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Flow Experience and Athletes' Performance With Reference to the Orthogonal Model of Flow

Nektarios A. Stavrou, Yannis Zervas, and Konstantinos Karteroliotis
University of Athens, Greece

Susan A. Jackson
University of Queensland, Australia

The purposes of the current study were to examine (a) the differences in Flow State Scale (FSS) subscales between the 4 experiential states of the orthogonal model (apathy, anxiety, relaxation, and flow), (b) the relationship between challenge, skills, and flow experience; and (c) the relationship between flow experience and athletes' performance. Two hundred twenty athletes volunteered to participate in this study. Challenge of the game and skills of the athlete were measured before and after competition. Thirty minutes after the competition, the FSS was used to measure flow experience. In addition, subjective and objective measures of athletes' performance were assessed. Athletes in the flow and relaxation states revealed the most optimal states, whereas the athletes in the apathy state showed the least optimal state. There were positive associations between athletes' flow experience and their performance measures, indicating that positive emotional states are related to elevated levels of performance. On the other hand, there were low or no correlations between athletes' performance and reported challenge of the game, whereas skills of the athlete were moderately correlated with flow. Multiple-regression analysis demonstrated significant prediction of athletes' performance based on flow experience during competition. Future research should examine the relationship between flow, athletes' performance, and additional dispositional and state variables.

The concept of flow has been used in psychology to describe the intrinsically rewarding experience that people can experience during an activity. According to Csikszentmihalyi and Csikszentmihalyi (1988), the concept of flow, or optimal experience, is obtained "when all the contents of consciousness are in harmony with each other, and with the goals that define the person's self. These are the subjective conditions we call pleasure, happiness, satisfaction, enjoyment" (p. 24). The

Stavrou, Zervas, and Karteroliotis are with the Dept. of Physical Education and Sport Sciences, University of Athens, Greece. Jackson is with the University of Queensland, Australia.

theory of flow experience has been applied in various research domains, such as work (e.g., Csikszentmihalyi & LeFevre, 1989), leisure (e.g., Kleiber, Larson, & Csikszentmihalyi, 1986), learning environments (e.g., Stein, Kimiecik, Daniels, & Jackson, 1995), psychopathology (Csikszentmihalyi, 1982), sports (e.g., Jackson, 1992, 1996; Jackson, Kimiecik, Ford, & Marsh, 1998; Jackson, Thomas, Marsh, & Smethurst, 2001), and exercise activities (e.g., Jackson & Eklund, 2002; Vlachopoulos, Karageorghis, & Terry, 2000). Flow experience has been described as an optimal subjective mental state marked by positive affect, centering of attention, absorption, spontaneous action, total immersion in performing an activity, perception of control over actions and the environment, immediate and unambiguous feedback, loss of self-consciousness, distortion of time, and perception of superior functioning (Csikszentmihalyi, 1982; Csikszentmihalyi & Csikszentmihalyi, 1988; Jackson, 1992, 1996). An important issue associated with the generation of flow is whether particular situational or personal characteristics facilitate the experience of flow. The examination of flow theory in various research domains, such as work, leisure activities, education, or sport indicates that flow experience differs in intensity and frequency, as well as with respect to the situational or individual factors that generate flow (Csikszentmihalyi, 1975; Csikszentmihalyi & Csikszentmihalyi; Privette, 1983; Privette & Bundrick, 1991; Ravizza, 1977; Stein et al., 1995).

Orthogonal Model of Flow Theory

A central issue of flow theory is that whether or not an individual is in flow depends on his or her perception of the existing challenges and the nature of his or her skills rather than on the objective nature of the challenges or skills themselves (Csikszentmihalyi, 1975, 1982). When the challenges and skills are perceived as being in balance, the person enjoys the moment and stretches his or her capabilities to learn new skills and increase self-esteem and personal complexity. Thus, the person feels that he or she can act on these skills without feelings of boredom, anxiety, or worry. On the other hand, when the skills outperform the challenge, there is relaxation, whereas when the skills and challenges are below average, there is apathy, and, finally, when the challenges outweigh the skills, there will be anxiety (Nakamura & Csikszentmiahlyi, 2002). A person could try to reach flow state by means of a twofold dynamic. For example, in an anxiety state, the person would try to increase personal skills to balance the level of challenge, or, if the person experiences relaxation, he or she would try to seek more challenging situations (Moneta & Csikszentmihalyi, 1996). In other words, as a person masters a challenging activity, his or her skill level increases. To continue experiencing flow, the person must try to find more complex skills, and so on, building greater complexity in the person (Csikszentmihalyi, 1990).

Moneta and Csikszentmihalyi (1996) examined the flow experience in various contexts, indicating that "the balance of challenges and skills has a positive effect in some contexts and little or no effect in others" (p. 302). In other words, the challenges of the competition and the skills of the athlete are two subjective experiential variables, which exert a dependent effect on each other or independent effect on the quality of experience. Before or during competition, challenge and skills level are dynamic in nature, depending on individual qualities (e.g., experience, mental preparation, physical preparation) or situational characteristics (e.g., importance of competition, difficult opponent). Stein and colleagues (1995) reported that in a competitive environment the level of a person's perceived skills is positively related with the quality of experience, whereas in a learning environment both the person's perceived skills and the challenges are related to the quality of experience.

Jackson and Roberts (1992) examined the balance between challenges of the competition and athletes' skills during their best and worst performances. The results revealed large differences in mean scores between challenges and skills in athletes' worst performances, whereas no differences were found in their best performances. Furthermore, the mean values of challenges and skills were higher in their best than in their worst performances.

Flow Experience and Athletic Performance

The relationship between the flow concept and sport performance is of great interest for athletes, coaches, and applied sport psychology consultants. Flow has been examined either as a phenomenon or as a concomitant of performance (Jackson & Csikszentmihalyi, 1999; Jackson & Wrigley, 2004), with a close relationship suggested between peak performance and flow (Jackson, 1992, 1999; Jackson & Roberts, 1992; Jackson et al., 1998; Jackson et al., 2001; Ravizza, 1977).

Examining the similarity or overlap between peak performance and flow, Privette (1983) and Privette and Bundrick (1991) described the distinguishing and similar characteristics of these concepts. They concluded that flow is an intrinsically rewarding experience, whereas peak performance is characterized as a person's optimal functioning. In addition, Privette and Bundrick (1997) reported that peak performance is characterized as playful, fun, and fulfilling, whereas flow is marked by fun and enjoyment.

Based on the aforementioned, the flow concept cannot be used interchangeably with the terms of *peak performance* and *peak experience,* because one might be in flow without necessarily achieving these other outcomes. When an athlete experiences peak performance, however, he or she appears to be in flow. Csikszentmihalyi and LeFevre (1989) state that flow experience constitutes a combination of characteristics that typify peak performance and peak experience, whereas Jackson (1988; Jackson & Roberts, 1992) proposed that flow might be a precursor to, or the psychological process underlying, peak performance.

Flow is associated with high levels of performance and positive experience. Jackson's qualitative content analyses of best performances (1992, 1995, 1996) and Jackson and Roberts's (1992) quantitative results showed that athletes' best performances were associated with flow characteristics. Athletes in their best performances indicated higher flow ratings than in either their worst performances or when they generally compete (Jackson & Roberts). Factors such as total commitment, clearly defined goals, feedback about how well an athlete is performing, concentration on performing the activity, task-relevant thoughts, sense of control, and feelings of fun, confidence, and enjoyment were among the most frequent psychological characteristics that athletes mentioned during high levels of performance (e.g., Gould, Eklund, & Jackson, 1992).

Kimiecik and Stein (1992) suggested that to better understand the flow experience researchers need to examine subjective states along with objective outcomes. Jackson and colleagues (2001) attempted to examine relationships between flow and both subjective and objective criteria. Measures of performance included finishing position and perceived success, and associations with flow were found with both types of measures.

To date, despite the great interest in examining the psychological issues of athletes' performance, sport psychologists have focused mainly on the negative factors of athletes' experience, such as anxiety and stress, ignoring the positive psychological qualities underlying elevated levels of performance. Identifying the relation between optimal psychological states and athletes' performance might be helpful to the development of mental training programs to help promote optimal mental states. From a theoretical point of view, the examination of the relationship between the orthogonal model and flow experience in sports has not been examined. In addition, the study of flow experience and sport performance to date has been based primarily on athletes' subjective perceptions and interviews during high and low levels of performance, as well as on the comparison of successful and less successful performances (Jackson, 1992, 1995, 1999; Jackson & Roberts, 1992). Therefore, it seems important to examine the independent relation of challenge and skills, as well as challenge:skill ratios, with flow experience and athletes' performance. Moreover, the examination of the relation between flow factors and both subjective and objective measures of performance might provide more comprehensive information about the psychological qualities that underlie sport performance, from a quantitative point of view. Thus, the purposes of the current study were to examine (a) the differences in Flow State Scale (FSS) subscales between the four experiential states of the orthogonal model (apathy, anxiety, relaxation, and flow); (b) the relationship between challenge, skills, and flow experience; and (c) the relationship between flow experience and athletes' performance.

Method

Participants

A sample of 220 athletes (51% male, 49% female) volunteered to participate in this study. They represented seven individual sports (80 track and field, 63 swimming, 34 shooting, 13 archery, 20 cycling, and 10 canoeing and kayaking). The athletes ranged in age from 16 to 38 years ($M = 19.95$, $SD = 4.61$), had competitive experience from 2 to 22 years ($M = 6.98$, $SD = 4.33$), and had participated in 10–450 national games, with a mean of approximately 88 games ($SD = 77.44$), and their experience in international games ranged from 0 to 125 competitions ($M = 6.78$, $SD = 16.39$). Participants met the following criteria: They (a) were active athletes in an individual sport, (b) had at least 2 years of competitive experience, and (c) had participated in at least 10 competitions. The criterion of individual sports was chosen, because flow might be experienced differently by team-sport athletes, and the latter are affected by different factors such as interaction with other team players. The criteria of minimum 2 years experience and 10 competitions were set to ensure that the athletes were familiar with the technique of their sports. In the beginning stages of their sports, technique is something that prevents athletes from focusing on their performance.

Instrumentation

The FSS. In this study, the Greek version of the FSS was used. The original FSS is a 36-item self-report scale developed by Jackson and Marsh (1996) to assess the magnitude of flow characteristics experienced during a specific event. Stavrou and Zervas (2004) in a series of three studies, using confirmatory factor analytic procedures, provided acceptable factor structure for the Greek version of the FSS. In addition, the Greek version of the FSS indicated acceptable internal consistency, content, and concurrent validity (Stavrou & Zervas). Each of the nine subscales consists of four items. Responses are given on a 5-point Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Flow experience is proposed to consist of a number of characteristics (e.g., Csikszentmihalyi, 1990). These characteristics typify the factors, or subscales, of the FSS (Jackson & Marsh), which assesses the following qualities: challenge–skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. In addition, a global flow score was included in the analysis to better understand the concept of flow experience from a more holistic perspective (Jackson & Marsh). The Cronbach's alphas of the FSS factors of the current study ranged between .77 and .93 and are shown in Table 1.

Challenge and Skills Measures. Two 11-point Likert-type scales were administered to measure the challenge of the competition and the perceived skill levels. This is the typical approach to assessing levels of challenge and skill used by Csikszentmihalyi and colleagues (e.g., Csikszentmihalyi & Csikszentmihalyi, 1988) and Jackson and colleagues (e.g., Jackson & Marsh, 1996; Jackson & Roberts, 1992). The anchors for the two scales used in this study ranged from 0 (*not at all*) to 10 (*very much*), with a midpoint of 5 (*medium*). The two scales were "How challenging was this event for you?" measuring the perceived challenge of the competition, and "How skilled were you in this event?" measuring the perceived skills of the athlete.

Demographics. A questionnaire was developed to obtain demographic information such as participants' gender, sport, and competitive experience.

Performance Measures

Subjective Measure of Performance. One hour before the competition, the athletes noted the exact performance (i.e., time, distance, score, or points) they set as a goal in the competition in which they intended to participate. Specifically, the question given to the athletes was "What is your target for this competition? Indicate the exact performance" (e.g., 560/600 points in archery, 7 m in long jump, 11 s in 100 m). Thirty minutes after the competition, the athletes marked the final performance they had just achieved in the event. The records were kept either by the athletes themselves or by the researchers. At the same time, the athletes completed an 11-point Likert bipolar scale from –5 (*very low performance*) to +5 (*very high*

Table 1 Flow State Scale: Intercorrelations Among the Subscales and the Global Flow Score

	Flow State Scale Subscales	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
X_1	Challenge–skill balance	(.81)	.38**	.64**	.68**	.46**	.61**	.39**	–.02	.75**	.82**
X_2	Action-awareness merging		(.78)	.29**	.33**	.36**	.35**	.34**	.19*	.28**	.58**
X_3	Clear goals			(.80)	.56**	.56**	.59**	.27**	–.02	.46**	.71**
X_4	Unambiguous feedback				(.86)	.45**	.61**	.39**	–.03	.66**	.78**
X_5	Concentration on task at hand					(.86)	.71**	.37**	–.10	.49**	.71**
X_6	Sense of control						(.88)	.45**	–.16	.60**	.79**
X_7	Loss of self-consciousness							(.77)	–.03	.47**	.63**
X_8	Transformation of time								(.78)	–.02	.13
X_9	Autotelic experience									(.93)	.81**
X_{10}	Global flow score										(.93)

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

Note. Internal-consistency coefficients (Cronbach's α) are presented in parentheses along the diagonal.

performance), on which they evaluated their performance based on the target set before the competition.

Objective Measure of Performance. Three different formulae were used to objectively measure athletes' performance, with regard to the type of sport, as well as to the type of performance measurement (time, distance, point). The athletes were divided into three groups. Based on the suggestions of Lane, Terry, Beedie, Curry, and Clark (2001), a different formula was applied in each group, aimed to objectively measure athletes' performance. The performance measures took into account the best performance of the athlete, his or her preperformance goal, and the final result. Researchers have indicated that using either the preperformance goal as a criterion for estimating the relative success of performance outcome or judging the performance outcome with athlete's best performance is limited (Lane & Karageorgis, 1997; Martin & Gill, 1991, 1995). Using the best performance of the athlete and the preperformance goal provides a more comprehensive and fruitful measure of athlete's performance, because the previous best performance and preperformance goal can serve as criteria to determine the difficulty of the athlete's goal, as well as the relative success of the outcome.

The first performance-measure group comprised athletes for whom performance was measured in time. The "time sports" were track and field, swimming, cycling, and canoeing or kayaking. The performance was measured based on the following formula: (previous-best-performance time – result time) + (competition goal time – result time). The time was measured in tenths of a second. The second performance group constituted archers and shooters. The objective performance measure for "target sports" was obtained using the following formula: (points result – previous-best-performance points) + (points result – competition goal). The performance was measured in points. Triple jumpers, long jumpers, pole-vaulters, and shot-putters made up the third performance group, in which athletes' performance was measured in distance. The objective performance measure for "distance sports" was measured using the following formula: (distance result – previous-best-performance distance) + (distance result – competition goal). Then, the three performance measures were transformed to z values to obtain a single measure of athletes' performance, which represented the objective performance measure.

Procedure

The athletes were recruited from various individual sports by contacting the coaches or the athletes themselves, visiting their sport clubs. They were informed about the purpose of the study, the assessment, and the procedure of data collection. The athletes were asked to voluntarily participate, and they completed a consent form, being informed about the confidentiality of the data.

The athletes completed the two scales regarding the perceived challenge of the game and their skills 1 day and 1 hr before the competition, with reference to how they felt at that time. Thirty minutes after the event, the athletes completed the FSS, as well as the challenge–skill ratings, based on how they felt during the competition. The instructions for the instruments were modified to be adequate for immediate use after the competition. The total duration of data collection was 6 months.

Statistical Analyses

Statistical analyses of the data were divided into two phases. The first phase consisted of preliminary data analysis to satisfy the assumptions of the main analyses that were conducted (the second phase). To satisfy the assumptions for conducting multivariate and univariate analyses of variance, data screening (univariate distribution, multivariate distribution, Mahalanobis distance values, Levene's test, F_{max} ratio values, Box's *M* test) was performed before main data analysis (Tabachnick & Fidell, 2006). In addition, Cronbach's α coefficient was used to examine the internal reliabilities of the FSS subscales.

In the second phase, univariate and multivariate statistical analyses were conducted to address the main purposes of the current study. To examine whether athletes in the four experiential states (apathy, anxiety, relaxation, flow) differed significantly in the FSS subscales during competition, multivariate analysis of variance (MANOVA) was conducted. Follow-up univariate ANOVAs were performed on the subscales when there were significant MANOVA effects (Scheffé test). In addition, Bonferroni adjustment was applied to control for the inflation of Type I error (Tabachnick & Fidell). Repeated-measure ANOVA was used to examine the differences between the three time measures (1 day before, 1 hr before, and 1 hr during competition) on the perceived challenge of the game and the skills of athletes (Tabachnick & Fidell, 2006). Gender differences were examined using a *t* test. To examine the relationships among the variables, Pearson's *r* correlation analysis was used. Fisher's *z* transformation was performed to examine whether the value of the correlations between challenge of the game and flow, compared with athletes' skills and flow, differed significantly. In addition, Fisher's *z* transformation was used to examine the difference in the value of the correlations between the two types of performance measure (subjective, objective) and the FSS subscales (Cohen, 1988). Standard multiple-regression analysis was conducted to examine the level of prediction of the flow subscales on the two types of performance measures (objective and subjective; Cohen, Cohen, West, & Aiken, 2003; Tabachnick & Fidell). To control for Type I error with the inclusion of several predictor variables, a *p* value of .01 was used for establishing significance in these analyses.

Results

Data Screening. Univariate and multivariate distribution analyses were performed before data analyses (Tabachnick & Fidell, 2006). Skewness and kurtosis indicated low values of the examined variables. Examination of Mahalanobis distance values indicated no multivariate outliers ($p < .001$) among the independent variables. The equality of covariance matrices was acceptable at the univariate level (Levene's test, F_{max} ratio values). The homogeneity of variance-covariance, however, was violated at the multivariate level (Box's *M* test). Therefore, Pillai's trace was chosen as the appropriate multivariate test statistic because of its robustness over test violations (Tabachnick & Fidell). No missing data were indicated in the sample.

Gender Differences. No significant differences were found between males and females in age ($t = .98$, n.s.), and competitive experience ($t = 1.16$, n.s.). The FSS subscales were examined for gender differences. No significant differences, Pillai's trace = .046, $F(2, 218) = 1.117$, n.s.) were found between males and females in flow experience.

Correlational Analysis. Significant intercorrelations were found among the flow state scale subscales (Table 1). The factors of the FSS indicated low- to high-value intercorrelations, ranging from .27 to .75, except for the factor transformation of time. Transformation of time did not correlate significantly with the other FSS subscales. The mean value of the FSS subscale intercorrelations (excluding time transformation) was .48 ($r_{mean} = .48$) with a shared variance proportion of 23%. Six of the scales (challenge–skill balance, clear goals, unambiguous feedback, concentration on task at hand, sense of control, and autotelic experience), however, revealed a mean correlation of .59 (shared variance 35%).

Significant positive correlations were found among the FSS subscales (except for time transformation) and athletes' performance (subjective, objective). These correlations are presented in Table 2. The value of the correlations between the two types of performance measures and FSS subscales were compared using Fisher's z transformation. The results indicated that subjective measure of performance was significantly more highly correlated with challenge-skill balance, loss of self-consciousness, autotelic experience, and global flow experience, when compared to the objective measure of performance. Regarding the rest of the FSS factors there were no significant differences, but there was a trend toward higher correlations with subjective compared with objective measures of performance. Summarizing the results of correlations between FSS and the two types of performance measures, the FSS factors indicated a mean value correlation of .33 and .42 with objective and subjective measures of performance, respectively.

The correlations between challenge of the game and athlete skills with the FSS factors and measures of performance (objective and subjective) are presented in Table 2. An important issue of the correlational analysis was whether the value of the correlations of athletes' skills with flow experience was higher than those between challenge of the competition and flow experience (Cohen, 1988; Meng, Rosenthal, & Rubin, 1992; Steiger, 1980). Fisher's z transformation was applied to examine whether there were significant differences in the value of the correlations of the two dimensions of the orthogonal model (challenge–skills) of flow experience and the FSS factors. The results indicated significantly higher correlations between athletes' skills and FSS subscales compared than between challenge of the game and FSS subscales (Table 2).

In addition, Fisher's z transformation showed a significant increase in the value of correlations between athletes' skills and flow experience as the time to competition approached ($p < .05$; 1 day before: $r_{mean} = .22$, 1 hr before: $r_{mean} = .28$, during competition: $r_{mean} = .34$). On the other hand, the correlations between perceived challenge and flow experience remained rather stable (1 day before: $r_{mean} = .15$, 1 hr before: $r_{mean} = .14$, during competition: $r_{mean} = .18$; Table 2).

Repeated-measure ANOVAs were conducted to examine the changes in perceived challenge of the game and skills of the athletes among the three time measures (1 day before, 1 hr before, and 1 hr during competition). The results indicated no significant differences either for perceived challenge of the game, $F(2, 218) = .168$, n.s., or athletes' skills, $F(2, 218) = 1.260$, n.s.

Table 2 Correlations Among Athletes' Performance, Challenge of the Competition, Skills of the Athlete, and Flow State Scale (FSS) Subscales

	Challenge of the Competition			Skills of the Athlete				
FSS subscale	**A**	**B**	**C**	**A**	**B**	**C**	**Objective measure of performance**	**Subjective measure of performance**
Challenge–skill balance	.29**	.36**	.35**	.34**	.41**	.49**†	.46**	.63**‡
Action–awareness merging	–.02	–.01	–.00	.12	.20*†	.25**†	.24**	.28**
Clear goals	.28**	.28**	.32**	.30**	.36**	.47**†	.25**	.31**
Unambiguous feedback	.13	.19*	.18*	.30**†	.35**†	.45**†	.45**	.49**
Concentration on task at hand	.10	.02	.11	.22**	.28**†	.33**†	.29**	.36**
Sense of control	.16	.10	.15	.21*	.28**†	.33**†	.41**	.47**
Loss of self-consciousness	.05	.03	.06	.12	.17*†	.25**†	.19*	.32**‡
Transformation of time	.03	.02	.08	–.11	–.15	–.08	–.02	–.03
Autotelic experience	.21*	.21*	.30**	.17	.23**	.29**	.52**	.71**‡
Global flow score	.21*	.20*	.26**	.27*	.35*†	.46**†	.48**	.61**‡
r_{mean}	.15	.14	.18	.22	.28	.34	.33	.42
Subjective performance	.06	.10	.14	.02	.11	.18*		
Objective performance	.16	.17*	.14	.15	.25**	.21*		

Note. A = 1 day before the competition; B = 1 hr before the competition; C = During competition

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

[a] Significantly higher correlation between "skills of the athlete" and FSS subscales than the "challenge of the competition" and FSS subscales (Fisher's *z* transformation). [b] Significantly higher correlation between "subjective measure of performance" and FSS subscales compared to the "objective measure of performance" and FSS subscales (Fisher's *z* transformation).

Orthogonal Model of Flow Theory. Using median splits, athletes were divided into low and high groups, with regard to the scales "challenge of situation" and "skills of athlete." Thus, based on the orthogonal model of flow, the athletes made up four states: apathy (low challenge–low skills), anxiety (high challenge–low skills), relaxation (low challenge–high skills), and flow (high challenge–high skills). MANOVA results indicated significant differences between the four states (Pillai's trace = .355, $F(3, 216) = 3.353$, $p < .001$). Follow-up ANOVAs (Scheffé test) on each dependent factor, applying Bonferroni adjustment, indicated significant differences in the following factors: challenge–skill balance, $F(3, 216) = 21.950$, $p < .001$, $\eta^2_p = .234$; action–awareness merging $F(3, 216) = 4.877$, $p < .01$, $\eta^2_p = .063$; clear goals, $F(3, 216) = 18.897$, $p < .001$, $\eta^2_p = .208$; unambiguous feedback, $F(3, 216) = 12.064$, $p < .001$, $\eta^2_p = .144$; concentration on task at hand, $F(3, 216) = 6.425$, $p < .001$, $\eta^2_p = .082$); sense of control, $F(3, 216) = 7.267$, $p < .001$, $\eta^2_p = .092$; loss of self-consciousness, $F(3, 216) = 4.853$, $p < .01$, $\eta^2_p = .063$; and autotelic experience, $F(3, 216) = 8.653$, $p < .001$, $\eta^2_p = .107$. The flow and relaxation states showed higher mean values in these FSS factors than the apathy and anxiety states, which indicated lower values in flow experience (Table 3). Table 3 also provides the differences between the four quadrants. Specifically, although flow state did not differ significantly from the relaxation quadrant (except for challenge–skill balance) there was a trend toward higher mean values in flow experience subscales. On the other hand, flow state showed significantly higher values than apathy state (except for action–awareness merging and transformation of time) and anxiety state (except for concentration on task at hand and transformation of time). In addition, the relaxation state revealed significantly higher mean values than the apathy state on six of the nine FSS factors (challenge–skill balance, clear goals, unambiguous feedback, concentration on task at hand, loss of self-consciousness, and autotelic experience).

Table 3 Scores on the Flow State Scale Subscales Based on the Orthogonal Model of Flow Theory, *M* (*SD*)

Flow State Scale subscale	Apathy–1	Anxiety–2	Relaxation–3	Flow–4
Challenge–skill balance[a,b,c,d]	11.71 (2.78)	12.78 (3.16)	13.91 (3.91)	15.94 (2.73)
Action–awareness merging[b]	12.00 (3.02)	11.58 (3.06)	13.53 (3.70)	13.49 (3.32)
Clear goals[a,b,d]	14.31 (2.83)	15.50 (2.06)	16.68 (2.83)	17.56 (2.48)
Unambiguous feedback[a,b,d]	11.43 (3.01)	11.75 (3.66)	13.53 (4.30)	14.71 (3.07)
Concentration on task at hand[a,d]	13.66 (3.58)	13.98 (3.48)	15.70 (3.73)	15.87 (3.01)
Sense of control[a,b]	13.00 (2.99)	13.60 (3.29)	14.77 (3.98)	15.51 (3.12)
Loss of self-consciousness[a,d]	12.46 (3.96)	13.25 (4.11)	14.96 (3.54)	14.37 (3.69)
Transformation of time	11.35 (3.18)	11.83 (3.51)	10.96 (3.75)	11.44 (3.81)
Autotelic experience[a,b,d]	11.48 (4.32)	12.45 (5.39)	12.92 (5.07)	15.44 (4.16)

[a] Group 4 significantly higher than Group 1. [b] Group 4 significantly higher than Group 2. [c] Group 4 significantly higher than Group 3. [d] Group 3 significantly higher than Group 1.

Performance Measures

No significant differences were found between the four states (apathy, anxiety, relaxation, and flow) on either the subjective measure of performance $F(3, 216) = 1.300$, n.s., or the objective measure of performance $F(3, 216) = 2.769$, n.s. Significant positive correlations were found between the FSS factors and performance measures, both subjective and objective (Table 2).

Prediction-of-Performance Measures

Standard multiple-regression analyses (Tabachnick & Fidell, 2006) were performed to examine the contribution of each of the FSS factors in the prediction of athletes' performance. Two standard multiple-regression analyses were conducted in which the FSS subscales served as the predictor variables, with the objective and subjective measures of performance as the dependent variable in the two separate regression analyses. Table 4 displays the unstandardized regression coefficients (*B*), standard error (SE *B*), standardized regression coefficients (β) *t* values, and the level of significance (*p*; Cohen et al., 2003; Tabachnick & Fidell). There was no evidence of multicollinearity among the independent variables. Regarding the subjective

Table 4 Standard Multiple-Regression Analysis on Subjective and Objective Performance Measures

Dependent variable	*B*	*SE B*	β	*t*
Subjective performance measure				
challenge–skill balance	.23	.07	.29	3.33**
action–awareness merging	.06	.05	.07	1.23
clear goals	.16	.07	.17	2.38
unambiguous feedback	–.02	.05	–.02	–0.29
concentration on task at hand	.01	.06	.01	0.16
sense of control	.06	.07	.08	0.94
loss of self-consciousness	–.04	.04	–.06	–1.06
transformation of time	–.02	.04	–.02	–0.39
autotelic experience	.30	.05	.53	6.61**
Objective performance measure				
challenge–skill balance	.25	.30	.09	0.83
action–awareness merging	.25	.20	.09	1.27
clear goals	.45	.29	.13	1.54
unambiguous feedback	.43	.23	.16	1.84
concentration on task at hand	–.07	.24	–.03	–0.30
sense of control	.46	.28	.16	1.61
loss of self-consciousness	–.35	.17	–.14	–2.01
transformation of time	–.00	.17	.00	–0.01
autotelic experience	.77	.20	.37	3.82**

**$p < .001$.

measure of performance, the R for regression was significantly different from zero, $F(9, 210) = 27.403$, $p < .001$, and the values of R^2, as well as adjusted R^2, were .54 and .52, respectively. The significant predictors were autotelic experience ($\beta = .53$) and challenge–skill balance ($\beta = .29$). The second regression analysis, using the FSS factors as the independent factors and objective measure of performance as the dependent variable, was also significant, $F(9, 210) = 11.319$, $p < .001$. The value of R^2 was .33, and the total explained variance for the objective measure of performance was 30%. The significant predictor was autotelic experience ($\beta = .37$), which predicted 33% (30% adjusted) of the variability of the objective measure of performance.

Discussion

Examining Athletes' Flow Experience

The results of this study indicated that the quality of experience between the four quadrants of the orthogonal model are differentiated. Specifically, the athletes in the flow and relaxation states showed the highest FSS factor scores, the athletes in the apathy state showed the lowest values, and the scores in the anxiety state were between flow and apathy. In general, the results showed that the athletes in flow and relaxation states experienced significantly higher flow characteristics, as assessed by the FSS, than athletes in the apathy state. In addition, significant differences were revealed between the athletes on apathy and anxiety, compared with flow state, with the latter having significantly higher positive experience. Furthermore, athletes in the relaxation state indicated significantly more positive experience than those in the apathy and anxiety states. This finding suggests that it is the athletes' skill level that is more important than the perceived challenge of the situation for getting into flow in a competitive environment. This result extends the research in flow theory, showing that the perception of skillfulness is essential to experience positive mental states, whereas challenge might have more of a secondary role in athletes' flow experience.

The importance of athletes' skills on the quality of their experience is further supported by the significantly higher correlations between the FSS factors and perceived skills, suggesting a close relationship, than the correlations between the FSS factors and perceived challenges. On the other hand, the lack of relationship between the challenge ratings and the flow subscales suggests that this variable might not be as relevant to flow experiences as one's perception of his or her skills in a competitive environment. Providing support to this notion, Stein and colleagues (1995) reported that challenge was related to the quality of experience only in a recreational-athletic sample, not in a competitive one.

Regarding the time-to-competition measures of athletes' skills and challenge of the situation, the value of the correlations between the skills and the FSS subscales increased as time for competition neared, whereas the correlations between challenge of the situation and flow remained stable across the three time measures. The correlational-analysis results suggest that, during competition, a skillful athlete will feel that he or she can meet the challenge of the game, have clear goals, and receive immediate and unambiguous feedback about how well he or she performs. In addition, elevated skills seem to have a positive relation to other qualities of experience, such as concentration and sense of control over the activity. Furthermore, the moderate positive correlations between challenge of competition with challenge–skill balance, autotelic experience, and clear goals suggest that a challenging competition will help athletes have an intrinsically enjoyable experience and set clear goals. The remaining flow dimensions did not indicate significant correlations with challenge of the game.

The value of the correlations of the challenge–skills ratings with the FSS factors ranged from low to medium, indicating that the quality of experience is affected not by the level of challenge and skills per se but might depend on the relative balance or imbalance between the two scales. Moneta and Csikszentmihalyi (1996) reported that the effect of challenges became positive for higher values of skills, whereas the negative effect of challenges became smaller as skills increased. In this study, athletes' skills revealed significant higher positive correlations—compared with the challenge of the competition—with the challenge–skill-balance dimension, indicating that in a competitive environment the athletes who estimate that they have the abilities to manage the demands of the game might be more likely to experience a balance of challenge and skills, even when the challenge is fairly high.

Based on the real-time-measure results of this study, the perceived skills of the athlete might be the primary factor for him or her to experience positive or optimal mental states, whereas perceived challenge seems to have a facilitative role only when athletes' skills are sufficiently high. From a practical point of view, coaches, athletes, and sport psychology consultants should focus on how skillful an athlete feels during a game, as well as on factors related to perceived skillfulness, such as self-confidence and perceived competence. Psychological-preparation programs could include positive thinking, self-talk, and goal-setting interventions to increase the level of athletes' perceived skills.

Challenge–Skills Ratings

According to the results of the present study, the level of perceived challenge of the competition and athletes' skills did not change across the three times of assessment (1 day before, 1 hr before, and 1 hr during competition). This suggests that how an athlete estimates his or her skills for the upcoming performance, as well as how challenging the competition is perceived to be, seems to remain stable close to, just before, and during the competition.

The level of perceived challenge of the game refers to a cognitive evaluation, which is based on, or modulated by, athletes' expectations or goals, as well as their perceived ability to manage competition demands. On the other hand, how skillful an athlete feels about an upcoming performance is based on an evaluation of his or her efficiency and skills, especially in relation to the level of difficulty of the competition. An unanticipated event, such as an athlete becoming injured, or a difficult opponent not participating at the competition could be associated with change in perceived challenges and skills. A challenging competition will become either frightening (if athletes feel that they cannot manage the demands of the situation because of an unexpected injury) or boring (if perceived skills outweigh the difficulty of the opponents). In relation to the four experiential states of the orthogonal model of flow theory, this finding suggests that an athlete's experience (i.e., flow, relaxation, boredom, or anxiety), might depend on how she or he feels at a certain time before the event (e.g., 1 day before the competition) and not just directly before the competition.

Little or no correlation was found between challenge of the competition and athletes' skills with performance measures, both objective and subjective. The lack of correlations between challenge and skills with athletes' performance indicated that these ratings did not have a direct and close relationship with the level of performance, suggesting that other psychological or environmental characteristics might be mediated in these relationships. Taking into consideration the independent relationship, as well as the ratio between challenge and skills, it might be that situational challenge and skills, as well as the balance between them, formulate athletes' flow experience, which in turn might affect the level of their performance.

Correlations of FSS Subscales

The FSS subscales indicated a wide range of intercorrelations. Low (r = .27) to high (r = .75) intercorrelations were found among most of the FSS factors. The exception was transformation of time, which had nonsignificant correlations with the other factors. With regard to the value of the correlations, some of the factors revealed closer relationships than others. Specifically, challenge–skill balance, clear goals, unambiguous feedback, concentration on task at hand, sense of control, and autotelic experience indicated the higher interfactor correlations, suggesting a close relationship among these factors in this sample (shared variance 35%). If these results can be generalized, then being in flow might be associated with high values in all six of these FSS subscales.

The high positive correlation between challenge–skill balance and autotelic experience indicates that enjoyment of the activity is related to whether an athlete feels fairly skillful to meet the demands of the competition. That is, the subjective ratio or balance between challenge of the situation and athletes' skills might be critical to the autotelic-experience dimension. The high positive correlations among autotelic experience, sense of control, and unambiguous feedback suggest that the enjoyment of the competition is associated with an athletes having a strong sense of control over actions, so as to have the desired result, and clear feedback of how well he or she performs. In addition, close relationships were found between challenge–skill balance, clear goals, and unambiguous feedback. These three dimensions can be thought of as "setting the stage for flow" (Jackson, 1996). In other words, perhaps these dimensions modulate the rest of flow-experience qualities and represent the preconditions to get into flow, as has been suggested by Nakamura and Csikszentmihalyi (2002).

The high correlation between challenge–skill balance and sense of control indicated that the perceived balance between the challenge of the game and the efficiency of athletes to meet the demands of the task is related to a sense of control over their efforts and performance. This will help athletes concentrate on the task at hand, eliminating irrelevant cues or errors, which also finds support in the high positive correlation between concentration and sense of control. Furthermore, challenge–skill balance, sense of control, and autotelic experience were closely related to the feedback given during the activity. This means that athletes' sense of control, concentration on the performing activity, and perceptions about skills to manage the demands of the situation would provide them the opportunity to have a strong and immediate sense of performance quality. In other words, if athletes feel that they can manage the demands of the competition and enjoy the activity, this will be associated with having clear information about their performance.

On the other hand, action–awareness merging and loss of self-consciousness showed low to moderate positive correlations (r mean = .36, range .27–.47) with the rest of the FSS factors. The highest correlation among this set of intercorrelations was between loss of self-consciousness and autotelic experience, suggesting that when athletes are free of worry about others' evaluations, this is linked with enjoying the situation. The relatively lower intercorrelations with these two dimensions indicates that action–awareness merging and loss of self-consciousness were more independent from the set of more strongly related flow dimensions in this sample of athletes. Further research is needed to examine how these two factors are experienced when an athlete is in flow state and whether the experience depends on particular characteristics of the sample, such as competitive experience (amateur vs. high level), type of sport (sports and physical activities), and level of participation (recreational to national level).

The lack of correlations that occurred between the FSS subscales and transformation of time indicated that the alteration of the sense-of-time factor was not relevant to the sport-flow experience of the athletes in this sample. Low associations have consistently been found with time transformation in athlete samples (e.g., Jackson & Marsh, 1996; Jackson et al., 1998, 2001). From a practical point of view, the occurrence and the positive evaluation of transformation of time might depend on specific sport requirements. For example, whereas in some sports (e.g., long jump, triple jump, shot put) sense of time is not important, it seems to be essential in sports such as running, cycling, swimming, archery, and shooting, constituting a checkpoint of athletes' performance. Cyclists, swimmers, and long-distance runners should cover the intermediate distances in specific times, using these times as a mark of their performance or using their tempo as a way to get feedback, preserving themselves from disorientation of time. In addition, the sense of loss of time requires, or presupposes, a high level of implementation and good technical performance, which might only be experienced by elite athletes in favorable conditions.

Performance Measures and Flow Experience

In comparison with the other flow dimensions, autotelic experience and challenge–skill balance indicated higher positive correlations with athletes' performance, which is in agreement with Jackson and colleagues' (1998, 2001) research findings. Specifically, the results of the current study indicated that high levels of performance are enjoyable in nature. In high levels of performance, athletes enjoy the moment, providing support to the notion that best performance shares common characteristics with flow experience. In addition, a crucial issue for high levels of performance is whether an athlete participating in a challenging activity feels that he or she can manage the requirements of the game, achieving the desired result. The positive correlation that occurred between unambiguous feedback and performance indicates that during high levels of performance athletes have a strong sense of how well they perform. This gives them the opportunity to recognize errors and make corrections. Feedback about correct performance motivates athletes to keep trying, whereas error-related information works better to facilitate skill acquisition (Magill, 2004). In addition, the positive correlation between sense of control and performance suggests that an athlete who feels in control also performs at a high level.

Regression analysis indicated that more than half the variability of subjective performance was predicted by two FSS factors, namely, autotelic experience and challenge–skill balance. Regression analyses showed that autotelic experience was the most significant predictor of athletes' performance. Thus, if an athlete enjoys the activity, this is associated with achieving high levels of performance. In the case of the subjective measure of performance, challenge–skill balance was the next most significant predictor of performance. In other words, the balance between the perceived demands of the competition and perceived skill level seems important for athletes' self-reported measures of performance. Relative to the regression analysis of the objective measure of performance, autotelic experience predicted almost a third of the variability of athletes' performance. The pattern of results across the two measures of performance demonstrated that autotelic experience is the most significant predictor of the flow dimensions for the athletes in this sample. In other words, if an athlete really enjoys his or her experience, this might be helpful in the upcoming performance. In qualitative research with athletes, Jackson (1996) found that autotelic experience was the most highly endorsed factor when athletes were describing their flow experiences.

The current study provided interesting and useful findings for flow theory, which is a well-accepted area in psychology, although there are certain limitations that should not be overlooked. First, we examined flow experience from a quantitative perspective. Trying to quantify athletes' flow experience has certain limitations, because it cannot portray the subjective nature of flow phenomenon. In addition, the FSS has the same limitations as all self-report instruments that quantify athletes' experience. Although self-report instruments provide substantial information, they are limited in the extent to which they can tap into the subjective nature of athletes' experience during sport participation. As Csikszentmihalyi (1992) and Jackson and Marsh (1996) have mentioned, the content of flow cannot be perfectly assessed by a score on a questionnaire. Researchers should take into consideration the complex nature of flow experience. Using various instruments and research methods will be helpful to capture, understand, and interpret the experience of flow from an athlete's perspective. For example, the experience sampling method (Csiksentmihalyi & Csikszentmihalyi, 1988) could be useful in providing crucial information in the assessment and understanding of flow experience as it occurs during a sport activity. Finally, the sample of the present study consisted only of athletes of individual sports. Using team-sport athletes, flow experience might be different. In addition, because participants of this study were competitive athletes, the results might not be generalizable to participants in recreational or leisure activities.

Future research is needed to examine flow experience in a variety of sport activities (i.e., individual vs. team sports), levels of athlete (amateur vs. high level), environments (i.e., leisure, everyday activities vs. competitive sports), and the temporal relationships between competition and the formulation of challenge and skills. This will aid understanding of when these perceptions are formed and how stable they are over time. A measure of athletes' skills and challenge of the competition 1 week or more before competition will provide fruitful information regarding the dimensions of the orthogonal model of flow.

In addition, the perception of competition challenge and athletes' skills, as well as the relative balance between challenge and skills, in different sport contexts needs further examination. Moreover, interindividual and intraindividual differences need to be examined to understand potential influences on challenge and skills.

The current study examined flow only in one competition. To better capture flow experience, it would be interesting to examine how an athlete reacts in various competitive conditions (e.g., two or three competitions). For this purpose, qualitative research, using interviews, would be useful for enlightening the content of competition flow experiences. A qualitative approach can provide important information regarding the subjective nature of flow experience and how athletes formulate flow in a sport setting. Furthermore, qualitative methods (e.g., interpretive phenomenological analysis, in-depth interviews) can overcome quantitative restraints, providing information, interpretation, and understanding of flow phenomena from an athlete's point of view (Sparkes & Partington, 2003).

The current study had the advantage of examining flow in real-time measure, before and during competition. Although no causality can be implied from this study, it does seem from this, and other flow research, that the experience of flow can have an important positive influence on performance. Athletes' skills might be the critical factor for attaining flow in competitive sport, because athletes in relaxation and flow states revealed the most positive experiential characteristics. Challenge and skills seem to be formulated before competition and remain stable close to the game. The results of the present study provide important information to coaches and sport psychology consultants, and might be of use in formulating psychological preparation programs that will foster the experience of flow, and, in turn, facilitate athlete's performance.

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