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The Importance of Challenge for the Enjoyment of Intrinsically Motivated, Goal-Directed Activities

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Abstract

Although early interview-based analyses of the enjoyment of intrinsically motivated, goal-directed activities (e.g., chess, rock climbing, art making) suggested the importance of relatively difficult, "optimal" challenges, subsequent findings derived from a wider range of activities have not provided consistent support for this proposition. Two studies were conducted to clarify the relation between challenge and enjoyment. Study 1 focused on a single activity—Internet chess. The importance of challenge was evident at the subjective level (perceived challenge strongly predicted enjoyment) as well as the objective level (games against superior opponents were more enjoyable than games against inferior opponents, and close games were more enjoyable than blowouts). In Study 2, the experience sampling method was used to examine the enjoyment of challenge across a wide range of everyday activities. Activity motivation (intrinsically motivated, non-intrinsically motivated) and activity type (goal directed, non-goal directed) moderated the relation. Implications for theories of intrinsic motivation are discussed.

Keywords

optimal challenge, intrinsic motivation, chess, enjoyment

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Why do people voluntarily engage in difficult, sometimes even dangerous activities for which they receive no discernible extrinsic rewards? This was the question that originally prompted a program of research that attempted to identify the intrinsically rewarding features of "autotelic" (from the Greek *auto* = self and *telos* = goal) activities—intrinsically motivated, goal-directed activities that require significant energy output (physical or mental) on the part of the actors (Csikszentmihalyi, 1975). Interviews with experienced rock climbers, chess players, athletes, and artists suggested that among the key conditions associated with the enjoyment of these activities was the presence of relatively difficult challenges that nevertheless were not beyond the participant's perceived capacities.

Subsequent investigations of optimal challenges typically used the experience sampling method (ESM; Larson & Csikszentmihalyi, 1983) to examine experience across the full range of activities individuals engaged in during their everyday lives (Adlai-Gail, 1996; Carli, Delle Fave, & Massimini, 1988; Clarke & Haworth, 1994; Delle Fave, Bassi, & Massimini, 2003; Ellis, Voekl, & Morris, 1994; Haworth & Evans, 1995; Hektner, 1996; Jones, Hollenhorst, & Perna, 2003; Massimini & Carli, 1988; Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003). In these studies, which typically measured both perceptions of challenge and perceptions of skill, perceptions of skill were consistently linked to enjoyment, but perceptions of challenge were not. Often, relatively challenging activities appeared to be no more enjoyable than relatively easy activities (Adlai-Gail, 1994; Carli et al., 1988; Clark & Haworth, 1994; Ellis et al., 1994; Haworth & Evans, 1995; Shernoff et al., 2003; Stein, Kimiecik, Daniels, & Jackson, 1995). Indeed, zero-order correlations between challenge and enjoyment, from those studies that reported them, were either null or negative (Chen, Darst, & Pangrazi, 2001; Hektner, 1996; Moneta & Csikszentmihalyi, 1996; Shernoff et al., 2003).

In assessing the implications of these findings, it is necessary to keep in mind that the studies they are derived from typically did not restrict their focus to autotelic activities but rather sampled a wide range of the everyday activities participants engaged in.[1] Many of these everyday activities,

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such as school-related activities and work-related activities, are not activities typically engaged in voluntarily for fun (i.e., intrinsically motivated) but out of obligation or necessity (e.g., Graef, Csikszentmihalyi, & McManama Gianinno, 1983). There is experimental evidence to suggest that in the context of such activities, individuals may most enjoy relatively low levels of challenge (Harter, 1978; Koestner, Zuckerman, & Koestner, 1987). More generally, the conditions that contribute to the enjoyment of activities for which intrinsic motivation has already been established appear to differ from those associated with the enjoyment of non-intrinsically motivated activities (e.g., Elliot & Harackiewicz, 1994).

Even intrinsically motivated activities, however, may differ in the extent to which challenge promotes enjoyment. Watching television, for instance, is typically an intrinsically motivated activity, yet the relevance of perceptions of challenge for the enjoyment of television viewing seems dubious. Television viewing, like other spectator activities, does not have a clear set of goals built into it. When watching television, the focus of attention is not on one's own actions but on the actions of other persons or things. Perceived challenge—a construct that implies the active pursuit of goals—should therefore have less relevance for the enjoyment of such non-goal-directed activities.

The Present Research

An implication of the preceding discussion is that the importance of challenge for the enjoyment of autotelic activities—activities that are both intrinsically motivated and goal directed—can only be adequately assessed by examining the enjoyment of challenge within the context of these activities while preserving their characteristically intrinsic motivational contexts. Accordingly, in Study 1, we used a minimally intrusive study design to examine the within-person relation between challenge and enjoyment in the context of an exemplary autotelic activity (Csikszentmihalyi, 1975)—the game of chess. Here, we expected the importance of challenge would manifest at both the subjective level (in terms of a strong relation between perceived challenge and enjoyment) and the objective level (in terms of the enjoyment of relatively difficult games). In Study 2, the assumption underlying Study 1—that challenge is most enjoyable in the context of activities that are both intrinsically motivated and goal directed—was tested by examining variations in the challenge–enjoyment relation across a wide range of everyday activities that varied by both activity motivation (intrinsically motivated, non-intrinsically motivated) and activity type (goal directed, non-goal directed).

Study 1

The notion that we most enjoy optimally challenging activities that are not too easy or too difficult implies a curvilinear, inverted U-shaped relation between difficulty and enjoyment, so that increases in difficulty should lead to increases in enjoyment up to an optimal level (i.e., the apex of the curve), after which further increases in difficulty lead to decreases in enjoyment. Of the many autotelic activities individuals pursue during their leisure, zero-sum competitive games such as chess, tennis, and poker have structural characteristics that appear particularly well suited for modeling this relation. In zero-sum games, difficulty is largely determined by the relative skill level of one's opponent. Being paired with an inferior opponent represents a relatively low level of difficulty, and being paired with a superior opponent represents a relatively high level of difficulty. Conveniently, the ratings systems used in many zero-sum games such as chess offer a meaningful, continuous metric with which to precisely estimate the degree of balance between activity demands and participant skills.

Although no previous study has examined the relation between enjoyment and the skill level of one's opponent in a real-world setting, a finding from a previous laboratory-based study (Epstein & Harackiewicz, 1992) has some relevance. Participants who competed against and eventually defeated an out-of-sight opponent who (participants were told before competing) was inferior in skill was associated with more process-based enjoyment than competing against and eventually defeating a superior opponent. However, as Epstein and Harackiewicz (1992) were careful to note, the somewhat artificial nature of the study design limits the generalizability of the finding.[2] Indeed, if we consider the competitive activities individuals regularly engage in during their free time, it is clear that they often enjoy pushing their skills to their limit, and even actively seek such opportunities (Csikszentmihalyi, 1975, 1990). Along these lines, athletes have reported that they sometimes find it difficult to focus against inferior opponents because of the lack of challenge provided by these games (Jackson & Csikszentmihalyi, 1999). In the context of a familiar, competitive intrinsically motivated activity, therefore, individuals may most enjoy competing against equal or even superior opponents.

A second indicator of difficulty in the context of zero-sum games is *relative performance*—how well a player performs relative to his or her opponent. Outperforming an opponent by a wide margin implies a very low level of difficulty for that player, and being defeated by a wide margin implies a very high level of difficulty. Thus, for the same reason we expected a curvilinear relation between relative skill level and enjoyment, we expected the relation between relative performance and enjoyment to be curvilinear, too. Perhaps less obvious than the curvilinear nature of the relation, however, is the location of the curve's apex. That is, where along the curve is enjoyment maximized? Controlling for opponent skill level (to make the question more approachable), do tennis hobbyists, for example, tend to most enjoy nontournament matches in which they outperform their opponents by a comfortable margin (e.g., 6-2, 6-2), or do they most enjoy much closer matches that go "down to the wire"?

Feeling good about one's performance while engaged in an intrinsically motivated activity is positively related to enjoying that episode of engagement (e.g., Delle Fave et al., 2003; Jone et al., 2003). In general, then, outperforming an opponent should be more enjoyable than being outperformed by that opponent. However, it also seems clear that in the context of competitive intrinsically motivated activities, very close games tend to be more exciting and suspenseful than more one-sided games, for both players involved. Given these two considerations, we suspected that the predicted curvilinear relation between relative performance and enjoyment would peak when players outperformed their opponents by a relatively small margin.

Method

Participants. An online ad for the study was posted on the home page of the chess website, Caissa's Web (http://www.caissa.com). To encourage participation, prospective participants were informed that at the conclusion of the study they would be provided with various statistics regarding their chess playing styles (e.g., average number of "blunders" per game), computed using chess analysis software. All participants were preexisting members of the chess site who freely engaged in chess as a form of leisure.

The study began with 121 adults (119 males and 2 females). During the course of the study, 14 participants withdrew. In addition, we eliminated data from all participants who played fewer than three games against rated opponents during the study (14 participants), as well as data from 4 participants whose survey responses were patterned and consistently implausible. Finally, because only 2 of the participants were female, we discarded their data to control for gender. The final sample thus consisted of 87 males.

The mean age of participants was 42.1 years (SD = 12.1, range = 23-75). Participants, on average, had 28 years of chess-playing experience (SD = 13.8, range = 4-70). Sixty-nine percent of the sample was American. The remaining 31% represented a wide range of countries including Canada (8%), Germany (4%), Sweden (2%), and Denmark (2%).

Participants played a total of 1,430 games over the study period—an average of 16.4 games per participant.[3] All games were regular, nontournament games.

Measures

Enjoyment. Immediately following each game, participants completed a short online survey that asked them to indicate how interesting, exciting, and fun the game they had just played was, using a 5-point scale (1 = *not at all*, 5 = *very much*). These three items showed high reliability (α = .88) and were averaged to create a composite enjoyment measure.

Relative chess rating. All members of the chess site had a chess rating corresponding to their skill level, based on the standard Elo chess rating system used by the World Chess Federation. This chess rating is a numeric value derived using statistical and probability theory and is updated continually according to recent results against other rated players.[4] Relative chess rating represented the difference between a participant's chess rating and his or her opponent's chess rating. For example, if a participant with a chess rating of 1500 played a game against an opponent with a chess rating of 1750, the participant's relative rating for that game would be –250.

Relative performance. We used Fritz 8 chess analysis software (Viva Media: New York, NY) to estimate the degree to which participants outperformed or were outperformed by their opponents, based on the average *material score* of each game. The material score at any given point during a chess game is computed based on the total value of one player's pieces minus the total value of the other player's pieces, using a standard chess piece value system (pawn = 1 point, bishop/knight = 3 points, rook = 5 points, queen = 9 points). So, for example, at the very beginning of a chess game, the material score is always 0 because both players have all their pieces. If, after a few moves, a player captures one of his opponent's pawns, the material score becomes +1. Because our analysis was at the game level, we averaged all of the play-by-play material scores over the course of each game to derive a single relative performance score per game.

Game outcome. This variable represented whether the participant lost or won a given game (0 vs. 1, respectively). Games that ended in a draw or stalemate (n = 42) were coded as .5.

Perceived challenge. A question in the postgame survey asked participants to indicate how challenging the game they just played was, using a 5-point scale (1 = *not at all*, 5 = *very much*).

Perceived skill. A question in the postgame survey asked participants to indicate how well they played, using a 5-point scale (1 = *not at all*, 5 = *very much*).

Procedure

It is necessary to briefly review how the chess website operates. When members of the website wish to play a game, they navigate to a "waiting room" where the usernames and chess ratings of other members who are seeking a game are listed. Members may either select an opponent from the list or post their own "seeking a game" notice. Once a member selects one of the listings from the seeking a game list, a message stating, "Matchup made, ready to begin" appears on both players screens, along with the opponent's username. The game then begins. Play is "real time," meaning there is no significant delay between what players do and what they and their opponents see on their screens. At the end of each game, each player's chess rating is automatically adjusted according to whether he or she won or lost the game, and the rating of the opponent. The new ratings are then displayed to both players. Participants are then given an option of returning to the waiting room to seek another match or of exiting the site.

Table 1. Means, Standard Deviations, and Pooled Within-Person Correlations of Study 1 Variables

	M	*SD*	1	2	3	4	5	6	7
1. Enjoyment	3.35	0.98	—	—	—	—	—	—	—
2. Relative rating	25.43	191.17	.27**	—	—	—	—	—	—
3. Relativeperformance	0.13	1.80	.09	.30**	—	—	—	—	—
4. Outcome	0.56	0.48	.10	.38**	.52**	—	—	—	—
5. Perceived challenge	3.44	1.07	.68**	–.39**	–.11	–.17**	—	—	—
6. Perceived skill	3.10	1.21	.50**	.05	.33**	.46**	.26**	—	—
7. Postgame affect	2.78	1.00	.49**	.00	.23**	.55**	.35**	.62**	—

**$p < .01$.

During the 2-week study period, the only change made to the usual routine was that immediately following each game participants were automatically linked to a brief online survey (hosted on the chess site's server) that measured enjoyment, perceived challenge, and several other experiential variables. After completing this survey, participants were automatically linked to the waiting room, where they had the option of playing another game or exiting the website. Objective information about the games, including the chess ratings of participants and their opponents, the board moves made by participants and their opponents, and the outcome of each game, was automatically downloaded from the website's server.

Data Analytic Strategy

Because of the observational nature of the study design, it was not possible to control for all potential confounds. Of greatest concern here was the potentially confounding effect of competitive outcome. In most of the analyses, enjoyment was the outcome variable. Enjoyment was intended to represent process-based enjoyment—how much enjoyment participants experienced *during* the games they played. Because enjoyment was assessed after participants completed their games, the possibility that enjoyment ratings would be influenced by whether participants won or lost the games they played was a serious concern.

Two steps were taken to address the potentially confounding effect of outcome. First, to encourage participants to clearly differentiate between enjoyment experienced during the games and affect experienced following the games, items tapping postgame affect were also included in the survey and were clearly differentiated from the questions measuring enjoyment by both the wording of the questions and their physical location on the survey. Second, when appropriate, outcome was statistically controlled by including it as a predictor or by examining wins and losses separately.

The data represented a two-level hierarchical structure: games (Level 1) nested within players (Level 2). Multilevel models were therefore used in all analyses. Because most predictors had meaningful zero points, they were entered into the models uncentered unless otherwise noted. In all models, intercepts and slopes were designated as random except where noted.

Results

The means, standard deviations, and pooled within-person correlations of Study 1 variables are presented in Table 1. The pattern of correlations suggests participants were clearly distinguishing between game enjoyment and postgame affect. For example, whereas outcome was strongly correlated with postgame affect ($r = .55$), it was uncorrelated with enjoyment ($r = .10$, *ns*).

Perceived challenge, perceived skill, and enjoyment. Table 1 shows that both perceived challenge and perceived skill were strongly correlated with enjoyment. To assess their independent effects, they were both entered as Level 1 predictors (person centered) into a two-level model. Competitive outcome was also included to statistically control for it. The relation between perceived challenge and enjoyment was positive and significant, $\gamma_{10} = .56$, $se = .02$, $t = 23.89$, $p < .001$, as was the relation between perceived skill and enjoyment, $\gamma_{20} = .21$, $se = .02$, $t = 8.98$, $p < .001$. A chi-square contrast indicated that the relation between perceived challenge and enjoyment was significantly stronger than the relation between perceived skill and enjoyment, $\chi^2 = 142.30$, $p < .001$.

Relative chess rating and enjoyment. A two-level quadratic model was used to model the predicted curvilinear relation between relative rating and enjoyment. Enjoyment was regressed on relative rating and relative rating^2. The quadratic term was significant, $\gamma_{20} = -2.3 \times 10^{-2}$, $se = 5.6 \times 10^{-3}$, $t = -4.95$, $p < .001$, indicating the relation between relative rating and enjoyment was best represented by an inverted-U shaped curve (see Figure 1). To test for the significance of the linear term, we ran the model without the quadratic term (Cohen & Cohen, 1983). The linear term was also significant, indicating that players most enjoyed games against opponents who had higher ratings than their own, $\gamma_{10} = -1.2 \times 10^{-3}$, $se = 2.2 \times 10^{-4}$, $t = -5.53$, $p < .001$. The apex of the curve was found to represent a difference in ratings between players and opponents of 262 Elo points. In other words, on

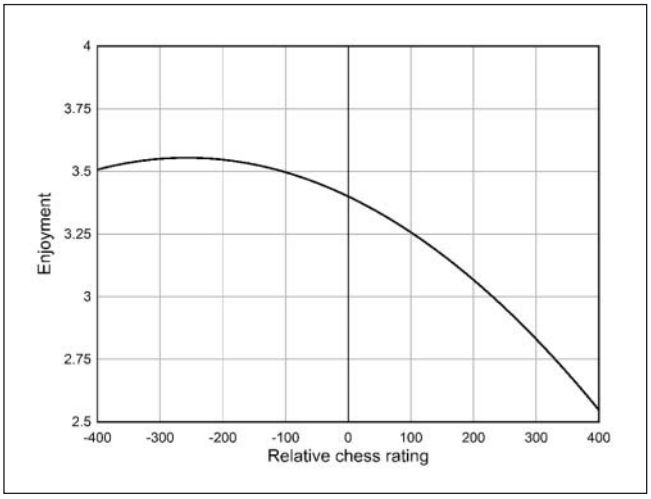

Figure 1. Enjoyment as a function of relative chess rating
Relative chess rating values represent participant chess ratings minus opponent chess ratings.

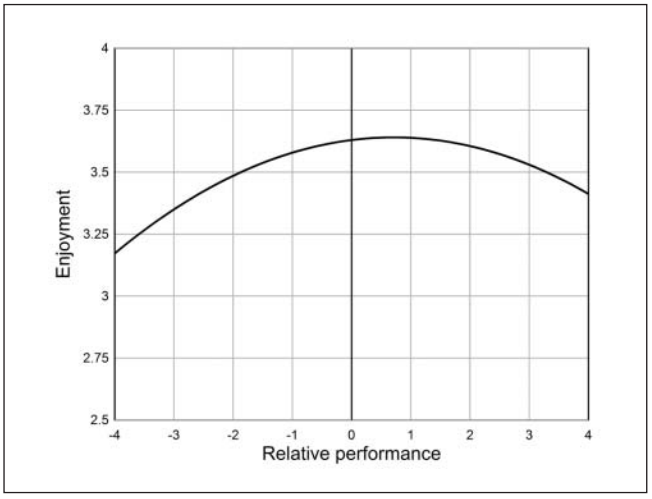

Figure 2. Enjoyment as a function of relative performance
Relative performance values represent pawn units.

average, players most enjoyed competing against opponents who had ratings that were 262 points higher than their own ratings. The probability of a player winning such a game is approximately 20%.[5]

In the previous analysis, we did not control for outcome, as this would have led to interpretational issues. However, because outcome did not vary randomly across relative rating, this leaves open the possibility that the higher reported enjoyment of games against superior opponents was due to the confounding effect of postgame affect (which was strongly correlated with outcome (see Table 1). Although this seems unlikely, given that most games against superior players ended as losses, we conducted a subsequent analysis designed to more effectively test this possibility. A two-level model compared the enjoyment of games against superior opponents that ended as losses ($n = 400$) with the enjoyment of games against inferior opponents that ended as wins ($n = 595$). Games against superior opponents that ended as losses were more enjoyable than games against inferior opponents that ended as wins ($M = 3.36$ vs. $M = 2.99$, respectively), $p < .001$. When postgame affect replaced enjoyment as the outcome variable, the opposite pattern emerged. That is, postgame affect was higher after defeating inferior opponents than after losing to superior opponents ($M = 2.96$ vs. $M = 2.29$, respectively), $p < .001$.

Relative performance and enjoyment. A two-level quadratic model was used to model the predicted curvilinear relation between relative performance and enjoyment. Relative performance and relative performance^2 were entered as predictors. Relative rating and outcome were also included as predictors to hold them constant.

The quadratic term (relative performance^2) was significant, $\gamma_{20} = -2.3 \times 10^{-2}$, $se = 3.5 \times 10^{-3}$, $t = -6.58$, $p < .001$, indicating that the relation between relative performance and enjoyment was best represented by an inverted-U shaped curve (see Figure 2). The apex of the curve was located at a relative performance score of .78 pawn values. This indicates that against equally rated opponents, players most enjoyed games in which they held a small performance advantage over their opponent (slightly less than the value of a single pawn). When the model was run without the quadratic term, the linear term was significant, $\gamma_{10} = 2.9 \times 10^{-2}$, $se = 1.4 \times 10^{-3}$, $t = 2.05$, $p < .05$, indicating that outperforming one's opponent was more enjoyable than performing equally.

A final multilevel analysis was conducted to determine whether relative chess rating moderated the relations examined in the previous analysis. All the predictors used in the previous analysis were again entered into Level 1 of a two-level model, along with two new ones: relative rating*relative performance and Relative rating*relative Performance^2. For both computational and interpretative reasons, these two interactions were designated as fixed (Snijders & Bosker, 1999). The relative Rating*Relative Performance interaction was significant, $\gamma_{30} = 1.4 \times 10^{-4}$, $se = 5.6 \times 10^{-5}$, $t = 2.54$, $p < .05$, indicating that the apex of the curve shown in Figure 2 shifted slightly to the right for games against opponents with higher relative chess ratings (i.e., superior opponents) and to the left for games against inferior opponents. However the relative rating*relative performance^2 interaction was not significant ($t = -0.29$, *ns*). In other words, regardless of an opponent's chess rating, the curvilinear nature of the relation between relative performance and enjoyment remained—closer games tended to be more enjoyable than blowouts.

Discussion

In the context of Internet chess games played by experienced chess players, a strong relation between challenge and

enjoyment was evident. The within-person, zero-order correlation between perceived challenge and enjoyment was strong (r = .68) and exceeded the correlation between perceived skill and enjoyment (r = .51). Furthermore, this strong reation remained even after controlling for perceived skill, suggesting that challenge can contribute to enjoyment even when not accompanied by corresponding perceptions of skill.

The remaining analyses used two objective measures of difficulty as proxies for challenge. Doing so made it possible to assess the degree of relative difficulty that maximized enjoyment. Consistent with the notion that enjoyment is maximized by challenges that are not too easy and not too difficult, the relation between relative chess rating and enjoyment was curvilinear. The location of the apex of the curve indicated that enjoyment was maximized when participants played against opponents who had considerably higher chess ratings than they had (262 Elo points higher). The shape of the relation between relative performance and enjoyment was also curvilinear, with the location of the curve's apex indicating that players most enjoyed games in which they held a slight performance advantage over their opponents, calculated to be less than the value of a single pawn.

Of course, very challenging games often ended in defeat, and losses, as would be expected, lead to lower postgame affect compared to wins. However, the affective responses to games were clearly distinguishable from the enjoyment experienced during the games themselves and were predicted by different factors. Although a considerable number of laboratory-based studies of the enjoyment of competitive activities suggest the importance of positive performance outcomes (namely, winning) for enjoyment, in the context of familiar activities for which intrinsic motivation has already been established (as in Study 1), variations in enjoyment may be most tied to the process-based characteristics of these games (e.g., level of challenge, immediacy of feedback, nature of the goals, etc.) rather than what happened before the games (e.g., a previous win or loss) or the prospect of what may happen at their conclusion (e.g., a victory or defeat).[6] Indeed, a defining feature of autotelic activities is their capacity to channel attention away from such concerns and toward the task at hand (Csikszentmihalyi, 1975).

The enjoyment of challenge and perceptions of competence. Cognitive evaluation theory (CET; Deci & Ryan, 1985) conceives of the enjoyment of challenge as rooted in perceptions of competence. According to CET, we enjoy optimal challenges because "it is success at optimally challenging tasks that allows people to feel a true sense of competence" (Deci & Ryan, 2000, p. 260). This conceptualization of the enjoyment of challenge as rooted in perceptions of competence is not easily reconciled with findings from Study 1. Perceptions of challenge strongly predicted enjoyment even after controlling for perceptions of skill. Additionally, players most enjoyed games in which they performed only slightly better than equally rated opponents—outperforming these opponents by a wider margin was not as enjoyable (see Figure 2). It would seem unlikely that outperforming an equally rated opponent by a small margin would provide more positive competence information than outperforming the same opponent by a wider margin, so it is unclear how CET would account for this difference in enjoyment.

We offer one possible explanation. Studies of competitive balance in sports leagues have found that when a league lacks competitive balance (i.e., winning percentages vary widely and games tend to be lopsided), spectators tend to find the games boring—even when the home team wins—because of their predictability, and game attendance goes down (Fort & Quirk, 1995; Neale, 1964). In the context of intrinsically motivated, zero-sum sports and games, it is likely that such an effect applies not only to observers but to actors as well. That is, when we engage in these activities, part of the enjoyment comes from the *suspense* of not knowing what the ultimate outcome will be. Outcome uncertainty adds significance and drama to one's immediate actions, and promotes further involvement in the activity. When outcome uncertainty is low—as when a chess player outperforms his or her opponent by a wide margin—so too is the degree of suspense. Future research which more directly examines this possibility may yield important findings.

Implications for other intrinsically motivated competitive activities. In considering the implications of these findings for other real-world, intrinsically motivated competitive activities, three points should be made. First, the intrinsic rewards of very challenging, autotelic activities may partly stem from the deep attentional involvement typically associated with such activities (Abuhamdeh & Csikszentmihalyi, in press). Sometimes, however, individuals engage in autotelic activities less for the purpose of mental or physical involvement than for other benefits. A member of a softball league, for example, may enjoy his Sunday games more for the socializing and camaraderie than for the game itself. To the extent that an individual engaged in an autotelic activity derives enjoyment from sources other than the essential elements of the activity, we would expect the strength of the relation between challenge and enjoyment to be reduced accordingly. Second, zero-sum competitive activities vary in the degree to which challenges are bound to the performance of opponents. Golf, snooker, and many other zero-sum competitive activities incorporate subgoals with difficulty levels that are independent of how well or poorly opponents perform (e.g., making par, striking a ball into a pocket). For this reason, the enjoyment experienced by individuals engaged in these zero-sum activities is likely to be less tied to the skill levels of their opponents than would be the case for other zero-sum competitive activities such as chess or tennis (e.g., if your tennis partner is unable to hit the ball over the net, the game quickly becomes boring). Third, any state or trait-level factor that increases performance anxiety is also likely to reduce the strength of the challenge–enjoyment relation. All participants were experienced chess players who

presumably had already established a sense of their own competence (or incompetence) at chess. Furthermore, the games were played in familiar, natural settings and were Internet based. All three of these factors (experience with the activity, games played in a familiar setting, and relative anonymity provided by the Internet) likely minimized performance anxiety and may therefore have contributed to the strong relation between challenge and enjoyment.

Limitations. Study 1 examined factors associated with the enjoyment of Internet chess using a minimally intrusive study design. Though this affords confidence in the ecological validity of the findings, the observational nature of the study design limited the amount of control that was possible. Three specific consequences of this limitation deserve mention. First, as with all studies based on observational data, it is not possible to rule out the possibility of spurious relations. Second, because all participants were male, it is possible one or more of the examined relations may be moderated by gender.[7] Third, all participants in the study were experienced chess players. Previous research indicates both the linear and curvilinear relation between difficulty and enjoyment is sensitive to individual differences (Abuhamdeh & Csikszentmihalyi, 2009; Engeser & Reinberg, 2008; Jagacinski, Kumar, & Kokkinou, 2008; Keller & Bless, 2008; Schüler, 2009a). Thus if personality differences exist between chess players and nonplayers, these differences may moderate one or more of the relations examined in Study 1. Although one recent study found the elite chess players who completed the Freiburg Personality Inventory did not significantly differ in their personality profiles from population norms (Vollstadt-Klein, Grimm, Kirsh, & Bilalic, 2010), findings from other studies suggest that chess players may be high in introversion (Kelly, 1985), orderliness and unconventional thinking (Avni, Kipper, & Fox, 1987), and sensation seeking (Joireman, Fick, & Anderson, 2002). This last finding appears especially relevant, as individuals high in sensation seeking may most enjoy unusually high levels of challenge.

Study 2

The strength of the relation between perceived challenge and enjoyment found in Study 1 contrasts sharply with previous estimates of this relation within the intrinsic motivation literature, which range from –.10 (Moneta & Csikszentmihalyi, 1996) to .21 (Tauer & Harackiewicz, 2004), and is a reflection of the considerable heterogeneity of the relation across contexts. The primary purpose of Study 2 was to account for this heterogeneity. We previously proposed that the strength of the challenge–enjoyment relation is strongest for intrinsically motivated, goal-directed activities. In Study 2 we tested this proposition by examining activity motivation (intrinsically motivated, non-intrinsically motivated) and activity type (goal directed, non-goal directed) as potential moderators of the challenge–enjoyment relation across a wide range of everyday activities.

Method

Participants. We used data from the Sloan Study of Youth and Social Development, a national longitudinal study investigating the experiences of middle and high school students as they are socialized into adulthood (Csikszentmihalyi & Schneider, 2000). These data were collected in three waves: 1992-1993 (Year 1), 1994-1995 (Year 3), and 1996-1997 (Year 5). Twelve sites across the United States were selected to represent variation in racial and ethnic composition, labor force composition, and economic stability. Although the original data were longitudinal, only data collected in Year 1 were analyzed in the current study.

A total of 1,109 students participated in the Year 1 study. Four hundred and ninety-eight of these participants (45.1%) were male, and 611 (54.9%) were female. Participants came from the 6th grade (27.3%), 8th grade (28.1%), 10th grade (23.6%), and 12th grade (20.9%).

Procedure. The ESM (Larson & Csikszentmihalyi, 1983) was used to gather information regarding the day-to-day subjective experiences of participants as they occurred in real-world settings. Capturing immediate experience as such avoids many of the biases introduced by retrospective recall over longer periods (Redelmeier & Kahneman, 1996; Schwartz & Sudman, 1994). Furthermore, because the ESM samples experience across a wide range of real-world activities, the technique offers a degree of ecological validity that is not possible using laboratory-based methods.

Each participant was given a wristwatch programmed to emit random signals eight times each day for 7 days, between 7:30 a.m. and 10:30 p.m. This resulted in a total of 56 signals per person during the study week. Each time participants were paged, they completed a two-page Experience Sampling Form (ESF). The ESF assessed both objective (e.g., time, location, activity) and subjective (e.g., interest, perceived challenge) aspects of participants' momentary situation.

Participants responded to a total of 29,764 signals, a 48% response rate. A previous assessment of response patterns in this data set indicated a relative lack of participant response bias (Mulligan, Schneider, & Wolfe, 2000). The open-ended responses to the question "What were you doing when you were paged?" were subsequently categorized by trained coders into 160 discrete activities (e.g., listening to a lecture, talking with a friend)

Measures

Enjoyment. Enjoyment was a composite of three ESF items: one that asked participants how much they *enjoyed* the activity they were engaged in (1 = *not at all,* 10 = *very much*), another that asked how *interesting* they found the activity to be (1 = *not at all*, 9 = *very much*), and a third that asked how *exciting* they found the activity to be (1 = *not at all*, 7 = *very much*). Responses to *interesting* and *exciting* were rescaled to a 10-point scale. This composite measure of

Table 2. Means, Standard Deviations, and Pooled Within-Person Correlations of Study 2 Scale-Level Variables

	M	*SD*	Range	1	2	3
1. Enjoyment	6.17	2.38	1-10	—	—	—
2. Perceived challenge	3.89	2.93	1-9	.06***	—	—
3. Perceived skill	6.43	2.72	1-9	.26***	.11***	—

Valid *N* (listwise) = 25,292.
***$p < .001$.

enjoyment has commonly been used in intrinsic motivation research as a measure of enjoyment and showed good reliability ($\alpha = .71$).

Perceived challenge. A single item in the ESF asked respondents to indicate how challenging they perceived the activity to be (1 = *not at all*, 9 = *very much*).

Perceived skill. A single item in the ESF asked respondents to indicate how skilled they were in the activity(1 = *not at all*, 9 = *very much*).

Activity motivation (intrinsically motivated, non-intrinsically motivated). Within the intrinsic motivation literature, no standard operational definition for intrinsically motivated activities exists. At the theoretical level, however, two key features are apparent. First, intrinsically motivated activities are pursued voluntarily, in the absence of external constraints (Deci & Ryan, 1985; Harackiewicz, Manderlink, & Sansone, 1984). Second, intrinsically motivated activities are pursued for the enjoyment participants experience during the activities (Csikszentmihalyi, 1975; Ryan, Williams, Patrick, & Deci, 2009). Accordingly, two items in the ESF were used to distinguish intrinsically motivated activities from non-intrinsically motivated activities. One item asked respondents whether they engaged in the activity because they "wanted to," "had to," or had "nothing else to do" (multiple responses were possible). A second item asked respondents whether the activity was more "like work, "like play," "both," or "neither." Intrinsically motivated activities were operationalized as activities that participants engaged in because they "wanted to" *and* that were perceived to be more like play than work ($n = 4,377$). Non-intrinsically motivated activities were operationalized as activities participants engaged in because they "had to" and that were perceived to be more like "work" ($n = 4,832$).Out of the total 9,205 observations, 525 were associated with activities involving physical satiation (e.g., eating, sleeping/resting). These activities are considered outside the purview of theories of intrinsic motivation (e.g., Csikszentmihalyi, 1975; Deci & Ryan, 1985) and were therefore not included in the analyses.

Activity type (goal directed, non-goal directed.). Of the observations coded as either intrinsically motivated or non-intrinsically motivated, 5,056 were designated as goal directed, and 2,045 were designated as non-goal directed. Activities designated as goal directed included most school-related activities ($n = 3,422$), sports/games ($n = 613$), and hobbies ($n = 271$). Activities designated as non-goal directed included watching television ($n = 770$) and most forms of socializing ($n = 695$). Observations with activity descriptions that did not allow for classification into one category or the other (e.g., "talking with classmates," "writing/reading," "standing") were not included in the analyses ($n = 1,436$).

Data Analytic Strategy

To test activity motivation as a moderator of the challenge–enjoyment relation, intrinsically motivated, goal-directed observations ($n = 1,145$) were compared with non-intrinsically motivated, goal-directed observations ($n = 3,913$). To test activity type as a moderator, intrinsically motivated, goal-directed observations were compared with intrinsically motivated, non-goal-directed observations ($n = 1,860$). This analytic approach was used to account for the unbalanced nature of the data across levels of the two factors (a large majority of the non-intrinsically motivated activities were also goal directed). Because of the low number of observations in the non-intrinsically motivated, non-goal-directed category ($n = 128$), these observations were not included in the analyses.

As in Study 1, the data represented a two-level hierarchical structure: observations (Level 1) nested within persons (Level 2). Thus, multilevel models were used to examine the relations of primary interest. Unless otherwise noted, continuous predictors were person centered, dummy variables were left uncentered, and both intercepts and slopes were designated as random

Results

Means, standard deviations, and within-person correlations of Study 2 scale-level variables are shown in Table 2. As can be seen, the zero-order within-person correlation between challenge and enjoyment averaged over all activities was weak but significant ($r = .06$).

As a preliminary analysis, we examined the heterogeneity of both the challenge–enjoyment relation and the skill–enjoyment relation between activities. Perceived challenge and perceived skill were entered as predictors into a two-level cross-classified model (Fielding & Goldstein, 2006; Raudenbush & Bryk, 2002), with both person and activity

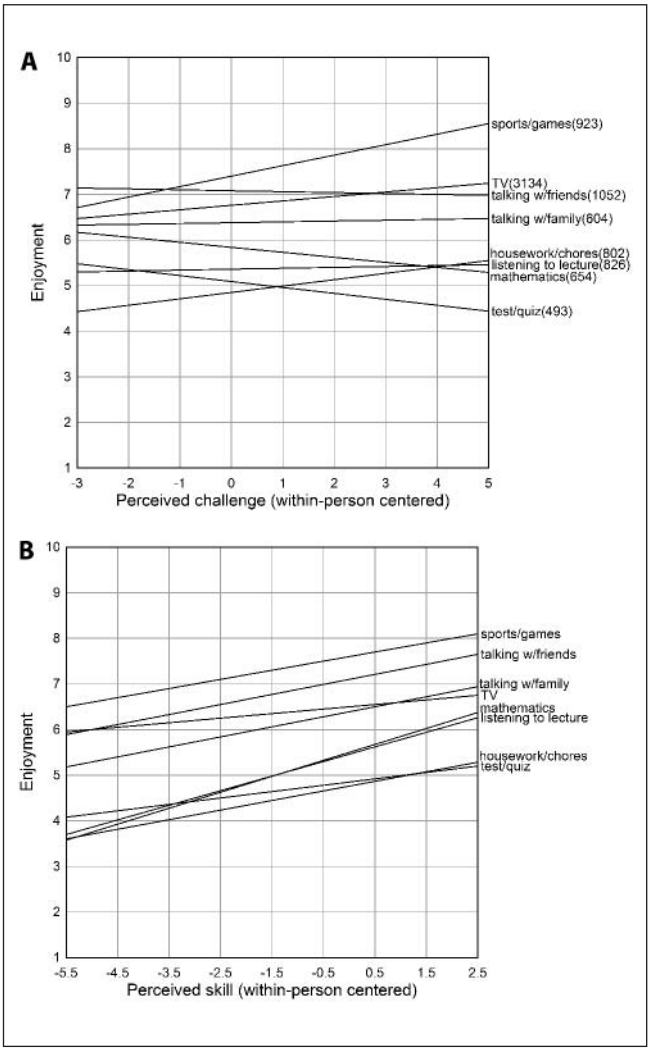

Figure 3. Enjoyment as a function of perceived challenge (3a) and perceived skill (3b) for several of the most commonly reported activities

Number of observations is in parentheses. Other commonly reported activities (not shown) included eating (1,369), sleeping/resting (1,126), walking/transit (1,114), homework/study (1,102), personal care/grooming (1,059), and sitting/standing (945).

designated as Level 2 cross-random factors.[8] This approach resulted in the partitioning of these two sources of variance, allowing for the within-person, between-activity variance of the two relations (challenge–enjoyment, skill–enjoyment) to be measured. As expected, the challenge–enjoyment slopes varied considerably more between activities, $\sigma^2 = 1.2 \times 10^{-2}$, $se = 3.5 \times 10^{-3}$, $z = 4.84$, $p < .001$, than the skill–enjoyment slopes did, $\sigma^2 = 3.4 \times 10^{-3}$, $se = 2.1 \times 10^{-3}$, $z = 1.66$, $p < .10$. Figure 3 plots the within-person slopes of eight of the most frequently reported activities, for both perceived challenge (Figure 3a) and perceived skill (Figure 3b).[9] These estimates were derived by running separate two-level models for each activity, with one predictor (perceived challenge or perceived skill) per model.

Table 3. Relation Between (a) Challenge and Enjoyment and (b) Skill and Enjoyment for Intrinsically Motivated (IM), Goal-Directed Activities (Reference Group); IM, Non-Goal-Directed Activities; and Non-IM, Goal-Directed Activities

	Coefficient	*SE*	*t* ratio
Intercept, γ_{00}	7.71	0.07	114.16***
Non-IM, goal directed, γ_{01}	–2.49	0.07	43.03***
IM, non-goal directed, γ_{02}	0.11	0.08	1.47
Challenge, γ_{10}	0.16	0.02	7.43***
Challenge*Non-IM, Goal Directed, γ_{11}	–0.13	0.03	–5.20***
Challenge*IM, Non-Goal Directed, γ_{12}	–0.12	0.03	–3.51***
Skill, γ_{20}	0.12	0.03	4.39***
Skill*Non-IM, Goal Directed, γ_{21}	0.10	0.03	3.12**
Skill*IM, Non-Goal Directed, γ_{22}	0.06	0.03	1.66

**$p < .01$. ***$p < .001$.

Activity motivation and activity type as moderators of the challenge–enjoyment relation. Two dummy variables were created: one to represent intrinsically motivated, non-goal-directed activities, and another to represent non-intrinsically motivated, goal-directed activities. Because intrinsically motivated, goal-directed activities were not represented by a dummy variable, this category of activities served as the reference category. Also included as predictors were perceived challenge, perceived skill, and four terms representing the interactions of these two variables with the two dummy variables: (a) Perceived Challenge*Intrinsically Motivated, Non-Goal Directed; (b) Perceived Challenge*Non-Intrinsically Motivated, Goal Directed, (c) Perceived Skill*Intrinsically Motivated, Non-Goal Directed, and (d) Perceived Skill*Non-Intrinsically Motivated, Goal Directed. All four interactions were designated as fixed.

Table 3 presents the results of this analysis. As predicted, the relation between challenge and enjoyment was stronger for intrinsically motivated, goal-directed activities than it was for both non-intrinsically motivated, goal-directed activities, $\gamma_{diff} = .13$, $se = .03$, $t = 5.20$, $p < .001$, as well as intrinsically motivated, non-goal-directed activities, $\gamma_{diff} = .12$, $se = .03$, $t = 3.51$, $p < .001$. In contrast to perceived challenge, perceived skill predicted enjoyment more strongly for non-intrinsically motivated, goal-directed activities than for intrinsically motivated, goal-directed activities, $\gamma_{diff} = .10$, $se = .02$, $t = 3.12$, $p < .001$. Perceived skill also predicted enjoyment more strongly for intrinsically motivated, non-goal-directed activities than for intrinsically motivated, goal-directed activities, although this difference was only marginally significant, $\gamma_{diff} = .06$, $se = .03$, $t = 1.66$, $p < .10$.

A chi-square contrast indicated that with respect to intrinsically motivated, goal-directed activities, the relation between perceived challenge and enjoyment was

significantly stronger than the relation between perceived skill and enjoyment, $\chi^2 = 73.95$, $p < .001$.[10]

Discussion

Results from Study 2 begin to account for the considerable heterogeneity apparent in the relation between challenge and enjoyment across activities. Consistent with previous laboratory-based findings that indicated participants chose more challenging activities when the activities were framed as games rather than tests or assignments (Harter, 1978; Koestner et al., 1987), challenge was a stronger predictor of enjoyment for intrinsically motivated, goal-directed activities than for non-intrinsically motivated, goal-directed activities. Additionally, challenge more strongly predicted enjoyment for intrinsically motivated activities that were goal directed compared to intrinsically motivated activities that were not goal directed. These findings suggest that the lack of consistent support for challenge as an important predictor of enjoyment may be partly due to the tendency to examine the relation across the full range of activities participants engage in. During our day-to-day lives, many of the activities we engage in are not intrinsically motivated, and many of the intrinsically motivated activities we do engage in do not involve the active pursuit of goals. In the United States, for example, approximately half of working adults' leisure time is spent watching television (Polivka, 2008). Thus, examining the relation between challenge and enjoyment across all activities is likely to significantly underestimate the strength of the relation for autotelic activities such as rock climbing, art making, and playing chess—the types of activities theories of intrinsic motivation were specifically developed to explain.

For intrinsically motivated, goal-directed activities, perceived challenge was a stronger predictor of enjoyment than perceived skill, replicating what was found for the chess games examined in Study 1. For such activities, which are typically associated with relatively low performance anxiety (Csikszentmihalyi, 1975), the pursuit of high challenge in itself may be intrinsically rewarding, independent of how successfully the challenges are met. These results add to a growing body of findings that indicate the enjoyment of interesting, goal-directed activities cannot be fully accounted for by perceptions of task competence (Cury, Elliot, Sarrazin, Da Fonseca, & Rufo, 2002; Elliot & Harackiewicz, 1994; Freitas & Higgins, 2002; Sansone, 1986, 1989).

Although the within-person correlation between challenge and enjoyment for sports and games ($r = .40$) is higher than previous estimates of this relation in the extant literature, it is considerably lower than what was found in Study 1 ($r = .68$). Clearly, there are other factors that moderate the relation between challenge and enjoyment besides the two examined in Study 2. One possibility that may be worth examining is whether attention is divided among two or more concurrent activities. For a surprising number of observations in Study 2, participants indicated they were engaged in a secondary activity concurrent with the primary activity (e.g., working on homework while playing a video game), and there were some indications that these observations were associated with a lesser enjoyment of challenge than when attention was focused exclusively on a single activity. Future research is needed to more fully examine this and other potential moderators, as well as the more immediate phenomenological experiences these moderators may affect (e.g., attentional involvement, anxiety).[11] In this way, the important question "Why don't individuals always enjoy high levels of challenge?" may be addressed.

In assessing the generalizability of the results from Study 2, one must keep in mind that the sample consisted of 6th through 12th graders. Because adults were not represented, it is possible that one or more of the examined relations may be moderated by age. Additionally, as with all findings based on observational data, spurious relations cannot be ruled out.

General Discussion

In an early interview-based study of optimal experience (Csikszentmihalyi, 1975), a chess player described his most enjoyable moments playing chess in this way: "It is exhilarating, like I'm succeeding at putting a very hard puzzle together." Results from Study 1 provide clear empirical support for such testimony. The most enjoyable games were those in which players outplayed higher rated opponents by relatively small margins. These were very challenging games that in terms of outcome probabilities, the players should have lost.

Despite the importance of challenge for the enjoyment of the chess games examined in Study 1, the relation between challenge and enjoyment, in contrast to the relation between skill and enjoyment, appears to vary widely between activities, as results from Study 2 indicated. At a minimum, future assessments of optimal challenges should take into account the motivational contexts of the activities (e.g., whether they are intrinsically motivated) as well as the nature of the activities themselves (e.g., whether they are goal directed). Because challenge appears to be particularly important for the enjoyment of intrinsically motivated, goal-directed activities, a greater focus on these activities, using minimally intrusive methodologies, may offer the best potential for further theoretical development.

Although the current findings highlight the importance of challenge for the enjoyment of sports, games, and other leisure activities, we do not wish to suggest that this is exclusively the case. Even in the typically highly extrinsically motivated environment of the classroom, where every young person in the United States spends a good proportion of his or her life for 13-plus years, it is possible for some students to feel more motivated and in better moods while engaged in very challenging activities (Csikszentmihalyi, Rathunde, & Whalen, 1996). How to create situations in everyday life that

provide the types of experiences found in intrinsically motivated, goal-directed activities is the great practical challenge confronting intrinsic motivation research.

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Notes

1. Three notable exceptions are a study of rock climbers (Delle Fave, Bassi, & Massimini, 2003), a study of kayakers (Jones, Hollenhorst, & Perna, 2003), and a study of basketball players and golfers (Stein, Kimiecik, Daniels, & Jackson, 1994). All three studies used an analytical framework based on challenge-skill "channels" that does not allow for an assessment of the independent relation between challenge and enjoyment, as the main effects of challenges and skills are confounded with their interaction. Zero-order correlations between challenge and enjoyment were not reported.
2. Participants were led to believe they were about to compete against another participant, situated out of sight in another room, in a word game (Boggle). They were told that their opponent had scored either higher ("superior" opponent) or lower ("inferior" opponent) than they had scored on a previous trial (in reality, this opponent information was bogus and randomly assigned). Drawing from self-efficacy theory (Bandura, 1986), the researchers reasoned that participants who believed they were competing against inferior opponents would enjoy the activity more while engaged in the activity than participants who believed they were competing against superior opponents, as being paired with an inferior opponent would create expectancies for success (i.e., winning) rather than failure (i.e., losing). This prediction was supported. However, because participants were unable to monitor their performance relative to that of their "opponents" during the games, the outcome expectancies instilled in participants before the beginning of each game likely had an exaggerated impact on enjoyment, as the authors noted. Additionally, the game was played in an unfamiliar, evaluative context (a psychological laboratory). Participants may therefore have experienced a greater degree of performance anxiety than what is typical in more familiar, natural settings, and this too would have increased the impact of outcome expectancies on enjoyment.
3. Because only a small percentage of the chess site's members participated in the study, the large majority of games were played between study participants and nonparticipants. In a small number of games ($n = 44$), however, both players were participants. In these cases, to avoid potential problems arising from statistical nonindependence, we only included the data from one of the two participants.
4. More information on this rating system can be found at the website of the World Chess Federation (http://www.fide.com).
5. The personality inventory participants completed at the end of the study period included an item that asked participants to indicate the extent to which their chess rating accurately reflected their "true" skill level. Participants believed their chess ratings significantly underestimated their true skill levels, $p < .001$. These self-ratings did not moderate the linear relation between relative chess rating and enjoyment.
6. A number of laboratory-based studies of the enjoyment of competitive activities suggest enjoyment (and therefore presumably intrinsic motivation) is promoted by positive competitive outcomes—namely, winning. Participants who were told that they won a competitive activity subsequently enjoyed the activity significantly more the next time they engaged in it than participants who were told that they lost (Reeve & Deci, 1996; Reeve, Olson, & Cole, 1985, 1987; Standage, Duda, & Pensgaard, 2005; Tauer & Harackiewicz, 1999; Vallerand, Gauvin, & Halliwell, 1986; Vallerand & Reid, 1984; Vandiskeene & Deci, 2004; Weinberg & Ragan, 1979). The intervening period between competitive outcome and subsequent task engagement was as long as 3 weeks (Vallerand & Reid, 1984). Although this carryover effect between competitive outcome and subsequent enjoyment appears useful in understanding the development of intrinsic motivation for unfamiliar, interesting activities in evaluative contexts, it appears less useful for understanding the enjoyment of familiar activities for which intrinsic motivation has already been established (e.g., hobbies). We used a multilevel lag model to test for the presence of a carryover effect between competitive outcome and the games that followed, and did not find a carryover effect—the degree to which a player enjoyed a game was not predicted by whether he or she won or lost the previous game. That no carryover effect was found here is consistent with previous work within the intrinsic motivation literature that suggests a distinction should be made between factors that develop intrinsic motivation (perhaps largely by reducing performance anxiety during the early stages of skill acquisition) and factors that maintain it (Elliot & Harackiewicz, 1994; Sansone, 1986; 1989).
7. A recent examination of "seeking a game" notices posted by 400 members of the Internet Scrabble Club (http://www.isc.ro/) indicated these players sought opponents who, on average, had significantly higher skill ratings than their own ratings (Abuhamdeh & Csikszentmihalyi, 2009b). This finding suggests that these Scrabble players, like the chess players in Study 1, most enjoyed games against superior opponents. Although it was not possible to determine the gender of the

Scrabble players, it is likely that a considerable percentage of them were female, given Scrabble is significantly more popular at the club and tournament levels among women than men (Edley & Williams, 2001).

8. A three-level model (observations nested within activities nested within persons) would not have been appropriate here given activities and persons were not related in a clean hierarchical fashion. A given activity was typically reported by more than one participant (i.e., participants nested within activities), but a participant typically engaged in more than one activity (i.e., activities nested within participants).
9. Of frequently reported school activities, the three strongest within-person correlations between challenge and enjoyment were for music/band ($r = .48$; $n = 145$), physical education ($r = .30$; $n = 159$), and fine art ($r = .26$; $n = 122$). Of nonschool activities, the three strongest within-person correlations were for sports/games ($r = .40$; $n = 923$), athletic hobbies ($r = .38$; $n = 211$), and video games ($r = .33$; $n = 261$).
10. Exploratory analyses yielded two results that deserve mention. First, for a relatively small number of observations ($n = 367$), participants indicated that they engaged in the current activity because they both "had to" and "wanted to," and that the activity was both "like play" and "like work." The relation between challenge and enjoyment for these observations (which were mostly associated with school-related activities) was not statistically different than for observations characterized by purely intrinsically motivated motivational orientations. Second, there was a strong, positive relation between person-level mean challenge and enjoyment, $\gamma_{01} = .23$, $se = .02$, $t = 10.43$, $p < .001$. In other words, participants who, on average, reported relatively high levels of challenge also experienced greater enjoyment overall, over and above the within-person relation between challenge and enjoyment. No such person-level effect emerged for perceived skill, $\gamma_{02} = -.02$, $se = .02$, $t = -1.25$, *ns*.
11. Engeser and Rheinberg (2008) recently tested the possibility that activity importance moderates the relation between a balance of challenges and skills and the experience of flow (operationalized using a scale that tapped feelings of control, a distorted sense of time, ease of concentration, and other dimensions of flow experiences), and found evidence consistent with this (i.e., the more personally important the activity, the less flow-like experiences were when challenges were balanced by skills). Performance anxiety is one plausible mediator of this moderator effect.

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