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Flow and Regulatory Compatibility: An Experimental Approach to the Flow Model of Intrinsic Motivation

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The authors propose that the experience of flow (Csikszentmihalyi, 2000) as reflected in the deep involvement in an activity perceived as intrinsically rewarding represents a regulatory compatibility experience. The research addresses the notion that the compatibility of critical person (e.g., skills) and environmental factors (e.g., demands) involved in a given activity elicits subjective experiences that render the respective activity rewarding. Two studies are reported that investigate the consequences of compatibility of skills and task demands during task engagement. Departing from correlational research, the present studies employ a newly developed experimental paradigm to document the causal impact of such a skills/demands compatibility on the emergence of flow. Experiment 2 revealed that individuals characterized by a strong habitual action-orientation were most sensitive to the manipulation of the skills–demands compatibility.

Keywords: *action-orientation; flow experience; intrinsic motivation; regulatory compatibility*

The analysis of what motivates people to engage in activities is among the most fundamental topics of social science. This question has fascinated generations of researchers who have developed a wide array of perspectives (Reeve, 2005) and addressed the fact that behavior can be intrinsically motivated in the sense that individuals engage in activities because the activity is perceived as rewarding in and of itself—regardless of extrinsic rewards or punishments. A number of different types of intrinsic motivation have been suggested, and distinct factors involved in the emergence of intrinsic motivation have been emphasized (cf. Heckhausen, 1991). Accordingly, intrinsic motivation has been conceptualized with reference to quite a number of constructs and mechanisms, and there is no consensus about what constitutes the defining aspects of intrinsic motivation.

The central aim of the present work was to test one particularly prominent model of intrinsic motivation: flow theory as proposed by Csikszentmihalyi (2000). This model focuses on a specific subjective experience—a state of "flow"—that can emerge during task engagement: the deep involvement in an activity that is perceived as rewarding in and of itself. Exemplary cases where individuals typically enter such a state of a "flow experience" are (a) the artist who is fully absorbed in the activity of painting or playing an instrument, (b) the sportsman or sportswoman performing at the limits of his or her capability, or (c) the surgeon who is completely absorbed in his or her surgical activity. According to flow theory, a crucial boundary condition for the emergence of flow is the compatibility of (a) the individual's level of skills in

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the respective domain and (b) the level of task demands the individual is confronted with. In fact, the fit of skills and task demands is at the heart of the conceptualization of intrinsic motivation in flow theory. We set out to test this crucial causal assumption in two experimental studies using a newly developed paradigm. On the theoretical level, we propose that in most general terms, some sort of a "regulatory compatibility experience" is involved in every type of intrinsic motivation.

REGULATORY COMPATIBILITY

Reflecting the core assumption proposed in flow theory, we argue that the various conceptualizations of intrinsic motivation proposed in the literature share one common aspect: the experience of a *regulatory compatibility*—broadly defined as the compatibility of person characteristics (e.g., level of skill, habitual goal orientation, personal needs or standards) and structural settings or environmental characteristics (e.g., task demands, task framing, availability of distinct means, salience of specific outcomes or incentives). In most general terms, regulatory compatibility can be described as a phenomenological experience that arises when individuals experience a compatibility of (personal and situational) factors that are involved in performing a task or activity.

We propose that whenever individuals' available means fit with the affordances or requirements of the respective situation, a regulatory compatibility experience is likely to emerge. Available means can be reflected in strategic orientations of goal pursuit (e.g., being focused on avoiding errors or on ensuring hits), skills and competencies (e.g., experience in playing a game, driving a car), as well as personality traits (patience, tenaciousness) or habitual orientations (e.g., a chronic promotion or prevention focus, action- vs. state-orientation). Affordances and requirements of a given situation can be reflected in the manner of goal pursuit that is most suitable (e.g., eagerly striving vs. carefully proceeding), the level of task demands or challenges involved in an activity (e.g., the difficulty level of a game), the framing of relevant end-states or outcomes (e.g., gaining vs. not losing points), or other structural characteristics involved in a given activity (e.g., time pressure, distraction). Note that our position is not that regulatory compatibility necessarily results in flow experiences (deep involvement and eager task pursuit). For example, it may well be the case that experiencing regulatory compatibility results in a positive state of relaxation and quiescence. Our position is that individuals enjoy regulatory compatibility experiences, are willing to spend additional time experiencing a state of regulatory compatibility again, and are thus intrinsically motivated to engage in such behavioral episodes.

Several lines of previous research illustrate that regulatory compatibility has the potential to enhance intrinsic motivation (cf. Csikszentmihalyi, 2000; Freitas & Higgins, 2002; Harackiewicz & Sansone, 1991; Kruglanski et al., 1975; Tauer & Harackiewicz, 1999). The present research specifically investigates how the fit between individuals' skills and the situational task demands affects intrinsic motivation. Building on the work by Csikszentmihalyi and colleagues (Csikszentmihalyi, 2000; Nakamura & Csikszentmihalyi, 2002), we propose that a flow experience represents a regulatory compatibility experience in the sense that the person characteristic "skill" is compatible and fits with the environment characteristic "task demands." Investigating this issue, our empirical work focuses on three aspects. First, we present a new experimental paradigm that allows for an investigation of the proposed causal impact of regulatory compatibility as proposed in flow theory (the compatibility of skills and task demands). Our work is innovative and goes beyond previous research on flow experiences in that we developed a new method that is designed to test the core assumption underlying the flow model of intrinsic motivation using an experimental (rather than correlational) approach.

Second, we present two studies designed to obtain evidence concerning flow theory's most basic assumption about the role of the compatibility of skills and task demands in the emergence of intrinsic motivation. In this context, we assessed several indicators of the flow experience and related variables such as task involvement and enjoyment, time perception, and the subjectively perceived fit of skills and task demands. Based on the latter variable, we put the potential mediating role of perceived fit of skills and task demands to a test.

Third, in Experiment 2 we extended the analysis of the boundary conditions of flow experiences and put a higher order regulatory compatibility assumption (i.e., a compatibility effect involving skills and task demands as well as a third factor reflecting a distinct personality characteristic) to the test. Specifically, we tested the hypothesis that the experience of flow is most likely to be observed in individuals high in action-orientation. This reflects an intriguing extension of previous work. In line with flow theory, we propose that flow experiences are related to action-orientation as a personality characteristic because this trait contributes to one's readiness to experience deep involvement during task engagement.

In combination, the present work addresses factors that have not been studied in other previous work on regulatory compatibility, which largely focused on the compatibility of aspects related to goal orientations (cf. Harackiewicz & Sansone, 1991), regulatory focus (cf. Freitas & Higgins, 2002), or the framing of the task (cf. Kruglanski et al., 1975). In contrast to these previous lines of research, we focus on the compatibility of skills and task demands as a distinct case of regulatory compatibility. Given the widespread notion that this specific case of compatibility is a crucial and fundamental source of motivation (e.g., it is typically emphasized in the literature on motivation in the workplace; cf. Frey, Jonas, & Greitemeyer, 2003), we think it is crucial to document the causal impact of this specific case of regulatory compatibility by applying a stringent experimental procedure. This is the core topic of the present contribution.

FLOW AS INTRINSIC MOTIVATION

Flow theory has been established as a fruitful approach to intrinsic motivation (Csikszentmihalyi, 2000). In this framework, intrinsic motivation is conceptualized as the experiential state that arises when individuals engage in skill-related activities under conditions of clear goals, immediate unambiguous feedback, and a perceived fit of skills and challenge (i.e., task demands). The latter assumption is of particular importance in the flow model and is sometimes referred to as the balance hypothesis (see Figure 1). In this respect, Nakamura and Csikszentmihalyi (2002) state, "Entering flow depends on establishing a *balance* [italics added] between perceived action capacities and perceived action opportunities" (p. 90). This focus on person–environment compatibility reflects our thoughts on regulatory compatibility as outlined earlier.

According to Nakamura and Csikszentmihalyi (2002), flow is an experiential state that is characterized by the following aspects: (a) The individual is in a state of intense and focused concentration on what he or she is doing; (b) a merging of action and awareness takes place; (c) the individual experiences a loss of reflective self-consciousness; (d) the individual feels a deep sense of control; (e) the individual's temporal experience is distorted (hours seem to pass like seconds); (f) worries and ruminative thoughts disappear; and (g) the individual enters a state of autotelic motivation indicated by the fact that engagement in the activity is perceived as rewarding in and of itself. As is evident, flow experiences involve aspects that need not necessarily be present in every case of intrinsic motivation (e.g., a loss of reflective self-consciousness or a distorted sense of time are not fundamental elements of intrinsic motivation in the more general sense of the term).

Note that flow experiences can be differentiated from other positive joyful experiences one might be involved in (e.g., watching a movie, listening to music, watching a sunset). These more passive experiences might be conceptualized as peak experiences (Maslow, 1968). A crucial difference between peak experiences and flow lies in the fact that peak experiences tend to be perceptual, receptive, and passive, whereas in a flow experience the individual participates in an active interaction with the environment that involves the execution of skill-related behaviors (Privette, 1983). This focus on skills and the active application of skills in a challenging environment is a defining feature of flow theory (Csikszentmihalyi, 1988).

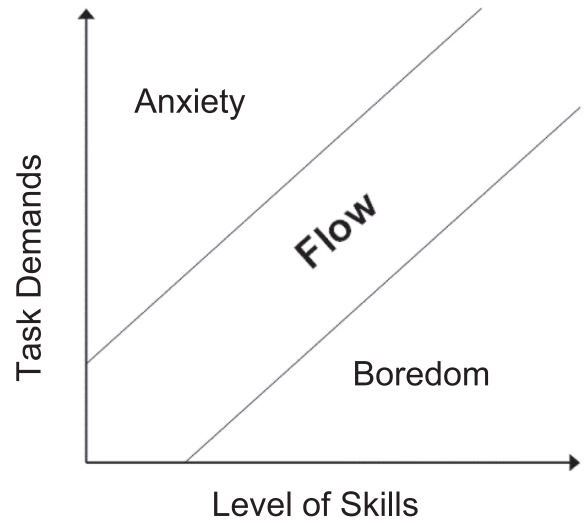

Figure 1 The flow channel.

It seems noteworthy that conceptual assumptions regarding experiences during task engagement that are quite similar to the ones in flow theory have been discussed and tested by researchers addressing the role of challenge and threat in performance situations (cf. Blascovich & Mendes, 2000). These authors proposed a model of challenge and threat, arguing that the ratio of evaluated resources to demands determines whether an individual will be challenged or threatened during performance. Specifically, the model holds that challenge occurs when evaluated resources meet (or exceed) evaluated demands, whereas threat occurs when demands exceed resources. Empirical studies revealed that challenge is associated with better performance than threat (cf. Blascovich, Seery, Mugridge, Norris, & Weisbuch, in press). This is well in line with the regulatory compatibility assumption and the flow model of intrinsic motivation.

It is important to note that flow experiences are not necessarily exceptional and relatively rare because they can occur in everyday episodes such as washing dishes or driving a car. These everyday episodes depict so-called *microflow* experiences (as compared to deep flow experiences). Moreover, flow is not necessarily related to positive ethical or social consequences because flow experiences can become addictive (e.g., gambling, video games) and flow can be experienced when individuals engage in antisocial activities (e.g., crime and warfare).

A METHODOLOGICAL PERSPECTIVE ON FLOW RESEARCH

More than 25 years ago, Mannell (1979) reviewed the available evidence on the flow model and stated, "The development of the concepts of flow and peak experiences is based on non-experimental study and neither concept has received rigorous study in the psychological laboratory" (p. 185). This statement still seems to hold true. In an extensive literature search, we found that most studies looked at the relationship between flow states operationalized as experiences where participants report a balance between challenges and skills and other outcome variables proposed in flow theory. This correlational research substantially supports the outlined balance hypothesis (Csikszentmihalyi & LeFevre, 1989; for overviews, see Csikszentmihalyi & Rathunde, 1993; Nakamura & Csikszentmihalyi, 2002).

Interestingly, we found only two published studies using an experimental approach in testing the flow model (Mannell & Bradley, 1986; Rheinberg & Vollmeyer, 2003).[1] Mannell and Bradley (1986) manipulated the clarity of the task (the setting structure). In line with the assumption that flow experiences are more likely when the structure of the task is unambiguous and it is clear what should be done (Csikszentmihalyi & Rathunde, 1993), Mannell and Bradley observed more absorption in the task under conditions of clear goals. More recently, Rheinberg and Vollmeyer (2003) experimentally investigated the impact of different difficulty levels of a computer game on flow experiences. Participants reported highest levels of flow following those trials of the game when the difficulty was set to a medium (rather than high or low) level. This is in line with the balance hypothesis of the flow model according to which flow experiences emerge under conditions of a balance between challenge and skills. To our knowledge, these studies currently represent the only (published) work using an experimental approach in order to test the basic causal assumptions of the flow model. Thus, the conclusion that experimental methods have been used very little in this field is still accurate.

Most studies in the field used the experience sampling method (ESM) as a valuable tool for the study of flow experiences. The ESM involves signaling research participants at random times throughout the day and asking them to report on the nature and quality of their experience (e.g., the current level of perceived task demands, etc.; cf. Csikszentmihalyi & LeFevre, 1989; Csikszentmihalyi & Rathunde, 1993; Nakamura & Csikszentmihalyi, 2002).

Although the ESM is a valuable research tool, it seems that providing experimental evidence in support of the flow model would be a very meaningful addition to this field of research. Specifically, an experimental approach could address several problematic aspects of the ESM and accordingly the field could benefit from evidence based on experimental studies. First, given the correlational nature of ESM data, it is hardly possible to disentangle the impact that flow-*un*related aspects of activities exert on the level of flow experience from the impact of flow-related aspects. Typically, flow emerges most intensely when individuals engage in distinct activities—for example, when playing an instrument or a game or a sport (Massimini & Carli, 1988). However, it is unclear what distinct aspects of these activities trigger the flow experience because the correlational nature of experience sampling data makes it very difficult to disentangle the impact of flow-related aspects from those that are unrelated. Second, based on the same logic, it is hardly possible to decompose the impact that the distinct flow-related aspects (goal clarity, skill–demands compatibility, availability of immediate and unambiguous feedback) exert on the level of flow, that is, it is unclear which of these flow-related aspects of the observed activities contribute to the flow experience and to what degree. Again, the correlational nature of the data makes it difficult to determine which of the flow-related factors is most important. Third, as is always true when working with correlational evidence, the data do not provide us with unambiguous information regarding the causal impact of the flow-related factors. In sum, given the fact that the available empirical evidence on flow experiences so far is almost exclusively correlational in nature, it seems meaningful to apply an experimental approach as a complementary strategy to test the causal hypotheses of the flow model.

In addition to the fact that experimental findings would be valuable in order to test the causal propositions of flow theory, there is also another methodological reason that encouraged us to develop an experimental paradigm: An experimental method to induce flow in the laboratory would be very helpful for analyzing the specific characteristics of the flow experience when they are "fresh" in the mind and this would enable us to get reports from participants who can come up with a description of the flow state that is experience-near and therefore quite accurate. It is noteworthy that exactly this methodological issue led Csikszentmihalyi and colleagues to apply the experience sampling method in order to collect experience- near descriptions of what individuals experience in their everyday lives (Csikszentmihalyi, 2000; Csikszentmihalyi & Rathunde, 1993). Moreover, a systematic analysis of the consequences of flow experiences seems to be much more feasible in the controlled setting of the laboratory than in the field.

In sum, we maintain that there are strong arguments in favor of an experimental analysis of flow. Hence, one major goal of the present research focuses on presenting an experimental paradigm for testing the balance hypothesis.

EXPERIMENT 1

Flow theory holds that flow experiences require skills, concentration, and perseverance and that entering flow is largely a function of the activity's structural conditions. Therefore, when trying to induce flow experiences, it is most important to find an adequate activity. Csikszentmihalyi and Rathunde (1993) pointed out that clear goals and unambiguous feedback are available in most games. Moreover, according to Privette (1983) game playing can be understood as a prototypic flow activity. Therefore, we decided to use a computer game encompassing the requirements of flow experiences. We adapted a specific version of the computer game widely known under the name *Tetris* and developed different versions to manipulate the skills–demands compatibility. Specifically, the adapted version allowed for a dynamic and automatic increase or decrease in task difficulty depending on participants' individual performance.

We expected participants playing the game under adaptive playing mode conditions (skills = demands) to report higher scores on indicators of intrinsic motivation and the flow experience than those playing the game under conditions of boredom (skills > demands) or overload (skills < demands). Moreover, we assumed that the perceived fit of skills and task demands represents a crucial mediator of the effects elicited by the experimental manipulation of the skills–demands compatibility.

Method

Design, Participants

Participants were 72 undergraduate students (44 females) at the University of Mannheim who were offered 2 Euros for their participation. Participants played a computer game and were randomly assigned to one of three game conditions representing a boredom condition (low task demands), an adaptive condition (task demands automatically and continuously adapted to participants' level of skill), and an overload condition (very high task demands). Following the game-playing period of 8 minutes, participants completed a questionnaire designed to assess the different dimensions of flow experiences.

Procedure. The aim of the Tetris game is to arrange "falling" objects so that they constitute completely filled lines at the bottom of the playing field. The falling objects can be moved to the right or left and rotated in 90° steps with assigned keys on the keyboard. The main idea underlying our experimental paradigm is to manipulate the fit between skills and demands by creating distinct playing modes. The game was therefore programmed in three distinct playing modes. In the boredom condition the objects keep falling at a very slow rate, regardless of the player's performance, and the player has no tool available to accelerate the falling speed of the objects. We expected persons to experience a negative state of boredom in this playing mode condition. In the adaptive (flow) condition the speed with which the objects keep falling is adapted to the player's performance. If the player successfully fills five lines or more (using a maximal number of 30 consecutive objects), the speed is automatically increased by one step. If the player accomplishes only three lines or less (using a maximal number of 30 consecutive objects), the speed is decreased by one step. Thus, the speed is adapted to the player's performance to keep the player within the flow channel reflected in a fit between skills and task demands. We anticipated that persons in this playing mode would differ significantly from the other conditions with regard to the intensity and quality of their experiences while playing the game. In the overload condition, objects initially start falling pretty fast and the speed is increased to an even higher level if the person manages to fill five lines (so that it is extremely difficult to fill any lines).

Immediately after playing the game, participants received a questionnaire and responded to several items designed to assess specific dimensions of experiences during task engagement on response scales with end-points labeled (1) *not at all true* and (7) *completely true*.

The flow state is usually measured by self-reports concerning the level of involvement, concentration, and enjoyment (Nakamura & Csikszentmihalyi, 2002). In the present research, we set out to focus on two distinct components of the flow experience that have been discussed as elements of this distinct type of intrinsic motivation: (a) a feeling of accelerated passing of time and (b) a deep involvement in and enjoyment of the activity.

Perception of time. To assess participants' sense of time, we asked them to indicate on a horizontal line (10 cm in length) with end-points labeled *very short* and *very long* their subjective estimate of the length of time they spent playing the game. Note that previous work based on the experience sampling method revealed that higher intrinsic motivation is associated with a subjective experience of time passing more quickly (Conti, 2001). Accordingly, time perception seems to be a valid indicator of one distinct component of the experience of intrinsic motivation.

Feeling of control. Flow theorists argue that a sense of control reflects one crucial element of the flow experience. However, sense of control can reflect different things (e.g., sense of control over outcomes vs. sense of control over how the game is proceeding [reflecting procedural control]). In the present study, we focused basically on the former component of control and the questionnaire included a 10-item scale designed to assess the perceived control over outcomes (sample items read, "I had the necessary skill to play the game successfully," "I knew exactly what I had to do," and "I think I performed well in the game"). This scale was internally consistent with Cronbach's alpha = .93. Note that given the nature of the task we used in the present studies (with completed lines as a clear and visible indicator of the outcome reached in the game) and the nature of the measure (assessing perceived control over outcomes), the perceived control scale serves largely as a manipulation check of the experimental manipulation in the sense that one would expect highest control ratings under conditions of boredom (skills > demands) and lowest levels of control ratings under overload conditions (skills < demands) if the manipulation is actually influencing the skills–demands compatibility.[2]

Note that this measure of perceived control over outcomes can be fruitfully used to document that the three playing mode conditions represent three distinct experiential states (as indicated by high, middle, and low scores on the measure of perceived control). Moreover, based on the measure of perceived control, we can address the question whether participants who experience a certain level of uncertainty regarding the outcome of the task (i.e., a somewhat limited degree of control over outcomes as most probably experienced in the adaptive playing mode condition) will still report higher engagement and enjoyment of the task compared to conditions where participants are likely to experience a strong sense of control over outcomes (as is the case in the experimental condition where ability exceeds task demands). This idea regarding a beneficial effect of a moderate level of uncertainty is conceptually similar to a point made by other authors regarding the pleasures of uncertainty (cf. Wilson, Centerbar, Kermer, & Gilbert, 2005). These authors have shown that positive mood following a positive event lasted longer in people who experienced the positive event under conditions of uncertainty (vs. certainty). This suggests that uncertainty can prolong the pleasure people derive from an event.

Involvement and enjoyment. Experiencing task engagement as rewarding in and of itself is the most crucial and characteristic feature of intrinsic motivation. We assessed this experience with a 14-item scale designed to assess involvement in and enjoyment of the activity (sample items read, "I was strongly involved in what was happening in the game," "I was not involved" [reversed], "I was thrilled," "I'd love to play the game again," and "I would consider buying the game for private use"). The scale was internally consistent with Cronbach's alpha = .95. It is worth mentioning that the measure of involvement and enjoyment contains items that assess the desire to engage in the activity again in the future, which reflects the willingness to engage in the activity in a free choice setting. Thus, the scale seems to cover a dimension of intrinsic motivation that is often seen as a crucial component of the assessment of intrinsic motivation (willingness to engage in the relevant activity in a free choice time period). We acknowledge the fact that applying an actual free choice measure would have been a more stringent assessment of intrinsic motivation. Nonetheless, it seems fair to conclude that the self-report measure that we applied in the present research at least partially captures this component of intrinsic motivation.

Perceived fit of skills and task demands. Perceived fit of skills and task demands was assessed by asking participants to respond to the item "To what degree did the demands of the game match your ability?" on a scale ranging from (1) *not at all* to (7) *completely*.

Results and Discussion

Performance. We submitted the number of lines completed in the Tetris game (as our measure of performance on the task) to a one-factorial analysis of variance (means are depicted in Table 1). The analysis revealed a significant effect of the experimental manipulation, $F(2, 69) = 21.49$, $p < .001$, reflecting the fact that participants in the adaptive playing mode condition reached higher performance scores on the task than their counterparts in both the boredom condition, $t(69) = 5.18$, $p < .001$, and the overload condition, $t(69) = 6.07$, $p < .001$.

Perception of time. Next, we submitted participants' judgments of the length of time spent on the task to a one-factorial analysis of variance (1 participant did not respond to this item). This analysis revealed a significant effect of the experimental manipulation, $F(2, 68) = 5.41$, $p < .009$ (means are depicted in Table 1). As expected, participants in the adaptive playing mode condition indicated that they spent less time on the task than their counterparts in both the boredom condition, $t(68) = 2.55$, $p < .02$, and the overload condition, $t(68) = 3.07$, $p < .004$. Supporting the outlined flow theory, these results suggest that engaging in a task under conditions of a fit between skills and task demands results in a feeling of an accelerated passing of time. This is well in line with the findings reported by Conti (2001), which revealed that an experience of accelerated passing of time is a specific element of intrinsic motivation.

TABLE 1: Effects of Skills–Demands (In)Compatibility on Perceived Control, Involvement, and Enjoyment and the Perceived Fit of Skills and Demands (Experiment 1)

	Skills–Demands (In)Compatibility					
	Skills > Demands	SD	*Skills = Demands*	SD	*Skills < Demands*	SD
Performance (number of lines completed)	16.3^{a}	2.3	23.4^{b}	4.3	15.1^{a}	6.6
Perceived time spent on task	60.0^{a}	20.9	45.8^{b}	20.7	63.1^{a}	16.0
Perceived control	5.8^{a}	0.8	4.7^{b}	1.0	3.3^{c}	1.0
Involvement/enjoyment	3.6^{a}	1.5	4.8^{b}	1.3	3.7^{a}	1.1
Perceived fit	2.8^{a}	1.8	4.6^{b}	1.7	3.8^{b}	1.4

NOTE: Means within rows not sharing a common superscript are significantly different, $p < .05$.

Perceived control. The scores on the perceived control scale were submitted to a one-factorial (playing mode: boredom, adaptive, overload) ANOVA (1 participant failed to respond to these items). As is evident from Table 1, participants reported highest levels of perceived control in the boredom condition (skills > demands) and lowest levels in the overload condition (skills < demands) with the adaptive playing mode condition (skills = demands) falling in between, $F(2, 68) = 45.41$, $p < .001$; contrast comparing boredom with adaptive playing mode conditions, $t(68) = 4.10$, $p < .001$; contrast comparing overload with adaptive playing mode conditions, $t(68) = 5.45$, $p < .001$. That is, in the present activity boredom is associated with perceived control—which is not surprising given the specific nature of the task and the nature of the control measure (focusing on control over outcomes). The fact that participants in the three experimental conditions experienced different levels of control indicates that our operationalization of boredom, flow, and overload was successful.

Involvement and enjoyment. We assessed effects of the manipulation of the skills–demands compatibility on involvement in and enjoyment of the activity by submitting the scores on the involvement and enjoyment scale to a one-factorial ANOVA (condition means are depicted in the middle panel of Table 1). Reflecting a significant impact of the experimental manipulation, $F(2, 69) = 6.22$, $p < .004$, participants in the adaptive playing mode condition reported higher levels of involvement and enjoyment than their counterparts in both the boredom condition, $t(69) = 3.21$, $p < .003$, and the overload condition, $t(69) = 2.87$, $p < .006$. This pattern indicates that there is in fact a causal relationship between the (in)compatibility of skills and task demands and the level of intrinsic motivation as reflected in the scores on the involvement and enjoyment scale. This supports the crucial balance hypothesis of flow theory.

Note that the effect of the playing mode manipulation on involvement and enjoyment remained robust even when participants' performance on the task was controlled for. Specifically, an analysis testing the potential mediating role of performance on the task revealed that this variable had no mediating impact. To conduct this analysis, we first coded the adaptive playing mode +1 and both the boredom and the overload condition 0. Following the procedure proposed by Kenny, Kashy, and Bolger (1998), we then regressed the scores on the involvement and enjoyment scale on the playing mode condition. Playing mode emerged as a significant predictor, $\beta = .39$, $t(70) = 3.53$, $p < .002$. Next, we regressed the performance scores on the playing mode dummy variable and found that playing mode was a significant predictor, $\beta = .61$, $t(70) = 6.51$, $p < .001$. Finally, we entered both the playing mode as well as performance scores as predictors in the analysis and found that playing mode remained a strong predictor, $\beta = .35$, $t(69) = 2.50$, $p < .02$, whereas the coefficient for performance was nonsignificant, $\beta = .06$, $t < 1$. That is, the effect of the playing mode manipulation on involvement and enjoyment cannot be accounted for by participants' performance on the task, which indicates that (at least in the present context) flow is not merely a function of performance outcomes attained during task engagement.

With respect to the role of perceived control in the task engagement process, we think it is noteworthy that participants obviously experienced more involvement and enjoyment in the adaptive playing mode condition although they reported a lower level of control (over outcomes) compared to participants in the boredom condition. This suggests that a certain degree of uncertainty with respect to one's performance outcome may be beneficial with respect to the emergence of task enjoyment.

Perceived fit of skills and task demands. Given the findings obtained on the involvement and enjoyment scale, one may wonder whether this pattern can actually be attributed to the fact that participants perceived a fit of skills and task demands under adaptive playing mode conditions—which would render additional support to the balance hypothesis proposed in flow theory. To test this assumption, we submitted the scores on the item assessing the perceived fit of skills and demands to a one-factorial ANOVA (condition means are depicted in the bottom panel of Table 1), which revealed a significant effect of playing mode, $F(2, 69) = 7.85$, $p < .002$. Participants in the adaptive playing mode condition reported a significantly higher level on the perceived fit measure than their counterparts in the boredom condition, $t(69) = -3.95$, $p < .001$, and the overload condition, although this latter difference reached only trend-level significance, $t(69) = 1.71$, $p < .10$.

To put the assumed mediating role of the perceived fit of skills and demands to a systematic test, we ran additional regression analyses. Again following the procedure proposed by Kenny et al. (1998), we tested whether the effect of the playing mode condition (again adaptive playing mode coded +1 and both the boredom and the overload condition coded 0) on involvement and enjoyment (as reported earlier this effect is significant, $\beta = .39$, $t(70) = 3.53$, $p < .002$) can be accounted for by the perceived fit of skills and demands. Accordingly, we regressed the perceived fit of skills and demands on the playing mode and found that playing mode was a significant predictor, $\beta = .36$, $t(70) = 3.18$, $p < .003$. Finally, we entered both the playing mode and the perceived fit as predictors in the analysis and found that perceived fit of skills and demands remained a strong predictor, $\beta = .41$, $t(69) = 3.77$, $p < .001$, whereas the coefficient for playing mode dropped substantially, $\beta = .25$, $t(69) = 2.26$, $p < .03$. A Sobel test indicated that this mediational effect is significant, $z = 2.43$ $p < .02$.[3] That is, although the mediation is partial in nature, this finding supports the assumption that the perceived fit of skills and task demands is involved in the emergence of intrinsic motivation as proposed in flow theory. Clearly, perceived fit is not the only relevant underlying mechanism, but it is one crucial factor that accounts for a substantial part of the association between the playing mode manipulation and the experienced intrinsic motivation. And it is remarkable that perceived fit but not the actual performance level on the task could be identified as a mediating factor. This suggests that it is not the objective level of success on the task but rather the subjectively experienced fit of skills and task demands that is relevant with respect to the experience of task involvement and enjoyment in the present context.

PERSONALITY CHARACTERISTICS AND THE FLOW EXPERIENCE

Although the flow experience is conceptualized as basically determined by the compatibility of skills and demands, it is very likely that specific personality characteristics enhance or decrease the likelihood of flow experiences. Indeed, the proponents of the flow model discuss the characteristics of the "autotelic personality." Csikszentmihalyi, Rathunde, and Whalen (1993) define the autotelic personality as the conjunction of receptive qualities (i.e., openness to new challenges) and active qualities (i.e., readiness to engage and persist in high-challenge activities). In parallel, Nakamura and Csikszentmihalyi (2002) state that the autotelic personality is distinguished by the metaskills curiosity and interest in life, persistence, and low self-centeredness. Although such a perspective posits a positive relationship between personality variables related to these constructs and the frequency, intensity, as well as the ease with which a person experiences flow in daily life, up to now little is known about the role of such personality factors with respect to flow experiences. Note that the experimental approach allows for an appropriate examination of this issue because it provides the possibility of inducing compatibility of skills and demands independently of personality factors. We addressed this aspect by assessing a specific personality construct in the experiment reported next.

Again starting out from the notion of regulatory compatibility, we argue that—in addition to a fit of skills and task demands—personality factors may contribute to regulatory compatibility effects. In Experiment 2, we tested this assumption by relating flow effects to individuals' action-state orientation (Kuhl, 1994), specifically to the volatility-persistence component of action-orientation (Diefendorff, Hall, Lord, & Strean, 2000). This personality variable reflects the ability to stay in an action-oriented mode when engaged in a task, to effectively maintain focus on an activity, and to persevere until the task is complete. As mentioned earlier, flow theorists suppose that persistence reflects a metaskill that should contribute to the frequency, intensity, and ease with which a person experiences flow. If so, persons scoring high on the volatility-persistence measure of action-orientation are most likely to be sensitive to skills–demands manipulations and should experience the highest level of flow under conditions of a skills–demands compatibility.

EXPERIMENT 2

Method

Design, participants, and procedure. Participants were 149 undergraduate students (85 females, 5 cases unspecified) at the University of Mannheim who were offered 2 Euros for their participation. Participants played the Tetris game and were randomly assigned to one of three game conditions (boredom, adaptive, overload). As in Experiment 1, after the game, participants

TABLE 2: Effects of Skills–Demands (In)Compatibility on Perceived Control, Involvement, and Enjoyment and the Perceived Fit of Skills and Demands (Experiment 2)

	Skills-Demands (In)Compatibility					
	Skills > Demands	SD	*Skills = Demands*	SD	*Skills < Demands*	SD
Performance (number of lines completed)	15.8[a]	4.4	20.9[b]	8.9	17.2[a]	6.8
Perceived time spent on task	59.8[a,b]	23.9	50.3[b]	24.4	62.1[a]	26.8
Agitation	2.1[a]	1.0	2.7[b]	1.0	3.2[c]	1.1
Involvement/enjoyment	3.8[a]	1.4	4.6[b]	1.4	3.6[a]	1.4
Perceived fit	3.4[a]	2.1	4.7[b]	1.5	3.1[a]	1.4

NOTE: Means within rows not sharing a common superscript are significantly different, $p < .05$.

completed a questionnaire designed to assess the different dimensions of flow experience. The procedure was thus identical to the one used in Experiment 1 with two exceptions. First, rather than assessing the level of control participants perceived during task engagement, the present experiment focused on the affective reactions to the task. Hence, we replaced the items assessing perceived control with items assessing the degree to which participants experienced distinct affective reactions to the task, indicating a state of agitation (or relaxation). Sample items read, "I was agitated," "I was relaxed" (reverse coded), and "I felt nervous." The nine-item scale was highly reliable (Cronbach's alpha = .88) and computed in a way that higher scores reflect stronger agitation reactions to the task. Note that the agitation measure is most similar to the activation dimension of the structural model of affect proposed by Feldman Barrett and Russell (1998). In their model, activation is orthogonal to valence, a dimension that is best represented in the present context with the involvement and enjoyment scale. Specifically, the agitation scale assesses affective states along a dimension with end-poles reflecting (a) a low level of activation (reflecting relaxation) and (b) a high level of activation (reflecting nervous tension or agitation).

Parallel to Experiment 1, we can make use of the scores on this measure of agitation (a) to document that the three experimental conditions represent distinct experiential states (as indicated by high, middle, and low agitation scores) and (b) to address the question whether participants who experience a certain (middle) level of agitation (as most probably observed in participants in the adaptive playing mode condition) will still report higher engagement and enjoyment of the task compared to conditions where participants are likely to experience a low level of agitation (as is most probably the case in the experimental condition where ability exceeds the task demands).

A second significant modification was that participants filled out a questionnaire containing a measure of action-state orientation prior to the computer game.

Measurement of action-state orientation. The German version of the volatility-persistence subscale of the Action-Control Scale (Kuhl, 1994) was applied. This is a forced choice self-report measure designed to assess differences in the ability to stay in the action-oriented mode when necessary and to effectively maintain focus on an activity until the task is complete. The opposing poles of this dimension of action-orientation reflect volatility versus persistence. A sample item reads, "When I am busy working on an interesting project: (A) I need to take frequent breaks and work on other projects. (B) I can keep working on the same project for a long time" (option B represents the action-oriented response). This scale has been found to predict task involvement and responses on a scale assessing the Big Five dimension conscientiousness (Diefendorff et al., 2000). The internal consistency of the scale was acceptable, alpha = .65.

Results and Discussion

Performance. Performance scores (number of lines completed in the Tetris game) were submitted to a one-factorial ANOVA (condition means are reported in Table 2), which resulted in a significant effect of the experimental manipulation, $F(2, 146) = 7.30$, $p < .002$. Participants in the adaptive playing mode condition reached a higher performance level than their counterparts in both the boredom condition, $t(146) = 3.67$, $p < .001$, and the overload condition, $t(146) = 2.70$, $p < .01$.

Perception of time. The scores reflecting the estimated time spent on the task (2 participants did not respond to this item) were submitted to a one-factorial ANOVA. As depicted in Table 2, participants gave lower time estimates in the adaptive playing mode condition than in both the boredom and the overload condition, $F(2, 144) = 2.58$, $p < .08$. Additional contrast analyses revealed that the scores of participants in the adaptive playing mode condition differed significantly from the scores of their counterparts in the overload condition, $t(144) = 2.12$, $p < .04$, and the boredom condition, although this latter difference reached only trend-level significance, $t(144) = 1.75$, $p < .10$.

Agitation. The analysis of the scores on the agitation–relaxation scale (4 participants failed to respond to these items) revealed a significant effect of playing mode, $F(2, 142) = 13.76$, $p < .001$. As depicted in Table 2, participants reported highest levels of agitation in the overload condition and lowest levels in the boredom condition, with the adaptive playing mode condition falling in between. Both simple effects turned out significant—boredom versus adaptive conditions: $t(142) = 3.01$, $p < .004$; overload versus adaptive conditions: $t(142) = 2.29$, $p < .03$.

Involvement and enjoyment. The scores on the involvement and enjoyment scale (Cronbach's alpha = .95) were submitted to a one-factorial ANOVA. Reflecting a significant impact of playing mode, $F(2, 146) = 6.40$, $p < .003$, participants in the adaptive playing mode condition reported higher levels of involvement and enjoyment than their counterparts in both the boredom condition, $t(146) = 2.73$, $p < .008$, and the overload condition, $t(146) = 3.35$, $p < .002$; means are depicted in Table 2. Again, this is a clear-cut replication of the results obtained in Experiment 1.

Note that parallel to Experiment 1, the effect of the playing mode manipulation on involvement and enjoyment remained robust even when participants' performance on the task was controlled for. The respective mediation analysis revealed that performance on the task has no mediating impact. Again, we coded the adaptive playing mode +1 and both the boredom and the overload condition 0 and then regressed the scores on the involvement and enjoyment scale on the playing mode condition. Playing mode emerged as a significant predictor, $\beta = .39$, $t(70) = 3.53$, $p < .002$. Next, we regressed the performance scores on the playing mode dummy variably and found that playing mode was a significant predictor, $\beta = .29$, $t(147) = 3.71$, $p < .001$. Finally, we entered both the playing mode and performance scores as predictors in the analysis and found that playing mode remained a strong predictor, $\beta = .26$, $t(146) = 3.10$, $p < .01$, whereas the coefficient for performance was nonsignificant, $\beta = .08$, $t < 1$. That is, parallel to Experiment 1 actual performance on the task is not a crucial factor with respect to involvement and enjoyment in the present context.

With respect to the role of agitation in the task engagement process, we think it is noteworthy that participants obviously experienced more involvement and enjoyment in the adaptive playing mode condition although they reported a higher level of agitation compared to participants in the boredom condition. This suggests that a certain degree of agitation (i.e., arousal) may be beneficial with respect to the emergence of task enjoyment. This is well in line with the classic Yerkes-Dodson law (Yerkes & Dodson, 1908), which attributes a decisive role to individuals' level of arousal such that arousal is positively correlated with performance up to a critical threshold level of task difficulty.

Perceived fit of skills and task demands. An analysis of participants' scores on the item assessing perceived fit of skills and demands revealed a significant impact of playing mode (means are depicted in the bottom panel of Table 2), $F(2, 146) = 11.56$, $p < .001$. Again, contrast analyses indicate that participants in the adaptive playing mode condition reported higher levels on the perceived fit measure than their counterparts in both the boredom condition, $t(146) = 3.55$, $p < .002$, and the overload condition, $t(146) = 4.55$, $p < .001$.

Parallel to our analytic strategy applied in Experiment 1, we ran additional regression analyses. As noted earlier, playing mode emerged as a significant predictor of involvement and enjoyment, $\beta = .28$, $t(147) = 3.53$, $p < .002$. Next, we regressed the perceived fit of skills and demands on the playing mode and found that playing mode was a significant predictor, $\beta = .36$, $t(147) = 4.70$, $p < .001$. Finally, we entered both the playing mode and the perceived fit as predictors in the analysis and found that perceived fit of skills and demands remained a strong predictor, $\beta = .27$, $t(146) = 3.28$, $p < .002$, whereas the coefficient for playing mode dropped substantially, $\beta = .18$, $t(146) = 2.21$, $p < .03$. A Sobel test indicated that this mediational effect is significant, $z = 2.69$, $p < .01$.[4]

In combination, the findings of Experiments 1 and 2 consistently indicate that the skills–demands compatibility reflects a crucial causal factor underlying the emergence of intrinsic motivation. Moreover, the mediational analyses reveal that the perceived fit of skills and task demands plays a part in this context, which is also in line with the balance hypothesis proposed in flow theory.

Action-orientation as a moderator. In preparing our analyses addressing the moderating role of action-orientation, we first computed two dummy variables (one dummy for the boredom condition, coded 1 for participants in this condition and 0 for all others; and another dummy for the overload condition, coded 1 for participants in this condition and 0 for all others), thus defining the adaptive playing condition as a critical reference category. Next, we centered the action-orientation scores (subtracting the overall mean score from participants' action-orientation score) and computed interaction terms multiplying the dummy variables with the action-orientation scores.

TABLE 3: Regressing Scores on the Involvement and Enjoyment Scale Onto Action-State Orientation, Experimental Condition, and Interaction Terms (Experiment 2)

	B	SE B	β	t	p
Constant	4.45	.19		23.19	.000
Action-orientation	0.23	.09	.37	2.52	.013
Boredom dummy	–0.65	.27	–.21	–2.37	.019
Overload dummy	–0.86	.28	–.28	–3.13	.002
Boredom × Action-Orientation	–0.11	.12	–.13	–0.99	.324
Overload × Action-Orientation	–0.30	.13	–.24	–2.24	.027

These procedures allow us to test the interplay of our continuous moderator variable (action-orientation) with the categorical factor playing mode in regression analyses.

We regressed the scores on the involvement and enjoyment scale on the action-orientation scores, the two dummy variables, and the two interaction terms. The results of this analysis are summarized in Table 3 and graphically represented in Figure 2. As illustrated in Figure 2, the analysis reveals the expected effect of the experimental manipulation for highly action-oriented individuals (analyzed at +1 *SD*), $B_{\text{overload dummy}} = -1.56$, $t = -3.85$, $p < .001$; $B_{\text{boredom dummy}} = -0.92$, $t = -2.45$, $p < .02$. In individuals with a low action-orientation (analyzed at –1 *SD*), the experimental manipulation did not affect the task involvement and enjoyment ratings, both $t < 1$. Note that the inclusion of the interaction terms in the analysis increased the explanatory power of the regression model: The R^2 value of .107 in the simple model increased to .138, reflecting a marginally significant R^2 change ($p < .09$).

In sum, the results of the moderation analysis suggest that in the context of the present activity, the volatility-persistence component of action-orientation represents a crucial boundary factor that determines the degree to which individuals are sensitive to the compatibility of skills and task demands. This indicates that we obtained evidence in support of a higher order regulatory compatibility effect in the present study: the compatibility of a personality trait (action-orientation) and structural characteristics of the task manipulated by the skills–demands (in)compatibility. Both of these compatibility effects support our conceptualization of intrinsic motivation as regulatory compatibility.

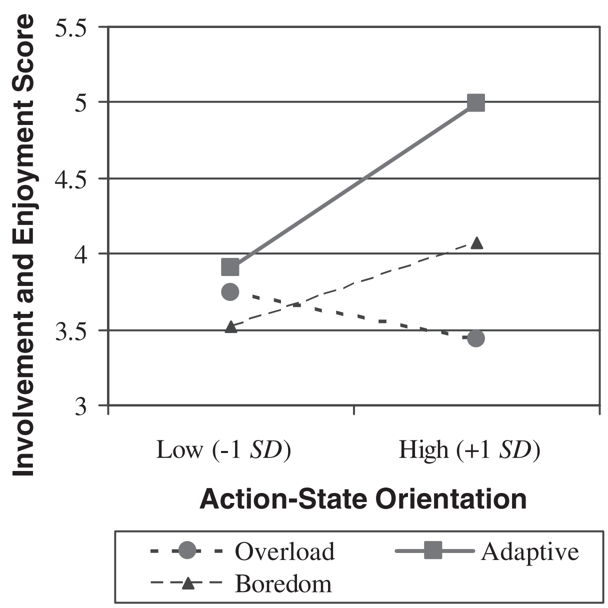

Figure 2 Graphic representation of the moderating effect of action-state orientation.

GENERAL DISCUSSION

Starting out from a general interest in intrinsic motivation, we investigated the impact of skill–demands compatibility on flow experiences as proposed in flow theory (Csikszentmihalyi, 2000). The obtained evidence provides strong support for the general assumptions of flow theory. First, the present results are based on an experimental approach that has so far been rather neglected in research on flow. The new experimental paradigm provides strong support for one crucial causal assumption proposed in flow theory. By using an experimental approach and thus eliminating the potential impact of confounding factors and uncontrolled third variables, our research goes beyond existing research on the determinants of flow experiences. The experimental approach also allows for a more systematic investigation of potential moderators in the form of personality variables as it avoids likely confounds of such personality factors with the conditions that elicit flow.

Second, the present results speak to the crucial role of experiencing a fit between skills and the task demands regarding the experience of flow. Specifically, when the mediational analyses controlled for perceived fit, the impact of the task–demand compatibility manipulation was significantly reduced. These findings suggest that the perceived fit of skills and task demands is important with respect to the emergence of intrinsic motivation. However, given that the reversed mediational model cannot be rejected (see notes 3 and 4), it remains an open question whether perceived fit is actually an underlying mechanism of perceived enjoyment or whether enjoyment and perceived fit merely represent two distinct although related elements of flow experiences.

From our perspective, the fact that the reversed mediation model cannot be rejected seems not particularly problematic for two main reasons. First, we think that we are still in a position to draw strong conclusions regarding the crucial role of the experienced fit with respect to the emergence of flow given that we manipulated fit in our studies. Using the expression coined by Spencer, Zanna, and Fong (2005), we think that our approach represents an example of the application of both possible strategies to "establish a causal chain"—testing mediation (by way of measuring the proposed mediator) as well as manipulating the proposed mediator. In combination, the observed findings render strong support for the claim that experiencing a fit between skills and task demands is a crucial causal factor regarding the emergence of flow. Second, we also acknowledge that flow theory is silent about whether individuals have to be consciously aware of the fit experience in order to reach a state of flow. That is, it may be the case that individuals cannot tell (on a self-report measure) whether they experienced a fit of ability to demands, but they may still experience a state of flow. Accordingly, it may not be of decisive importance to document that individuals consciously experienced a fit to make the point that fit (as manipulated by the task procedure) is a driving force regarding the experience of flow. In sum, we think it is fair to conclude that the observed findings speak to the role that a fit of skills and task demands plays in the emergence of flow.

A third important aspect of the present work with respect to flow theory is the fact that we obtained results that provide initial evidence with respect to potential moderators. Based on flow theory and the general notion of regulatory compatibility, we assumed that the experience of flow would depend on the degree to which specific personality factors fit with the structural requirements of the given task. That is, we argued that the experience of flow is more likely when an individual's personality matches with the characteristics of the situation. In support of this assumption, we observed that flow experiences were most pronounced for action-oriented (Kuhl, 1994) individuals. Presumably, the general orientation toward action (tenaciousness) and the ability to maintain focus on an activity (as compared to volatile individuals' tendency to be easily distracted and to lose concentration on a given task) reflect crucial prerequisites for the experience of flow. The moderating impact of the personality characteristic action-state orientation is particularly noteworthy given the fact that our experimental paradigm assured that task demands were adapted to individuals' skill level in adaptive task mode conditions. This implies that skills and demands matched similarly for high and low action-oriented participants; however, the induced skills–demands compatibility elicited flow only in participants who were high in action-orientation.

With respect to actual performance as a factor related to flow experiences, we want to emphasize that the question whether flow experiences affect actual task performance is an intriguing topic. Unfortunately, the relation between experienced flow and actual performance could not be meaningfully assessed in the present context. This is due to the fact that in our computer program, the difficulty level of the game was individually adapted to the player's skill level (particularly in the adaptive playing mode condition where task difficulty was actually strictly contingent on participants' individual performance). In essence, the main factor determining performance scores in the present context is the player's general ability, and accordingly, performance scores in this paradigm mainly reflect the player's baseline ability level. As a consequence, the interesting question whether flow experiences are related to actual task performance could not be meaningfully assessed in the present studies. However, this interesting and important topic can be addressed in future research applying our newly developed paradigm. In fact, it would be a very meaningful contribution to this line of research on intrinsic motivation to test whether flow experiences in an initial task engagement phase actually result in higher task involvement, persistence, and better performance levels in a subsequent task engagement phase. Additional studies are currently under way in our lab to address this intriguing question.

In conclusion, we want to emphasize that studying the sources of intrinsic motivation (with a special focus on causal mechanisms) is particularly relevant because it is often extremely important to know how to foster intrinsic motivation in applied settings. Accordingly, it is of major importance to understand the boundary conditions as well as the mechanisms underlying intrinsic motivation in the attempt to learn how to induce and maintain (intrinsic) motivation and to enhance the quality of everyday life experiences. Our findings indicate that it is crucial to consider the (structural) characteristics of the task as well as the characteristics of the person engaged in the task when one wishes to enhance the level of the individual's intrinsic motivation in task engagement. Specifically, the present studies highlight the fact that regulatory compatibility as reflected in the fit of skills and task demands is a powerful factor with respect to the emergence of intrinsic motivation.

NOTES

1. A study conducted by Danner and Lonky (1981) seems also relevant here. These authors assessed how much children from three different cognitive ability groups enjoyed three available tasks that varied in the level of required cognitive skills. Note that in this study, participants were not randomly assigned to different levels of skills–demands compatibility but they chose how much time to spend working on each task. Accordingly, this study cannot be considered a clear-cut experimental test of the balance hypothesis.

2. Note that we do not argue that experienced sense of control is necessarily a linear function of the skills–demands ratio. In line with flow theory, we assume that procedural sense of control should be highest under conditions of a match between skills and task demands. However, it seems plausible to assume that individuals' sense of control over outcomes is higher under conditions where perceived skills exceed perceived task demands. Given that the measure of control applied in the present study included several items referring to the outcomes attained in the game, we are dealing with a measure of the perceived control over outcomes here and accordingly it seems reasonable to interpret this measure basically as a manipulation check of the skills–demands manipulation.

3. We conducted reversed mediation analyses and found that enjoyment partially accounted for the relationship between the playing mode manipulation and perceived fit. Specifically, the coefficient for playing mode dropped from $\beta = .36$, $t(70) = 3.18$, $p < .003$, in the bivariate regression to $\beta = .19$, $t(69) = 1.72$, $p < .09$, in the regression including enjoyment scores, $\beta_{enjoyment} = .42$, $t(69) = 3.77$, $p < .001$.

4. Again, reversed mediation analyses revealed that enjoyment partially accounted for the relationship between the playing mode manipulation and perceived fit. The coefficient for playing mode dropped from $\beta = .36$, $t(147) = 4.70$, $p < .001$, in the bivariate regression to $\beta = .29$, $t(146) = 3.75$, $p < .001$, in the regression including enjoyment scores, $\beta_{enjoyment} = .25$, $t(146) = 3.28$, $p < .002$.

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