

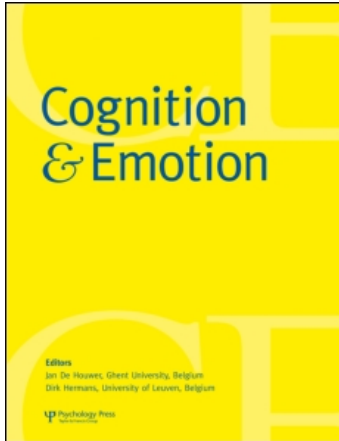
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Seeing and mastering difficulty: The role of affective change in achievement flow

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Achievement flow involves total absorption in an activity, high concentration without effort and merging of thought and action. The authors propose that achievement flow is facilitated by dynamic alternatives between low positive affect (“seeing difficulty”) and high positive affect (“mastering difficulty”). Consistent with this hypothesis, three studies showed that traits associated with reduced positive affect (avoidant adult attachment, schizoid-like personality style, introversion) and traits supportive of restoring positive affect (mastery orientation) predicted achievement flow, as assessed with a new operant motive test (OMT). Achievement flow motives were further found to be associated with flow experiences in achievement tasks (Study 1), intrinsic motivation in an academic context (Study 2), and volitional facilitation as assessed by removal of Stroop interference after experimentally induced difficulty and positive affect (Study 3). These findings offer converging evidence that flow experiences arise from dynamic changes in positive affect.

Keywords: Flow; Implicit motives; State versus trait; Positive affect; PSI theory.

Why do people spend hours and days riding their bike through a desert, sailing single-handed across the ocean or playing chess against a computer program? What affective dynamics characterize individuals who are driven to get fully immersed in tasks and to frequently experience flow in their daily life? Are there particular states or traits that predispose individuals to experience flow?

Flow is a state of intrinsic motivation in which a person is fully immersed in what he or she is doing for the sake of the activity itself (Csikszentmihalyi,

1975/2000, 1990). The present paper seeks to advance our theoretical understanding of flow by looking at some general principles of the motivational–emotional dynamics underlying flow within the person. More specifically, we propose the *affective change hypothesis*, which states that achievement flow arises from dynamic changes between low positive affect (“seeing difficulty”) and high positive affect (“mastering difficulty”).

In the following paragraphs, we begin by discussing classic work on flow, which has generally

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followed a phenomenological approach. Next, we propose a functional analysis of the psychology of flow, which decomposes flow into its underlying mechanisms. The affective change hypothesis is derived from this analysis. If the affective change hypothesis is correct, then flow motives and experiences should be especially prevalent among individuals with a combination of personality traits associated with reduced positive affect (seeing difficulty) and increased positive affect (mastering difficulty). Finally, we present three studies that tested our theoretical analysis using a newly developed operant motive test (Kuhl & Scheffer, 1999) to assess a motive disposition to seek flow in the achievement domain.

Previous research on flow

Traditionally, research on flow has adopted a phenomenological approach (Csikszentmihalyi, 1975/2000, 1990; Csikszentmihalyi & Larson, 1987; Csikszentmihalyi & LeFevre, 1989). This work successfully identified the major aspects of the flow state from the perspective of the experiencing person: High concentration and complete absorption with the activity at hand, merging of action and awareness, loss of self-consciousness, transformation of time and feelings of great freedom, enjoyment, and fulfilment.

In addition to offering a window into peoples' everyday experience, flow theory has contributed to our understanding of conditions that promote flow: Clarity of goals, unambiguous and immediate feedback, and balance between perceived challenges and skills. According to Csikszentmihalyi (1975/2000), an optimal balance between perceived challenges and skills is crucial for people to experience flow. To maintain a state of flow, people have to continuously adjust the balance of challenges and skills. On the one hand, they have to actively seek difficulty in order to keep perceived challenges high. On the other hand, they have to convince themselves that they will be able to master these challenges in order to keep perceived skills high. Csikszentmihalyi (1997) extended his balance model by postulating that flow can only be experienced when skills and challenges are both on

a high level. If challenges over-match skills, positive affect decreases and concentration increases until people fall in a state of arousal or fear. If skills over-match challenges, positive affect increases and concentration decreases until people fall in a state of relaxation or boredom.

Most research to date has started from the assumption that flow represents the perceived balance between challenges and skills, and related flow to other outcomes (Rheinberg, Vollmeyer, & Engeser, 2003). As a result, the notion that the challenge–skill balance is the key mechanism that causes flow has remained largely untested. Moreover, studies on flow have been largely correlational (Keller & Bless, 2008). Only recently, have researchers begun to experimentally manipulate the balance between personal skills and task demands and to explore the causal impact of an optimal balance on flow experience (Keller & Bless, 2008; Rheinberg & Vollmeyer, 2003; Schiefele & Roussakis, 2006). As such, the aim to unravel mechanisms that contribute to full absorption in an activity remains an important agenda in flow research.

Although flow research has so far been primarily concerned with flow as a motivational state, Csikszentmihalyi and colleagues (Csikszentmihalyi, Rathunde, & Whalen, 1993; Nakamura & Csikszentmihalyi, 2002) have also suggested the idea of an autotelic personality. Autotelic personalities tend to position themselves in situations that enable frequent experiences of flow states (Asakawa, 2004). In spite of this conceptual work, flow research has so far paid little attention to individual differences. Nevertheless, recent studies have shown that flow experiences are systematically related to individual differences such as fear of failure (Schüler, 2007), and performance-related action orientation (Keller & Bless, 2008). The latter findings indicate that it is important to consider individual differences when trying to unearth mechanisms underlying flow.

A functional analysis of achievement flow

The present analysis is confined to flow in the achievement domain, which is conceived of as the

intrinsic component of achievement motivation and characterised by actively seeking involvement in challenging tasks and enjoying the process of mastering these challenges. The tendency to seek flow in the achievement domain is an amalgam of the aroused need to master challenging tasks (seeing or seeking difficulty) and its mastery-approach implementation (mastering difficulty). According to the affective change hypothesis, these two components are differentially associated with positive affect. A focus on difficulty is associated with reduced positive affect (cf. Kuhl, 2000, 2001; Kazén & Kuhl, 2005), whereas a focus on mastery is associated with the ability to overcome instances of reduced positive affect and to get fully immersed in difficult tasks (Baldwin, 2001; Harackiewicz, Barron, Tauer, & Elliot, 2002; McGregor & Elliot, 2002). Thus, achievement flow is not expected to be based on a single affective state (e.g., positive affect) but dynamic changes between reduced and restored positive affect.

The affective change hypothesis is in accordance with Csikszentmihalyi's (1975/2000) conceptualisation of flow as a motivational state, which comes into play in situations that are neither overexciting nor boring, and thus yield an optimal arousal range. We extend this work by looking at within-person factors that help to manage the intricate balance between too much and too little positive affect. The affective change hypothesis is also compatible with classical conceptualisations of achievement motivation. According to McClelland and colleagues, affective changes early in life accompanying doing well or failing to do well in various learning situations provide the basis for motivation to succeed and to avoid failure (McClelland, 1985; McClelland, Atkinson, Clark, & Lowell, 1953). Affective changes also occur during implementation of achievement needs because an achievement-related episode typically starts with a phase of reduced positive affect (when a person is confronted with difficulty, challenge or frustration) that turns into positive affect when the person anticipates or obtains success (Kuhl, 2001, p. 551; McClelland, 1985; McClelland et al., 1953).

In a similar vein, the flow experience of thoughts and actions running fluidly and smoothly can be functionally described in terms of dynamic changes in positive affect. This assumption seems to run against the subjective experience of typical flow activities as purely interesting and fun. Thus, one might argue that in typical flow activities positive affect is constantly high because of the fun and interest in the task itself. Consistent with this assumption, positive affect is typically increased *after* flow activities (e.g., Rogatko, 2007). However, flow is linked to an optimal challenge (Atkinson, 1957; Csikszentmihalyi, 1990; Kuhl, 1978; Rheinberg & Vollmeyer, 2003). Challenging tasks inevitably involve obstacles, uncertainty, and frustration (i.e., seeing difficulty). Therefore, it takes self-regulatory abilities such as mastery-approach orientation (Elliot, 1999) to overcome obstacles and reductions in positive affect associated with a focus on difficulty *during* the flow activity (i.e., mastering difficulty). Such fine-grained self-regulatory abilities can occur intuitively and outside of individuals' conscious awareness (Jostmann, Koole, Van der Wulp, & Fockenberg, 2005; Koole & Jostmann, 2004). Furthermore, they become especially evident under difficult (e.g., demanding) conditions (Jostmann & Koole, 2007).

Coalitions of traits that are conducive to flow

The findings by Keller and Bless (2008), among others, show that flow does not arise for everybody as a result of optimal task conditions—even if task demands are dynamically adjusted to individuals' skill level. Conceivably, flow involves active self-regulatory processes that are subject to individual differences (such as action versus state orientation). Individual differences may not only influence how people perceive their own skills but also how they perceive and actively organise task demands. The latter aspect has typically been described as an environmental characteristic but may as well require specific personal characteristics.

According to the affective change hypothesis, a combination of two kind of traits is needed to support achievement flow. On the one hand, traits are needed that support a focus on difficulty and an inhibition of positive affect. On the other hand, traits are needed that help to restore positive affect and master difficulty. This specific combination of personality traits supports dynamic changes in positive affect that form the functional basis of achievement flow motivation. Examples of traits associated with chronic inhibition of positive affect are an independent, schizoid-like personality style (Kuhl & Kazén, 1997), avoidant adult attachment (Brennan, Clark, & Shaver, 1998), and introversion. Experimental analyses of the Big Five model have systematically demonstrated negative relationships between introversion and Gray's (1987) reward system: introversion is related to weaker experience of positive affect (Diener, Sandvik, Pavot, & Fujita, 1992), faster shifts of attention away from locations where points could be gained (Derryberry & Reed, 1994), and poorer performance in reward trials (Gupta & Nagpal, 1978; Nichols & Newman, 1986). Similarly, an independent, schizoid-like personality style is characterised by reduced associative learning between nonsense syllables and positive events (cf. Baumann, Kaschel, & Kuhl, 2007). Furthermore, Laurenceau, Troy, and Carver (2005) demonstrated that perceived progress towards intimacy is a strong source of positive affect above and beyond perceptions of intimacy. Independent and avoidant individuals, in contrast, emphasise self-reliance and actively distance themselves from social partners and emotion-laden material (Bowlby, 1988; Mikulincer & Florian, 1998) and thus inhibit positive affect.

Mastery orientation (Elliot, 1999) is an example of traits associated with self-regulatory abilities to overcome instances of reduced positive affect and to get fully immersed in difficult tasks. The link between mastery-approach and meta-cognitive, self-regulatory strategies has been supported by Baldwin (2001). Recent findings indicate that such self-regulatory strategies may operate intuitively through activation of the implicit self (Koole & Coenen, 2007; Koole & Jostmann, 2004).

Furthermore, mastery-approach has been found to predict absorption during studying activities and continued interest over students' college careers (Harackiewicz et al., 2002; McGregor & Elliot, 2002). Thus, mastery orientation may help independent individuals to self-generate positive affect in face of difficulties and to put intentions smoothly into action.

The present research and hypotheses

To summarise, the affective change hypothesis holds that flow is a complex motivational phenomenon that arises from the interaction between inhibited positive affect and upregulated positive affect. We designed the present three studies to empirically test the affective change hypothesis. We assume that individuals may actively seek for opportunities to experience flow in daily life. Thus, a strong tendency to experience flow states in daily life may be driven by a stable motive disposition. In all of our three studies, we therefore used a newly developed Operant Motive Test (OMT; Kuhl & Scheffer, 1999) to assess a motive disposition to seek flow in the achievement domain.

The present studies further investigated some of the personality correlates of the achievement flow motive. From the affective change hypothesis, it can be derived that flow motivation arises from the interaction between traits related to inhibited positive affect (seeing difficulty) and traits related to up-regulation of positive affect (mastering difficulty). In Studies 1 and 3, we investigated an independent (schizoid-like) personality style (Kuhl & Kazén, 1997) as a trait related to inhibited positive affect in conjunction with mastery orientation (Kuhl, 1999). In Study 2, we investigated avoidant adult attachment (Brennan et al., 1998) and introversion as traits related to inhibited positive affect in conjunction with mastery-approach goals (Elliot, 1999).

In addition to these general hypotheses, each study of the present research also tested more specific aspects of our theoretical analysis. In Study 1, we investigated the validity of our new motive measure of achievement flow by testing its

relationship with actual flow experiences in daily life. In addition, we predicted that flow motives would be distinct from implicit achievement motives that are assessed by traditional measures. In Study 2, we investigated competing negative traits (i.e., neuroticism) and goal orientations (i.e., achievement orientation) that did not match our theoretical rationale of affective change along the positive-affect dimension. Furthermore, we investigated the relationship between flow and intrinsic motivation. Because the achievement flow motive is conceived of as the intrinsic component of achievement motivation we expected a positive relationship with intrinsic study motivation among students.

Finally, the search for a specific pattern of personality traits that characterises individuals high in achievement flow motive represents a macro-analytical approach to system interactions. In Study 3, we also tested our affective change assumption on a micro-analytical level. If individuals high in achievement flow motive typically activate opposing personality systems (i.e., reduced and restored positive affect) they should have increased performance when experimentally activating both systems by using a difficult task (i.e., Stroop, 1935) and priming positive affect (cf. Kazén & Kuhl, 2005; Kuhl & Kazén, 1999). Individuals high in achievement flow were expected to show volitional facilitation as indicated by a significantly reduced Stroop interference after positive achievement primes.

STUDY 1

In Study 1, we conducted a first exploration of a new measure of flow motivation that is based on the OMT (Kuhl & Scheffer, 1999). Examples of achievement flow contents are illustrated in Figure 1. In the OMT, participants are to choose one main character from the ones depicted in the picture as protagonist and invent a story. The first question to be answered in response to each OMT picture is likely to elicit need descriptors (e.g., involvement in challenging task) whereas the second question is likely to elicit implementation

descriptors (e.g., mastery approach). The third and fourth questions are optional. The underlying assumptions are based on research indicating that moods and affective processes ("How does the person feel?") are critical indicators for enactment-related determinants like mastery-approach or mastery-avoidance, especially with regard to behavioural facilitation or inhibition (Baumann & Kuhl, 2005; Gray, 1987; Kazén & Kuhl, 2005; Kuhl, 2000; Kuhl & Kazén, 1999). Only if participants show both types of answers, that is, indicate a full choice and implementation sequence, the score on achievement flow motive is given.

In Study 1, we tested the validity of our new measure of achievement flow motive by showing its relationship with experiences of the various aspects of flow in daily life using the Experience Sampling Method (ESM; Csikszentmihalyi & Larson, 1987). The ESM is currently considered the gold standard in flow research because it allows the assessment of flow across different tasks and situations. Our hypothesis predicted that individuals high in achievement flow motive would create more experiences of flow across different tasks and situations. A second aim was to explore the overlap between our new operant measure of achievement flow motive and the established construct of *nAch* (need for achievement) as assessed by the Thematic Apperception Test (TAT). Because *nAch* is not confined to the *intrinsic* component of the achievement motive, we expected no significant correlation between the two constructs. More importantly, we expected the achievement flow motive to account for variance in flow experience after controlling for *nAch*.

Finally, we wanted to identify personality correlates of the achievement flow motive. We assessed an independent personality style as a trait associated with seeing difficulty. The independent personality style is conceptualised as a non-pathological analogue to the schizoid personality disorder described in psychiatric diagnostic manuals DSM-IV (American Psychiatric Association, 1994) and ICD-10 (World Health Organization, 1992). It is important to note that high values on an



	<p>What is important for the person in this situation and what is the person doing?</p> <p>"High concentration is important. The person is totally involved in climbing the steep mountain and focuses on holds."</p> <p>How does the person feel?</p> <p>"Invigorated, focused, and happy."</p> <p>Why does the person feel this way?</p> <p>"Because the person is confident of mastering this challenge."</p> <p>How does the story end?</p> <p>"The person reaches the top."</p>
	<p>What is important for the person in this situation and what is the person doing?</p> <p>"The fun of the game. The person is concentrated on the puzzle."</p> <p>How does the person feel?</p> <p>"Concentrated, elated."</p> <p>Why does the person feel this way?</p> <p>"The person likes to solve difficult puzzles."</p> <p>How does the story end?</p> <p>"The puzzle is solved."</p>

Figure 1. Two measurement examples of the achievement flow motive.

independent personality style do not indicate a personality disorder but a typical configuration of affective and cognitive systems. An independent, schizoid-like personality is associated with reduced sensitivity to positive affect (Baumann et al., 2007; Kuhl & Kazén, 1997). Consistent with this assumption, independent, schizoid-like personality correlates with reduced associative learning between nonsense syllables and positive events (i.e., reward), $r = -.24$, $p < .05$ (cf. Kuhl, 2001, p. 943), and reduced positive emotional contagion through the partner (cf. Kuhl & Kazén, 1997).

Our hypotheses predicted: (a) a significant relationship between achievement flow and flow experience; (b) a significant Independence

(independent personality style) \times Mastery interaction on achievement flow; and (c) significant relationships for achievement flow over and above $nAch$.

Method

Participants

Forty business students from the Nordakademie (23 women and 17 men) voluntarily participated in a career-development programme in form of an outdoor assessment centre organised by the Ellernhof, a provider of outdoor team trainings, leadership trainings and assessment centres near Lueneburg. The mean age of the participants was 23.4 years (range 18 to 29 years).

Materials

The OMT (Kuhl & Scheffer, 1999) was administered to assess the achievement flow motive.¹ Using a modified TAT technique, participants were presented with 15 pictures like the ones depicted in Figure 1. Participants were asked to invent a story and give their spontaneous associations to four questions (see Figure 1). The OMT differentiates four approach components for each motive on the basis of crossing two affective sources of motivation (positive vs. negative) with self-determined versus incentive-focused forms of motivation. For the achievement motive, the two positive modes of approach motivation can be described as self-determined *flow* (being absorbed in a challenging task) and *standards of excellence* (doing something well, being proud, focused on results) whereas the two motivational modes driven by negative affect are self-determined *coping with failure* (perception of threat associated with active coping) and *pressure to achieve* (social standards, relief after success). In addition, the OMT consists of a classical avoidance component for each motive (e.g., *fear of failure*). This differentiation allows the testing of theoretically interesting differences in the type of self-regulation involved in need-satisfaction. For the purpose of the present studies, the flow component was relevant.

Dominant contents for coding the achievement flow motive are: Curiosity and interest, feedback through the activity itself, learning something (because it is interesting, stimulating), concentration, being absorbed in a task, being challenged by the task, managing something all by oneself, fun with a task, and variety. However, these statements of intense, creative, and structured interaction with a task are only coded as achievement flow motive if they are accompanied by positive emotions: Elated, invigorated, euphoric, happy, focused, interested, etc. In all of the present studies, inter-rater agreement was above .85 for the achievement flow motive coding of the pictures following the same

procedure as outlined in Winter (1994) for TAT. No correction for length of protocol was necessary because there is only one coding for each picture of the OMT. Extensive research on the OMT is reported in Scheffer (2005) as well as in Kuhl, Scheffer, and Eichstaedt (2003), and Scheffer, Kuhl, and Eichstaedt (2003); see also Baumann, Kaschel, & Kuhl, 2005; Baumann, Kazén, & Kuhl, 2010).

The OMT shows sufficient reliability: (a) internal consistency of $\alpha = .70$ across the four approach components of the achievement motive when looking at the lower and higher quartile of the distribution (Scheffer et al., 2003); and (b) a retest stability of $r(27) = .73$ for achievement flow over a period of two years. The evaluation of the validity of each of the 15 OMT components (3 motives \times 5 enactment levels) plus sum scores represents a monumental task that at this point is far from finished. Nevertheless, there is some evidence on the validity of the achievement category. For example, adolescents high in achievement motive (calculated across the four approach components) were significantly more efficient in applying for an apprenticeship than adolescents low in achievement motive because their aspired positions matched their level of qualification (Heckhausen & Tomasik, 2002). Baumann et al. (2005) replicated and extended the typical finding that incongruence between implicit (OMT) and explicit achievement motives is associated with reduced subjective well-being and increased psychosomatic symptoms. In a Costa Rican sample, Chasiotis and Hofer (2003) found achievement flow to be significantly correlated with number of school years, $\beta = .29$, $t(2, 117) = 3.28$, $p < .001$, level of education, $\beta = .26$, $t(2, 117) = 2.89$, $p < .005$, and social economic status, $\beta = .21$, $t(2, 115) = 2.30$, $p < .03$. Thus, achievement flow motive is an important predictor of formal education in a cultural context in which public requirements for and public support of education are lower.

¹ A comprehensive scoring manual for the OMT is available in German and in English from the authors.

Need for achievement ($nAch$) was assessed using the TAT with seven pictures and David Winter's (1994) coding system. Inter-rater agreement on both instruments, OMT and TAT, was above .85. The Flow Short Scale (*Flow Kurz Skala*; FKS; Rheinberg et al., 2003) was used to assess flow as a state. The scale consists of ten items. Example items are: "My thoughts/activities run fluidly and smoothly", "I am totally absorbed in what I am doing", "I have no difficulty concentrating", "I feel just the right amount of challenge". Items were rated on a 7-point scale (1 = *completely disagree*, 7 = *completely agree*). In the present study, internal consistency of the FKS ranged from .91 to .95 across four test applications. Mean individual flow scores were moderately consistent across tasks $\alpha = .52$.

Independence was assessed using the independent (schizoid-like) personality style of the Personality-Styles-and-Disorders-Inventory (PSSI; Kuhl & Kazén, 1997). It consists of four items to be rated on a 4-point scale (0 = *not at all true of me*; 3 = *very strongly true of me*). In the present study, internal consistency was $\alpha = .72$. Individual differences in mastery orientation were assessed by eight items taken from the Motive Enactment Test (MET; Kuhl, 1999). Example items are: "The more difficult a task, the tougher my staying power becomes", and "When I can work for hours on a difficult project, I am completely happy". Items were rated on a 4-point scale (0 = *not at all*; 3 = *very strongly*). The scale reflects a tendency to be positively oriented toward achievement and to master difficulty. In the present sample, internal consistency was $\alpha = .90$.

Procedure

In one session, participants filled out the TAT (five participants were missing in session one). In a second session, participants filled out the OMT, PSSI and MET. Both sessions were a week apart and took place at the Nordakademie. One month later, the developmental assessment centre took place at the Ellernhof (two participants missed the assessment centre). Participants worked on five different outdoor team tasks characterised below. The tasks have been proven capable of inducing at

least moderate flow in most people. At random intervals, participants were stopped four times to fill out the FKS.

Building a bridge on a lake. Teams of 5–6 participants had to use diverse prepared materials they found in the wood nearby.

Mohawk walk. Participants had to help each other overcoming obstacles while climbing on cables and beams approximately 2 feet above the ground.

Labyrinth in the dark. Participants had to find their way together through a labyrinth in complete darkness, interrupted by problem-solving tasks given to them partly by intercom and partly by written messages they found on their way (they could be read by lighting a limited number of matches).

Giant ladder. About 5–6 participants had to help each other climbing a ladder consisting of six massive beams approximately 6 feet apart from each other up to a height of about 30 feet.

Flying eagle. At the end of the day participants sailed down on a rope from about 25 feet above the ground.

Results

Descriptive data on the OMT achievement flow scale and the other instruments are listed in Tables 1 and 2. In the TAT, participants wrote between 68 and 1241 words in response to seven pictures ($M = 484$, $SD = 243$). Standardised residuals, corrected for word length, were used for $nAch$. Correlations among variables in Study 1 are presented in Table 2. Consistent with our hypothesis, achievement flow was not significantly correlated with $nAch$. The correlation between achievement flow motive and flow experience ranged from $r = .21$ ($p < .20$) to $r = .39$ ($p < .02$) across tasks. The correlation between $nAch$ and flow experience ranged from $r = -.03$ to $r = .17$ ($p < .35$) across tasks.

Table 1. Distribution of raw scores in % (*n* in parentheses) of the OMT Achievement Flow Scale in each study

	<i>M</i>	<i>SD</i>	Score 0	Score 1	Score 2	Score 3
Study 1	0.23	0.48	76.2 (32)	16.7 (7)	2.4 (1)	–
Study 2	0.43	0.66	64.8 (94)	29.7 (43)	3.4 (5)	2.1 (3)
Study 3	0.25	0.51	75.8 (47)	17.7 (11)	3.2 (2)	–

Flow motive and flow experience

Consistent with expectations, the achievement flow motive was significantly related to flow experience in the outdoor assessment centre, $\beta = .37$, $t(1, 36) = 2.41$, $p < .03$. The relationship between achievement flow motive and flow experience remained significant when controlling for *nAch*, $\beta = .45$, $t(1, 29) = 2.57$, $p < .02$. In contrast, *nAch* was not significantly related to flow experience when controlling for achievement flow motive, $\beta = .20$, $t(1, 29) = 1.17$, $p < .26$. Thus, the new operant measure of achievement flow accounted for variance in flow experience over and above the traditional *nAch* as assessed by TAT.

Affective change hypothesis

A hierarchical regression analysis was conducted on achievement flow with an independent personality style and mastery entered in Block 1, and the Independence \times Mastery interaction entered in Block 2. Following a recommendation by Aiken and West (1991), predictor variables were standardised before calculating their interaction term in all studies. Dependent variables were standardised as well. Consistent with expectations, there

was a significant Independence \times Mastery interaction, $\beta = .40$, $t(1, 36) = 2.71$, $p < .01$. Unstandardised regression weights using a range of ± 1 *SD* for both predictor variables were used to graph this interaction. As depicted in Figure 2, highly independent participants reached high levels of achievement flow when orientated towards mastery. In contrast, highly independent participants reached low levels of achievement flow when not oriented towards mastery. The Independence \times Mastery interaction remained significant when controlling for *nAch*, $\beta = .40$, $t(1, 28) = 2.14$, $p < .05$. In contrast, the Independence \times Mastery interaction on *nAch* was not significant when controlling for achievement flow, $\beta = -.26$, $t(1, 28) = -1.56$, $p < .15$. Thus, achievement flow is promoted by a unique personality configuration, which is not necessarily needed for the achievement motive in general (*nAch*).

Because of the skewed distribution of achievement flow scores we conducted a regression analysis using dichotomised achievement flow scores as a dependent variable (achievement flow not present = 0 vs. present = 1) that does not assume interval scale. Again, there was a significant Independence \times Mastery interaction, $\beta = .48$,

Table 2. Descriptive data (mean, standard deviation, minimum and maximum) and correlations among variables in Study 1

	<i>M</i>	<i>SD</i>	Scale range	Observed range	<i>nAch</i>	Flow exp.	Independ.	Mastery
OMT: Achievement flow motive	0.23	0.48	0–15	0–2	–.26	.37*	.13	.21
TAT: Need for achievement (<i>nAch</i>)	3.80	1.91	–	0–9	–	.07	–.22	–.14
Flow experience	5.03	0.75	0–7	3.60–6.20	–	–	–.07	.51**
Independent personality style	3.30	2.19	0–12	0–7	–	–	–	.14
Mastery	10.05	5.33	0–24	0–20	–	–	–	–

Notes: OMT = Operant Motive Test; TAT = Thematic Apperception Test. * $p < .05$; ** $p < .01$.

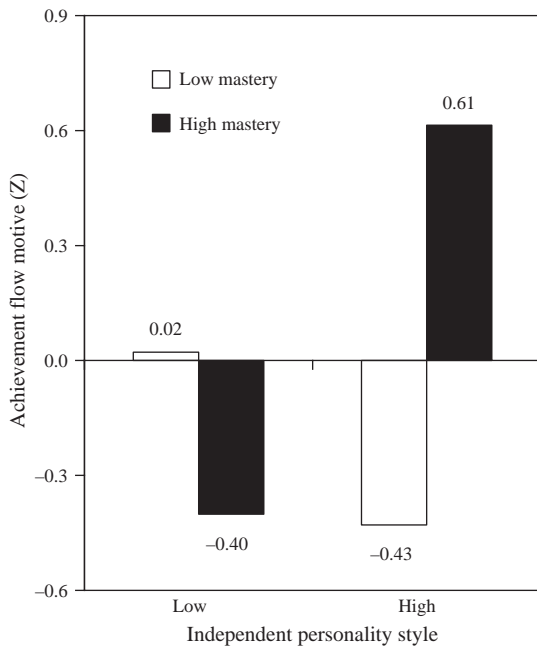


Figure 2. Achievement flow motive as a function of an independent personality style (Kuhl & Kazén, 1997) and mastery orientation (Kuhl, 1999) in Study 1.

$t(1, 36) = 3.42, p < .01$. Thus, the interaction effect was not driven by a few outliers.

Discussion

In Study 1, we validated our operant measure of achievement flow. We used the experience sampling method to assess flow experience across a variety of tasks and situations during an outdoor assessment centre. The tasks in the assessment centre at the Ellernhof were deliberately conceptualised to induce moderate and inconsistent flow

in most people, but strong and consistent flow in those people who have a disposition towards experiencing flow in many situations. The significant correlation between achievement flow motive and flow experience supports the validity of our measure: Individuals high in a motive disposition to seek flow in the achievement domain created more flow experience across different tasks.

Implicit motives are generally associated with specific motive-congruent memory episodes (Woike, Mcleod, & Goggin, 2003). “Implicit motives modulate encoding and recall of emotional experiences, vivid memories, and event-specific knowledge through non-conscious organising strategies that facilitate affective end states” (Woike, 2008, p. 99). Thus, the finding that individuals high in implicit achievement flow motive report having had more experiences of full absorption in difficult tasks is consistent with an implicit nature of our motive measure. The relationship remained significant after controlling for n Ach. Thus, achievement flow motive accounted for unique variance in flow experience.²

Consistent with our affective change assumption, a specific combination of personality traits was supportive of the achievement flow motive: An independent personality style in conjunction with mastery orientation was associated with high levels of achievement flow motive. Because independence (seeing difficulty) and mastery (mastering difficulty) are associated with opposing affective states (i.e., reduced vs. restored positive affect) their interaction may foster dynamic changes in positive affect that are conceived of

² The absence of convergent validity between achievement flow and n Ach does not discount the implicit nature of our measure. Both measures (TAT and OMT) assess motive-related knowledge that is rooted in preconceptual (partly even preverbal) states of development. However, the OMT extends the assessment of basic social needs from the preconceptual to the level of self-regulatory support of motive enactment (for a more comprehensive discussion on TAT and OMT see Baumann, Kazén, & Kuhl, 2010). Our focus on purely intrinsic types of regulation may explain the lack of convergence with n Ach. The intrinsic component is not strongly represented in Winter’s (1994) coding system in which n Ach is not coded unless standards of excellence are explicitly mentioned. In OMT achievement flow, in contrast, standards of excellence may be implicated in high concentration, curiosity, and interest but do not have to be explicated. The overlap between flow motive and n Ach may vary depending on the coding system for the TAT. For example, more fine-grained measures of n Ach such as Heckhausen’s (1963) system or the original coding system by McClelland et al. (1953) may unearth more of the commonality between measures. Nevertheless, our measure is expected to explain unique variance in flow experience because it is confined to the *intrinsic* component of the achievement motive.

as the functional basis of achievement flow motivation.

STUDY 2

To test the generalisability of our results, we used different measures of seeing and mastering difficulty in Study 2. We used an avoidant adult attachment style to assess reduced positive affect and a tendency to see difficulty because it is characterised by compulsive self-reliance and a preference for social and emotional distance (Brennan et al., 1998; Mikulincer & Florian, 1998). These characteristics are presumed to be indicative of an inhibition of positive affect for three reasons. First, perceived progress towards intimacy has been found to play a crucial role in positive affect (Laurenceau et al., 2005). Avoidant individuals' distancing from social partners, in contrast, is a step back from intimacy that is associated with frustration (i.e., low positive affect). Second, Mikulincer and Sheffi (2000) found well-documented reactions to positive affect such as broader categorisation (Isen, 1987) to be absent in avoidant individuals. This distancing from emotional-laden material may further reduce positive affect. Finally, avoidant individuals' self-reliance necessitates the use of analytical problem solving and planning in face of difficulties because the help of others is disregarded. The use of such analytical executive functions has been associated with reductions in positive affect (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999).

Mastery was assessed in terms of students' mastery-approach goals (Elliot, 1999). Our hypothesis predicted an Avoidant Attachment \times Mastery-Approach interaction. Avoidant adult attachment was expected to be associated with high levels of achievement flow if participants are high in mastery-approach. As a test of competing traits and goal orientations, we included extraversion, neuroticism and explicit achievement motivation. Because extraversion is associated with high sensitivity to positive affect (Gray, 1987; Larsen & Ketelaar, 1991), low extraversion (i.e.,

introversion) was expected to yield similar results to avoidant attachment in conjunction with mastery-approach. In contrast, because neuroticism is associated with high sensitivity to negative affect (Gray, 1987; Larsen & Ketelaar, 1991) it was not expected to predict achievement flow in conjunction with mastery-approach. Furthermore, explicit achievement motivation was expected to neither correlate with the achievement flow motive nor work as a substitute for mastery-approach in the interaction between seeing and mastering difficulty.

Finally, if our operant measure of achievement flow assesses the intrinsic component of achievement motivation it should become manifest in higher intrinsic motivation. In order to test this assumption, we assessed intrinsic study motivation for a psychology course among psychology undergraduates. The achievement flow motive at the beginning of the semester was expected to predict intrinsic study motivation at the end of the semester.

Method

Participants

One hundred forty-five (109 women and 36 men) psychology undergraduates at the university of Rochester, New York, participated voluntarily and received course credit in return for their participation. Their mean age was 19.2 years (range 18 to 22 years).

Materials

The English version of the OMT was administered to assess achievement flow. The Experiences in Close Relationships measure (ECR; Brennan et al., 1998) was used. The avoidant adult attachment was assessed by 18 items on a 7-point scale (1 = *not at all true of me*; 7 = *very true of me*). In the present sample, internal consistency (Cronbach's alpha) was $\alpha = .94$ for avoidance.

The Achievement Goal Questionnaire (Elliot, 1999; Elliot & Church, 1997) was used to assess participants' goals in their introductory psychology class. Mastery-approach, performance-approach,

and performance-avoidance scales were represented by six items, respectively, taken from Elliot (1999). An early version of the mastery-avoidance scale was represented by eight items (Elliot & McGregor, 2001). Participants responded on a 7-point scale (1 = *not at all true of me*; 7 = *very true of me*). For the purpose of the present study, the two mastery scales were relevant. In the present sample, internal consistencies were $\alpha = .85$ for mastery-approach and $\alpha = .88$ for mastery-avoidance goals.

The Intrinsic Motivation Inventory (IMI; Elliot & Church, 1997) was administered to assess participants' interest in a psychology introductory class. It consists of eight items. Participants responded on a 7-point scale (1 = *not at all true of me*; 7 = *very true of me*). In the present sample, internal consistency was $\alpha = .92$. Explicit achievement motivation was assessed with 16 items from the Personality Research Form (PRF; Jackson, 1984) in a *true* (= 1) versus *false* (= 0) format. In the present sample, internal consistency was $\alpha = .73$. Extraversion and Neuroticism were assessed with the NEO Five-Factor-Inventory (NEO-FFI; Costa & McCrae, 1992). Each scale consisted of 12 items. Participants responded on a 5-point scale (1 = *not at all true of me*; 5 = *very true of me*). In the present sample, internal consistencies were $\alpha = .82$ for Extraversion and $\alpha = .89$ for Neuroticism.

Procedure

At the beginning of the semester, students of an introductory psychology class who had volunteered to participate in the study received a questionnaire package containing the OMT, ECR, PRF, NEO-FFI, and the Achievement Goal Questionnaire. They were asked to return questionnaires at the next class meeting. At the end of the semester, participants rated their intrinsic motivation for the introductory psychology class.

Results

Correlations

As listed in Table 3, achievement flow motive was not significantly correlated with any of the variables assessed in Study 2. Avoidant adult attachment was negatively correlated with mastery-approach and intrinsic study motivation at the end of the semester. Mastery-approach was positively correlated with intrinsic study motivation. Surprisingly, there was a significantly positive correlation between mastery-approach and mastery-avoidance. This counter-intuitive finding may be due to the common mastery component of the two scales. The assumption that mastery-avoidance was more driven by mastery than by avoidance is further supported by the positive correlation with intrinsic motivation. Because our hypotheses are related to mastery-approach, any

Table 3. Descriptive data (mean, standard deviation, minimum and maximum) and correlations among variables in Study 2

	<i>M</i>	<i>SD</i>	<i>Scale range</i>	<i>Observed range</i>	<i>AAA</i>	<i>Mast. -appr.</i>	<i>Mast. -avoid.</i>	<i>IM</i>	<i>PRF</i>	<i>N</i>	<i>E</i>
OMT:	0.43	0.66	0–15	0–3	.14	.09	–.08	.14	–.02	–.07	.04
Achievement flow motive											
Avoidant adult attachment (AAA)	48.96	21.23	18–126	18–110	–	–.19*	.12	–.18*	–.10	.40***	–.32***
Mastery-approach	32.73	6.18	6–42	13–42		–	.56***	.35***	.38***	–.05	.21*
Mastery-avoidance	35.73	9.57	8–56	8–56			–	.26**	.18*	.28**	–.08
Intrinsic motivation (IM)	44.90	8.08	8–56	11–56				–	.20*	–.11	.20*
PRF achievement	10.30	3.32	0–16	1–16					–	–.07	.17*
Neuroticism (N)	35.84	9.13	12–60	18–59						–	–.43***
Extraversion (E)	42.06	6.77	12–60	25–58							–

Notes: OMT = Operant motive test; PRF = Personality research form. * $p < .05$; ** $p < .01$; *** $p < .001$.

counter-intuitive effects of mastery-avoidance are irrelevant.

Affective change hypothesis

A hierarchical regression analysis was conducted on achievement flow with avoidant adult attachment (seeing difficulty), mastery-approach (mastering difficulty), and mastery-avoidance entered in Block 1 and the two Avoidant Attachment \times Mastery interactions entered in Block 2. There were significant main effects of Avoidant Attachment, $\beta = .23$, $t(3, 141) = 2.63$, $p < .01$, Mastery-approach, $\beta = .28$, $t(3, 141) = 2.71$, $p < .01$, and Mastery-avoidance, $\beta = -.26$, $t(3, 141) = -2.56$, $p < .02$. Avoidant attachment and mastery-approach were associated with higher achievement flow motive. In contrast, mastery-avoidance was associated with a lower motive to seek flow in the achievement domain. More importantly, the Avoidant Attachment \times Mastery-approach interaction was significant, $\beta = .32$, $t(2, 139) = 3.04$, $p < .005$.

Unstandardised regression weights using a range of ± 1 SD for both predictor variables were used to graph this interaction. As depicted in Figure 3, achievement flow motive was high for avoidantly attached students who were oriented towards mastery-approach goals. In contrast, avoidantly attached students who were not oriented towards mastery-approach reached the lowest levels of achievement flow. Closely attached students reached low levels of achievement flow motive irrespective of their mastery-approach orientation. Findings were consistent with expectations. Entering the three-way interaction into the analysis did not yield a significant effect. The Avoidant Attachment \times Mastery-approach interaction remained significant when using dichotomised achievement flow scores as a dependent variable, $\beta = .34$, $t(2, 139) = 3.24$, $p < .001$. Thus, the interaction effect was not driven by a few outliers.

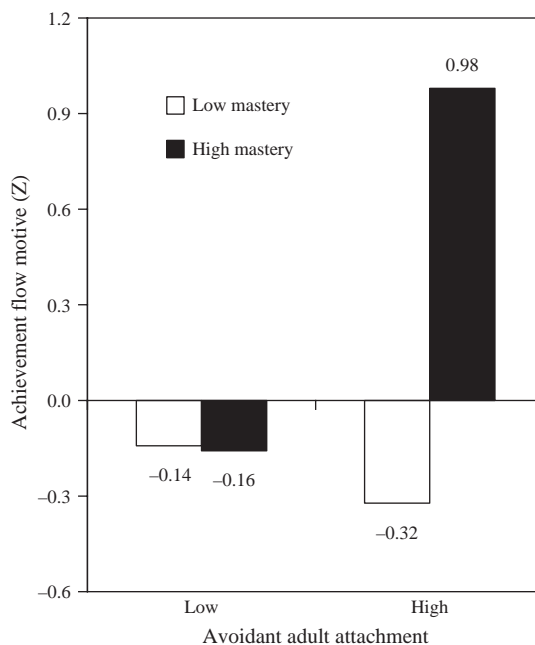


Figure 3. Achievement flow motive as a function of independence (avoidant attachment) in adult romantic relationships (Brennan et al., 1998) and mastery orientation (Elliot, 1999) in Study 2.

As a test of competing personality traits we entered extraversion into the regression equation instead of avoidant attachment. Low Extraversion (i.e., Introversion) was expected to show convergent results. Consistent with expectations, the Extraversion \times Mastery-approach interaction was significant, $\beta = -.35$, $t(2, 139) = -2.80$, $p < .01$.³ In contrast, Neuroticism was expected to yield divergent results from avoidant attachment because it is related to negative affect instead of reduced positive affect. Entering Neuroticism into the regression equation instead of avoidant attachment did not yield any significant results. Consistent with expectations, the Neuroticism \times Mastery-approach interaction was not significant. In a similar vein, the PRF achievement scale was not a substitute for mastery-approach orientation. Explicit achievement motivation predicted

³ Achievement flow motive was high for introverted students who were oriented towards mastery-approach goals ($M = 0.62$). In contrast, introverted students who were not oriented towards mastery-approach reached the lowest levels of achievement flow ($M = -0.44$). Extraverted students reached moderate levels of achievement flow motive irrespective of their mastery-approach orientation ($M = -0.02$ for high mastery-approach vs. $M = 0.03$ for low mastery-approach).

achievement flow neither directly nor in interaction with avoidant attachment, extraversion and neuroticism. Findings are consistent with the assumption, that it takes more than achievement motivation for an autonomous up-regulation of positive affect.

Achievement flow and intrinsic motivation

Achievement flow motive at the beginning of the semester was expected to predict intrinsic motivation for the introductory psychology class at the end of the semester. A regression analysis was conducted with achievement flow motive as a predictor variable, controlling for verbal SAT. Consistent with expectations, achievement flow motive predicted intrinsic motivation for the class when controlling for a general indicator of ability, $\beta = .19$, $t(1, 139) = 2.22$, $p < .03$. The finding contributes to the validity of achievement flow motive as measured by OMT.

Discussion

In Study 2, we used avoidance in adult attachment (Brennan et al., 1998) and mastery-approach orientation (Elliot, 1999), to gauge the effects of dynamic changes in positive affect on a motive disposition to seek flow in the achievement domain. The results of Study 2 indicate that avoidant attachment, in conjunction with mastery-approach orientation, significantly moderated participants' tendency to see options for getting fully immersed in activities: Avoidant adult attachment (seeing difficulty) was associated with increased achievement flow motive if participants adopted a mastery-approach orientation (mastering difficulty). In contrast, avoidant adult attachment was detrimental to achievement flow motive if participants did not adopt a mastery-approach orientation. Findings support the assumption that a combination of personality traits promoting affective change via joint activation of difficulty and mastery are needed to support a motive to seek achievement flow.

Neuroticism and introversion are two constructs that are very different from avoidant adult attachment. However, introversion and avoidant

adult attachment share a low sensitivity to positive affect whereas neuroticism is associated with high sensitivity to negative affect. Consistent with expectations, only introversion but not neuroticism interacted with mastery in predicting achievement flow. Thus, achievement flow is neither supported by emotional stability nor by dynamic changes in negative affect. The emotional dialectics that foster achievement flow seem to be confined to changes along the positive affect dimension. Furthermore, mastery orientation seems to comprise an ability to restore positive affect that is not captured in more global measures of explicit achievement motivation such as Jackson's (1984) Personality Research Form (PRF).

In addition to insights into the personality and affect dynamics of flow, results of Study 2 provide further evidence on the validity of the achievement flow motive. Participants' general tendency to see options for getting fully immersed in activities was associated with increased intrinsic motivation in a specific field of interest, that is, an introductory psychology course for psychology undergraduates.

STUDY 3

In addition to replicating the personality correlates of achievement flow motive obtained in Study 1, this study explored the validity of our functional analysis of achievement flow on a micro-analytical level. Achievement flow was expected to be associated with volitional facilitation in a reaction-time experiment because it reflects the system configuration that is necessary to implement difficult intentions. We chose the Stroop task (Stroop, 1935) because it is a widely studied example of a task involving a difficult intention: The intention to respond to the colour hue (and not content) in which incongruent colour words are printed (e.g., responding to the red colour hue of the word "green"). The additional time that participants need to overcome the competing tendency (i.e., reading the colour word rather than responding to the colour hue) compared to

control stimuli (e.g., a row of Xs presented in red colour) is called *Stroop interference*.

Kuhl and Kazén (1999) and Kazén and Kuhl (2005) have demonstrated that Stroop interference can be removed by joint activation of intention memory and positive affect (“Stroop-Killer” effect). Intention memory is conceived of as a network of central executive functions involving active maintenance of an intention in working memory and inhibition of premature initiation of action.⁴ It is activated whenever an action cannot be performed automatically because a problem has to be solved or a difficulty has to be overcome (e.g., the tendency to read the colour word in the Stroop task) or whenever an action has to be postponed until an appropriate moment for its enactment is encountered (cf. Goschke & Kuhl, 1993).

In the Stroop-Killer experiments by Kuhl and Kazén, intention memory was additionally loaded (i.e., difficulty increased) by using two consecutive Stroop stimuli or by inserting a trait rating after the Stroop stimulus. The sequencing of several action steps within a trial (e.g., prime–Stroop task–additional task) requires an action plan. Intention memory has to be activated and remains active (but decoupled from action) as long as the second task cannot be executed and has to be held in an active waiting state (i.e., until the first task is terminated). In the Stroop-Killer experiments, there was an optimal coupling of intention memory (“responding to the colour hue”) with its output system (“pressing the corresponding button”) after presentation of positive prime words. Kuhl and Kazén interpret the Stroop-Killer (i.e., the removal of Stroop interference after positive primes) as volitional facilitation.

There are two important prerequisites to assess volitional facilitation. First, the effect is obtained only with the first Stroop stimulus while the load posed on intention memory by the need of

temporal coding of two action steps is still present (Kuhl & Kazén, 1999). In contrast, the second action step (or a single Stroop stimulus) can be carried out without further activation of intention memory and inhibition of the intention–output pathway. Second, the positive prime has to be achievement-related (Kazén & Kuhl, 2005). Positive primes related to affiliation or power do not remove Stroop interference because they do not necessarily involve explicit intentions. On the contrary, forming explicit intentions to satisfy affiliation needs may even interfere with intuitive and spontaneous behaviour appropriate in social situations. Thus, positive affiliation and power primes may lead to a more global behavioural facilitation but not to a specific facilitation of volitional action (i.e., behaviour controlled by explicit plans and intentions).

In Study 3, we used the experimental procedure by Kuhl and Kazén (1999) and Kazén and Kuhl (2005) because it allowed us to experimentally manipulate the systems presumably involved in flow: Difficulty (associated with intention memory and reduced positive affect) and achievement-related positive affect. Participants high in achievement flow were expected to show increased volitional facilitation because they have a dispositional tendency to jointly activate these two systems that enable a smooth transition from intention into action: They typically see/seek difficulty and are convinced of being able to master it. Thus, they should show a greater reduction of Stroop interference when experimentally activating the flow-relevant systems than individuals low in achievement flow. Although positive primes significantly reduce Stroop interference in most individuals, the capacity to profit from positive incentives in the environment should be even greater for those individuals who can more easily up-regulate positive affect autonomously.

⁴ The inhibition component differentiates intention memory from the concept of working memory (e.g., Baddeley, 1996, 2000) and is necessary whenever a specific response is to be delayed or when a rather abstract intention is maintained in intention memory and premature specification of that intention is to be prevented. Furthermore, intention memory represents action-related rather than sensory information that is proposed to remain active until enactment of the intention (cf. Zeigarnik, 1927).

Method

Participants

Sixty (51 women and 9 men) psychology undergraduates at the University of Osnabrück, Germany, participated voluntarily and received course credit in return for their participation. Their mean age was 24.0 years (range 18 to 44 years).

Materials

As in Study 1, we used the OMT to assess achievement flow motive (Kuhl & Scheffer, 1999), the PSSI (Kuhl & Kazén, 1997) to assess an independent (schizoid-like) personality style and the MET (Kuhl, 1999) to assess mastery orientation in achievement situations. In the present study, internal consistencies were $\alpha = .73$ for the independent personality style and $\alpha = .77$ for mastery orientation.

The Critical Life Events Questionnaire (CLEQ; Kuhl & Kazén, 1999) was applied to assess individual word primes for the Stroop task. In this questionnaire, participants are asked to generate a series of words, or two-word statements, reminding them of seven positive events (e.g., success, being proud of taking a challenge) and seven negative events (e.g., failure, achievement pressure) they had experienced in achievement contexts. From a list of 60 neutral items, participants selected seven items that did not elicit in them any particular association with either positive or negative events. From each category, the six items with the least content overlap between categories were selected for inclusion in the experiment.

Design and procedure

The Stroop experiment included the factors Prime Type (positive vs. neutral vs. negative) and Stroop Stimulus (incongruent vs. control). Incongruent Stroop stimuli were presented using the colour words (and colour hues) *red*, *blue*, *green*, and *yellow*. Control stimuli were a row of four upper-case "Xs" in each of these hues. Each colour word and colour hue occurred with equal probability (25%). The Stroop experiment closely followed the procedure used by Kuhl and Kazén (1999) and

Kazén and Kuhl (2005). Each trial consisted of: (a) a 500 ms *fixation* stimulus ("+"); (b) a 1000 ms emotional or neutral *prime* presented in white ink and lower-case letters, which was previously self-generated or self-selected in CLEQ; (c) a to-be-responded-to *Stroop* stimulus (incongruent or control); and (d) a standard to-be-rated trait adjective presented in white ink and upper-case letters. The trait ratings were inserted to pose an additional load on intention memory during processing of the Stroop task by the need of sequencing several action steps within a trial.

Immediately after participants responded to the colour hue of the Stroop stimulus, the trait adjective was presented for self-evaluation using the following four categories: The trait describes me: "*not at all*", "*rather not*", "*somewhat*", "*completely*". There was a variable inter-trial interval of between 1 and 3 s. Trials were presented in a random sequence, which was the same for all participants. The main experimental part consisted of 36 trials (6 presentations of each 3×2 combination of Prime Type and Stroop Stimulus). Participants started with 16 practice trials (using a different set of primes and trait adjectives), in which participants got acquainted with the task and with their assignment of colour hues to computer keys. Although vocal responses have the advantage of being highly over-learned we used manual responses (which participants had to learn for this task) in order to stick most closely to the procedure used by Kuhl and Kazén. Key assignment was balanced across participants. The four keys used in all cases were the two nearest keys to the left and to the right shift keys.

The questionnaires (OMT, PSSI, MET, and CLEQ) were carried out in a group session at least two days before the experiment. The group session lasted about 90 minutes. The experimental session was carried out individually. Participants were told that the experiment dealt with attention to colours and colour words. They were to work on a series of trials. Their task was to react to the colour hue of the first stimulus appearing in colour, which could be either a colour word or a row of "Xs", as quickly and accurate as possible. Immediately after that, they should be prepared to

rate on a 4-point scale as quickly as possible whether or not they themselves possessed the trait presented in white ink and upper-case letters. Participants were told to regard the initial (previously self-generated) words appearing in white ink and lower-case letters as *task-preparation signals*. They were instructed to pay attention to the content of the prime word because it signalled the presentation of the two imperative tasks. After finishing the experimental task, participants were debriefed and received course credit in return for their participation. The experimental session lasted about 30 minutes. Five participants did not attend the experimental session.

Results

Correlations

There were no significant correlations among variables in Study 3. Achievement flow motive did not significantly correlate with an independent personality style ($r = .02$, *ns*) and mastery orientation ($r = .15$, $p > .26$), and an independent personality style did not significantly correlate with mastery orientation ($r = -.20$, $p > .13$).

Affective change hypothesis

A hierarchical regression analysis was conducted on flow with independent personality style and mastery orientation entered in Block 1 and their interaction term entered in Block 2. Consistent with expectations, there was a significant Independence \times Mastery Orientation interaction, $\beta = .34$, $t(1, 56) = 2.63$, $p < .02$. Unstandardised regression weights using a range of ± 1 *SD* for both predictor variables were used to graph this interaction. As depicted in Figure 4, highly independent students reached highest levels of achievement flow when orientated towards mastery. In contrast, highly independent students reached lowest levels of achievement flow when not oriented towards mastery. Students low on an independent personality style reached moderate levels of achievement flow irrespective of their mastery orientation.

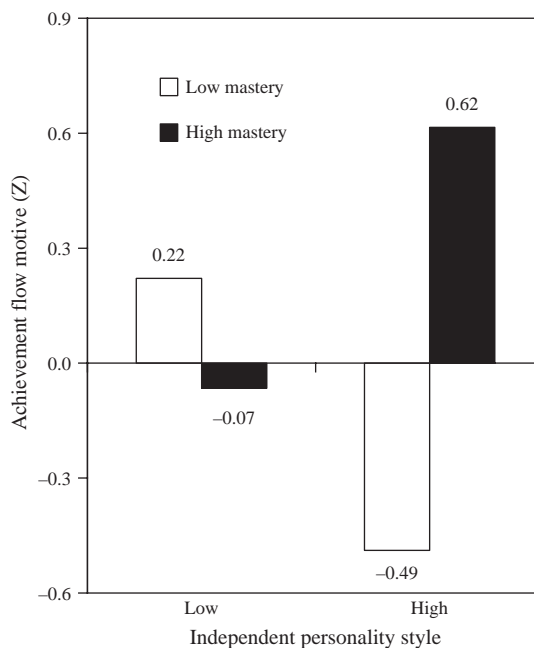


Figure 4. Achievement flow motive as a function of an independent personality style (Kuhl & Kazén, 1997) and mastery orientation (Kuhl, 1999) in Study 3.

Volitional facilitation

We established if we replicated the volitional facilitation effect that joint activation of intention memory and positive affect removes Stroop interference (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999). Latency data of the Stroop task were analysed using 3×2 (Prime Type \times Stroop Stimulus) analysis of variance (ANOVA), with repeated measures on both factors. The analysis yielded a highly significant main effect of Stroop Stimulus, $F(1, 108) = 38.29$, $p < .001$. Mean RTs for incongruent Stroop stimuli were significantly higher ($M = 1598$ ms) than mean RTs for control stimuli ($M = 1482$ ms). Thus, the average Stroop interference was 116 ms. More importantly, there was a significant Prime Type \times Stroop Stimulus interaction, $F(1, 108) = 38.29$, $p < .001$. Consistent with expectations, Stroop interference was non-significant after positive primes (23 ms, *ns*) whereas it was significant after neutral (181 ms, $p < .001$) and negative (144 ms, $p < .001$) primes. Stroop interference after positive primes was

significantly lower than Stroop interference after neutral, $t(54) = 3.77$, $p < .001$, and negative primes, $t(54) = 3.23$, $p < .01$.

Because faster reaction times may be due to a more lax response criterion, mean error rates were analysed using a 3×2 ANOVA. The analysis yielded no significant effects. On a descriptive level, Stroop interference (error rates in response to incongruent compared to control stimuli) was completely removed (or even reversed) after positive primes (Difference: -0.02% , *ns*). In contrast, Stroop interference was present after neutral primes (1.9% , *ns*) and significant after negative primes (3.3% , $p < .05$). The difference in Stroop interference after positive and negative primes (-0.02% vs. 3.3%) was only marginally significant, $t(54) = 1.63$, $p < .11$. Nevertheless, shorter reaction times after positive primes were not accompanied by increased error rates. An additional way to rule out a speed-accuracy interpretation of the specific effect of positive primes on the reduction of Stroop interference, was to calculate a correlation. A significant negative correlation between RTs and error rates might indicate a speed-accuracy trade-off. In the present study, the correlation between these two dependent variables was positive ($r_{\text{positive primes}} = .24$). To summarise, findings are consistent with the assumption that latency as well as error data of the Stroop task following positive primes are valid measures of volitional facilitation.

Achievement flow and volitional facilitation

Achievement flow was expected to facilitate the enactment of difficult intentions as indexed by a removal of Stroop interference after positive primes. To test this hypothesis, a regression analysis was conducted on the amount of Stroop interference in RTs after positive primes with achievement flow motive as a predictor. Achievement flow significantly predicted reduced Stroop interference in RTs, $\beta = -.33$, $t(53) = -2.53$, $p < .01$. Participants with flow response in the OMT had reduced RTs for incongruent compared to control stimuli (-64 ms) whereas participants without flow response had increased RTs for incongruent compared to control stimuli (47 ms).

Table 4. Correlations between achievement flow motive and Stroop interference as a function of prime valence in Study 3

	Stroop interference	
	RT	Error rates
Positive achievement primes	$-.33^{**}$	$-.28^*$
Negative achievement primes	.12	.04
Neutral primes	.01	$-.03$

Note: * $p < .05$; ** $p < .01$.

The regression analysis conducted on error rates also yielded a significant effect of achievement flow, $\beta = -.28$, $t(53) = -2.10$, $p < .05$. Higher achievement flow was associated with reduced Stroop interference in error rates. Participants with flow response in the OMT had reduced error rates for incongruent compared to control stimuli (-4.17%) whereas participants without flow response had increased error rates for incongruent compared to control stimuli (0.93%).

To control that positive affect is the moderating variable in the removal of Stroop interference, correlations between achievement flow and Stroop interference were calculated for all prime categories. As listed in Table 4, achievement flow was not correlated with reduced Stroop interference after neutral and negative prime. To summarise, higher achievement flow was associated with increased volitional facilitation as indexed by faster and more accurate enactment of difficult intentions in Stroop tasks after positive primes.

Discussion

Study 3 replicated the Independence \times Mastery interaction on achievement flow motive obtained in Study 1. An independent, schizoid-like personality style in conjunction with mastery orientation was supportive of achievement flow. In addition, Study 3 aimed at testing the system interaction effect in a reaction-time experiment. Consistent with expectations, the tendency to perceive opportunities for flow in ambiguous pictures was associated with volitional facilitation in a Stroop task: Participants high in achievement

flow more easily enacted the difficult intention of naming the colour hue of incongruent colour words. An alternative interpretation might be that participants high in achievement flow are more willing to take a risk of making errors in order to react as fast as possible. This alternative interpretation of our data can be ruled out because there was no speed–accuracy trade-off. Reduced Stroop interference was observed in reaction times and error rates.

The relationship between achievement flow and reduced Stroop interference supports the validity of our operant measure and sheds further light on the functional underpinnings of achievement flow. According to Kazén and Kuhl (2005) and Kuhl and Kazén (1999), removal of Stroop interference involves a joint activation of intention memory (i.e., seeing difficulty) and positive affect (i.e., mastering difficulty). Intention memory was experimentally activated by the use of two consecutive (to-be-responded-to) stimuli. Positive affect was experimentally induced by positive prime words. The significant relationship between achievement flow and reduced Stroop interference after positive primes supports the assumption that participants high in achievement flow jointly activate intention memory and positive affect more easily than participants low in achievement flow.

The finding that achievement flow was not associated with reduced Stroop interference after neutral or negative primes supports the crucial role of restoring (up-regulating) positive affect in order to smoothly translate difficult intentions into action. One may ask why positive achievement primes were even necessary in the Stroop experiment if flow-motivated individuals are mastery-oriented and able to up-regulate positive affect autonomously. The findings by Kazén and Kuhl (2005) indicate that the need content of the prime stimulus serves as a cue to install a specific configuration of mental systems that supports the enactment of need-relevant behaviours (see also Kuhl & Kazén, 2008). Priming “love” has completely different effects from priming “success”. In the neutral prime condition, however, there is no such cue because the prime is not need related. Thus, flow-motivated individuals may very well be

able to self-generate confidence in mastering challenging tasks. However, they do not blindly up-regulate positive affect in the absence of a need.

GENERAL DISCUSSION

In the present research, we proposed that achievement flow is supported by dynamic changes in positive affect. Three studies tested this affective change hypothesis by looking at the personality configuration of individuals with a strong tendency to seek flow in the achievement domain. Consistent with expectations, achievement flow was supported by the interaction of traits associated with seeing and mastering difficulty. More specifically, participants high in an independent, schizoid-like personality style (Studies 1 and 3), avoidant adult attachment (Study 2) and introversion (Study 2) scored high on achievement flow if they were also mastery oriented. In contrast, independence did not support achievement flow if participants were low in mastery orientation. Furthermore, mastery orientation did not support achievement flow if participants were low in independence.

The present studies obtained converging results using three different operationalisations of independence and two different measures of mastery in samples from two countries (USA and Germany). This methodological convergence increases confidence in the robustness of our findings. Independent (schizoid-like) personality style, avoidant adult attachment and introversion grasp highly distinct aspects of personality. However, one functional commonality is their association with reduced positive affect (cf. Kuhl, 2001). In contrast, a trait associated with negative affect (neuroticism) was not involved in achievement flow (Study 2). Findings are consistent with the assumption that dynamic changes in positive affect associated with the tendency to jointly focus on (or alternate between) seeing and mastering difficulty are crucial for achievement flow.

The present findings can also be related to the broader theories of personality, and are particularly compatible with personality systems interactions

(PSI) theory (Kuhl, 2000, 2001; Kuhl & Koole, 2004). Within the framework of PSI theory, achievement flow can be conceived of as an optimal coupling between intention memory and its output system (intuitive behaviour control) through positive affect (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999). According to PSI theory, reduced positive affect activates intention memory, that is, a network of central executive functions involving active maintenance of an intention in working memory, planning, analytical problem solving and inhibition of premature initiation of action (see Footnote 4). As such, a focus on difficulty (i.e., activation of intention memory) inhibits the enactment of intentions and allows mental simulation of possible solutions to a problem. It takes positive affect (e.g., expected success) to overcome the inhibition of action and recouple intention memory with its output system, according to PSI theory. Individuals high in mastery-approach (Elliot, 1999), or self-regulatory abilities (Jostmann et al., 2005; Koole & Jostmann, 2004) can more easily self-generate positive affect. However, positive affect may also foster the enactment of automatic action tendencies and behavioural routines if intention memory is not activated. Therefore, it is important to analyse system interactions. A focus on difficulty (or the experimental activation of intention memory) is a necessary prerequisite for positive affect to facilitate a smooth transition of intentions into action.

The volitional facilitation effect observed in Study 3 further supports our functional analysis on a micro-analytical level. According to previous research, volitional facilitation can be assessed by a removal of Stroop interference (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999). It is obtained when experimentally inducing a joint activation of intention memory (e.g., using more than one action step per trial) and achievement-related positive affect (e.g., priming "success"). The significant correlation between achievement flow and volitional facilitation indicates a prevalence of this system configuration in flow-motivated participants: In the Stroop task, they were faster and more accurate in enacting the difficult intention of naming the colour hue of

incongruent colour words after positive achievement primes. Thus, the volitional facilitation task could be a new method for examining flow processes. A clear advantage of the task is that it allows researchers to systematically manipulate the activation of flow-relevant cognitive and affective systems.

Operant measurement of achievement flow

The present studies used an operant motive test (OMT; Kuhl & Scheffer, 1999) to assess achievement flow. The validity of our new measure was supported by positive correlations with participants' flow experiences during an outdoor assessment centre (Study 1) and intrinsic study motivation (Study 2). In accordance with Csikszentmihalyi's idea of an autotelic personality (Csikszentmihalyi et al., 1993; Nakamura & Csikszentmihalyi, 2002), a motive disposition to seek achievement flow seems to enable individuals to create more experiences of flow across different tasks and situations. Because flow is typically characterised by self-absorption and a loss of self-consciousness, it seems very difficult to introspect about underlying causes. Our operant motive measure can circumvent these difficulties and extend the phenomenological approach to flow.

Achievement flow is conceived of as the intrinsic component of the achievement motive. This conceptualisation allows the connection of flow research to the literature on implicit motives. Affective change has long been proposed to play an important role in achievement motivation (Kuhl, 2001, p. 551; McClelland et al., 1953). To the extent that the assessed personality traits are indeed associated with the presumed affective states, the present findings offer some preliminary support for the assumption that affective change may be more crucial in flow motivation than positive affect per se. In a related vein, Oettingen, Pak, and Schnetter (2001) found that contrasting positive fantasies about the future with difficulties in reality increases the quality of goal commitment. In contrast, when individuals only indulge in positive fantasies about the future or only reflect

on difficulties in reality goal commitment is not adaptively adjusted to expectations of success.

In light of the findings that the OMT measure of achievement flow shows no (or even a negative) correlation with TAT *n*Ach but positive correlations with flow experience and specific combinations of self-reported traits, one may wonder if our flow measure is really implicit. Indeed, the TAT usually fails to converge with questionnaire measures (Brunstein & Maier, 2005; Schultheiss, Yankova, Dirlikov, & Schad, 2009; Spangler, 1992). However, achievement flow did not correlate significantly with any questionnaire measure expect for flow experience (see Tables 2 and 3). None of the other ten correlations with personality traits and explicit goal orientations reported throughout the three studies were significant. Thus, we replicated the typical dissociation found between implicit motives and self-reported goal orientations and traits. The finding supports the implicit nature of the OMT.

Moreover, our findings revealed significant correlations between our flow motive and specific combinations of personality traits. To our knowledge, such interactions effects have not been systematically analysed in the literature on operant motives and flow so far. The finding is informative because it provides deeper insight into the cognitive-affective underpinning of implicit motives. Conceivably, implicit motives do not simply support the activation of a single cognitive or affective systems (e.g., a certain trait) but rather modulate the complex configuration of cognitive and affective systems in order to be optimally prepared for need satisfaction (cf. Baumann et al., 2010; Kuhl & Kazén, 2008). Thus, our functional analysis of flow may contribute to bridging the gap between separate research disciplines such as personality, motivation and cognition.

Limitations and future perspectives

The present research remains preliminary and thus leaves a host of questions open for future research. First, the present studies are correlational. Future studies could experimentally manipulate a focus on

difficulty and/or mastery and test the effects on response tendencies in the OMT, the amount of flow experience and the removal of Stroop interference. Second, cognitive-affective systems were only indirectly inferred from participants traits. Future work should use more direct measures of affect in order to examine the role of affective change in achievement flow. For example, the tendency to restore positive affect (mastery) could be assessed in a face-discrimination task (Öhman, Lundqvist, & Esteves, 2001). In this task, participants high in self-motivation have been found to be faster in detecting happy faces among a crowd of angry faces (Koole & Jostmann, 2004).

Third, the affective change assumption was not tested dynamically. Future studies could investigate whether individuals high in flow motive simultaneously focus on difficulty and mastery or alternate between foci. Alternation may even yield different effects if the onset of a motivational episode is difficulty or mastery. The findings by Oettingen et al. (2001), for example, show that contrasting positive fantasies about the future with difficulties in reality only improves goal commitment if participants start with a positive fantasy.

Finally, the present studies focused on a motive to seek flow in the achievement domain. It would be important to investigate the differences and similarities of flow motivation involved in mutually co-ordinating one's own activities with other people. For example, flow frequently occurs while dancing, making love, conversing, and playing games with children. According to PSI theory (Kuhl, 2000, 2001), flow experience in the affiliative domain may rely more strongly on intuitive patterns of behaviour control (cf. Papoušek & Papoušek, 1987) that are easily disturbed by a focus on difficulty and reductions in positive affect (Kuhl, 2001). Future research should investigate stable causes of flow in the social domains of affiliation and power.

Conclusion

Why do people spend hours and days riding their bike through a desert, sailing single-handed across

the ocean or playing chess against a computer program? In light of the present findings, we can suggest some informed answers to this question. In terms of personality traits, flow may arise from a combination of independence and mastery traits. In affective terms, flow may arise from dynamic changes between reduced and restored positive affect. In cognitive terms, flow may arise from an optimal coupling of intention memory with its output system through participation of the implicit self. Finally, in motivational terms, flow may arise from active regulation of the challenge–skill balance within a person. Our findings are consistent with all of these perspectives on flow and show how highly intertwined personality, emotion, cognition and motivation are. The term “affective change” may be a common denominator for the functional underpinnings of flow across disciplines.

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