregated by subtracting the positive from the negative affect scores. A netto-achievement index was created by subtracting fear-of-failure from hope-of-success.

##### Measures at Time 2

At Time 2 the internal consistencies were .92 for the general flow score. For the flow subscales the internal consistencies were .82 (being-absorbed-by action) and .88 (for automaticity-in-action) (FKS, Rheinberg et al., 2003). Again, the item measuring the challenge-skill balance was dichotomized into a "challenge-skill group" and a "no challenge-skill group." For more differentiated analyses the no-challenge-skill group was divided into participants that felt too much challenged and those that felt too low challenged.

##### Measures at Time 3

The positive and negative affect scales of the PANAS at Time 3 were reliable (Cronbach  $\alpha = .87/.86$ ) and were aggregated to an affect index as described above. The performance in the intermediate examination was requested from the participants by directly asking them for their exam grades.

### 3.2 Results

#### Participant Attrition and Preliminary Analyses

The high drop-out rate of participants from Time 1 to Time 3 can be explained by the fact that the data collection at Time 3 took part in the vacation in which students had to work or were on holiday after their intermediate exams. Another reason may be that no further extra credits were offered. Participants who dropped out of the study did not differ from participants who further took part, neither in their affect or achievement motive at Time 1, nor in the flow measure or the challenge-skill balance at Time 2. Further preliminary analyses revealed that neither age, nor gender of the participants had a significant impact on the results reported below.

#### Consequences of Flow Experience and Descriptive Statistic

As predicted, flow experience was significantly associated with exam performance and affect at T3 (Table 2). Because

Table 2  
Intercorrelations (Pearson, two-tailed) and descriptive statistics of variables of Study 2

		1	2	3	4	5	6	<i>M</i>	<i>SD</i>
1	Flow experience	1	.10 <sup>1</sup>	.16**	.35**	.47**	.38**	4.65	.90
2	Challenge-skill balance		1	-.02 <sup>1</sup>	.01 <sup>1</sup>	.08 <sup>1</sup>	-.08 <sup>1</sup>	–	–
3	Achievement motive			1	.23	.25**	.42***	3.04	3.20
4	Exam performance				1	.24+	.50***	4.23	.85
5	Affect T2					1	.43***	1.60	.90
6	Affect T3						1	1.67	1.04

Note. + $p < .10$ , \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .  $N = 395$ . Exam performance and affect T3 were measured at Time 3 where only 52 students participated. <sup>1</sup>Spearman's Rho. When using challenge-skill balance as a continuous variable as described in the note of Table 1, the Pearson's correlation with flow experience was  $r = .03$ , *ns*; with achievement motive  $r = -.03$ , *ns*; with exam performance  $r = .10$ , *ns*; with affect T1  $r = .05$ , *ns* and with affect at T2  $r = -.02$ , *ns*.

affect at T2 was correlated with all three variables, it was controlled as a covariate in additional regression analyses. The association between flow experience and affect at T3 as well as flow experience and exam performance remained significant (overall model predicting affect:  $F(2, 51) = 7.48$ ,  $p < .001$ ,  $R^2 = .23$ ,  $\beta_{flow} = .24$ ,  $p < .05$ ; overall model predicting exam performance:  $F(2, 51) = 3.74$ ,  $p = .031$ ,  $R^2 = .14$ ,  $\beta_{flow} = .30$ ,  $p < .05$ ). Table 2 also shows the means and standard deviations of the variables and the significant correlation between flow experience and the achievement motive.

### Moderation Analysis

As in Study 1, a 2 (challenge-skill balance vs. no challenge-skill balance)  $\times$  2 (hope-of-success vs. fear-of-failure) ANOVA on flow experience was conducted. Hope-of-success and fear-of-failure were created by a median split of the netto-achievement index. There was no main effect of challenge-skill balance,  $F(1, 384) = 2.15$ ,  $p = .143$ , whereas the achievement motive was a significant predictor,  $F(1, 384) = 5.71$ ,  $p = .017$ ,  $\eta^2 = .02$ . In contrast to Study 1, the challenge-skill balance  $\times$  achievement motive interaction did not reach significance,  $F(1, 384) = 2.12$ ,  $p = .146$ ,  $\eta^2 = .005$ , using the aggregated flow score. To test whether the effect could be shown for the flow subscales, analyses were repeated with flow being-absorbed-by-action and flow automaticity-in-action as dependent variables. For flow being-absorbed-by-action the interaction effect was significant,  $F(1, 384) = 3.92$ ,  $p = .048$ ,  $\eta^2 = .01$ , indicating that participants high in hope-of-success who were in a challenge-skill balance were more absorbed-by-action than participants with fear-of-failure or participants with no challenge-skill balance. This interaction is illustrated in Figure 2. The main effects of the achievement motive,  $F(1, 384) < 1$ ,  $p = .43$ , and challenge-skill balance,  $F(1, 384) = 2.26$ ,  $p = .134$ , failed to reach significance. The ANOVA with flow automaticity-in-action revealed a main effect of the achievement motive,  $F(1, 384) = 9.45$ ,  $p = .002$ ,  $\eta^2 = .01$ , but no interaction effect.

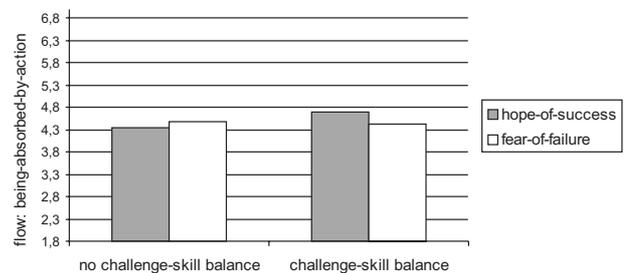


Figure 2. The achievement motive as a moderator of the challenge-skill-balance and flow-experience relationship (Study 2). Note. The mean flow being-absorbed-by-action score in the sample ranged from 1.8 to 7.0.

### Supplemental Analyses

As in Study 1, the moderator-effect reported above was further examined in order to prove our hypothesis by excluding alternative explanations. Similar to Study 1, the moderator as well as the dependent measure of the moderator analyses were correlated with affect at T3 (see Table 2). To ensure that the moderator effect was not influenced by affect at T3, it was controlled as a covariate in additional analyses of variance. The pattern of results was similar to the results reported above. Thus, the challenge-skill balance  $\times$  achievement motive interaction still predicted, as expected, flow in terms of being-absorbed-by-action significantly,  $F(1, 384) = 3.04$ ,  $p(\text{one-tailed}) = .041$ ,  $\eta^2 = .01$ .

To test whether the interaction effect was specific for the achievement motive, analyses with flow being-absorbed-by-action as the dependent variable were repeated with the affiliation motive and the power motive, respectively, and with the challenge-skill balance as predictors. For the affiliation motive, the main effect,  $F(1, 384) = 3.16$ ,  $p = .076$ , as well as the interaction challenge-skill balance  $\times$  affiliation motive,  $F(1, 384) = 3.33$ ,  $p = .069$ , were marginally significant. The ANOVA with the power motive revealed a significant main effect of power motive,  $F(1, 384) = 4.30$ ,  $p = .039$ ,  $\eta^2 = .01$ . This indicates that participants with high hope-of-power scores reported a higher amount of flow

compared to participants with high fear-of-power scores. The interaction of challenge-skill balance  $\times$  power motive, however, was not significant,  $F(1, 384) < 1$ .

As in Study 1 we tested whether the moderator effect of flow being-absorbed-by-action was different for participants who felt too much challenged or not challenged enough. The analysis of variance including the challenge-skill group and the too-high-challenged group, as well as the analysis based on the comparison between the challenge-skill group and the too-low-challenged group showed, as expected, that the interaction effects were comparable to the moderator effect reported above, reaching statistical significance when being tested one-tailed (too-high-challenged group:  $F(1, 285) = 3.41$ ,  $p(\text{one-tailed}) = .033$ ,  $\eta^2 = .02$ ; too-low-challenged group:  $F(1, 291) = 3.36$ ,  $p(\text{one-tailed}) = .034$ ,  $\eta^2 = .01$ ). Again, the type of no-challenge-skill balance did not make a difference.

### 3.3 Brief Discussion

The design of Study 2 allowed testing the achievement motive as a moderator of the challenge-skill-balance and flow-experience relationship. Further, because of its longitudinal design it allowed examining the long-term effects of flow experience on performance and affect.

As in Study 1 we found no main effect of challenge-skill balance on flow experience, but we found a significant interaction of challenge-skill balance  $\times$  achievement motive. This supports our assumption that the achievement motive plays a major role in the relationship between challenge-skill balance and flow experience. The effect was weaker than in Study 1 and only occurred in one of the two flow subscales (see general discussion for a possible explanation). As in Study 1, the challenge-skill balance  $\times$  motive interaction was marginally significant for another than the achievement motive. This again indicates that parts of the interaction effect could be ascribed to a superordinate or general hope motive that underlies these motives.

The results concerning the consequences of flow experience totally confirmed our hypothesis. As predicted, flow experience was associated with exam performance and affect.

## 4 General Discussion

The present studies aimed at extending previous research on antecedents of flow experience by drawing on an influential theory of motivation. Atkinson's (1957) risk-taking model suggested that the achievement motive might be a moderator of the relationship of challenge-skill balance and flow experience. Research on the risk-taking model suggests that individuals high in hope-of-success prefer task difficulties that match their skills. In contrast, individuals who are high in fear-of-failure avoid mean task difficulties

and instead prefer either too low or too high difficulties. Interpreting the challenge-skill balance, which Csikszentmihalyi and LeFevre (1989) assumed to be an important flow predictor, as a task with a mean difficulty, the achievement motive should be a moderator of the challenge-skill-balance and flow-experience relationship. Only individuals high in hope-of-success, but not individuals high in fear-of-failure should experience flow when they are in a challenge-skill balance. The results of Study 1 strongly supported this hypothesis. In Study 1 hope-of-success-motivated individuals, but not fear-of-failure-motivated individuals scored high on the flow measure when in a challenge-skill balance. That is, they experienced automaticity in preparing for the examination and additionally felt absorbed by the learning activity itself. The results of Study 2 also supported the hypothesis although the effects were weaker. Hope-of-success-motivated individuals in a challenge-skill balance experienced a higher amount of absorption-by-action in their preparing activities than fear-of-failure-motivated individuals. It could be argued that a situational characteristic might be responsible for the lacking effect of automaticity-in-action, the second flow scale. The most obvious situational difference between Study 1 and Study 2 is the different sample size. In Study 2 participants were asked for their flow experience while surrounded by 394 other students, whereas in Study 1 the sample was much smaller ( $N = 57$ ). Because larger groups are more likely a source of noise and distraction than smaller groups and because both noise and distraction have been shown to negatively influence flow experience (e.g., Csikszentmihalyi, 1990), the effects of Study 2 might have been disturbed. Further research is needed to test the influence of group size on flow experience in learning settings.

Another issue of both studies was to demonstrate that flow experience has a high and long-term impact on academic relevant variables. Although it can be assumed that exam performance and affect at the end of a semester must be influenced by a variety of predictors, as for example cognitive capacity, test anxiety or instrumental and social support, flow experience measured at the beginning of the semester still stands out as a significant predictor. This underlines the importance of motivational states for performance and affect.

### Limitations and Future Perspectives

One limitation of the present research is the correlational design of the studies that, strictly speaking, did not allow proving causality. In order to prove that the challenge-skill balance ratings and the achievement motive influence the flow experience and not vice versa, experimental designs are needed. One experimental study that varied the challenge-skill balance and analyzed the effects on flow experience was conducted by Rheinberg and Vollmeyer (2003). The authors varied the difficulty of a computer game and measured how much flow was experienced when the diffi-

culty of the game either fitted exactly to the participants' skills or was too high or too low for their skills. In accordance with our line of argumentation, the amount of flow experience depended on the task difficulty; the highest amount of flow experience was reported when task difficulty and skills were balanced. This result supports our assumption that the challenge-skill-balance rating influenced the flow experience and not vice versa. A further experiment is required where additionally hope-of-success and fear-of-failure are varied experimentally.

Another issue that warrants discussion is that the challenge-skill balance was measured by self-report. Our participants rated whether the current challenge in the course lectures was too low or too high for their skills or exactly fitted their skills. It could be criticized that – as true for all self-report measures – the self-rating must not correspond with the objective challenge-skill balance and that, as a consequence, some participants made realistic ratings whereas others did not. However, according to flow theory, the subjective perception rather than the objective measure of the fit between challenge and skills are relevant for predicting flow experience. This is of high interest for research on learning motivation. Learning motivation and flow experience are *psychological* phenomena that are highly sensible to be influenced by other psychological variables, as for examples self-ratings of competence, expectancies and, as could be shown in this study, by self-ratings of the challenge-skill balance. This stresses the relevance of *subjective* ratings and perceptions that were often neglected in academic learning contexts, in which skills and abilities are often assumed to be the most important antecedents of academic performance.

With the present work we could support research focusing on motivational aspects of learning, especially on the functional state of learning. As already mentioned above, Engeser and colleagues (2005) found that flow experience explained variance in an objective performance measure that was independent of all predictors usually measured to predict performance in learning settings. This shows that it is worth to further analyze the antecedents of flow experience and to additionally draw practical conclusions in order to enhance flow experience. The findings of the present research suggest that flow experience can be enhanced by reducing fear-of-failure. This could be done for example by applying trainings to reattribute failure (see Rheinberg & Krug, 1999), or by matching the academic challenge with the students' skills. Future research is needed to test this conclusion empirically.

Another future perspective is to gain more information about flow experience by extending the way of measurement. For example, the experience-sampling method (e.g., Csikszentmihalyi & Larson, 1987; Schallberger & Pfister, 2001) could be used to ask for the experience of flow not only during lectures at university, but also during learning sessions at home or learning in cooperation with others. Furthermore, it is important to know whether these effects can be generalized, in order to scrutinize whether the mod-

erator effects of the flow antecedents and flow consequences can be replicated in nonacademic learning settings, for example in sports.

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