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Relationships between Flow, Self-Concept, Psychological Skills, and Performance

SUSAN A. JACKSON

Queensland University of Technology

PATRICK R. THOMAS

Griffith University

HERBERT W. MARSH

University of Western Sydney

CHRISTOPHER J. SMETHURST

The University of Queensland

The main purpose of this study was to examine psychological factors of potential relevance to athletic flow experiences. A secondary purpose was to empirically examine the relationship between flow and optimal performance. Understanding factors that may be associated with flow will help to make this optimal mental state more accessible to researchers and practitioners. Self-concept and use of psychological skills were predicted to be related to self-reported flow states. Competitive athletes across three sports completed dispositional assessments of athletic self-concept, psychological skills, and flow. The athletes also completed a post-event flow assessment, as well as other questions relating to their performance, after a specified competitive event. Positive relationships were found between flow and aspects of self-concept, and the relationships between flow and psychological skills use were also in the expected directions. In addition, the

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Address correspondence to: Dr. Sue Jackson, School of Human Movement Studies, Queensland University of Technology, Victoria Park Rd, Kelvin Grove, QLD, Australia 4059, Ph 61-7-3864 3508, Fax 61-7-3864 3980. Email: sa.jackson@qut.edu.au

predicted positive relationship between a post-event flow assessment and performance criteria was obtained. This study builds on earlier research that has investigated antecedents of flow, and contributes to the expanding knowledge base of psychological factors related to optimal experience and performance.

Understanding the psychological factors that accompany successful athletic performance is a high priority for applied sport psychology, with a major area of focus being mental links to optimal performance. To advance knowledge in this area, it is important to examine specific psychological constructs with theoretical relevance to optimal performance in order to understand what psychological processes might be contributing to quality of performance. The present study examined specific links between self-concept, psychological skills and strategies, and the optimal mental state of flow, as well as relationships between flow and optimal performance. Examination of these relationships served the purposes of furthering the study of antecedents of flow state in sport, as well as investigating the relationship between flow and quality of athletic performance.

The first and primary construct examined was flow. Flow is an optimal psychological state that occurs when there is a balance between perceived challenges and skills in an activity (Csikszentmihalyi, 1990). It is a state of concentration so focused that it amounts to absolute absorption in an activity. Research on flow in sport and exercise has increased in recent years (e.g., Jackson, 1992; 1995; 1996; Jackson, Kimiecik, Ford, & Marsh, 1998; Jackson & Marsh, 1996; Kimiecik & Stein, 1992), and Csikszentmihalyi (1992) has encouraged application of flow theory to physical activity settings, which is where some of his initial research into flow began (Csikszentmihalyi, 1975). Based on their respective research findings, Jackson and Csikszentmihalyi (1999) have recently written a book describing flow in sport and how to attain this optimal mental state. Knowledge of factors associated with the attainment of flow is an important goal for those interested in the quality of athletes' experience and performance in competition.

Theoretically, flow, as an optimal mental state, would be expected to be associated with optimal athletic performance as well as providing an optimal experience. Flow is generally viewed as a peak performance state, and there is some support for this assumption (e.g., Jackson & Roberts, 1992; McInman & Grove, 1991). Nonetheless, more research is needed to empirically examine the relationship between flow and performance in sport.

Correlational support for a positive relationship between ratings of flow and perceptions of peak performance was obtained by Jackson and Roberts (1992) who asked athletes to reflect on their best performances, and found flow characteristics to be endorsed. Other writers (e.g., McInman & Grove, 1991; Privette & Bundrick, 1991) have concluded that flow and peak performance share many similar characteristics, but should still be viewed as conceptually distinct. Privette and Bundrick (1991) distinguished the two concepts by defining flow as an intrinsically rewarding experience and peak performance as optimal functioning. Jackson (1996) distinguished between the two concepts by describing peak performance as a standard of accomplishment, while flow describes a psychological state.

Assessments of flow tied to specific performances are important to obtain, in order to further knowledge of how these two factors relate to each other. In a recent study by Jackson and colleagues (Jackson et al., 1998), correlational support was obtained for a relationship between self-reported flow state and ratings of perceived success with both measures taken after a competitive event. Beyond identifying any associations between flow and peak performance, it is important to ascertain whether it is possible to promote the state of flow. That is, is there a set of conditions or factors that are positively associated with athletes being able to attain flow? A preliminary study that examined this question (Stein, Kimiecik, Daniels, & Jackson, 1995) failed to identify any substantive relationship between the psychological constructs: goals, competence, and confidence, and attainment of flow in three different sport settings: a weekend tennis tournament, college basketball activity classes, and amateur senior golf. More recently, Jackson et al. (1998) did find associations between flow and three psychological variables: intrinsic motivation (positive), perceived ability (positive), and cognitive anxiety (negative). Further research is needed to understand possible psychological antecedents of flow, at both the immediate level of the flow experience (state) as well as propensity to experience flow in general in physical activity (dispositional flow). The present study examined relationships between two sets of psychological factors predicted to be positively related to flow: athletic self-concept and psychological skills. Both dispositional and state flow experiences were included in order to examine relationships with self-reported flow experiences in general as well as with self-reported flow within particular competitive events.

We chose to examine associations between athletic self-concept and flow because there is evidence that self-concept facilitates other favorable outcomes in sport and exercise, as well as being a desired outcome of participation itself (Marsh, Hey, Johnson, & Perry, 1997). For example, components of physical self-concept have been associated with athletic participation (e.g., Jackson & Marsh, 1986), fitness indicators (e.g., Marsh & Redmayne, 1994), and self-esteem (e.g., Sonstroem, 1997). The significance of the physical self is evidenced by the wealth of research that is accumulating in this area, illustrated in a recent volume dedicated to the topic (Fox, 1997). Fox writes that physical self-concept has come to be viewed as an important determinant of behavior and a contributor to mental health and well-being. However, little is known about the relationship of athlete self-concept to flow experiences. A related construct, perceived ability, has been shown to be positively related to flow (Jackson et al., 1998; Jackson & Roberts, 1992). Perceived ability can be thought of as a general assessment of self-concept related to ability in particular situations. Self-concept researchers (e.g., Marsh, 1997; Marsh et al., 1997) favor a multidimensional approach to self-concept assessment, where several relevant dimensions of self-concept are used, rather than a unitary construct. Recently, Marsh et al. (1997) have developed a self-report instrument that assesses dimensions of athletic self-concept. Based on multidimensional self-concept theory, a sport-specific assessment of self-concept would be predicted to relate more closely to optimal sport experiences than a generalized self-concept assessment, and was thus selected as the instrument of choice in the present study. Athletic self-concept was expected to be positively related to flow based on the positive associations that have been found between perceived ability and flow (Jackson et al., 1998; Jackson & Roberts, 1992). Positive perceptions of one's athletic prowess were expected to positively influence the challenge-skill balance equation critical to flow as well as to enable the performer to focus on the task and not have the concerns of the out-of-flow performer. Of the multiple dimensions of athletic self-concept (Marsh et al., 1997) those assessing mental skills, sport skills, and overall performance were expected to relate most closely to sport flow experiences.

The second area examined for potential relevance to understanding athletes' flow experiences was their strategic use of psychological skills. The skills involved in regulating arousal, processing information, and managing emotions are particularly important for competitive athletes (Thomas, Murphy, & Hardy, 1999). These skills are commonly targeted in training programs and have been found to differentiate successful and unsuccessful athletes (Mahoney, Gabriel, & Perkins, 1987; Thomas & Over, 1994). Flow is not an easy state to attain, and getting in to flow involves a certain level of psychological skills, such as ability to control attention (Csikszentmihalyi, 1990). The importance of psychological skills to athletic performance is well documented in the sport psychology literature (e.g., Hardy, Jones, & Gould, 1996; Williams & Krane, 1998). Recently, Thomas et al. (1999) have developed a self-report instrument to measure athletes' psychological skills and performance strategies. Eight areas are assessed including self-talk, emotional control, automaticity, goal-setting, imagery, activation, negative thinking, and relaxation. In general, it was expected that the more proficient athletes are at using psychological skills in their sport, the more likely they will experience flow due to developing greater control over their thoughts and emotions during performance. More specifically, the psychological factors predicted to be most related to flow experience were automaticity, the absence of negative thinking, goal-setting, emotional control, and relaxation. These skills were considered to be most conceptually relevant to the dimensions of flow from the eight psychological skill areas assessed by the Thomas et al. (1999) instrument.

In summary, the relationships between flow and two sets of psychological constructs, athletic self-concept and psychological skills, were examined in order to increase understanding of how these constructs may be associated with flow experiences. In addition, flow was expected to demonstrate positive associations with performance assessments and it was considered important to empirically examine this relationship due to a lack of research directly examining the flow-performance link.

METHOD

Participants

A total of 236 athletes, representing three sports, were involved in this two-part study, which included dispositional (Part 1) and state assessments (Part 2). The three sports represented were orienteering ($n = 112$), surf life saving ($n = 92$), and road cycling ($n = 32$). The sports selected for inclusion in this study, although quite different from each other, did share some similar qualities: all involved a structured race format, were subject to prevailing environmental conditions, and were of a continuous nature. In addition to the continuous structured race format, the majority of performances involved endurance events. These similarities meant that the findings would have potential transferability to sports sharing similar characteristics. Other considerations in participant selection were to obtain a large number of athletes competing at different levels, to include both males and females, and to include diversity in age. The sample included athletes competing at a broad range of performance levels. Of the 231 athletes for whom relevant data were available, 10.4% were competing at an international level, 41.6% national, 6.1% junior national, 35.9% state, and 6.1% at club level. The number of years the participants had been taking part in their sport ranged from 0.25 to 45 years ($M = 9.7$, $SD = 7.4$). All three sports involved male and female competitors (34% female, 66% male). The age range of the participants was 16 to 73 years ($M = 29.8$, $SD = 13.9$).

Participants were asked to report the time spent per week on various aspects of their training. Because the data were not normally distributed, the median and inter-quartile (IQR) ranges were calculated. The sample median for total training time was 10 hours per week, with the IQR also being 10 hours. This total time was comprised of the physical, technical, and psychological aspects of their training. For physical aspects of training, a median of 7 hours was spent per week, with an IQR of 6 hours. The median time spent on technical aspects was 1.5 hours, with an IQR of 2 hours. Mental training had a median of 0 hours per week, with an IQR of 1 hour.

Instruments

The four psychological inventories and the performance assessment used in this study are described below.[1] Coefficient alphas for the inventory subscales obtained in this study are shown in Table 1. All alphas were above acceptable levels (.72 to .96).

Flow State Scale (FSS). This instrument assesses the nine theorized dimensions of flow, as discussed by Csikszentmihalyi (e.g., 1990) and supported in qualitative research with athletes (e.g., Jackson, 1996). The instrument is designed to assess flow experience in a particular situation, with respondents instructed to answer the questions in relation to a specified event. The dimensions assessed via the nine factor scale are challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation, and autotelic experience. Each dimension comprises a subscale of the total inventory, and is assessed by four items on a five-point Likert-type scale, ranging from 1 *(Strongly disagree)* to 5 *(Strongly agree)*. Research by Jackson and Marsh (1996) showed the reliability of the subscales to be acceptable, ranging from .81 to .86, with a

[1] Further information about the psychological inventories can be obtained from the authors upon request.

Table 1
Means, Standard Deviations, and Coefficient Alphas for the Psychological Scales

Questionnaire Subscale		*DFS*			*FSS*	
	(*M*)	(*SD*)	α	(*M*)	(*SD*)	α
Challenge-Skill Balance	3.86	0.58	0.80	3.76	0.68	0.76
Action-Awareness Merging	3.38	0.70	0.85	3.11	0.85	0.88
Clear Goals	4.13	0.63	0.80	4.14	0.59	0.82
Unambiguous Feedback	4.03	0.66	0.86	3.62	0.75	0.81
Concentration on the Task	3.67	0.74	0.89	3.66	0.90	0.91
Sense of Control	3.73	0.65	0.84	3.50	0.84	0.89
Loss of Self-Consciousness	3.33	0.83	0.72	3.48	0.88	0.79
Transformation Time	2.87	0.88	0.80	2.82	0.86	0.87
Autotelic Experience	4.11	0.58	0.77	3.48	1.09	0.92
		EASDQ				
	(*M*)	(*SD*)	α			
Skills	4.28	1.10	0.93			
Body	4.06	1.27	0.96			
Aerobic	4.17	1.15	0.92			
Anaerobic	3.45	1.37	0.96			
Mental	4.31	1.01	0.90			
Performance	4.16	1.03	0.94			
		TOPS				
	(*M*)	(*SD*)	α			
Activation	3.47	0.78	0.81			
Relaxation	3.42	0.81	0.88			
Imagery	3.26	0.99	0.88			
Goal-Setting	3.78	0.86	0.85			
Self-Talk	3.23	0.95	0.85			
Automaticity	2.86	0.79	0.77			
Emotional Control	3.48	0.74	0.82			
Negative Thinking	2.29	0.76	0.82			

Note. *DFS* = Dispositional Flow Scale; *FSS* = Flow State Scale; *EASDQ* = Elite Athlete Self-Description Questionnaire; *TOPS* = Test of Performance Strategies.

mean alpha of .83. Further, confirmatory factor analyses supported the nine factor model, as well as a hierarchical model with one higher order global flow factor. As discussed by Marsh (Marsh, 1998; Marsh & Jackson, 1999) establishing the validity of a psychological construct is an ongoing process which should involve both within and between-network studies. While the confirmatory factor analysis approach represents the within-network approach, the between-network approach involves attempting to establish a logical, theoretically consistent pattern of relations between measures of flow and other constructs. As part of this process, studies by Jackson et al. (1998) and Marsh and Jackson (1999) have demonstrated empirical support for psychological constructs hypothesized to be substantially related to flow.

Dispositional Flow Scale (DFS).[2] A dispositional version of the flow scale was developed to assess propensity to experience flow in physical activity (Jackson et al., 1998). This scale is essentially a parallel version of the FSS, with items re-worded to assess frequency of flow experience while participating in physical activity. A 5-point Likert-type scale, ranging from 1 (*Never*) to 5 (*Always*) is used to assess the dispositional items. Reliability of the nine subscales has been found to be at acceptable levels, ranging from .70 to .88 (Jackson et al., 1998). Confirmatory factor analyses have shown that the dispositional version has a similar structure to the FSS, with both a nine factor first order model and a higher order model receiving support (Marsh & Jackson, 1999). However, in confirmatory factor analyses conducted to date, there is stronger support for the first order than the higher order global flow model for both the DFS and the FSS (Jackson & Marsh, 1996; Marsh & Jackson, 1999). Similar to the FSS, between-network approaches described in Jackson et al. (1998) and Marsh and Jackson (1999) have demonstrated expected relationships between the DFS and other psychological constructs.

Elite Athlete Self-Description Questionnaire (EASDQ). This measure of self-concept developed by Marsh et al. (1997) covers six areas: skills, body, aerobic fitness, anaerobic fitness, mental competence, and overall performance, with four to five items per subscale (Marsh et al., 1997). A 6-point Likert-type scale is used to assess the items, ranging from 1 (*False*) to 6 (*True*). Reliability estimates were found by Marsh et al. to be good, alphas ranging from .83 to .89, with a mean of .85. The hypothesized six factor and higher order structure were supported by confirmatory factor analyses with two different elite athlete groups (Marsh et al., 1997).

Test of Performance Strategies (TOPS). This instrument recently developed by Thomas et al. (1999) measures athletes' use of psychological skills and strategies in competition on eight subscales: activation, relaxation, imagery, goal setting, self-talk, emotional control, negative thinking and automaticity. The same skills and strategies are also measured at practice except for negative thinking which is replaced by a measure of attentional

[2] The Dispositional Flow Scale has been renamed from its original name, Trait Flow Scale (Jackson et al., 1998), to more accurately reflect what it purports to measure.

control. Each subscale, identified by exploratory factor analysis, consists of four items and responses are made on a 5-point Likert-type scale, ranging from 1 (*Never*) to 5 (*Always*). Reliability of the competition subscales ranges from .74 to .80 with a mean of .78 (Thomas et al., 1999). Because of the large number of measures used in the present study, and the substantial overlap between the constructs measured in competition and practice, the data from the TOPS practice subscales were not included in the present analyses.

Performance data. Performance was assessed by both self-report and finishing position data in a specified event. Athletes were asked to rate their performance in the event being assessed, in comparison to all other similar competitions in which they had participated. Ratings were on an 11-point scale, ranging from 0 (*Extremely low*) to 10 (*Extremely high*). The sub-sample of orienteers were also asked to report the number of minutes of errors they made on the course, which is a common performance assessment made in this sport. In addition to these self-report measures, finishing position was recorded and used as a gross assessment of performance. This objective measure of performance was used as each of the sports involved a race format.

Procedure

Contact was initially made with each sport's organizing body, and subsequently with coaches and event administrators. Informed consent procedures were followed, and athletes interested in taking part in the study were asked to complete the questionnaires, which were organized into packets, and distributed prior to competition by the sport's administrators and/or coaches. Completed questionnaires were either collected at the conclusion of competition or mailed back to the investigators in pre-paid envelopes. Participants were asked to complete two questionnaires: the first in their own time but not directly before or after competing; and a second, shorter questionnaire to be completed after a specified competitive event. The first questionnaire included all the dispositional measures (DFS, EASDQ, TOPS) plus demographic information. The post-competition questionnaire was completed by a subsample of the respondents (n = 208), and included the FSS and performance-related questions. Respondents were asked to indicate the length of time between when they finished their event and when they completed the post-competition questionnaire. As the data were not normally distributed, median and IQR were calculated. The median time to completion of the post-competition questionnaire was 6.25

hours, with the IQR being 21 hours. Thus, there was considerable variability in when participants completed this questionnaire.

Questionnaire return rates across the three sports were as follows: orienteering 55%, surf life saving 48% (Part 1) and 32% (Part 2), and cycling 19%. Less structured support was obtained from the cycling association contacted for this study, resulting in a low return rate from this group. Extreme weather conditions during the collection of the life saving competition data may have affected the Part 2 return rates for this sport.

Predicted and Analyzed Relationships

Predictions were made regarding expected relationships between the psychological factors assessed by the flow scales (FSS/DFS), the self-concept scale (EASDQ), and the test of psychological skills and strategies (TOPS). Because the EASDQ and TOPS assess factors at a dispositional level, it was expected that relationships between these scales and flow would be greater for dispositional than for state flow. Self-concept factors expected to be most highly related to flow were: overall performance, mental competence, and sport skills. The remaining three scales from the EASDQ, assessing perceptions of body, aerobic, and anaerobic fitness, were not expected to be strongly related to flow.

Of the psychological skills assessed by the TOPS, all except negative thinking were expected to be positively associated with flow, with the following factors predicted to be most strongly related: automaticity, negative thinking (inverse relationship), goal setting, emotional control, and relaxation. Finally, flow state was predicted to be positively associated with self-ratings of performance, and negatively associated with errors in orienteering and overall finishing position across the three sports (i.e., the more errors and the higher the finishing position, the less self-reported flow).

To assess the predicted relationships between flow, self-concept, and psychological skills, hierarchical regression and canonical correlation analyses were conducted. To examine the relationship of flow state to performance, standard multiple regressions were conducted on the performance criteria, using the FSS responses as the predictor variables.

RESULTS

Descriptive Results

The means and standard deviations for the psychological variables are shown in Table 1. The scores on the flow scales indicated moderate endorsement of the items for the group as a whole, with the average across the subscales for the dispositional items being 3.68, and 3.51 for the state items (on a 5-point scale). Similar moderate endorsement of items for the group as a whole was found for the self-concept measure (4.07 on a 6-point scale) and the psychological skills use scale (3.22 on a 5-point scale).

Bivariate correlations between the dispositional flow subscales and the self-concept and psychological skills subscales are shown in Table 2. Significant correlations ($p < .01$) ranged between .17 and .70, with a median $r = .38$. This set of correlations was higher than the parallel set of significant correlations for the FSS (not shown), which ranged between .18 and .48, with a median $r = .25$. Bivariate correlations between the self-concept and psychological skills subscales ranged between -.01 and .66, with a median $r = .37$. Thus, although correlations were moderate to high, there was no evidence of a problem with bivariate collinearity among the psychological variables. The issue of multicollinearity was addressed more directly in the regression analyses, described below.

Relationships Among the Psychological Factors

Hierarchical regressions with global flow factors. To assess whether global flow scores were associated with differences in self-concept and psychological skills, hierarchical multiple regressions were conducted, using pairwise deletion for missing values, with dispositional and state global flow as the criterion variables respectively. The eight TOPS and six EASDQ factors were included as independent variables for the dispositional and state flow regressions, with the addition of the nine dispositional flow factors in the prediction of state flow. Due to the large number of independent variables and the fact that some shared substantial variance, as indicated by the bivariate correlations, a tolerance analysis was conducted for multicollinearity, as recommended by Tabachnick and Fiddell (1996). The tolerance test showed all variables to be within acceptable limits and multicollinearity was not evident.

The hierarchical regression procedure allowed for examination of the level of prediction of each set of psychological variables on the criterion, dispositional or state flow. Change in R^2 was calculated in two ways:

Table 2
Correlations Between Dispositional Flow (DFS), TOPS, and EASDQ Factors

FLOW (DFS)	Chal-Skill Balance	Action-Awareness	Clear Goals	Unambig. Feedback	Concentrat. on Task	Sense of Control	Loss of Self-Conscious.	Time Transform.	Autotelic Experience	Flow Total
TOPS										
Activation	.47	.34	.46	.38	.48	.47	.14	.01	.33	.55
Relaxation	.47	.32	.42	.31	.43	.46	.28	–.08	.31	.52
Imagery	.40	.33	.53	.31	.42	.37	.02	.04	.31	.48
Goal Setting	.39	.21	.61	.38	.41	.42	.01	–.09	.33	.46
Self-Talk	.36	.14	.44	.18	.37	.36	.07	.08	.31	.41
Automaticity	.09	.49	–.04	.13	.06	.11	.14	.09	–.03	.20
Emot. Control	.41	.28	.44	.32	.58	.54	.27	–.03	.36	.57
Neg. Think.	–.42	–.30	–.47	–.31	–.52	–.53	–.33	.07	–.29	–.56
EASDQ										
Skill	.67	.50	.45	.47	.38	.49	.16	–.13	.15	.55
Body	.32	.38	.25	.26	.23	.26	.01	–.01	.17	.33
Aerobic	.40	.39	.24	.30	.25	.24	.06	–.07	.06	.33
Anaerobic	.28	.33	.31	.35	.24	.27	–.03	.01	.22	.35
Mental	.59	.40	.65	.45	.68	.62	.15	–.02	.44	.70
Performance	.66	.47	.59	.39	.57	.61	.17	–.06	.40	.67

Note. Correlations greater than .16 are statistically significant at $p \leq .01$ (two-tailed).

(a) $R^{2\,ch}1$, the value of R^2 when each predictor variable was entered into the regression equation first, providing information on how much variance each predictor variable set could explain of the criterion, without regard to any of the other constructs; and (b) $R^{2ch}2$, the value of R^2 when each predictor variable was entered into the regression equation last, providing information on how much unique variance could be explained by each set of predictors after controlling for all other constructs. The test procedure in SPSS was used to calculate the second set of values (SPSS, 1994, 6.1 Syntax Reference Guide, p. 627). This procedure was adopted because there was not a strong a priori reason for entering the variables in a particular order, but by following the two-step approach, it was possible to examine each variable singly and in combination with other variables. Furthermore, because the variables did share some common variance, it was considered a better approach to running independent standard multiple regressions.

Both self-concept ($R^{2\,ch}1 = .53$) and psychological skills ($R^{2\,ch}1 = .58$) accounted for substantial amounts of variance in dispositional flow when entered into the regression equation first. There was considerable overlap between these two predictors however, as the amount of unique variance ($R^{2ch}2$) each accounted for was low, 6 and 10% respectively. The total $R^2 = .64$, $F(14, 220) = 27.47$, $p = .0000$. The second regression equation examined the prediction of state flow from these same two predictors plus the addition of the dispositional flow factors. Considerably less variance in state flow was accounted for by the dispositional predictors, total $R^2 = .44$, $F(23, 183) = 6.33$, $p = .0000$. Dispositional flow accounted for the most initial variance ($R^{2\,ch}1 = .36$) as well as the greatest amount of unique variance ($R^{2ch}2 = .13$) in state flow. Psychological skills use ($R^{2ch}1 = .30$) initially explained more variance in state flow than self-concept ($R^{2ch}1 = .18$), but there was substantial overlap in their contributions (psychological skills use: $R^{2\,ch}2 = .06$; self-concept: $R^{2\,ch}2$ ns).

Canonical correlation analyses. To further examine the relationship between flow, self-concept, and athletes' psychological skill use, canonical correlation analysis was employed. This analysis allowed for examination of which factors comprising the respective constructs were contributing most to the global relationships. Two canonical correlations were run to examine the relationship between the subscales of dispositional and state flow respectively, with the subscales of the self-concept (EASDQ) and psychological skills (TOPS) variables.

The first canonical correlation analysis involved the DFS subscales as criterion variables and the EASDQ and TOPS subscales as the predictor set. The omnibus multivariate test of significance indicated that a significant relationship was present between these sets of variables, Wilks's lambda = .05, $F(126, 1634) = 6.10$, $p = .000$. Canonical correlation analysis indicated that four canonical functions were statistically significant, however, only the first predicted more than 10% of the variance in the criterion set and consequently only the first function will be interpreted. The canonical correlation between the two sets of variables was $Rc = .87$, with the redundancy index for the predictor set indicating that this covariate could explain 30% of the variance in the criterion set.

The canonical loadings for the first function are shown in Table 3. Canonical loadings greater than .30 are considered meaningful (Pedhazur, 1982). The highest loadings for the flow set were challenge-skill balance (.83), sense of control (.79), clear goals (.76), concentration (.75), and action-awareness merging (.67). Amongst the predictor variables, the self-concept performance (.88), mental competence (.87), and skills (.77) had the highest loadings. From the TOPS, the highest loadings were negative thinking (-.66), activation (.66), emotional control (.66), and relaxation (.64). To summarize these relationships, positive self-concept for skilled performance (mental & physical), combined with keeping an appropriate level of activation/relaxation and staying in control of one's thoughts and emotions, were predictive of dispositional flow.

To examine the relationship between state flow and the dispositional subscales of the EASDQ and the TOPS, canonical correlation analysis was conducted with subscales of the FSS as criterion variables, and the EASDQ, and TOPS as predictor variables. The omnibus multivariate test of significance indicated that a significant relationship was present between the two sets of variables, Wilks's lambda = .19, $F(126, 1420) = 2.78$, $p = .000$. Canonical correlation analysis indicated that four canonical functions were statistically significant, however, only the first predicted more than 10% of the variance in the criterion set and consequently only the first function will be interpreted. The canonical correlation between the two sets of variables was $Rc = .66$, with the redundancy index for the predictor set indicating that this covariate could explain 15% of the variance in the criterion set.

The canonical loadings for the first function are also shown in Table 3. The highest loadings for the flow set were concentration (.80), sense of control (.78), clear goals (.75), and challenge-skill balance (.70). Amongst the predictor variables, the self-concept mental competence (.80), performance (.78), and skills (.62) had the highest loadings. From the TOPS, the

Table 3
Canonical Loadings Between Flow and the Psychological Predictors

Variables	Canonical Correlation Loadings DFS	FSS
Criterion Variables		
Challenge-skill balance	.83	.70
Sense of control	.79	.78
Clear goals	.76	.70
Concentration on task at hand	.75	.80
Action-awareness merging	.67	.53
Unambiguous feedback	.59	.54
Autotelic experience	.45	.17
Loss of self-consciousness	.30	.54
Transformation of time	-.08	-.03
Predictor Variables		
EASDQ-Performance	.88	.78
EASDQ-Mental	.87	.81
EASDQ-Skills	.77	.62
TOPS-Negative thinking	-.66	-.73
TOPS-Activation	.66	.68
TOPS-Emotional Control	.66	.73
TOPS-Relaxation	.64	.67
TOPS-Goal Setting	.61	.45
TOPS-Imagery	.60	.52
TOPS-Self-talk	.48	.43
EASDQ-Aerobic	.47	.42
EASDQ-Anaerobic	.44	.37
EASDQ-Body	.44	.34
TOPS-Automaticity	.21	.29

highest loadings were negative thinking (-.73), emotional control (.73), activation (.68), and relaxation (.67). Thus, a very similar pattern of results was obtained for the prediction of state flow as was found for dispositional flow. Positive self-concept for skilled performance (mental & physical), combined with keeping an appropriate level of activation/relaxation and staying in control of one's thoughts and emotions, were predictive of state flow, although the extent of this relationship was lower than the corresponding relationship found for dispositional flow.

Relationship of Flow to Performance

Self-reported performance levels. Rating of overall performance in the event being assessed had scores ranging from 0 to 9 ($M = 6.2$, $SD = 2.5$) for the total group. For the orienteers, the number of minutes of errors re-

Table 4
Standard Multiple Regressions on Performance Measures

Criterion variable	Predictor variables	B	SE B	Beta
Subjective performance rating	*Flow state:*			
	Autotelic experience	.95	.15	.42
	Challenge-skill balance	.93	.26	.26
Errors (Orienteers)	Autotelic experience	-2.23	.63	-.36
	Clear goals	-3.44	1.20	-.31
	Action-awareness	-1.52	.75	-.19
	Unambiguous feedback	3.30	.94	.37
Finishing Position	Clear goals	-2.60	.96	-.24
	Challenge-skill balance	-1.79	.91	-.19
	Action-awareness	-1.18	.60	-.15

Note. Due to space limitations, only significant beta weights are shown. All are significant at $p <$ .05.

ported ranged from 0 to 45 (M = 6.5, SD = 6.7). To examine whether flow experienced in the event was related to these performance criteria, two standard multiple regressions were run, using overall performance rating and errors as the criterion variables, and FSS dimensions as the predictor variables.

Significant beta weights from the resulting regression equations are shown in Table 4. For the total group, overall performance ratings were predicted by flow state, $R^2 = .46$, $F\ (9, 196) = 18.70$, $p = .0000$. The flow dimensions contributing significantly to the regression equation were autotelic experience and challenge-skill balance.

The regression equation for errors in orienteering was also significant, $R^2 = .33$, $F\ (9, 96) = 5.33$, $p = .0000$, indicating that self-reported flow experienced in the event predicted errors made on the course. Several flow dimensions contributed significantly to the regression equation: autotelic experience, clear goals, action-awareness merging, and unambiguous feedback. As shown in Table 4, all predictions were in the expected direction except for the relationship between feedback and errors. There was an unexpected positive relationship between unambiguous feedback and number of errors made by the orienteers.

Finishing position in the event. Final position in the race ranged across the total group from 1 to 36 (M = 7.44, SD = 6.47). To examine whether flow predicted finishing position, a standard multiple regression was conducted, using this performance measure as the criterion variable and flow state as the predictor variable. The regression equation was significant, $R^2 = .13$, F (9, 185) = 3.04, $p = .0020$. As shown in Table 4, clear goals, challenge-skill balance, and action-awareness merging contributed significantly to the prediction of finishing position.

Correlations between the three performance measures were of a moderate level. The correlation between errors and finishing position was .46, while the correlation between ratings of overall performance and finishing position was –.31, demonstrating some correspondence between where participants finished in their races and their self-ratings of performance. The correlation between errors and ratings of overall performance was –.54, showing that factors other than finishing position influenced self-ratings of performance.

DISCUSSION

This investigation extends the examination of the flow construct in sport settings by expanding the knowledge base about antecedents and consequences of experiencing this optimal mental state. In this study, flow was both a criterion and a predictor variable. First, possible psychological correlates of flow were examined via associations with self-concept and psychological skills use. Then, flow state was investigated as a predictor variable of performance in competition, to examine empirically the connection between experience of flow and quality of performance.

In general, the predictions made regarding the expected relationships between the factors assessed in this study were well-supported. For example, where positive relationships were expected between flow and dimensions of the self-concept and psychological skills measures, these were mostly found. Exceptions, as described below, were the extent of relationship between flow and the psychological skills of automaticity and activation. Stronger relationships were found between the dispositional psychological predictors and the corresponding dispositional version of the flow scale than with the state version, as expected.

Positive perceptions of self as an athlete, and the strategic use of psychological skills were associated with the experience of flow during athletic participation. At the specific subscale level, the canonical correlation results demonstrated that the three factors from the EASDQ predicted to be most highly related to flow (mental competence, overall performance, and skills) did emerge as the strongest predictors. From the TOPS, four of the five psychological factors predicted to relate most highly to flow were found to have moderate to high associations with the flow dimensions. The one exception was automaticity, which did not prove to be a strong predictor of flow. Theoretically, it was expected that a measure of automaticity would relate strongly to several aspects of flow, including the global flow measure. Thomas et al. (1999) have found their automaticity measure has not been associated with the other factors assessed by the TOPS to date. It is possible that athletes may have been misinterpreting the items designed to assess this factor, confusing genuine automaticity with a disorganized or laissez faire approach to competition. For example, one of the automaticity items reads, "During competition, I don't think about performing much—I just let it happen." This apparent ambiguity about what the automaticity subscale is designed to measure may provide an explanation for the lack of a strong relationship with flow in the present study. Further research is needed on the TOPS automaticity subscale in order to understand the role of automaticity in athletes' mental and physical performance.

Another of the TOPS factors that did not specifically match predictions was the activation factor. Although a positive relationship was predicted between activation and flow, we did not expect activation to be one of the stronger predictors of flow. Canonical correlation analyses demonstrated moderate to high associations between the activation factor and flow. On reflection, it makes sense that a factor designed to assess activation levels would be associated with flow, which is operationally defined as occurring when there is a perceived balance between challenges and skills in a situation (Csikszentmihalyi, 1990). When there is an imbalance between challenges and skills, either anxiety or boredom is predicted, and these concepts are also related to activation. The activation factor was measured by items such as "I can increase my energy to just the right level for competitions," which implies a balancing of physical readiness with the challenge of the competition.

Predictions made regarding the relationship of flow to performance were moderately well supported. Not surprisingly, the stronger relationships were found between flow and the self-reported performance levels. As was found in an earlier study (Jackson et al., 1998), the strongest associations between a self-report assessment of performance and flow state were with the autotelic experience and challenge–skill balance dimensions of flow. When considering the errors reported by the orienteering sample, several flow dimensions were significant predictors. One unexpected finding was a positive relationship between the flow dimension, unambiguous feedback, and number of errors made. It seems that feedback regarding performance, when it focused on errors rather than positive aspects of performance, may have had the unwanted effect of generating more errors. Csikszentmihalyi's (e.g., 1990) descriptions of the feedback dimension of flow focus on the information provided by an activity that lets the person know about the progress he or she is making toward the desired goal. Whether this feedback is positive or negative has not been portrayed as critical; Csikszentmihalyi has highlighted rather the immediate and clear nature of the feedback in flow. The finding of a positive relationship between feedback and errors in this study indicates negative feedback may contribute to further errors (and thus less flow). Future research should attempt to clarify the relationship of different types of feedback to flow and performance. In an interesting study by Kirschenbaum, Owens, and O'Connor (1998), a positive self-monitoring technique involving focusing only on positive feedback contributed to improved psychological skills and better performance for a group of golfers.

In predicting an objective performance criterion, flow state was able to explain a small amount of variance in finishing position. The general nature of the objective performance measure used in this study could account for the low relationships. There are of course problems with relying on finishing position as a measure of performance. However, it was the only consistent performance marker across the three sports included in this study. While providing a gross assessment of level of performance, finishing position does not take into account personal performance levels, the number of competitors in an event, nor the range of factors that might influence ordering of competitors. Despite these problems with the measure of performance, the fact that significant relationships were found with flow state provides an encouraging starting point for further research in this area. The limitation imposed by the variability in when the post-performance questionnaire was completed, as discussed under the section, Limitations and Future Research Directions, is another factor to be considered when interpreting the flow-performance findings in this study.

Understanding the Sport Flow Experience

The pattern of relationships found regarding flow and its relationship to psychological and performance factors contributes to the growing knowledge base of the sport flow experience. The dimensional analysis of flow, via the FSS and more recently, the DFS, is providing a picture of optimal sport experience that highlights in particular four of the nine flow dimensions. Challenge-skill balance, concentration on the task at hand, sense of control, and clear goals were the strongest factors to emerge in the canonical correlation analysis with the EASDQ and TOPS factors. These dimensions also emerged as strong factors with a different set of predictor variables in a recent study by Jackson et al. (1998). Another point of similarity between these studies was the moderately high loading for the loss of self-consciousness dimension in the state flow canonical analyses, compared with low loadings for this factor in the dispositional flow analyses. Thus, it appears that specific flow experiences in sport are tied to a letting go of worry about the self, even though athletes perhaps do not recognize this as an important characteristic for flow experiences in sport in general.

The relationships between facets of self-concept, psychological skills, and flow found in the present study uncovered further information on possible flow antecedents in sport. Previously, it has been shown that perceived ability is an important predictor of flow (Jackson et al., 1998; Jackson & Roberts, 1992), and the positive relationships with dimensions of athletic self-concept found in the present study confirm and strengthen this association between self-perceptions and experience of flow. It appears that the perceived skills component of the challenge-skill equation that defines flow (Csikszentmihalyi, 1990) seems to be critical to the sport flow experience. The use of the EASDQ in the present study provides detail on what aspects of self perceptions might be particularly relevant to the global "skills" component of the challenge-skill balance equation for athletes. Perceiving one is skilled both physically and mentally, as well as being competent in performance situations, was found to facilitate flow for the athletes in this study.

The positive associations between flow and the psychological factors assessed by the TOPS further highlighted the importance of mental skills to flow. In particular, the avoidance of negative thinking, combined with good emotional control, relaxation, appropriate activation levels, and, to a lesser extent, setting goals, use of imagery, and positive self-talk facilitated flow in this study. The extent to which athletes used these psychological skills and strategies in competition did help to explain variation in their experience of flow. Links have thus been established between athletes' mastery and use of psychological skills and strategies and their experience of flow in competition. However, there was considerable overlap between the measures of self-concept and psychological skills used in this study. This limits the extent to which definitive conclusions can be reached about their separate contributions to the prediction of flow.

Athletes in this study were asked about the relative time they devoted to the physical, technical, and psychological components of their sport. As indicated in the median values for psychological skills training, the amount of time spent in developing these skills was very low to non-existent for the group as a whole. In view of the relationships that were found between the factors assessed in this study, it is clearly important for athletes to develop positive athletic self-concepts and to master psychological skills and strategies for competition, to be in a position to facilitate flow and optimal performance. The mean values for self-reported flow demonstrated that the participants as a group experienced flow dimensions some of the time in general and to a moderate extent in the specific events being assessed. With enhancement of self-concept and greater use of psychological skills, flow ratings may increase—a step for future research.

The types of sports included in this study may have had some bearing on the extent of flow experienced. As discussed, all three sports followed a competitive structured race format, and were of a continuous, primarily endurance-based nature. They were also subject to prevailing environmental conditions. As discussed by Jackson (1995; Kimiecik & Jackson, in press) many factors affect the flow experience, both within-individual and those pertaining to the environment. Competition may act as either a facilitator or detractor of flow, an issue discussed by Kimiecik and Jackson (in press). A structured type of event, and one that is continuous in nature may facilitate flow, in comparison to more unstructured, stop-start events, where there are potentially more uncontrollable factors for the athlete to deal with. Non-favorable environmental factors were shown by Jackson (1995) to be major disruptors of flow. Future research should help to delineate sport-related factors that influence the flow experience.

Four dimensions of flow stood out as most predictive across the performance measures: challenge–skill balance, autotelic experience, clear goals, and action-awareness merging. Two of these dimensions, challenge–skill balance and clear goals were also among the strongest flow factors to emerge in the analyses with self-concept and psychological skills. Thus, it appears that these two factors are particularly relevant for understanding both flow antecedents and optimal performance. The other two robust flow dimensions from the flow-performance analyses, autotelic experience and action-awareness merging, demonstrate the link between enjoyment of the experience, becoming totally absorbed in what you are doing, and quality of performance.

Limitations and Future Research Directions

The conclusions that can be drawn regarding the relationships found in this study are encouraging, however, they need to be understood in terms of the limitations imposed by the research approach employed. As with all self-report studies, the robustness of the findings are dependent on the validity of the responses provided. The athletes were asked to reflect on their sport experiences, both in general as well as in relation to a specific event completed prior to their event-based responses. The retrospective nature of the responses could have been clouded by social desirability, by attitudes toward performances recently completed, or by other factors to do with their sport involvement not tapped by the present study. As with most field research, the investigators did not have complete control over the data collection and this may have compromised some of the questionnaire results. The investigators were reliant on the sports' administrators to distribute the questionnaires and this limited the extent to which these procedures were able to be controlled. Although clear written instructions were given both to administrators and athletes regarding when the questionnaires were to be completed, the demonstrated variability in when the post-performance questionnaire was answered showed the lack of investigator control over these procedures and limits the robustness of the conclusions that can be drawn from the data. Another limitation, as previously noted, was the use of finishing position as a performance measure, and future research would benefit from using more specific and robust measures of performance when examining associations with flow or other psychological constructs.

The instruments used to assess the psychological constructs of interest demonstrated acceptable levels of reliability and may serve as useful tools for future research. As with any self-report instrument, the utility of the scales used in this study is dependent on how well they assess the constructs they are designed to measure. Being relatively new scales, each is open to further development and refinement. For example, revised versions of the flow scales have recently been developed, incorporating several new items found to perform better than their original counterparts (Jackson & Eklund, 2001). The Experience Sampling Method (Csikszentmihalyi & Larson, 1987) is another tool for assessing flow, one which provides for immediate and on-going assessment of experience, and creative ways of applying this approach in sport are needed. In addition to considerations of what measures are used, and when they are taken, there are other ways of extending the knowledge base about flow and optimal performance. For example, conducting interventions to manipulate factors predicted to be associated with flow or successful performance, and assessing changes in these criterion variables, would provide stronger conclusions regarding optimal performance, mental and/or physical.

Examining differences between athletes performing at a range of levels, and in a wide variety of sports and physical activities, as well as noting changes in participants' responses across different situations, will help to promote understanding of both flow and quality of athletic performance. There is an on-going need to keep refining the psychometric tools used in this study, as well as to develop other valid measurement approaches to explore further the question of what are important psychological factors to the experience of optimal psychological states and optimal athletic performance.

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