Examining the Motivation-Performance Relationship in Competitive Sport: A Cluster-Analytic Approach

Article *in* International journal of sport psychology · March 2012

5 authors, including:


Sophie Berjot
Université de Reims Champagne-Ardenne

Robert J Vallerand
Univ du Québec à Montréal


Camille Amoura
Université d'Artois


Elisabeth Rosnet
Université de Reims Champagne-Ardenne

URGENT

To the

"INTERNATIONAL JOURNAL OF SPORT PSYCHLOGY"
c/o Edizioni LUIGI POZZI Via Panama 68, 00198 ROMA (Italy)
Tel ++39 06 855 35 48 - fax ++39 06 855 41 05
E-mail: *edizioni_pozzi@tin.it*

FORM FOR INSTITUTIONS
We wish to subscribe to
"International Journal of Sport Psychology"

☐ for 2012 (€ 180,00)

☐ for 2012 by priority mail (€ 220,00)

FORM FOR INDIVIDUALS
I wish to subscribe to
"International Journal of Sport Psychology"

☐ for 2012 (€ 120,00)

☐ for 2012 by priority mail (€ 170,00)

☐ 2012 ISSP membership (€ 80,00)
by priority mail (€ 100,00)

The Journal should be sent to the following address (please Typewrite)

Name ______________________________

Address ______________________________

Town ______________________________

State ______________________________

Money should be sent to EDIZIONI LUIGI POZZI Via Panama 68,
00198 ROMA (Italy)

Date ____________________ Signature ____________________

Please charge EURO ____________________ to my VISA/MASTERCARD

Card account N. ______________________________

Account Name ______________________________

Account Address (if different from the delivery address below) ____________________

Signature ____________________ ____________________

Expiry date ____________________ ____________________

Name ______________________________

Address ______________________________

Postal/Zip Code ______________________________

Country ______________________________

International Journal of Sport Psychology

Vol. 43 - N. 2 - March-April 2012

CONTENTS

Original Contributions

Int. J. Sport Psychol.

Listed in Impact Factor APA Div 47 web.site, Current Contents/Social & Behavioral Sciences, PsycLIT, PsichINFO online database

NOTE TO CONTRIBUTORS

Owing to a new organization of the Editorial Board, all correspondence concerning manuscripts should be directed to

Edizioni Luigi Pozzi s.r.l.
International Journal of Sport Psychology
Via Panama 68, 00198 Rome, Italy

The papers must be transmitted by the website http:www.ijsp-online.com

The papers can be also submitted by e-mail: edizioni_pozzi@tin.it

Six issues are published annually in: February, April, June, October, and December. Further special issues may be published, containing the Proceedings of national or international conferences, if requested and supported by the organizers of the meetings.

2012 SUBSCRIPTION RATES:
Individual: 120,00 Euro (170,00 Euro by priority mail).
Institutions: 180,00 Euro (220,00 Euro by priority mail).
Memberships of the ISSP: 80,00 Euro (100,00 Euro by priority mail).

Notices of upcoming international events journals and books for review must be sent to:
Edizioni Luigi Pozzi srl, International Journal of Sport Psychology
Via Panama 68, 00198 Rome, Italy

Business correspondence, subscriptions, and *address changes* should be mailed
to Edizioni Luigi Pozzi, Via Panama 68, 00198 Rome, Italy.
Tel. ++39 06 855.35.48; Fax ++39 06 855.41.05; E-mail: edizioni_pozzi@tin.it
www.edizioniluigipozzi.it

Autorizzazione del Tribunale di Roma n. 13404 del 24 giugno 1970 - Direttore responsabile: Luigi Pozzi - Trimestrale - sped. abb. post. - 45% - art. 2 comma 20/b L. 662/96 - Filiale di Roma

Finito di stampare nel mese di aprile 2012 dalle Arti Grafiche Tris, s.r.l.
via delle Case Rosse, 23 - 00131 Roma

Int. J. Sport Psychol., 2012; 43: 79-102

Examining the motivation-performance relationship in competitive sport: A cluster-analytic approach

NICOLAS GILLET*, SOPHIE BERJOT**, ROBERT J. VALLERAND***, SOFIANE AMOURA** *and* ELISABETH ROSNET**

(*) EA 2114 Psychologie des Ages de la Vie, Université François-Rabelais de Tours, France
(**) EA 4298 Laboratoire de Psychologie Appliqué, Université de Reims Champagne-Ardenne, France
(***) Laboratoire de Recherche sur le Compartment Social, Université du Québec à Montréal, Canada

In the present research, we adopted a person-centered approach for identifying motivational profiles. Both in junior national fencers (Study 1) and long-distance running athletes (Study 2), cluster analyses showed three motivational profiles: a Low group, a Moderate group, and a High group. In both studies, results also revealed that athletes characterized by the High motivational profile obtained the highest levels of performance. Finally, in Study 2, results revealed that such better performance was achieved at a cost, as athletes in the High group displayed higher levels of emotional and physical exhaustion than those in the Low and Moderate clusters. Theoretical and practical implications of the findings are discussed.

KEY WORDS: : Cluster analyses, Motivational profiles, Performance, Self-determination theory, Sport

Athletes may engage in a sport activity for multiple reasons. For instance, some might find the activity enjoyable, while others might desire to prove themselves by outperforming others. In addition, it is also possible that a given athlete is involved in sport for several reasons both because they display a spontaneous interest for the activity and because they want to outperform others. In fact, recent research supports that point (e.g., Gillet, Vallerand, & Rosnet, 2009; Hodge, Allen, & Smellie, 2008). One theory that posits the existence of several types of motivation is Self-Determination Theory (SDT; Deci & Ryan, 1985, 2008; Ryan & Deci, 2000). Deci and Ryan (1985) have proposed a multidimensional conceptualization of motivation in which it is the quality or the type of

** Correspondence to Nicolas Gillet, Psychologie des Âges de la Vie E.A. 2114, Université François-Rabelais de Tours, UFR Arts et Sciences Humaines, Département de psychologie, 3 rue des Tanneurs, 37041 Tours Cedex 1, France. E-mail: nicolas.gillet@univ-tours.fr*

motivation rather than the total amount of motivation that is important for predicting outcomes. Specifically, SDT differentiates between autonomous and controlled forms of motivation. Autonomous motivation involves acting with a full sense of volition and endorsement of an action. In contrast, controlled motivation involves a sense of coercion and implies that one's behavior is governed by external and/or internal pressures (Ryan & Deci, 2000).

The distinction between autonomous and controlled motivation is not conceptualized as a dichotomy within the SDT framework, but rather as a continuum reflecting a range of autonomous and controlled reasons for behavioral engagement (Deci & Ryan, 1985; Ryan & Deci, 2000). Intrinsic motivation is the most autonomous form of motivation. Next on the continuum are the different types of extrinsic motivation that can be autonomous (i.e., identified regulation) or controlled (i.e., introjected and external regulations). Finally, at the least self-determined end of the continuum, SDT posits the existence of the concept of amotivation which represents a relative absence of motivation (see Deci & Ryan, 2008, for a definition of each form of motivation).

Motivation, Performance, and Burnout

Recent investigations have shown that autonomous motivation leads to high levels of competitive performance (e.g., Gillet, Vallerand, Amoura, & Baldes, 2010; Mouratidis, Vansteenkiste, Lens, & Sideridis, 2008). Examining the relationships between motivation and performance, these studies have used one of two strategies: (1) using an autonomous motivation composite score (e.g., averaging intrinsic motivation and identified regulation) or (2) using the self-determination index which entails assigning weights to the different forms of motivation as a function of their levels of self-determination and summing all products into one score (see Pelletier & Sarrazin, 2007). The motivational profile approach used in recent research (Gillet, Vallerand, & Rosnet, 2009; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009) allows researchers to investigate how different forms of motivation combine to produce distinct motivational profiles and determine how each cluster relates to outcomes such as performance and burnout. Drawing on this argument, we adopted a person-centered approach in the present research to examine athletes' motivational profiles.

According to SDT, higher levels of motivation do not necessarily yield more optimal outcomes if the motivation is controlled rather than autonomous. Dozens of studies have shown that autonomous motivation lead to more positive consequences (e.g., more positive affect, enhanced performance) than controlled motivation (see Vallerand, 2007, for a review in sport). However, controlled motivation did not always lead to negative consequences. For example, adolescents who are competent in their sport may want to continue practicing this activity to prove they are skilful and receive acceptance and recognition from others (e.g., peers, parents, coaches). Past studies in various settings have shown that controlled forms of motivation may also lead to positive outcomes. Vallerand et al. (1993) have found that introjected and external regulations toward school activities were positively correlated with various positive outcomes such as concentration and positive emotions in the classroom, academic satisfaction and performance, and behavioral intentions of continuing schooling. In the sport domain, Brière, Vallerand, Blais, and Pelletier (1995) showed that introjected regulation was positively correlated with positive emotions, interest, and satisfaction. In a longitudinal study with swimmers, Pelletier, Fortier, Vallerand, and Brière (2001) showed that introjected regulation was a significant predictor of persistence 10 months after the assessment of athletes' motivation, but became non significant 22 months later. These researchers thus suggested that introjected regulation could represent temporary reasons for training. Finally, Chantal, Guay, Dobreva-Martina, and Vallerand (1996), in a sample of 98 Bulgarian elite athletes, found that best performing athletes (i.e., title and medal holders in national and international events) displayed higher levels of controlled motivation and amotivation than less successful athletes. An argument for the potential positive association between controlled motivation and performance is that athletes with controlled motivation might be the best performers but only if they also have at least moderately high levels of autonomous motivation. Additional studies are needed to test this hypothesis.

Although controlled motivation might play a role in predicting performance, it might nonetheless result in increasing the likelihood that athletes will suffer from burnout. Raedeke and Smith (2001) consider athlete burnout to be a psychological syndrome depicted by physical and emotional exhaustion, reduced sense of athletic accomplishment, and sport devaluation. One important determinant of this process may be the athletes' sport motivation (Cresswell & Eklund, 2005). Specifically, differences between autonomous and controlled motivations have emerged in terms of their relationship with burnout. Controlled motivation has been found to be positively related to burnout whereas autonomous motivation negatively related to burnout in occupational (e.g., van Beek, Taris, & Schaufeli, 2011) and sport settings (e.g., Curran, Appleton, Hill, & Hall, 2011; Isoard-Gautheur, Oger, Guillet, & Martin-Krumm, 2010). In the present research, we tried to answer the question of whether a motivational profile could lead to high levels of both performance and burnout.

Motivational Profiles

Autonomous and controlled motivations often co-occur because sport activities are rarely just intrinsically motivated. Indeed, it is entirely possible that several people scored high on both autonomous and controlled motivations and it is thus important to consider the ways in which the different forms of motivation might interact (see Lepper, Corpus, & Iyengar, 2005). For instance, many adolescents may engage in sport both because they enjoy the activity and because they want to please their parents. Recent research in the SDT framework has used cluster analyses to examine individuals' motivation in various settings such as education (e.g., Vansteenkiste et al., 2009), work (e.g., Gillet, Berjot, & Paty, 2010), exercise (e.g., Wang & Biddle, 2001), and sport (e.g., Chian & Wang, 2008; McNeill & Wang, 2005). Cluster analyses allow researchers to categorize individuals into homogeneous groups whose members share similar motivational characteristics. It is thus possible to examine the combination of motivation types and determine whether autonomous and controlled forms of motivation may serve a synergistic function to predict sport-related outcomes.

However, to the best of our knowledge, only three sport studies (i.e., Gillet, Berjot, & Paty, 2009; Gillet, Vallerand, & Rosnet, 2009; Vlachopoulos, Karageorghis, & Terry, 2000) have looked at emerging clusters using strictly SDT constructs. For instance, Gillet, Vallerand, and Rosnet (2009) have identified distinct motivational profiles using a cluster analytic approach with two samples of junior national tennis players (Study 1) and fencers (Study 2). In Study 1, four clusters emerged. The first cluster included athletes (18% of the sample) who displayed high levels of intrinsic motivation, identified regulation, introjected regulation, and external regulation, but low levels of amotivation. The second cluster included athletes (41% of the sample) whose motivational profile was characterized by relatively moderate levels of intrinsic motivation and identified regulation, but relatively low levels of controlled motivation and amotivation. The third cluster included athletes (28% of the sample) who displayed a high level of autonomous motivation, and low to moderate levels of controlled motivation and amotivation. Finally, the fourth cluster included participants (13% of the sample) who displayed moderate levels of autonomous motivation, but moderate to high levels of controlled motivation and amotivation. In Study 2, results revealed the existence of three clusters. Although Gillet, Vallerand, and Rosnet (2009) replicated two of the four motivational profiles found in Study 1 (i.e., high autonomous-high controlled motivation cluster and moderate autonomous-low controlled motivation cluster), they found one different motivational profile characterized by moderate levels of both autonomous and controlled motivations, and low levels of amotivation. Then, these researchers examined group differences in athletes' subsequent performance over the course of a competitive season. In Study 1, the group with the least autonomous motivational profile yielded lower levels of sport performance than the other three profiles. In Study 2, athletes in the least autonomous cluster performed worse than those characterized by high levels of both autonomous and controlled motivation, and low levels of amotivation. It is important to note that a truly autonomous motivation cluster (i.e., a high autonomous-low controlled motivation group) was neither obtained in these two studies nor in the research conducted by Gillet, Berjot, and Paty (2009). These findings suggest that a pure autonomous motivational profile may not appear in samples of top performers. However, future research is still needed to test this hypothesis.

Other recent investigations have also shown that a motivational profile characterized both by high levels of autonomous and controlled motivations may lead to positive outcomes (e.g., enjoyment, satisfaction; see Ratelle, Guay, Vallerand, Larose, & Senécal, 2007; Vansteenkiste et al., 2009; Vlachopoulous et al., 2000). In addition, Amabile (1993) proposed that controlled motivation can combine synergistically with autonomous motivation to predict high levels of individuals' performance, only when one displays high initial levels of autonomous motivation. She also suggested a combination of autonomous and controlled motivations may lead to the highest levels of performance when the task is complex. In contrast, SDT emphasizes the importance of the quality of motivation (i.e., autonomous vs. controlled) and proposes that the presence of high levels of controlled motivation is not beneficial (Deci & Ryan, 2008). Does the synergistic combination of autonomous and controlled motivations lead to the best performance in a sample of competitive athletes? Do autonomous and controlled motivations work synergistically to positively predict all outcomes (i.e., cognitive, affective, and behavioral)? Future research using cluster analyses is clearly needed to answer these questions.

The Present Research

In light of the above, the first purpose of the present research was to identify competitive athletes' motivational profiles on the basis of their scores on the different types of motivation proposed by SDT (Deci & Ryan, 1985). Sport performance represents one of the key outcomes in elite sport but little research has been done in the sport context using SDT framework, especially with a cluster analytic approach (Vallerand, 2007). We thus aimed to examine how the athletes' motivational profiles related to objective sport performance (Studies 1 and 2), and also to emotional and physical exhaustion (Study 2).

STUDY 1

Using a cluster analytic approach, we sought to identify distinct motivational profiles in a sample of elite junior fencers. In line with past research using cluster analyses in education and sport (e.g., Ratelle et al., 2007; Gillet, Vallerand, & Rosnet, 2009, Study 2), we expected three clusters to emerge: (1) a cluster characterized by moderate scores on autonomous motivation and low scores on controlled motivation cluster; (2) a cluster characterized by moderate scores on both autonomous and controlled motivations; and (3) a cluster characterized by high scores on both autonomous and controlled motivations. In light of the aforementioned theoretical rationale and empirical evidence, we hypothesized that athletes in the high autonomous-high controlled motivation group would obtain the highest levels of subsequent fencing performance, controlling for athletes' prior performance.

Method

Participants and Procedure

Participants were 153 French junior national fencers (87 females and 66 males) aged 14 years. In the present sample, there were 52 epée fencers, 48 foil fencers, and 53 sabre fencers among the top 30 of France for their respective age and weapon group. This sample was not the same as that used by Gillet, Vallerand, and Rosnet (2009, Study 2; 250 French junior national fencers aged 15 years). The procedure is similar in the two studies but none of the athletes were included in both samples. The present study received ethical approval from the French Fencing Federation. Data were collected across one season from 2001-2002 to 2006-2007. Athletes were informed by the last author that their participation in the study was voluntary and they were free to withdraw at any time. They were also assured that their answers would remain confidential. Before the beginning of the fencing season, participants were requested to complete a questionnaire administered by the last author in order to assess their motivation toward fencing. At the end of the season, their sport performance was obtained via the French Fencing Federation.

Measures

Sport motivation. The French version of the Sport Motivation Scale (SMS; Brière et al., 1995) was used to measure athletes' motivation toward fencing. The SMS consists of 28 items assessing intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. Participants were asked to indicate, on a 7-point Likert scale (1 = *does not correspond at all* and 7 = *corresponds exactly*), the extent to which each item represented a reason why they practice fencing. The SMS has demonstrated acceptable validity and reliability in many previous studies (e.g., Pelletier & Sarrazin, 2007). In the present study, the internal consistency for all the subscales of the SMS was satisfactory (between .71 and .85).

Sport performance. Two objective performance scores were used in the present study. First, we obtained one measure of performance reflecting the number of points won by a competitor during the season following questionnaire completion (i.e., end of season performance). After each national competition, the French Fencing Federation attributes a number of points to each competitor according to his/her ranking during the competitive event, the number of athletes who participated in the competition, the level of other competitors, and the importance of the competition. At the end of the year, the points won in each national competition (four competitions during the season) are added up to create a single index reflecting the athlete's overall performance. Thus, in this method, the higher the level of fencers' performance during national events, the more points won at the end of the season. Second, the points won by each fencer were also used as a performance variable for the previous season (to control for past performance).

Results

Preliminary Analyses

Given that the correlations among the motivation subscales ranged between -.11 and .48, the multicollinearity issue was not a concern in subsequent analyses (Hair, Anderson, Tatham, & Black, 1998). Preliminary analyses also showed six cases with a distance from the mean higher than three times the value of the standard deviation. Due to the fact that cluster analysis is sensitive to outliers (Hair et al., 1998), these six cases were excluded from the total of original 153 cases, retaining a final sample size of 147 fencers.

Table I
Correlations Between the Study Variables (Study 1)

Variables	*M*	*SD*	1	2	3	4	5	6	7
1. Intrinsic motivation	5.08	0.95	.85						
2. Identified regulation	3.90	1.20	.48**	.78					
3. Introjected regulation	4.43	1.52	.38**	.40**	.76				
4. External regulation	2.54	1.20	.18*	.35**	.39**	.71			
5. Amotivation	1.20	0.40	-.04	-.11	-.05	.07	.82		
6. Previous season performance	238.1	106.0	.14	.13	.07	.05	-.08	-	
7. End of season performance	308.1	88.2	.24*	.32**	.10	.24*	-.10	.43**	-

Note. * $p < .05$, ** $p < .001$. Alpha coefficients are reported on the diagonal.

Main Analyses

First, scores on intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation were included in a hierarchical cluster analysis using Ward's method of linkage with the squared Euclidian distance measure in order to identify motivational profiles. The five forms of motivation included in the clustering procedure were assessed on a 7-point Likert scale. Therefore, these variables were not converted into z scores (Hair et al., 1998). Inspection of the agglomeration coefficients from the hierarchical analysis and dendograms suggested that a three-cluster solution was the most appropriate. A posterior examination of this three-cluster solution appeared to be theoretically sound and parsimonious enough compared to a four-, five- or more than five-cluster solution. Indeed, the agglomeration schedule showed a larger increase in the coefficients from three clusters merging to two (21%) compared to merging four clusters to three (13%), five clusters to four (9%), and six clusters to five (8 %). In addition, the three-cluster solution explained 45% of the variance, while the four-cluster, five-cluster, and six-cluster solutions explained 51%, 56%, and 59%, respectively. Finally, the homogeneity within each cluster (i.e., the *H* coefficient) for the three-cluster solution was satisfactory with *H* values between .76 and .85 (Tryon & Bailey, 1970).

Second, a nonhierarchical k-means cluster analysis was conducted, specifying a three-cluster solution and the initial cluster centers resulting from the hierarchical cluster analysis. The final centroids in the k-means analysis were similar to the initial cluster centers, and the results of the hierarchical method were thus confirmed. Means and standard deviations of the motivation subscales for the three groups are reported in Table II and Figure 1 represents each motivational profile.

To examine whether differences existed among the three clusters on the five forms of motivation, a one-way multivariate analysis of variance (MANOVA) was conducted. Results revealed significant differences between the three clusters on the five motivational constructs, $F(10, 280) = 36.70$, $p < .001$, $\eta^2 = .57$. Then, Univariate F values showed a significant effect of cluster membership on each type of motivation except for the amotivation subscale. Detailed results of these univariate analyses as well as clusters' size and means are shown in Table II. Post hoc Tukey tests were conducted to examine the pairwise comparison between clusters on intrinsic motivation, identified regulation, introjected regulation, and external regulation. Results revealed that the three groups were significantly distinct from each other ($p < .05$) on these four motivation subscales. Results from chi-

TABLE II

Descriptive Statistics for the Three-Cluster Solution (Study 1)

Variable	**Cluster 1 "Low" (n = 36)**		**Cluster 2 "Moderate" (n = 79)**		**Cluster 3 "High" (n = 32)**					**Cohen's *d***		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2	C1 vs. C2	C1 vs. C3	C2 vs. C3
Intrinsic motivation	4.44_a	0.97	5.05_b	0.83	5.79_c	0.65	22.29	.001	.24	-0.68	-1.64	-0.99
Identified regulation	3.00_a	0.95	3.77_b	0.91	5.25_c	0.89	53.20	.001	.43	-0.83	-2.44	-1.64
Introjected regulation	2.49_a	0.86	4.78_b	1.01	5.86_c	0.92	116.50	.001	.62	-2.44	-3.78	-1.12
External regulation	1.74_a	0.62	2.36_b	1.01	3.77_c	1.13	40.05	.001	.36	-0.74	-2.23	-1.32
Amotivation	1.17_a	0.36	1.22_a	0.43	1.14_a	0.34	.58	.56	.01	-0.13	0.09	0.21
Previous season performance	241.3_a	105.0	229.8_a	109.4	255.2_a	99.4	.65	.52	.01	0.11	-0.14	-0.24
End of season performance	296.5_a	92.5	295.6_a	85.1	341.6_b	86.3	3.43	.05	.05	0.01	-0.50	-0.54

Note. For each dependent variable, means with different subscripts indicate a significant difference at $p < .05$ using Tukey test. C1 = Cluster 1; C2 = Cluster 2; C3 = Cluster 3.

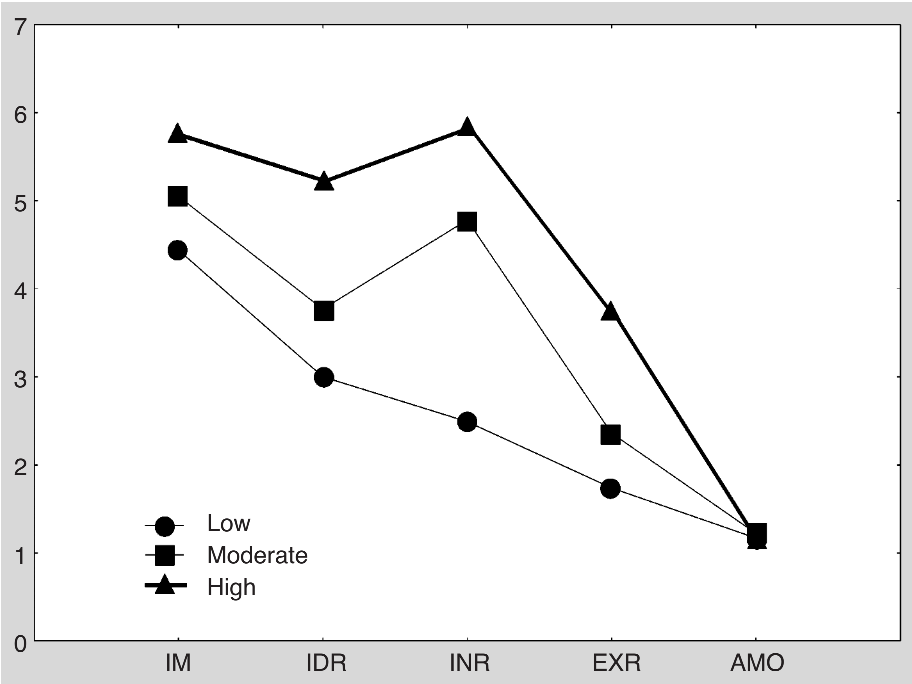

Figure 1. Motivational profiles identified in Study 1. IM = Intrinsic Motivation; IDR = Identified Regulation; INR = Introjected Regulation; EXR = External Regulation; AMO = Amotivation. No differences among clusters were found for the amotivation subscale.

square analyses also revealed that the proportion of gender in each cluster did not differ, χ^2 (df = 2, N = 147) = .26, p = .88.

The first cluster included 24% of the sample (n = 36) and was labeled the Low group. This cluster included athletes whose motivational profile was characterized by moderate levels of autonomous motivation (i.e., intrinsic motivation and identified regulation), and low levels of controlled motivation (i.e., introjected regulation and external regulation) and amotivation. The second cluster was labeled the Moderate group and represented 54% of the sample (n = 79). Athletes in this cluster showed moderate to high levels of autonomous motivation, moderate levels of controlled motivation, and low levels of amotivation. Finally, participants in the third cluster represented 22% of the sample (n = 32) and included athletes who displayed high levels of both autonomous and controlled motivations, and low levels of amotivation. Thus, this cluster was labeled the High group[1].

We then examined whether the three motivational profiles related to sport performance. A first ANOVA with the cluster as the between subjects factor and the sport performance during the previous season as dependent variable revealed no difference among clusters, $F(2, 139) = .65$, $p = .52$, $\eta^2 = .01$. The results of a second ANOVA on the end of season performance (i.e., fencing performance during the season following questionnaire completion) revealed a significant effect for clusters, $F(2, 144) = 3.43$, $p < .05$, $\eta^2 = .05$[2]. Tukey tests indicated that athletes in the High cluster ($M = 341.6$) performed higher than those in the two other groups. No significant differences emerged between the Low ($M = 296.5$) and the Moderate ($M = 295.6$) clusters. Finally, an ANCOVA was conducted on the end of season performance controlling for the previous season's performance. Results were the same as those of the ANOVA for the end of season performance ($p < .05$ and $\eta^2 = .05$).

Brief discussion

The primary objective of the present study was to uncover motivational profiles for sport participation among junior elite fencers. Results of cluster analyses using SDT's behavioral regulations revealed the presence of three clusters: the Low group, the Moderate group, and the High group. The second purpose of this study was to examine how the clusters differed with regards to performance. In line with our hypothesis, the High profile demonstrated the highest levels of fencing performance. These results confirm those obtained by Gillet, Vallerand, and Rosnet (2009, Study 2) who showed, in a sample of 250 junior national fencers aged 15 years, that athletes characterized by high levels of both autonomous and controlled mo-

---

[1] The three clusters were labeled the "Low", "Moderate", and "High" groups to facilitate the reading of the manuscript. However, it is important to note that these clusters are characterized by their levels of both autonomous and controlled motivations. Thus, these labels do not always reflect the scores on the two dimensions as it is the case for the Low cluster (characterized by moderate levels of autonomous motivation and low levels of controlled motivation).

[2] Two ANOVAs with four-cluster and five-cluster solutions as the between subjects factor and end of season performance as dependent variable, were performed. No significant effects were obtained confirming that a three-cluster solution was the most suitable in the present study.

tivation, and low levels of amotivation were the best performers. The present results are also in line with the suggestion by Amabile (1993) that the combination of autonomous and controlled motivations predict high levels of individuals' performance. Contrary to previous research on the motivation-performance relationship (e.g., Mouratidis et al., 2008) which has not considered controlled motivation and only looked at the role of autonomous motivation in predicting sport performance, these findings suggest that it is important to investigate the combined effects of autonomous and controlled motivations to better understand the impact of motivation on performance.

Study 2

While Study 1 yielded important information on motivational profiles that exist in elite sport, it was deemed necessary to conduct a second investigation with athletes engaged in another competitive sport activity in order to enhance the generalizability of the findings. Thus, the purpose of this second study was threefold. First, we sought to verify that the clusters identified in Study 1 could be generalized to a sample of long-distance runners. Second, we investigated the role of these motivational profiles in sport performance. In line with the results found in Study 1 and also in the second study conducted by Gillet, Vallerand, and Rosnet (2009), it was hypothesized that athletes with the High profile would be the best performers, controlling for several variables (i.e., number of participations in the race, years of experience in long-distance running, hours of training per week, and number of current injuries). However, although a High motivational configure may have a positive impact on sport performance, we do not know if such a beneficial effect comes at a cost on some other outcomes (e.g., affective consequences). Burnout among athletes, especially emotional and physical exhaustion, has increasingly been recognized as a serious problem (see Goodger, Wolfenden, & Lavallee, 2007). Thus, the third purpose of the present study was to examine the relationship of motivational profiles to emotional and physical exhaustion. Past studies have constantly shown that controlled motivation was positively associated with burnout (e.g., Isoard-Gautheur et al., 2010; Lonsdale, Hodge, & Rose, 2009). Thus, it was hypothesized that the profile characterized by the highest levels of controlled motivation (i.e., the High profile) should be positively associated with athletes' performance and burnout.

Method

Participants and Procedure

One hundred and fifty three athletes (23 females and 130 males) competing in the 24th edition of the "*Marathon des Sables*" participated in the study. Participants' mean age was 41.29 years (*SD* = 9.00; range = 24-73) and came from twenty different countries (e.g., England, France, Spain, Switzerland). The average number of participations in the Marathon des Sables was 1.60 (*SD* = 1.38) and the average best individual ranking in the Marathon des Sables was 250.27 (*SD* = 204.52). Participants' years of experience in long- distance running were 9.76 years (*SD* = 8.30). On average, participants trained 11.13 hours weekly (*SD* = 8.66) during the last month before the beginning of the Marathon des Sables and 11.73 hours weekly (*SD* = 9.45) during the last three months. On average, participants reported having 1.04 acute injuries (*SD* = 1.29) during the last 12 months.

The Marathon des Sables is an endurance race across the Sahara Desert taking place at the end of March or the beginning of April. It is considered as the toughest footrace on Earth because athletes have to complete a distance equivalent to 5 ½ regular marathon in 6 or 7 days. During this foot race with food self-sufficiency, each participant must carry his/her own backpack containing food, sleeping gear and other material. At each arrival post, an official time-keeper takes down the daily order of arrival for each competitor. The daily race ranking is calculated by adding the time taken to run that stage of the race plus penalties, if applicable. General ranking is calculated by adding together times for each stage of the race.

Participation was voluntary and no incentive was offered for athletes to take part in the present study. Participants completed the French or English version of the questionnaires through an online survey before the beginning of the Marathon des Sables. A call for voluntary participation was posted on the official website of the Marathon des Sables during the two preceding weeks of the competition. An electronic mail was also sent to all the participants by the person in charge of the competition organization. IP addresses were checked to detect potential duplicate responders. No such duplicates were identified. At the end of the race, participants' individual performance was obtained via the official website of the Marathon des Sables.

Measures

Sport motivation. As in Study 1, the SMS was used. Cronbach alpha coefficients for all motivation variables were acceptable (between .65 and .87).

Sport performance. The objective measure of performance used in the present study was the final ranking of each athlete at the end of the Marathon des Sables. Thus, the lower the performance scores, the better the athletes' performance during the Marathon des Sables.

Emotional and physical exhaustion. The five-item emotional and physical exhaustion subscale from the Athlete Burnout Questionnaire (Raedeke & Smith, 2001) was employed (e.g., "*I am exhausted by the mental and physical demands of my sport*"). The stem for each item was "*How often do you feel this way?*" Participants responded to items on a 5-point Likert-scale anchored by 1 (*almost never*) and 5 (*most of the time*). Acceptable internal consistency, test-retest reliability, and construct validity have been previously reported (Raedeke & Smith, 2001). Cronbach alpha for the emotional and physical exhaustion subscale was also satisfactory in the current study (α = .90).

Results

Preliminary analyses

Results of the correlation analyses involving the different performance variables revealed that the higher the levels of autonomous and controlled motivations, the more positive the performance (see Table III). Two cases *were found to be outliers and were deleted, leaving 151 participants for the subsequent analyses.*

Main analyses

As in Study 1, a hierarchical cluster analysis with Ward's method was first conducted. Examination of dendograms and agglomeration schedules suggested that a three-cluster solution was the most suitable. The homogeneity within each cluster (i.e., the *H* coefficient) for the three-cluster solution was satisfactory with *H* values between .75 and .90 (Tryon & Bailey, 1970). Then, results from a k-means cluster analysis confirmed the consistency of the three-cluster solution. Table IV presents the means and standard deviations for all the motivation variables in each cluster and Figure 2 displays the three motivational profiles.

A one-way MANOVA was conducted using profile groups as the independent variable and the five forms motivation assessed in the present study as the dependent variables. Results showed significant differences between the three groups, $F(10, 288) = 41.70$, $p < .001$, $^2 = .59$. Follow-up univariate analyses indicated significant ($p < .001$) group differences on all motivation variables. Tukey post hoc tests were examined to identify cluster differences. Clusters 1 and 2 did not differ from one another on intrinsic motivation,

TABLE III
Correlations Between the Study Variables (Study 2)

Variables	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Intrinsic motivation	4.03	1.23	.87						
2. Identified regulation	3.29	1.36	.50**	.70					
3. Introjected regulation	4.82	1.48	.36**	.34**	.73				
4. External regulation	2.50	1.40	.42**	.41**	.30**	.83			
5. Amotivation	1.53	0.84	.27*	.26*	.16	.33**	.65		
6. Exhaustion	1.79	0.71	.16	.13	.17*	.32**	.40**	.90	
7. Final ranking[a]	318.4	212.6	-.13	-.20*	-.14	-.24*	-.18*	-.04	-

Note. * $p < .05$, ** $p < .001$. [a] The lower the score, the more positive the performance. Alpha coefficients are reported on the diagonal.

TABLE IV

Descriptive Statistics for the Three-Cluster Solution (Study 2)

Variable	**Cluster 1 "Low" (n = 52)**		**Cluster 2 "Moderate" (n = 38)**		**Cluster 3 "High" (n = 61)**					**Cohen's *d***		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2	C1 vs. C2	C1 vs. C3	C2 vs. C3
Intrinsic motivation	3.41_a	1.24	3.58_a	1.04	4.84_b	0.84	31.21	.001	.30	-0.15	-1.35	-1.33
Identified regulation	2.56_a	1.26	2.74_a	0.82	4.25_b	1.14	38.32	.001	.34	-0.17	-1.41	-1.52
Introjected regulation	3.28_a 1.04	5.66_b	0.89 5.61_b	0.95	100.29	.001	.58	-2.46	-2.34	0.05		
External regulation	1.63_a	0.87	1.75_a	0.64	3.72_b	1.22	78.49	.001	.52	-0.16	-1.97	-2.02
Amotivation	1.17_a	0.36	1.44_a	0.68	1.91_b	1.04	13.21	.001	.15	-0.50	-0.95	-0.53
Exhaustion	1.52_a	0.53	1.69_a	0.60	2.09_b	0.80	10.93	.001	.13	-0.30	-0.84	-0.57
Final ranking[a]	397.5_a	207.2	305.3_{ab}	234.4	260.7_b	184.4	6.03	.01	.08	0.42	0.70	0.21

Note. For each dependent variable, means with different subscripts indicate a significant difference at $p < .05$ using Tukey test. C1 = Cluster 1; C2 = Cluster 2; C3 = Cluster 3. [a] The lower the score, the more positive the performance.

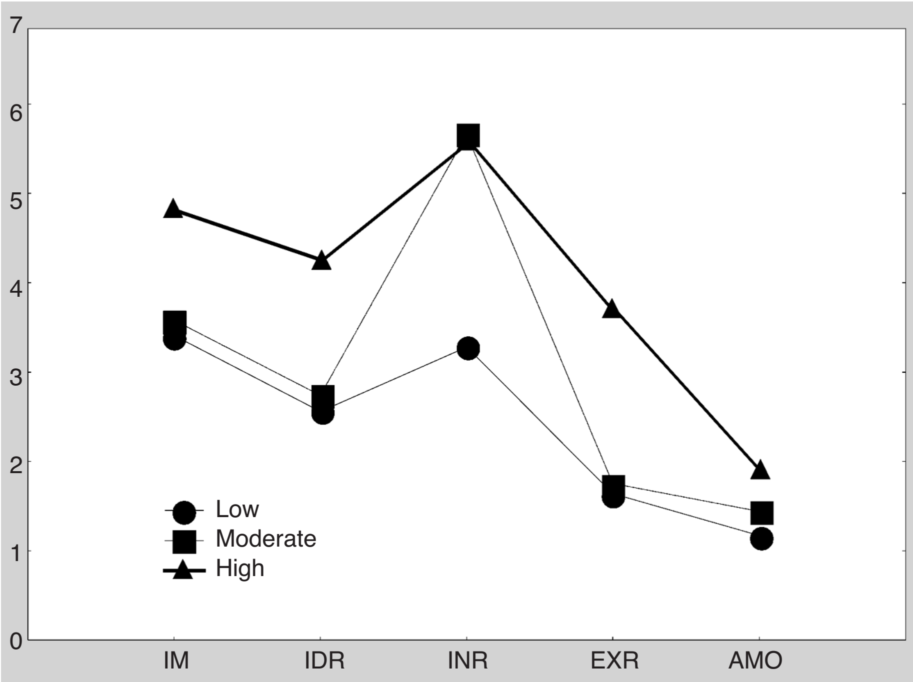

Figure 2. Motivational profiles identified in Study 2. IM = Intrinsic Motivation; IDR = Identified Regulation; INR = Introjected Regulation; EXR = External Regulation; AMO = Amotivation. The Low and Moderate clusters did not differ from one another on intrinsic motivation, identified regulation, external regulation, and amotivation, and were characterized by lower scores on these four types of motivation than the High cluster. The Low cluster displayed lower scores on introjected regulation than the two other clusters which did not differ between them.

identified regulation, external regulation, and amotivation, and were characterized by lower scores on these four types of motivation than Cluster 3. Cluster 1 displayed lower scores on introjected regulation than the two other clusters which did not differ between them (see Table 4). A chi-square analysis also showed that there were significant gender differences in the classification of athletes in the three clusters, χ^2 (df = 2, N = 151) = 6.09, $p < .05$. Specifically, females were overrepresented in Cluster 1, but underrepresented in Clusters 2 and 3.

The three profiles obtained in the present study were similar to those obtained in Study 1. The first profile (n = 52; 34.4% of the sample) was thus labeled the Low group as it was represented by moderate levels of autonomous motivation, and low controlled motivation and amotivation scores. The second profile (n = 38; 25.2% of the sample) was labeled the Moderate group as athletes in this cluster showed moderate to high levels of autonomous motivation, moderate levels of controlled motivation, and low levels of amotivation. Finally, the third profile (n = 61; 40.4% of the sample) was labeled the High group as this profile was characterized by high levels of both autonomous and controlled motivations, and low scores of amotivation.

An ANOVA and Tukey tests were conducted to determine whether there were significant differences among the three clusters on the performance variable. Results on final ranking revealed significant effects for clusters, $F(2, 141) = 6.03$, $p < .01$, $\eta^2 = .08$[3]. Post hoc tests indicated that only one significant difference emerged. The High group performed better than the Low group. All the mean performance scores for each group are detailed in Table 4. An ANCOVA was also conducted on the performance variable controlling for age, the number of participations in the Marathon des Sables, the years of experience in long-distance running, the hours of training per week during the last month and the last three months before the beginning of the Marathon des Sables, and the number of temporal injuries during the last 12 months. Results were similar as those reported above ($p < .05$ and $\eta^2 = .07$).

Finally, a one-way ANOVA was performed with emotional and physical exhaustion as the dependent variable for each cluster. The ANOVA was significant (see Table 4). More specifically, the High group was more emotionally and physically exhausted than the two other groups which did not significantly differ[4].

[3] Two ANOVAs with four-cluster and five-cluster solutions as the between subjects factor and final ranking as dependent variable, were performed. Results revealed significant effects but the increase in the number of clusters did not lead to a better explanation of sport performance. For instance, for the four-cluster solution, there were only two significant differences for final ranking (between Clusters 1 and 2, and between Clusters 1 and 3). No other cluster differences emerged. These results suggested that the four-cluster and five-cluster solutions did not offer a better explanatory framework to predict sport performance and confirmed that a three-cluster solution was the most suitable in the present study.

[4] The present results revealed that the three clusters did not differ among them on the frequency of training during the last month and the last three months before the beginning of the Marathon des Sables. Athletes in the High group did not train more than those in the other clusters and thus an increase in the number of training hours did not explain why these athletes performed better and were more exhausted.

Brief discussion

The first purpose of the present study was to verify that the clusters identified in Study 1 could be generalized to a sample of long-distance runners. As in Study 1 with young elite fencers, three clusters emerged in this sample: (1) a Low cluster, (2) a Moderate cluster, and (3) a High cluster. The second purpose was to determine how each cluster related to sport performance controlling for the number of prior participations in the race, years of experience in long-distance running, hours of training per week, and number of current injuries. Results revealed that the High profile lead to the highest levels of sport performance. These results are in accordance with past research that has looked at the motivation-performance relationship (e.g., Gillet, Vallerand, & Rosnet, 2009).

However, it should be noted that although the present results showed that the motivational profile with the highest levels of both autonomous and controlled motivation was conducive to better sport performance, they also revealed that athletes in this motivational profile were more emotionally and physically exhausted than those in the two other clusters. These results suggest that it is not sufficient to adopt a variable-oriented approach (e.g., using the self-determination index) to fully understand the role of motivation in the prediction of different outcomes. Researchers must also examine how groups of athletes endorse different types of motivation using a person-oriented approach (e.g., using cluster analyses).

General Discussion

In the present research, we conducted cluster analyses in order to identify distinct motivational profiles and then examined their relationships with performance (Studies 1 and 2), and emotional and physical exhaustion (Study 2). The results of both studies revealed the existence of three motivational profiles: (1) a Low cluster, (2) a Moderate cluster, and (3) a High cluster. The present results also showed that athletes with the High profile obtained the best sport performance but were more emotionally and physically exhausted than those in the two other clusters.

Motivational profiles

The first purpose of the present research was to identify the motivational profiles that characterize competitive athletes of different ages, from various countries, and practicing different sport activities. It was hypothesized that three profiles, reflecting different levels of autonomous and controlled motivation, would be uncovered. Results of both studies provided support for the hypotheses. Specifically, participants in the Low cluster were characterized by moderate levels of autonomous motivation, and low levels of controlled motivation and amotivation. The Moderate cluster was moderate to high on autonomous motivation, moderate on controlled motivation, and low on amotivation. Finally, participants in the High Cluster had high scores on autonomous and controlled motivation, and low scores on amotivation. In line with our hypotheses, we did not find a truly autonomous profile characterized by high levels of autonomous motivation and low levels of controlled motivation. These results are not surprising because recent research (e.g., Gillet, Vallerand, & Rosnet, 2009; Ratelle et al., 2007, Studies 1 and 2) have also failed to identify a purely autonomous profile in competitive sport settings. Ratelle and her colleagues (2007) have suggested that competitive settings (as in the present research) may not be successful in fostering an autonomous profile. However, future research is needed to identify the environmental conditions under which an autonomous motivational profile might be found.

Motivation and performance

The second purpose of the present research was to examine the effects of each motivational profile on sport performance. Several studies (e.g., Ntoumanis, 2002) have used both motivation and outcomes to create the clusters. However, it is impossible with this methodology to investigate how the motivational profiles are independently related to the different outcomes. We thus only included the different forms of motivation in the cluster analyses and we then conducted analyses of variance to determine whether the clusters differed significantly with respect to performance. We found that displaying high levels of both autonomous and controlled motivation lead to the best performances. This can be considered as a medium effect (Cohen, 1988) since the effect sizes (Cohen's *d*) were comprised between .50 and 70 for the Low and High clusters. These findings are in line with the results of recent studies (e.g., Gillet, Vallerand, & Rosnet, 2009; Ratelle et al., 2007, Studies 1 and 2) that have also shown that a High cluster was associated with high levels of performance. These findings suggest that high levels of controlled motivation might be beneficial for performance in competitive settings, if individuals also display high levels of autonomous motivation and low levels of amotivation. However, as mentioned above, we did not find a truly self-determined profile proposed by SDT (i.e., a profile characterized by high levels of autonomous motivation, and low levels of controlled motivation and amotivation). SDT posits that autonomous motivation is associated with more optimal outcomes than controlled motivation (Deci & Ryan, 2008). In accordance with SDT, it is thus possible that this pure autonomous motivation profile would be associated with higher levels of performance than a high motivation profile (i.e., high autonomous and high controlled motivation). Future studies should continue to examine the motivation-performance relationship using cluster analyses to test this hypothesis.

Motivation and burnout

Although the present results revealed that a motivational profile characterized by high levels of both autonomous and controlled motivation was associated with the highest levels of performance, they also showed that this profile predicted the highest levels of emotional and physical exhaustion. This can be considered as a medium-to-large effect (Cohen, 1988) since the effect sizes (Cohen's *d*) were .84 and .57 for the Low and High clusters, and the Moderate and High clusters, respectively. In other words, a High motivational profile can have both positive effects on performance and a negative influence on burnout. Ratelle et al. (2007, Study 3) have found similar results with these two motivational outcomes: performance and persistence. Indeed, the High motivational profile related to the highest levels of performance, while this profile was worse for promoting academic persistence than having a self-determined motivational profile (characterized by high levels of autonomous motivation, and low levels of controlled motivation and amotivation). These results revealed that it is not enough to only consider an overall self-determined motivation score in order to fully understand the influence of athletes' motivation on distinct outcomes. Researchers must also take into account the characteristics of the motivational profiles (i.e., the combination of the different types of motivation). However, future research using a person-oriented approach is needed to investigate the role of a motivational profile characterized by high levels of both autonomous and controlled motivation in the prediction of sport outcomes in competitive settings. Future research in non competitive contexts is also needed to examine whether a High cluster may predict other positive outcomes than performance.

Limitations

Although the present research provides evidence for the role of athletes' motivation in the prediction of sport performance, some limitations need to be mentioned. First, even though we used a prospective design in both studies, it is nevertheless inappropriate to make causal inferences. Future research with experimental designs (e.g., using paraliminal priming; see Bargh & Chartrand, 2000) is needed in order to provide more clarity regarding the direction of causality among the study variables. For instance, we could use both autonomous and controlled words for the High motivational profile and only autonomous words for the pure autonomous motivational profile. Second, we did not consider the determinants of athletes' motivational profiles in the present research. In order to identify the environments that are conducive to self-determined motivational profiles, future research using cluster analyses should examine potential determinants (e.g., autonomy-supportive versus controlling coaching style) of athletes' motivation. Third, according to Vallerand (1997), it is necessary to consider the situation or the context in which individuals operate to study precisely the motivation-outcomes relationship. Indeed, a given form of motivation (e.g., external regulation) may lead to both adaptive and maladaptive outcomes as a function of the situation or the context in which the individuals interact (e.g., O'Connor & Vallerand, 1994) but also depending on the type of consequences (i.e., behavioral, cognitive, and affective). Researchers should attempt to determine whether the sport structures (i.e., competitive versus recreational activities) and level of competition (e.g., district, regional, and national) would be moderators of the relation between motivational profiles and sport outcomes. Finally, motivation is not the unique predictor of performance. Future research including motivation and other psychological determinants (e.g., passion, affect, anxiety) of performance is needed.

In sum, different motivational profiles were identified in competitive sport settings and these distinct profiles did not lead to the same levels of performance. Based on the present results, it seems important to increase athletes' autonomous motivation in order to reinforce their sport performance. One of the social factors that can have a significant impact on athletes' motivation is coaches' behaviors (see Mageau & Vallerand, 2003). More specifically, autonomous forms of motivation may be enhanced by autonomy-supportive behaviors (Deci & Ryan, 1987). Supervisors are said to be autonomy-supportive when they take individuals' perspective and provide opportunities for choice and participation in the decision-making process, while minimizing the use of pressure. Thus, coaches should behave in an autonomy-supportive manner to satisfy athletes' basic psychological needs, and increase their autonomous motivation and their performance. The present research provided important information regarding motivational profiles and showed that it is appropriate to use a person-oriented approach for predicting motivational outcomes. However, additional research using cluster analyses is needed to investigate the motivation-performance relationship.

REFERENCES

Amabile, T. M. (1993). Motivational synergy: Toward new conceptualizations of intrinsic and extrinsic motivation in the workplace. *Human Resource Management Review, 3*, 185-201. doi:10.1016/1053-4822(93)90012-S

Bargh, J. A., & Chartrand, T. L. (2000). The mind in the middle: A practical guide to priming and automaticity research. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 253-285). New York: Cambridge University Press.

Brière, N. M., Vallerand, R. J., Blais, M. R., & Pelletier, L. G. (1995). Développement et validation d'une mesure de motivation intrinsèque, extrinsèque et d'amotivation en contexte sportif : L'Échelle de Motivation dans les Sports (EMS) [On the development and validation of the French form of the Sport Motivation Scale]. *International Journal of Sport Psychology*, *26(4)*, 465-489. http://www.ijsp-online.com

Chantal, Y., Guay, F., Dobreva-Martinova, T., & Vallerand, R. J. (1996). Motivation and elite performance: An exploratory investigation with Bulgarian athletes. *International Journal of Sport Psychology*, *27(2)*, 173-182. http://www.ijsp-online.com

Chian, L. K. Z., & Wang, C. K. J. (2008). Motivational profiles of junior college athletes in Singapore: A cluster analysis. *Journal of Applied Sport Psychology, 20*, 137-156. doi: 10.1080/10413200701805265

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Cresswell, S. L., & Eklund, R. C. (2005). Motivation and burnout among top amateur rugby players. *Medicine and Science in Sports and Exercise, 37*, 469-477. doi:10.1249/01.MSS.0000155398.71387.C2

Curran, T., Appleton, P. R., Hill, A. P., & Hall, H. K. (2011). Passion and burnout in elite junior soccer players: The mediating role of self-determined motivation. *Psychology of Sport and Exercise, 12*, 655-661. doi: 10.1016/j.psychsport.2011.06.004

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, *53*, 1024-1037. doi: 10.1037/0022-3514.53.6.1024

Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology, 49*, 14-23. doi: 10.1037/a0012801

Gillet, N., Berjot, S., & Paty, B. (2009). Profil motivationnel et performance sportive [Motivational profile and sport performance]. *Psychologie Française*, *54*, 173-190. doi: 10.1016/j.psfr.2009.01.004

Gillet, N., Berjot, S., & Paty, E. (2010). Profils motivationnels et ajustement au travail : Vers une approche intra-individuelle de la motivation [Motivational profiles and work adjustment: Toward an intraindividual approach of motivation]. *Le Travail Humain, 73*, 141-162. doi: 10.3917/th.732.0141

Gillet, N., Vallerand, R. J., Amoura, S., & Baldes, B. (2010). Influence of coaches' autonomy support on athletes' motivation and sport performance: A test of the hierarchical model of intrinsic and extrinsic motivation. *Psychology of Sport and Exercise, 11*, 155-161. doi: 10.1016/j.psychsport.2009.10.004

Gillet, N., Vallerand, R. J., & Rosnet, E. (2009). Motivational clusters and performance in a real-life setting. *Motivation and Emotion*, *33*, 49-62. doi: 10.1007/s11031-008-9115-z

Goodger, K., Wolfenden, L., & Lavallee, D. (2007). Symptoms and consequences associated with three dimensions of burnout in junior tennis players. *International Journal of Sport Psychology, 38(4)*, 342-364. http://www.ijsp-online.com

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis* (5th ed.). Upper Saddle River: Prentice Hall.

Hodge, K., Allen, J. B., & Smellie, L. (2008). Motivation in masters sport: Achievement and social goals. *Psychology of Sport and Exercise, 9*, 157-176. doi: 10.1016/j.psychsport.2007.03.002

Isoard-Gautheur, S., Oger, M., Guillet, E., & Martin-Krumm, C. (2010). Validation of a French version of the Athlete Burnout Questionnaire (ABQ) in competitive sport and physical education context. *European Journal of Psychological Assessment, 26*, 203-211. doi: 10.1027/1015-5759/a000027

Lepper, M. R., Corpus, J. H., & Iyengar, S. S. (2005). Intrinsic and extrinsic motivation orientations in the classroom: Age differences and academic correlates. *Journal of Educational Psychology, 97*, 184-196. doi: 10.1037/0022-0663.97.2.184

Lonsdale, C., Hodge, K., & Rose, E. (2009). Athlete burnout in elite sport: A self-determination perspective. *Journal of Sports Sciences, 27*, 785-795. doi: 10.1080/02640410902929366

Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. *Journal of Sports Sciences*, *21*, 883-904. doi: 10.1080/0264041031000140374

McNeill, M., & Wang, C. K. J. (2005). Psychological profiles of elite sports players in Singapore. *Psychology of Exercise and Sport, 6*, 117-128. doi: 10.1016/j.psychsport.2003.10.004

Mouratidis, M., Vansteenkiste, M., Lens, W., & Sideridis, G. (2008). The motivating role of positive feedback in sport and physical education: Evidence for a motivational model. *Journal of Sport & Exercise Psychology*, *30(2)*, 240-268. http://journals.humankinetics.com/jsep

Ntoumanis, N. (2002). Motivational clusters in a sample of British physical education classes. *Psychology of Sport and Exercise, 3*, 177-194. doi: 10.1016/S1469-0292(01)00020-6

O'Connor, B. P., & Vallerand, R. J. (1994). Motivation, self-determination, and person-environment fit as predictors of psychological adjustment among nursing home residents. *Psychology and Aging, 9*, 189-194. doi: 10.1037/0882-7974.9.2.189

Pelletier, L. G., Fortier, M. S., Vallerand, R. J., & Brière, N. M. (2001). Associations between perceived autonomy support, forms of self regulation, and persistence: A prospective study. *Motivation and Emotion*, *25*, 279-306. doi: 10.1023/A:1014805132406

Pelletier, L. G., & Sarrazin, P. (2007). Measurement issues in self-determination theory and sport. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Self-determination theory in exercise and sport* (pp. 143-152). Champaign, IL: Human Kinetics.

Raedeke, T. D., & Smith, A. (2001). Development and preliminary validation of a measure of athlete burnout. *Journal of Sport & Exercise Psychology, 23(4)*, 281-306. http://journals.humankinetics.com/jsep

Ratelle, C. F., Guay, F., Vallerand, R. J., Larose, S., & Senécal, C. (2007). Autonomous, controlled, and amotivated types of academic motivation: A person-oriented analysis. *Journal of Educational Psychology*, *99*, 734-746. doi: 10.1037/0022-0663.99.4.734

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*, 54-67. doi: 10.1006/ceps.1999.1020

Tryon, R. C., & Bailey, D. E. (1970). *Cluster analysis*. New York: McGraw-Hill.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (pp. 271-360). New York: Academic Press. doi: 10.1016/S0065-2601(08)60019-2

Vallerand, R. J. (2007). Intrinsic and extrinsic motivation in sport and physical activity: A review and a look at the future. In G. Tenenbaum & R. E. Eklund (Eds.), *Handbook of sport psychology* (3rd ed., pp. 49-83). New York: John Wiley.

Vallerand, R. J., Pelletier, L. G., Blais, M. R., Brière, N. M., Senécal, C. B., & Vallières, E. F. (1993). On the assessment of intrinsic, extrinsic, and amotivation in education: Evidence on the concurrent and construct validity of the Academic Motivation Scale. *Educational and Psychological Measurement, 53*, 159-172. doi: 10.1177/0013164493053001018

van Beek, I., Taris. T., & Schaufeli, W. B. (2011). Workaholic and work engaged employees: Dead ringers or worlds apart? *Journal of Occupational Health Psychology, 16*, 468-482. doi: 10.1037/a0024392

Vansteenkiste, M., Sierens, E., Soenens, B., Luyckx, K., & Lens, W. (2009). Motivational profiles from a self-determination perspective: The quality of motivation matters. *Journal of Educational Psychology, 101*, 671-688. doi: 10.1037/a0015083

Vlachopoulos, S. P., Karageorghis, C. I., & Terry, P. C. (2000). Motivation profiles in sport: A self-determination theory perspective. *Research Quarterly for Exercise and Sport, 71(4)*, 387-397. http://www.aahperd.org/rc/publications/rqes

Wang, C. K. J., & Biddle, S. J. H. (2001). Young people's motivational profiles in physical activity: A cluster analysis. *Journal of Sport & Exercise Psychology, 23(1)*, 1-22. http://journals.humankinetics.com/jsep

Manuscript submitted *Accepted for publication April 2012.*

Int. J. Sport Psychol., 2012; 43: 103-116

Associations of leisure, work-related and domestic physical activity with cognitive impairment in older adults

PO-WEN KU[1,4], KENNETH R. FOX[2], LI-JUNG CHEN[3], PESUS CHOU[4]

[1] *Graduate Institute of Sports and Health, National Changhua University of Education, Taiwan*
[2] *Centre for Exercise, Nutrition and Health Sciences, University of Bristol, UK*
[3] *Department of Exercise Health Science, National Taiwan University of Physical Education and Sport, Taiwan*
[4] *Institute of Public Health and Community Medicine Research Center, National Yang-Ming University, Taiwan*

This *study aimed to explore independent associations between leisure-time physical activity (LTPA), work-related, and domestic physical activity (WDPA) and specific parameters of physical activity (frequency, duration and intensity) with cognitive impairment. A total of 2,727 older adults (65+) participating in the 2005 Taiwan National Health Interview Survey were studied. Information on frequency, duration and intensity for each type of LTPA and WDPA was self-reported. Multivariate logistic regression models were undertaken to compute adjusted odds ratios (AOR) for LTPA and WDPA when predicting cognitive impairment assessed by the Mini-Mental State Examination. LTPA rather than WDPA was associated with cognitive impairment (p=0.01). Participants expending less energy in LTPA had higher risk (AOR= 1.84, 95%CI: 1.13-2.29). Risk reduction among the three components of LTPA was only associated with duration of activity (p=0.02). Regular engagement in LTPA for at least 30 minutes is associated with reduced risk of cognitive impairment.*

KEY WORDS: exercise, Cognitive impairment, Dementia, Physical activity.

With the rapid global growth in the older sector of the population, the prevalence of age-related disorders, such as immobility, cognitive impairment and dementia is dramatically increasing. This adds an increasing societal burden in terms of health and social care, and individual and family suffering (Access Economics, 2006). In 2001, there were 24.3 million people with dementia worldwide, with the number expected to be 81.1 million by

Correspondence to: Li-Jung Chen, PhD, Department of Exercise Health Science, National Taiwan University of Physical Education and Sport. No. 16, Section 1, Shuang-Shih Rd., Taichuang, Taiwan 404. (E-mail: ljchen@ntupes.edu.tw)

2040 with 4.6 million new cases per year (Ferri et al., 2005). According to the global burden of disease estimates in the 2003 World Health Report, dementia accounted for 11.2% of years lived with disability in people aged 60 years and older, which was more than stroke (9.5%), musculoskeletal disorders (8.9%), cardiovascular disease (5.0%), and all forms of cancer (2.4%) (World Health Organization, 2003). The identification of modifiable factors for delaying or preventing cognitive deterioration has therefore become a crucial issue (Coley et al., 2008; Lautenschlager & Almeida, 2006).

There is a strong and well-established evidence base for both the protective and therapeutic benefits of physical activity for a range of physical diseases and disabling conditions and these benefits are equally available for older people (UK Department of Health, 2011; US Department of Health and Human Services, 2008). With older adults, prospective cohort studies have shown that physical activity is associated with lower risk of subsequent cognitive impairment, dementia, Alzheimer's and Parkinson's disease (Hamer & Chida, 2009; Ku, Stevinson, & Chen, 2012; Lautenschlager & Almeida, 2006; Plassman, Williams, Burke, Holsinger, & Benjamin, 2010; Solfrizzi et al., 2008). Physical activity in most of these studies has been categorized as leisure-time physical activity (LTPA). Less attention has been paid to other domains of physical activity in daily life, such as work-related and domestic physical activity (WDPA). However, it has been increasingly recognized that WDPA can contribute to some aspects of health (Hu et al., 2004; Matthews et al., 2007; Phongsavan, Merom, Marshall, & Bauman, 2004). Furthermore, WDPA that often features as a natural part of daily routines may be an important aspect of older people's lives, reflecting good physical function, independence and engagement with local communities. Many of the studies adopted overall physical activity levels across different activities (Yamada et al., 2003), often in terms of energy expenditure or composite scores during a certain period. These make it difficult to explore the independent associations of various forms of physical activities with risk of cognitive impairment or dementia. In addition, most studies have examined simple comparisons between no or low physical activity and high physical activity. Very few have sufficient detail in the measure to investigate comparisons of frequency, intensity, duration or more categories of volume. Each of these components may provide different mechanisms by which activity may influence cognitive deterioration. However, there has been little indication in the literature for the relative importance of level of frequency, intensity, sustained duration, or total volume in the activity – cognitive impairment relationship.

In order to address some of these shortcomings, the specific research objectives were to (a) examine the relationships among LTPA, WDPA and cognitive impairment with a nationally representative sample of Taiwanese older adults; (b) investigate the independent associations of frequency, intensity, duration and total volume of activity with cognitive impairment.

Methods

Data and sample

The data was derived from the 2005 Taiwan National Health Interview Survey. A nationally representative sample was selected by the National Health Research Institute using a multistage stratified systematic sampling design with probability proportional to size, controlling for the degree of urbanization, geographic location and administrative boundaries. In the survey, the target population was the 22,615,307 individuals whose households were registered in any one of the 23 counties or cities in Taiwan in the end of 2004. In total, 187 out of 358 villages, townships, or districts from 23 counties or cities were sampled, representing 30,680 individuals. Recruits aged less than 12, 12-64, and 65+ years were interviewed in their homes yielding a sample totaled 24,726 participants (response rate: 80.6%) (Taiwan National Health Research Institute, 2006). Among them, only participants aged 65 and older (n=2,724, male: 1348) were analyzed in the present study.

Measures

Cognitive Impairment

Cognitive impairment was assessed using a Chinese version of the Mini Mental State Examination (MMSE)(Guo et al., 1988). The MMSE is a brief 30-point instrument that has been widely used for screening cognitive impairment, examining orientation, registration, attention, calculation, recall, and visuo-spatial ability (Folstein, Folstein, & McHugh, 1975). The MMSE scores were adjusted for educational ability norms. The MMSE cut-off point for people who are illiterate is less than 14, but for those who have schooling (or are literate) is less than 24 (Guo, et al., 1988).

Physical activity

LTPA was measured with the following question. 'Have you taken part in any sport or exercise activities in the past 2 weeks?' Positive respondents then were asked to identify, from 31 named activities, the type of physical activity they engaged in (including walking, jogging, rope skipping, swimming etc.) and an open category for other activities not listed was also available. Frequency (sessions), duration (minutes) and perceived exertion (speed of breathing) of each types of LTPA were then self-reported. Participants were able to specify up to five types of LTPA. Metabolic equivalent (MET) intensity levels for each activity were assigned (Ainsworth et al., 1993; Ainsworth, Haskell, & Whitt, 2000). Energy expenditure (kcal) of each activity per week was calculated by the formula: activity intensity code (kcal/min) × frequency (sessions) × duration for each time (min)/2. Then, the energy expenditure values were added to provide total weekly amount of energy expenditure. Participants were grouped into four levels (0, 1-999, 1000-1999, 2000+ kcal/week) (I-M Lee & Skerrett, 2001). Participation in WDPA was assessed using the following questions. 'Have you taken part in any work-related or domestic physical activity in the past 2 weeks?' (e.g. farm work, heavy lifting, heavy work, fishing work, or household chores etc). Positive respondents then were asked to identify the type of physical activity they engaged in from 10 named activities and an open category for other activities was also available. Frequency and duration of each types of WDPA were also provided. Similarly, participants were able to specify up to five types of WDPA. Following the same procedure of computation, the total weekly amount of energy expenditure for WDPA was then estimated. Total weekly amount of energy expenditure for overall physical activity (OPA) was created by adding up the amount of LTPA and WDPA. The reliability and validity of the activity measure and its details of computing energy expenditures have been reported elsewhere (Lan, Chang, & Tai, 2006).

Covariates

Based on previous research (Coley, et al., 2008; Solfrizzi, et al., 2008), potential covariates were identified: (i) socio-demographical factors; gender, age (65-74, 75-84, 85+), education level (illiterate, literate but no formal schooling, primary school, secondary school, college+), marital status (widowed, separated/divorced, never been married, and with spouse/partner), working status (never, used to, still work), monthly income (New Taiwan Dollars: 0, 1-9999, 10000-19999, 20000+), living status (alone vs. with families/other): (ii) lifestyle behaviors; alcohol consumption (yes vs. no) and smoking (daily, sometimes, quit, never smoke); (iii) body mass index (BMI) was calculated by measured height and weight (>26.99, 24-26.99, 18.5-23.99, and <18.5)(Taiwan Department of Health, 2003) and self-reported health status, including stroke (yes vs. no), fall (yes vs. no), activities of daily living (some or great difficulties vs. no difficulties at all) and depressive symptoms (yes vs. no) assessed using the Center for Epidemiologic Studies Depression Scale (CES-D)(Ku, Fox, & Chen, 2009; Ku, Fox, Chen, & Chou, 2012). These variables were included in the subsequent regression analyses.

Data Analyses

Descriptive statistics were computed to cross-tabulate the relationships between different types of physical activity, other variables and cognitive impairment and to characterize the sample structure. Chi-square tests were used to investigate the underlying correlates. The adjusted odds ratios (AORs) were assessed to examine the association of OPA with cognitive impairment (1= yes, 0= no) after controlling for potential confounders. Then, the same procedures for examining the independent associations of LTPA and WDPA with cognitive impairment were performed. Given the significant association for LTPA and cognitive impairment, the contributions of the three components of LTPA were estimated using multiple logistic regression models. In the models, the three parameters were computed in approximately one standard deviation as a unit difference for comparability (frequency: per 3 sessions/week, duration: per 30 minutes/session, intensity: per 2 kcals/minute). Additionally, further analyses based on the perceived exertion (speed of breathing: no change, slightly fast, fast or very fast), activity frequency (0, 1-2, 3-4, 5+ sessions per week), and duration (0-14, 15-29, 30-59, 60+ minutes per session), were also conducted. Few participants (n=217) performed several forms of exercise. They were excluded from the three-component analysis due to the difficulty in determining their overall activity frequency, intensity and duration during leisure time.

The interaction between LTPA, WDPA and covariates was tested with no significance being found ($p > 0.05$). Multi-collinearity was checked and the results showed that it was not a problem for these analyses (Belsley, Kuh, & Welsch, 1980; de Vaus, 2002). All analyses were conducted using SPSS 16.0.

Results

Among this sample of Taiwanese older adults aged 65 or older, the overall prevalence of cognitive impairment was 24.4%. Table 1 shows the cross-tabulation of cognitive impairment with the underlying covariates. With the exception of five variables (gender, working status, living status, WDPA and smoking), all variables were significantly related to cognitive impairment ($p < 0.05$). Participants who had cognitive impairment were more likely to be older, have experienced lower educational levels, had not been married, had lower income, had been inactive during leisure time, had been sedentary, had no alcohol intake, were underweight, had a personal history of stroke, fall and depressive symptoms, and had some or great difficulties in activities of daily living.

With multivariate adjustment, OPA was not significantly related to cognitive impairment in the fully adjusted model (p=0.16) (See Table 2). However, when LTPA and WDPA were included in the fully adjusted model, LTPA was significantly associated with cognitive impairment (p=0.01). Older adults who reported no leisure time physical activity had a higher risk of cognitive impairment (0 kcal/week: AOR=1.84, 95%CI: 1.13-2.29; reference: 2000+kcal/week). The overall association between WDPA and cognitive impairment in the fully adjusted model was not significant (p=0.12) (See Table II). However, participants who reported WDPA (1-999 kcal/week) had a reduced risk of cognitive impairment.

TABLE I

Characteristics of Participants Aged 65 Or Older With Cognitive Impairment In Taiwan

Variables	n	Cognitive Impairment (%)	χ^2 test
Socio-demographic			
Gender			p=0.40
Female	1201	25.1	
Male	1231	23.6	
Age			p<0.001
85+	101	43.6	
75-84	811	26.3	
65-74	1520	22.1	
Education level			p< 0.001
Illiterate	806	17.9	
Literate but no formal schooling 129	42.6		
Primary school	981	33.7	
Secondary school	351	14.2	
College+	165	7.9	
Marital status			p=0.001
Widowed	723	27.5	
Separated/divorced	145	26.9	
Never been married	67	38.8	
With spouse/partner	1493	21.9	
Working status			p=0.09
Never	521	27.4	
Used to	1522	24.2	
Still work	388	21.1	
Monthly income (NT dollar)			p<0.001
0	299	25.8	
1-9999	1390	27.3	
10000-19999	380	22.6	
20000+	344	12.8	
Living status			p=0.56
Alone	247	25.9	
With family/others	2185	24.2	
Lifestyle behaviors			
LTPA			p< 0.001
0 (kcal/wk)	1022	30.4	
1-999	852	21.4	
1000-1999	347	19.0	
2000+	196	15.3	
WDPA			p=0.10
0 (kcal/wk)	1944	24.8	
1-999	197	17.3	
1000-1999	70	24.3	
2000+	216	26.9	
OPA			p< 0.001
0 (kcal/wk)	778	31.2	
1-999	853	21.3	
1000-1999	371	20.8	
2000+	430	21.2	
Drinking			p=0.02
Yes	500	20.4	
No	1932	25.4	

(Segue)

(Segue) TABLE I

Variables	n	Cognitive Impairment (%)	χ^2 test
Smoking			p=0.64
Daily	415	25.3	
Sometimes	20	15.0	
Quit	249	26.1	
Never smoke	1747	24.0	
Health Status			
Body Mass Index			p< 0.001
>26.99	726	20.9	
24-26.99	437	22.7	
<18.5	131	39.7	
18.5-23.99	731	23.3	
Stroke			p< 0.001
Yes	143	37.8	
No	2289	23.5	
Fall			p< 0.001
Yes	492	32.3	
No	1940	22.4	
Activities of Daily Living			p< 0.001
Some or great difficulties	225	46.2	
No difficulties at all	2207	22.2	
Depressive symptoms			p< 0.001
Yes	489	34.4	
No	1937	21.7	

OPA: overall physical activity; LTPA: leisure-time physical activity, WDPA: work-related and domestic physical activity.

Table III presents the results of the relationship of three parameters of LTPA with cognitive impairment. The results showed that frequency, duration and intensity were each found to be significantly associated with cognitive impairment in separate one-component models (all $p<0.001$). However, when the three components were all entered into the same model, only the association for physical activity duration remained significant ($p=0.02$) (See Table III).

Further analyses based on perceived exertion found that significant associations with cognitive impairment were observed in the models for frequency ($p=0.03$) and duration ($p=0.01$) after adjusting for potential confounders. However, when the three components were all included in the same model, only the association for duration remained marginally significant ($p=0.06$) (0-14 minutes/session: AOR=1.74, 95%CI: 1.00-3.05; 15-29 minutes/ session: AOR=1.67, 95%CI: 1.04-2.67; 30-59 minutes/session: AOR=1.04, 95%CI: 0.72-1.51; reference: 60+minutes/session) (Data not shown), which is consistent with the result of the previous analysis.

Table II

Multiple Logistic Regression Analysis For Adjusted Odds Ratios Of OPA, LTPA, And WDPA For Predicting Cognitive Impairment.

Variables	**OPA Model**			**LTPA and WDPA Model**		
	n	**AOR[a]**	**95% CI**	**n**	**AOR**	**95% CI**
Socio-demographic						
Gender			p=0.28			p=0.20
Female	922	1.16	0.89-1.50	916	1.19	0.92-1.55
Male	1082	1		1073	1	
Age		p=0.002				p=0.003
85+	81	2.49**	1.46-4.24	81	2.47**	1.45-4.22
75-84	650	1.24	0.96-1.59	649	1.26	0.98-1.62
65-74	1273	1		1259	1	
Education level			p<0.001			p<0.001
Illiterate	583	1.32	0.66-2.63	580	1.18	0.59-2.37
Literate but no formal schooling	100	5.68***	2.66-12.15	99	5.22***	2.43-11.24
Primary school	828	4.00***	2.08-7.70	820	3.80***	1.96-7.35
Secondary school	336	1.54	0.76-3.10	333	1.50	0.74-3.03
College+	157	1		157	1	
Marital status			p=0.03			p=0.01
Widowed	557	1.34*	1.03-1.76	554	1.41**	1.07-1.85
Separated/divorced	128	1.42	0.91-2.24	128	1.52*	0.96-2.40
Never been married	58	1.91*	1.04-3.52	58	1.94*	1.05-3.60
With spouse/partner	1261	1		1249	1	
Monthly income (NT dollar)			p=0.02			p=0.04
0	273	1.70*	1.05-2.74	270	1.70*	1.05-2.76
1-9999	1077	1.81**	1.20-2.73	1071	1.74**	1.15-2.64
10000-19999	331	1.29	0.81-2.05	326	1.32	0.83-2.20
20000+	323	1		322	1	
Lifestyle behaviors						
OPA			p=0.16			
0 (kcal/wk)	636	1.17	0.82-1.65			
1-999	708	0.87	0.61-1.22			
1000-1999	312	0.88	0.59-1.32			
2000+	348	1				
LTPA						p=0.01
0 (kcal/wk)				827	1.84*	1.13-2.29
1-999				699	1.28	0.78-2.10
1000-1999				297	1.16	0.67-2.02
2000+				166	1	
WDPA						p=0.12
0 (kcal/wk)				1602	0.73	0.49-1.09
1-999				166	0.50*	0.28-0.88
1000-1999				53	0.73	0.34-1.60
2000+				168	1	
Drinking			p=0.25			p=0.22
Yes	439	0.84	0.62-1.13	434	0.83	0.61-1.12
No	1565	1		1555	1	
Health						
Body Mass Index			p=0.001			p=0.02
>26.99	721	0.87	0.66-1.13	716	0.89	0.68-1.16

(Segue)

(Segue) TABLE II

Variables	**OPA Model**			**LTPA and WDPA Model**		
	n	**AOR**[a]	**95% CI**	**n**	**AOR**	**95% CI**
24-26.99	430	0.98	0.72-1.33	427	1.01	0.75-1.38
<18.5	130	1.87**	1.22-2.86	130	1.81**	1.17-2.78
18.5-23.99	723	1		716	1	
Stroke			p=0.05			
Yes	121	1.56*	1.01-2.43	119	1.53*	0.97-2.40
No	1883	1		1870	1	
Fall			p=0.01			p=0.01
Yes	397	1.47**	1.12-1.92	395	1.47**	1.12-1.92
No	1607	1		1594	1	
Activities of Daily Living			p=0.001			p=0.001
Some or great difficulties	181	1.87**	1.29-2.70	180	1.86**	1.28-2.70
No difficulties at all	1823	1		1809	1	
Depressive symptoms			p=0.22			p=0.27
Yes	281	1.22	0.89-1.66	280	1.19	0.87-1.63
No	1723	1		1709	1	

a: Adjusted Odds Ratio; ***: *p*< .001; **: *p*< .01; *: *p*< .05.
OPA: overall physical activity; LTPA: leisure-time physical activity, WDPA: work-related and domestic physical activity.
All the models: Omnibus model χ^2 test (*p*<0.05); Hosmer & Lemeshow test (*p*> 0.05).

TABLE III
Multiple logistic regression analysis for adjusted odds ratios of three components of LTPA for predicting cognitive impairment

Components	**One-component Models**[a]			**Three-component model**[b]		
	AOR		95% CI	AOR		95% CI
Frequency		p<0.001			p=0.27	
Per 3 sessions/week[c]	0.84		0.76-0.92	0.93		0.81-1.06
Duration		p<0.001			p=0.02	
Per 30 mins/session[c]	0.80		0.72-0.89	0.85		0.74-0.98
Intensity		p=0.001			p=0.76	
Per 2 kcals/min[c]	0.80		0.71-0.91	0.97		0.80-1.18

LTPA: leisure-time physical activity; AOR: Adjusted Odds Ratio; CI: confidence interval
All the models: Omnibus model χ^2 test (*p*< 0.001); Hosmer & Lemeshow test (*p*> 0.05)
a. Each model comprised only one component. These models were conducted separately with adjustment for all covariates, including sex, age, education level, marital status, monthly income, drinking, BMI, stroke, falls, ADL and depressive symptoms;
b. Three components and all covariates were included into the same model.
c. These units are approximately equal to one standard deviation.

Discussion

This study showed that physical activity at LTPA rather than WDPA is associated with risk reduction of cognitive impairment in this national sample of Taiwanese older adults. This result was achieved even when adjusted for important confounding variables, including health and capacity for activities of daily living. This reflects a previous study, revealing that work-related physical activity is not significantly related to the risk of dementia (Rovio et al., 2007). Similarly, a recent study found that the associations of different domains of physical activity with depressive symptoms were only observed in leisure-time activity instead of others, such as work-related, transport-related or domestic activity (Teychenne, Ball, & Salmon, 2008). However, this study was based on a sample of women aged 18-65, rather than older people. These findings imply that the variety of physical activity within different contexts in later life may be differentially associated with mental disorder, including cognitive impairment. Additionally, among the three components of LTPA, only duration, especially engagement for at least 30 minutes, seems to be associated with reduced risk of cognitive impairment.

Different contexts of physical activity provide different exposures or degrees of exposure to the range of bio-psychosocial mechanisms operating in exercise. WDPA tends to be repetitive, obligatory or routine. In contrast, physical activities during leisure time may provide a sense of enjoyment, fulfillment, and social interactions (Teychenne, et al., 2008). Concurrent with the cognitive reserve theory, participation in cognitive simulating leisure activities can accumulate cognitive reserve, which may in turn maintain or improve cognitive functioning (Stern, 2006; Verghese, Cuiling, Katz, Sanders, & Lipton, 2009). Moreover, the current recommendation for health promotion is that older adults should engage in 150 minutes a week of moderate-intensity, or 75 minutes a week of vigorous-intensity physical activity, or an equivalent combination of moderate- and vigorous-intensity physical activity (UK Department of Health, 2011; US Department of Health and Human Services, 2008). However, WDPA is more likely to involve shorter duration and lower intensity that may not be adequate for yielding mental health benefits. Compared with those who expended energy expenditure of at least 2000 kcal/week in WDPA, those with a medium dose of WDPA (1-999 kcal/week) had a lower risk of cognitive impairment. Notably, the overall association of WDPA with cognitive impairment is relatively weak and statistically non significant. Thus, there remain gaps in our understanding of this relationship.

Although all the three components contribute to the determination of amount of energy expended from physical activity, only duration emerged as an independent correlate of cognitive impairment after adjusting for frequency, intensity and other confounders (I-Min Lee, 2008). These findings were supported by the analyses based on different assessment of physical activity intensity (i.e. subjective exertion and METs). The explanation for this remains unclear and may simply be that this parameter best describes overall commitment and involvement in LTPA. However, this finding is consistent with those of a meta-analysis of intervention trials in older adults, suggesting that exercise sessions needed to be at least 30 minutes long to be effective for the improvement of cognitive function (Colcombe & Kramer, 2003). Better mental health outcomes, such as anxiety symptoms reduction, with exercise sessions exceeding 30 minutes was also observed in another meta-analysis of intervention trials among older adults (Herring, O'Connor, & Dishman, 2010). Additionally, a 10-year follow-up study for the Finland, Italy and the Netherlands elderly found that duration of physical activity is more important than intensity in the reduction of risk of disability (Van Den Brink et al., 2005). Spirduso, Poon and Chodzko-Zajko (2008) proposed a hypothetical model for physical activity effects and cognition, suggesting that physical activity not only improves cognition directly but also enhances physical (e.g. activities of daily living) and mental resource (e.g. anxiety), which may in turn augment cognitive performance. That may partly explain the underlying role of duration in the exercise-cognition relationships among older adults. However, to date very few studies have examined the dose response (in terms of frequency, duration and intensity) effects of exercise on cognitive function in older adults, Further research is warranted to compare various frequencies, intensities and durations while adjusting for total energy expenditure to achieve a better understanding regarding the optimal dose requiring to elicit cognitive health benefits.

Given the self-reported data and the cross-sectional research design, caution should be applied when interpreting results. However, these data suggest that those older adults who engage in leisure time physical activity in their lives are less likely than those who are inactive to experience cognitive impairment, even when taking into account other potentially explanatory factors such as capacity for activities of daily living. It also adds to the very limited evidence base for physical activity and older adults in East Asian countries and specifically with a Taiwanese population. Further well-designed prospective cohort studies, preferably investigation based on using objective measures of physical activity such as accelerometry, or extended randomized controlled trials are required to establish whether LTPA can prevent or delay cognitive decline.

Acknowledgements

This work was supported by Taiwan National Science Council (Grant No.: 98-2410-H-018-034-MY2). The analysis is based on original data sets provided by the National Health

Research Institutes in Taiwan. The interpretation and conclusions contained herein do not represent those of the National Health Research Institutes. The authors would like to thank the institution for allowing them to access the data sets.

REFERENCES

Access Economics. (2006). *Dementia in the Asia Pacific region: the epidemic is here.* Canberra: Access Economics.

Ainsworth, B. E., Haskell, W. L., Leon, A. S., Jacobs, D. R., Montoye, H. J., Sallis, J. F., & Paffenbarger, R. S. (1993). Compendium of physical activities: classification of energy costs of human activities. *Medicine and Science in Sports and Exercise, 25*, 71-80.

Ainsworth, B. E., Haskell, W. L., & Whitt, M. C. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise, 32*, S498-S516.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression diagnostics: identifying influential data and sources of collinearity*. New York: John Wiley & Sons.

Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults. *Psychological Science, 14*(2), 125.

Coley, N., Andrieu, S., Gardette, V., Gillette-Guyonnet, S., Sanz, C., Vellas, B., & Grand, A. (2008). Dementia Prevention: Methodological Explanations for Inconsistent Results. *Epidemiol Rev, 30*(1), 35-66. doi: 10.1093/epirev/mxn010

de Vaus, D. (2002). *Analyzing social science data: 50 key problems in data analysis*. London: Sage.

Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., . . . Scazufca, M. (2005). Global prevalence of dementia: a Delphi consensus study. *The Lancet, 366*(9503), 2112-2117.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*(3), 189-198.

Guo, N. W., Liu, H. C., Wong, P. F., Liao, K. K., Yan, S. H., Lin, K. P., . . . Hsu, T. C. (1988). Chinese Version and Norms of the Mini-Mental State Examination. *Journal of Rehabilitation Medicine Association*(16), 52-59.

Hamer, M., & Chida, Y. (2009). Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence. *Psychological Medicine, 39*(1), 3-11. doi: doi:10.1017/S0033291708003681

Herring, M. P., O’Connor, P. J., & Dishman, R. K. (2010). The effect of exercise training on anxiety symptoms among patients: a systematic review. *Archives of Internal Medicine, 170*(4), 321.

Hu, G., Eriksson, J., Barengo, N. C., Lakka, T. A., Valle, T. T., Nissinen, A., (2004). Tuomilehto, J. (2004). Occupational, Commuting, and Leisure-Time Physical Activity in Relation to Total and Cardiovascular Mortality Among Finnish Subjects With Type 2 Diabetes. *Circulation*, 01.CIR.0000138102.0000123783.0000138194.

Ku, P. W., Fox, K. R., & Chen, L. J. (2009). Physical activity and depressive symptoms in Taiwanese older adults: A seven-year follow-up study. *Preventive Medicine, 48*(3), 250-255.

Ku, P. W., Fox, K. R., Chen, L. J., & Chou, P. (2012). Physical Activity and Depressive Symptoms in Older Adults: 11-Year Follow-Up. *American Journal of Preventive Medicine, 42*(4), 355-362.

Ku, P. W., Stevinson, C., & Chen, L. J. (2012). Prospective Associations Between Leisure-Time Physical Activity and Cognitive Performance Among Older Adults Across an 11-Year Period. *Journal of Epidemiology, 22*(3). doi: doi:10.2188/jea.JE20110084

Lan, T.-Y., Chang, H.-Y., & Tai, T.-Y. (2006). Relationship between components of leisure physical activity and mortality in Taiwanese older adults. *Preventive Medicine, 43*(1), 36-41.

Lautenschlager, N. T., & Almeida, O. P. (2006). Physical activity and cognition in old age. *Current Opinion in Psychiatry, 19*, 190-193.

Lee, I.-M. (2008). Current issues in examining dose-response relations between physical activity and health outcome. In I.-M. Lee (Ed.), *Epidemiologic methods in physical activity studies* (pp. 56-76). New York: Oxford University Press.

Lee, I.-M., & Skerrett, P. J. (2001). Physical activity and all-cause mortality: what is the dose-response relation? *Medicine and Science in Sports and Exercise, 33*(6 Suppl.), S459-S471.

Matthews, C. E., Jurj, A. L., Shu, X.-O., Li, H.-L., Yang, G., Li, Q., . . . Zheng, W. (2007). Influence of exercise, walking, cycling, and overall nonexercise physical activity on mortality in Chinese women. *American Journal of Epidemiology, 165*(12), 1343-1350.

Phongsavan, P., Merom, D., Marshall, A. L., & Bauman, A. (2004). Estimating physical activity level: the role of domestic activities. *Journal of Epidemiology and Community Health, 58*, 466-467.

Plassman, B. L., Williams, J. W., Burke, J. R., Holsinger, T., & Benjamin, S. (2010). Systematic Review: Factors Associated With Risk for and Possible Prevention of Cognitive Decline in Later Life. *Annals of Internal Medicine, 153*(3), 182-193. doi: 10.1059/0003-4819-153-3-201008030-00258

Rovio, S., Kareholt, I., Viitanen, M., Winblad, B., Tuomilehto, J., Soininen, H., . . . Kivipelto, M. (2007). Work-related physical activity and the risk of dementia and Alzheimer's disease. *International Journal of Geriatric Psychiatry, 22*(9), 874-882.

Solfrizzi, V., Capurso, C., D'lntrono, A., Colacicco, A. M., Santamato, A., Ranieri, M., . . . Panza, F. (2008). Lifestyle-related factors in predementia and dementia syndromes. *Expert Review of Neurotherapeutics, 8*(1), 133-158. doi: doi:10.1586/14737175.8.1.133

Spirduso, W. W., Poon, L. W., & Chodzko-Zajko, W. (2008). Using resources and reserves in an exercise-cognition model. In W. W. Spirduso, L. W. Poon & W. Chodzko-Zajko (Eds.), *Exercise and its mediating effects on cognition* (pp. 3-11). Champaign, IL: Human Kinetics.

Stern, Y. (2006). Cognitive Reserve and Alzheimer Disease. *Alzheimer Disease & Associated Disorders, 20*(2), 112-117.

Taiwan Department of Health (2003). Identification, Evalution and Treatment of Overweight and Obesity in Adults in Taiwan. Taipei: *Taiwan Department of Health*.

Taiwan National Health Research Institute. (2006). Sampling report of 2005 National Health Interview Survey (pp. 1-18). Taipei: National Health Research Institute.

Teychenne, M., Ball, K., & Salmon, J. (2008). Associations between physical activity and depressive symptoms in women. *International Journal of Behavioral Nutrition and Physical Activity, 5*(1), 27.

UK Department of Health. (2011). Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers. London: Department of Health.

US Department of Health and Human Services. (2008). 2008 Physical activity guidelines for Americans Washington: US Department of Health and Human Services.

Van Den Brink, C. L., Picavet, H., Van Den Bos, G. A. M., Giampaoli, S., Nissinen, A., &

Kromhout, D. (2005). Duration and intensity of physical activity and disability among European elderly men. *Disability and Rehabilitation, 27*(6), 341-347.
Verghese, J., Cuiling, W., Katz, M. J., Sanders, A., & Lipton, R. B. (2009). Leisure Activities and Risk of Vascular Cognitive Impairment in Older Adults. *J Geriatr Psychiatry Neurol, 22*(2), 110-118. doi: 10.1177/0891988709332938
World Health Organization. (2003). World Health Report 2003—Shaping the future. Geneva: WHO.
Yamada, M., Kasagi, F., Sasaki, H., Masunari, N., Mimori, Y., & Suzuki, G. (2003). Association Between Dementia and Midlife Risk Factors: the Radiation Effects Research Foundation Adult Health Study. *Journal of the American Geriatrics Society, 51*(3), 410-414.

Int. J. Sport Psychol., 2012; 43: 117-136

Examining the mediating role of cohesion between athlete leadership and athlete satisfaction in youth sport

KYLE F. PARADIS* *and* TODD M. LOUGHEAD **

(*)The University of Western Ontario,Canada
(**)University of Windsor

The purpose of the present study was to examine whether cohesion served as a mediator between athlete leadership and athlete satisfaction in youth sport. Participants were 205 competitive youth sport athletes ranging from 13-17 years old (M_{age} = 15.01 years, SD = 1.27). Participants completed the Leadership Scale for Sports (LSS; Chelladurai & Saleh, 1980), the Youth Sport Environment Questionnaire (YSEQ; Eys, Loughead, Bray, & Carron, 2009), and the Athlete Satisfaction Questionnaire (ASQ; Riemer & Chelladurai, 1998). Structural equation modelling was used to test for mediation. Overall the results indicated that task cohesion mediated the relationships between formal and informal task athlete leadership behaviours and task athlete satisfaction outcomes. Further it was found that social cohesion mediated the relationship between formal and informal social athlete leadership behaviours and social athlete satisfaction outcomes. Findings from the present study augment the group dynamics literature as theoretical, methodological, and practical implications are discussed.

KEY WORDS: Cohesion, Leadership, Satisfaction, Youth Sport.

Cohesion has been one of the most researched small group constructs across a variety of disciplines such as social psychology, organizational psychology, military psychology, and sport psychology (Carron & Brawley, 2000). In fact, cohesion has been considered one of the most important small group variables (Golembiewski, 1962; Lott & Lott, 1965). Cohesion has been defined as “a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs” (Carron, Brawley, & Widmeyer, 1998, p. 213). This definition implicitly conveys the

Correspondence to: Kyle F. Paradis, School of Kinesiology, Thames Hall/3M Centre, University of Western Ontario, 1151 Richmond St. London, Ontario, Canada, N6A3K7 (E-mail: kparadis@uwo.ca)

assumption concerning cohesion and satisfaction; that higher perceptions of cohesion are related to higher levels of satisfaction (e.g., Spink, Nickel, Wilson, & Odonokon, 2005). Cohesion has also been operationalized as multidimensional in nature (Carron, Widmeyer, & Brawley, 1985). Hence, not surprisingly, in addition to satisfaction, Carron and Chelladurai (1981) noted that a number of other factors contribute to perceptions of cohesion. For instance, leadership behaviours have been shown to be related to cohesion in sport (e.g., Jowett & Chaundy, 2004; Westre & Weiss, 1991).

One model that allows for the examination of cohesion, leadership, and satisfaction is Carron's (1982) conceptual model for the study of cohesion in sport. Carron's conceptual model is a linear model comprised of inputs, throughputs, and outputs. The inputs are the antecedents of cohesion, the throughputs are the types of cohesion, and the outputs are the consequences of cohesion. According to the model, the antecedents that are related to perceptions of cohesion fall into four categories: environmental, personal, team, and leadership.

The throughputs of cohesion refer to the different types of cohesion. Carron et al. (1998) noted that theoreticians in the area of group dynamics emphasized the need to distinguish between task- and social-orientation of groups. Consequently, Carron et al. (1998) defined task cohesion as the general orientation of a team towards its goals and objectives, while social cohesion is defined as the general orientation towards developing and maintaining social relationships within the team.

Finally, the consequences of cohesion also referred to as outcome variables can include a wide variety of constructs. Some of these may include but are not limited to such outcomes as performance (Carron, Colman, Wheeler, & Stevens, 2002), athlete satisfaction (Spink et al., 2005), intention to return (Spink, 1995; 1998), collective efficacy (Heuzé, Raimbault, & Fontayne, 2006), and role involvement (Eys & Carron, 2001).

Inherent in Carron's (1982) conceptual model for the study of cohesion in sport is the notion that cohesion serves to mediate the relationship between its antecedents and consequences. Testing for meditational relationship is critical since mediating variables (cohesion in the present study) establish "how" and "why" one variable predicts an outcome variable (MacKinnon, 2008). Not surprisingly, there are many benefits in identifying meditational models. For instance, it aids in the development of practical and applied interventions. That is, the identification of mediators is important since it indicates which variables could be targeted for intervention (Baron & Kenny, 1986).

Given the importance of mediational research, a few studies have examined whether cohesion serves as a mediator in sport. To the best of our knowledge only one study has examined cohesion as a mediator and found that social cohesion mediated the relationship between coaching leadership behaviour of *training and instruction* and an athlete's intention to return (Spink, 1998). However, it should be noted that this study examined only one leader behaviour (i.e., training and instruction) and only social cohesion as a mediator. Consequently, no other leader behaviours were examined as predictors, while task cohesion was not examined as a potential mediating variable.

Although research has examined cohesion as a mediator in relation to the antecedent of leadership (i.e., coaching leader behaviours) and the consequence of intention to return, it is important to investigate other possible relationships between additional antecedents and consequences hypothesized in Carron's (1982) model. In terms of the antecedents of cohesion, the present study examined athlete leadership. This variable was selected since the majority of leadership research in sport has focused on the coach (e.g., Cumming, Smith, & Smoll, 2006). However, Loughead, Hardy, and Eys (2006) have suggested that teammates represent another significant source of leadership within sport teams. These authors have labelled this athlete leadership and have defined it as an athlete occupying a formal or informal leadership role who influences team members to achieve a common goal. In fact, several studies have highlighted the importance of athlete leaders. More specifically, research has shown that athlete leaders and coaches differ in their use of leadership behaviours (Loughead & Hardy, 2005), athlete leadership is related to perceptions of cohesion (Vincer & Loughead, 2010), better team communication (Hardy, Eys, & Loughead, 2008), and athletes having a more satisfied athletic experience (Eys, Loughead, & Hardy, 2007).

In terms of the consequences of cohesion, the present study examined athlete satisfaction. Chelladurai and Riemer (1997) defined athlete satisfaction as "a positive affective state resulting from a complex evaluation of the structures, processes, and outcomes associated with the athletic experience" (p. 135). This outcome was selected for a number of reasons. First, research has shown that the level of athlete satisfaction influences sport participation; that is, those athletes who are more satisfied with their overall athletic experiences are less likely to drop out of sport (Fraser-Thomas, Côté, & Deakin, 2008). Second, research has shown athlete satisfaction to be related to both cohesion (e.g., Spink et al., 2005) and leadership (e.g., Chelladurai, 1984; Price & Weiss, 2000; Riemer & Chelladurai, 1995; Riemer & Toon, 2001; Weiss & Friedrichs, 1986).

Therefore, the purpose of the present study was to investigate whether cohesion served as a mediator between athlete leadership behaviours and relevant facets of athlete satisfaction in youth sport. As was pointed out above, research has shown that both athlete leadership (e.g., Eys et al., 2007) and cohesion (e.g., Spink et al., 2005) are related to athlete satisfaction. While athlete leadership behaviours (e.g., Vincer & Loughead, 2010) are also related to cohesion. That is, a positive mediational relationship was expected between athlete leader behaviours, cohesion, and athlete satisfaction. Prior to testing for mediation, a theoretical decision was made to examine meditational models that reflected a common classification in group dynamics research: task- and socially-oriented distinctions (Carron et al., 1985). All three variables used in the present study contained both task- and socially-oriented constructs. As for cohesion, the distinction is quite apparent with the YSEQ containing two factors that are labeled and reflect this distinction (i.e., task and social cohesion). Task cohesion refers to an individual's perception about the closeness, bonding, and similarity around the team's task, as well as the individual's feelings about his or her personal involvement with the group's task and goals. Social cohesion reflects an individual's perception about the closeness, bonding, and similarity around the team as a social unit, as well as the individual's feelings about his or her personal acceptance and social interaction with the team. However, the distinction is not as apparent in the other two variables and begs the question as to which athlete leadership behaviours and which dimensions of athlete satisfaction are considered to be task- and socially-oriented. In terms of athlete leader behaviours, Chelladurai (2007) suggested that the leader behaviour of *training and instruction* (i.e., leadership behaviours aimed at helping athletes improve their skill level and performance) is task oriented, while *social support* (i.e., concern for the welfare of teammates, developing a positive group atmosphere and warm interpersonal relationships with teammates) is considered to be socially oriented. The behaviour of *positive feedback* (i.e., leadership behaviour recognizing and rewarding teammates behaviours) could be considered either task or socially oriented as it alludes to rewarding behaviour pertaining to a successful task performance, as well as providing psychological benefits on a social level. Likewise, the leader behaviours of *autocratic behaviour* (i.e., leadership behaviours that involve independence in decision making) and *democratic behaviour* (i.e., leadership behaviours that allows for participation in decision making) refer to decision making styles and thus could also have either task and/or social implications.

As for athlete satisfaction, Chelladurai and Riemer (1997) noted that dimensions could be delineated into task/social, and team/individual distinctions. Of the eight dimensions assessed, six of them are considered task-related: satisfaction with *training and instruction* (i.e., satisfaction with the training and instruction provided by athlete leaders), *individual performance* (i.e., satisfaction with his/her task performance), *team performance* (i.e., satisfaction with the team's level of performance), *team task contribution* (i.e., satisfaction with the athlete leadership provided to the athlete), *team integration* (i.e., satisfaction with the team members' contribution towards the team's task), and *personal dedication* (i.e., satisfaction with the athlete's own personal contribution to the team). Of these six, three are team-oriented (*team integration*, *team performance*, and *team task contribution*), and three are individual-oriented (*personal dedication*, *individual performance*, *and training and instruction*). The remaining two dimensions are considered socially oriented: satisfaction with *personal treatment* (i.e., satisfaction with the leadership behaviours that directly influences the athlete), and *team social contribution* (i.e., satisfaction with how athlete leaders contribute to the athlete as a person). Therefore, athlete satisfaction was examined from both a task and social perspective, and an individual and team level perspective.

Therefore, it was hypothesized that task cohesion would positively mediate the relationship between task athlete leadership (*training and instruction, democratic behaviour, autocratic behaviour,* and *positive feedback*) and team task satisfaction (*team integration, team task contribution,* and *team performance*) and individual task satisfaction (*training and instruction, personal dedication,* and *individual performance*). It was also hypothesized that social cohesion would positively mediate the relationship between social athlete leadership (*social support, democratic behaviour, autocratic behaviour,* and *positive feedback*) and social athlete satisfaction (*personal treatment,* and *team social contribution*).

Method

Participants

The participants were 205 competitive youth athletes from the sports of soccer (n = 157) and basketball (n = 48). There were a total of 86 male and 119 female athletes with a mean age of 15.01 years (SD = 1.27). The athletes had been on their current team for 3.33 years (SD = 2.03) and were involved in their current sport on average for 8.44 years (SD = 2.98). The majority of athletes, 75% (n = 153) considered themselves as a starter and 25% (n = 52) a non- starter on the team. In terms of leadership status, 66% (n = 136) of athletes identified themselves as occupying some sort of leadership role with 19% (n = 39) of athletes as a formal leader, and 47% (n = 97) as an informal leader. Finally, 34% (n = 69) considered themselves as non-leaders.

Measures

Cohesion. Cohesion was measured using the Youth Sport Environment Questionnaire (YSEQ; Eys et al., 2009). The YSEQ is an inventory that assesses cohesion in youth between the ages of 13 to 17 years. The YSEQ contains 16 items that assess task and social cohesion. Task cohesion contains eight items and a sample item is "We all share the same commitment to our team's goals." Social cohesion contains eight items and a sample item is "I spend time with my teammates." All items are scored on a 9-point Likert-type scale anchored at the extremes of 1 (*strongly disagree*) and 9 (*strongly agree*). Therefore, higher scores reflect stronger perceptions of cohesion. Research using the YSEQ has provided evidence that the inventory is valid and reliable. In particular, scores from the YSEQ have demonstrated adequate internal consistency for both task and social cohesion dimensions, and have shown adequate content, predictive, and factorial validity (Eys et al., 2009).

Athlete leadership. Athlete leader behaviours were assessed using a modified version of the Leadership Scale for Sports (LSS; Chelladurai & Saleh, 1980). The modified version has been used in previous athlete leadership research (e.g., Loughead & Hardy, 2005; Vincer & Loughead, 2010). The only modification from the original LSS concerned the stem which preceded the items. In the original version, the stem reads "My coach" whereas in the athlete leader version the stem reads "The formal and informal athlete leader(s) on my team". Thus, athletes were asked to provide a response for both formal and informal leaders for each item. The LSS is a 40 item inventory that assesses five dimensions of athlete leader behaviours: *training and instruction*, *democratic behaviour*, *autocratic behaviour*, *social support*, and *positive feedback*. The *training and instruction* dimension consists of 13 items with an example item being: "Explains to each athlete the techniques and tactics of the sport." *Democratic behaviour* consists of eight items with an example item being: "Lets the athletes share in decision making." *Autocratic behaviour* consists of five items with an example item being: "Does not explain their actions." The *social support* dimension contains nine items with an example item being: "Helps the athletes with their personal problems." The p*ositive feedback* dimension contains five items with an example item being: "Gives credit where credit is due." Responses are provided on a 5-point Likert-type scale anchored at the extremes of 1 (*never*) to 5 (*always*). Therefore, higher scores reflect stronger perceptions of athlete leader behaviours. The scores from the LSS demonstrated adequate internal consistency, as well as content, predictive, and factorial validity when utilised to assess athlete leadership (Loughead, & Hardy, 2005; Vincer & Loughead, 2010) and youth sport (e.g., Chelladurai & Carron, 1981; Cumming, Smith, & Smoll, 2006; Westre & Weiss, 1991).

Athlete satisfaction. Athlete satisfaction was measured using 28 items from eight dimensions of the Athlete Satisfaction Questionnaire (ASQ; Riemer & Chelladurai, 1998) that were anticipated as relevant to youth sport based on previous research (e.g., Bray, Beauchamp, Eys, & Carron, 2005; Jeffery-Tosoni, Eys, Schinke, & Lewko, 2011). The full version of the ASQ contains 56 items measuring 15 dimensions. However, dimensions pertaining to *medical personnel*, *budget*, *ethics*, and *academic support services* were omitted as they were not pertinent to youth sport. The dimensions of *ability utilization* and *strategy* were not used because they reflect coaching leadership and are not relevant to athlete leadership. Items pertaining to coaching leadership that could also reflect athlete leadership were slightly modified to reflect satisfaction the participants had for their athlete leaders. Thus, the eight dimensions that were used in the present study were: *individual performance* (3-items; e.g., "I am satisfied with the improvement in my skill level"), *team performance* (3-items; e.g., "I am satisfied with the team's win/loss record this season"), *personal treatment* (5-items; e.g., I am satisfied with the extent to which the athlete leaders are behind me"), *training and instruction* (3-items; e.g., "I am satisfied with the instruction I receive from my athlete leaders"), *team task contribution* (3-items; e.g., "I am satisfied with the constructive feedback I receive from my athlete leaders"), *team social contribution* (3-items; e.g., "I am satisfied with the degree to which my athlete leaders accept me on a social level"), *team integration* (4-items; e.g., "I am satisfied with how the team works to be the best"), and *personal dedication* (4-items; e.g., "I am satisfied with my dedication during practices"). All of the responses from the ASQ are provided on a 7-point Likert-type scale anchored at the extremes by 1 (*not at all satisfied*) to 7 (*extremely satisfied*). The scores from the ASQ demonstrated adequate internal consistency as well as content, predictive and factorial validity, and in a wide variety of samples (Riemer & Chelladuarai, 1998) including youth sport (e.g., Bray et al., 2005; Jeffery-Tosoni et al., 2011).

Procedure

The current study utilized a descriptive cross-sectional survey design in which data were collected using self-report measures. Ethics approval was obtained from the university's research ethics board. Once ethics approval was granted, the principal investigator approached youth sport associations to request permission to contact their coaches. Coaches were then contacted requesting permission to survey their athletes and letters of information were sent prior to data collection to the coach, parents, and athletes describing the study. Data collection occurred before or after a practice at the coach's discretion. Each athlete was distributed a questionnaire package that contained definitions of formal and informal athlete leadership, a copy of the LSS, YSEQ, and ASQ. Also, a verbal explanation of the study was given prior to completing the questionnaire package. The principal investigator remained present to answer any questions. Return of the questionnaires signified consent which took approximately 20 minutes to complete. After the questionnaire package was returned, participants were thanked for their time and given the opportunity to enter their name into a draw for their participation.

Results

Descriptive Statistics

Means, standard deviations, internal consistency values (see Table I), and bivariate correlations (see Table II) were calculated for the five dimensions of athlete leader behaviours for both formal and informal leadership, the two dimensions of cohesion, and the eight dimensions of athlete satisfaction. The internal consistency values for the various dimensions ranged from.67 to .92 (see Table I).

One 2 (gender) X 20 (cohesion, athlete leadership, satisfaction) MANOVA was used to determine if there were gender differences. Bonferroni type adjustments were used (Tabachnick & Fidell, 2007) for the follow-

Table I
Descriptive Statistics for Athlete Leadership, Cohesion, and Athlete Satisfaction

Variable	Mean	SD	α
1. Training and Instruction-Formal[a]	3.46	0.66	.85
2. Democratic Behaviour-Formal[a]	3.60	0.68	.78
3. Autocratic Behaviour-Formal[a]	2.68	0.89	.72
4. Social Support-Formal[a]	3.38	0.83	.84
5. Positive Feedback-Formal[a]	3.94	0.88	.84
6. Training and Instruction-Informal[a]	3.12	0.64	.84
7. Democratic Behaviour-Informal[a]	3.43	0.66	.75
8. Autocratic Behaviour-Informal[a]	2.56	0.77	.67
9. Social Support-Informal[a]	3.36	0.75	.80
10. Positive Feedback-Informal[a]	3.88	0.81	.81
11. Task Cohesion[b]	7.12	1.38	.90
12. Social Cohesion[b]	6.76	1.65	.92
13. Team Integration[c]	5.63	1.00	.80
14. Personal Dedication[c]	5.89	0.92	.78
15. Personal Treatment[c]	5.69	1.06	.84
16. Team Task Contribution[c]	5.50	1.17	.76
17. Team Social Contribution[c]	5.64	1.10	.78
18. Team Performance[c]	5.55	1.06	.71
19. Individual Performance[c]	5.65	0.96	.70
20. Training & Instruction[c]	5.45	1.24	.80

Note. [a]Scores for the athlete leadership variables can range from 1-5.
[b]Scores for the cohesion dimensions can range from 1-9.
[c]Scores for athlete satisfaction can range from 1-7.

up univariate ANOVAs given there were 20 attributes (.05/20 = $p < .0025$). The results showed that the majority of attributes were non-significant between males and females: athlete leadership behaviours of training and instruction-formal ($M_{males} = 3.53 \pm .67$; $M_{females} = 3.41 \pm .65$; $p = .229$, Cohen's $d = .18$[1]), training and instruction-informal ($M_{males} = 3.23 \pm .65$; $M_{females} = 3.04 \pm .62$; $p = .035$, Cohen's $d = .29$), democratic behaviour-formal ($M_{males} = 3.49 \pm .68$; $M_{females} = 3.68 \pm .68$; $p = .054$, Cohen's $d = .28$), democratic behaviour-informal ($M_{males} = 3.26 \pm .61$; $M_{females} = 3.55 \pm .66$; $p = .0020$, Cohen's $d = .46$), autocratic behaviour-formal ($M_{males} = 2.86 \pm .81$; $M_{females} = 2.55 \pm .92$; $p = .017$, Cohen's $d = .36$), autocratic behaviour-informal ($M_{males} = 2.72 \pm .71$; $M_{females} = 2.44 \pm .79$; $p = .010$, Cohen's $d = .37$), social support-formal ($M_{males} = 3.15 \pm .77$; $M_{females} = 3.54 \pm .84$; $p = .001$, Cohen's $d = .48$), social support-informal ($M_{males} = 3.07 \pm .73$; $M_{females} = 3.56 \pm .70$; $p = .000$, Cohen's $d = .69$), positive feedback-formal ($M_{males} = 3.70 \pm .87$; $M_{females} = 4.10 \pm .85$; $p = .001$, Cohen's $d = .47$), positive feedback-informal ($M_{males} = 3.58 \pm .82$; $M_{females} = 4.09 \pm .73$; $p = .000$, Cohen's $d = .66$), task cohesion ($M_{males} = 7.07 \pm 1.52$; $M_{females} = 7.15 \pm 1.27$; $p = .695$, Cohen's $d = .06$), social cohesion ($M_{males} = 6.48 \pm 1.67$; $M_{females} = 6.96 \pm 1.61$; $p = .034$, Cohen's $d = .29$), team integration ($M_{males} = 5.68 \pm 1.09$; $M_{females} = 5.59 \pm .94$; $p = .528$, Cohen's $d = .09$), personal dedication ($M_{males} = 5.79 \pm 1.03$; $M_{females} = 5.95 \pm .83$; $p = .251$, Cohen's

TABLE II

Bivariate Correlations Between Athlete Leadership, Cohesion, and Athlete Satisfaction

Variable	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. TI-F	.62**	.47**	.33**	.27**	.18*	.39**	.24**	.32**	.19**	.35**	30**	.33*	.27**	.41**	.40**	.35**	.24**	.25**	.42**
2. TI-I	-	.26**	.47**	.29**	.36**	.18*	.28**	.11	.17*	.31**	26**	.26**	.20**	.32**	.31**	.23**	.28**	.17*	.30**
3. DB-F		-	.64**	.07	.02	.55**	.38**	.54**	.37**	.42**	.30**	.35**	.23**	.43**	.42**	.34**	.27**	.17*	.41**
4. DB-I			-	.04	.11	.39**	.45**	.40**	.44**	.38**	.33**	.31**	.27**	.40**	.38**	.30**	.30**	.20**	.32**
5. AB-F				-	.79**	-.01	-.07	-.09	-.15	-.06	-.04	-.02	-.04	-.08	-.03	-.03	-.06	-.02	-.02
6. AB-I					-	-.06	.03	-.20*	-.15*	.03	-.03	.03	-.01	-.01	.04	-.01	.10	.03	.05
7. SS-F						-	.76**	.66**	.49**	.32**	.37**	.24**	.16*	.34**	.36**	.41**	.14*	.18**	.33**
8. SS-I							-	.52**	.62**	.30**	.42**	.24**	.25**	.36**	.33**	.40**	.21**	.25**	.31**
9. PF-F								-	.67**	.39**	.34**	.32**	.30**	.40**	.36**	.37**	.23**	.21**	.33**
10. PF-I									-	.39**	.40**	.40**	.40**	.39**	.36**	.41**	.32**	.32**	.30**
11. Task										-	.61**	.75**	.56**	.66**	.72**	.56**	.54**	.59**	.68**
12. Soc											-	.46**	.42**	.52**	.50**	.65**	.43**	.45**	.45**
13. TI												-	.66**	.75**	.77**	.61**	.67**	.64**	.77**
14. PD													-	.57**	.55**	.55**	.57**	.67**	.55**
15. PT														-	.83**	.65**	.56**	.59**	.79**
16. TTC															-	.64**	.52**	.63**	.82**
17. TSC																-	.56**	.57**	.60**
18. TP																	-	.55**	.51**
19. IP																		-	.60**
20. TI																			-

Note. * $p < .05$; ** $p < .01$; TI-F = Training and Instruction-Formal; TI-I = Training and Instruction-Informal; DB-F = Democratic Behaviour-Formal; DB-I = Democratic Behaviour-Informal; AB-F = Autocratic Behaviour-Formal; AB-I = Autocratic Behaviour-Informal; SS-F = Social Support-Formal; SS-I = Social Support-Informal; PF-F = Positive Feedback-Formal; PF-I = Positive Feedback Informal; Task = Task Cohesion; Soc = Social Cohesion;
TI = Team Integration; PD = Personal Dedication; PT = Personal Treatment; TTC = Team Task Contribution; TSC = Team Social Contribution; TP = Team Performance; IP = Individual Performance; TI = Satisfaction with Training and Instruction.

d = .17), personal treatment (M_{males} = 5.67 ± 1.02; $M_{females}$ = 5.69 ± 1.08; *p* = .855, Cohen's *d* = .02), team task contribution (M_{males} = 5.51 ± 1.19; $M_{females}$ = 5.49 ± 1.16; *p* = .895, Cohen's *d* = .02), team social contribution (M_{males} = 5.50 ± 1.15; $M_{females}$ = 5.75 ± 1.06; *p* = .124, Cohen's *d* = .23), team performance (M_{males} = 5.63 ± 1.06; $M_{females}$ = 5.48 ± 1.07; *p* = .318, Cohen's *d* = .14), individual performance (M_{males} = 5.55 ± 1.11; $M_{females}$ = 5.73 ± .84; *p* = .208, Cohen's *d* = .19), and satisfaction with training (M_{males} = 5.49 ± 1.29; $M_{females}$ = 5.42 ± 1.21; *p* = .677, Cohen's *d* = .06).

Testing for Mediation

Mediation was tested using structural equation modelling (*SEM*) using the maximum likelihood method of parameter estimation in AMOS 18.0 (Arbuckle, 2009). Holmbeck (1997) outlined steps in testing for mediation when using *SEM*. The first step is to test the direct effects model (i.e., athlete leadership→athlete satisfaction); that is whether the independent variable (i.e., athlete leadership) predicts the outcome variable (i.e., athlete satisfaction). The second step is to test the mediator model (i.e., athlete leadership→cohesion→athlete satisfaction); that is whether the mediator variable (i.e., cohesion) is related to the predictor variable (i.e., athlete leadership) and the outcome variable (i.e., athlete satisfaction). Assuming adequate fit, the third step is to test a combined effects model that contains both the direct effects and mediated effects. The final step is to conduct a χ^2 difference test to determine whether the model in step 2 fits the data significantly better than the model in step 3. If the step 2 model is of best fit than full mediation is supported. However, if the step 3 model is of best fit than this suggests partial mediation. Further, it should be noted that the standardized parameter estimate (SPE) in step 3 should be reduced for partial mediation or reduced to non-significance compared to those in the step 1 model to support full mediation. When assessing model fit, the following fit indices were examined: the Comparative Fit Index (CFI; Bentler, 1990), the Normative Fit Index (NFI; Bentler & Bonett; 1980), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the Root-Mean-Square Error of Approximation (RMSEA; Browne & Cudeck, 1993), and the Standardized Root-Mean-Square Residual (SRMR; Bentler, 1995). Cut off values for the CFI, NFI, and TLI are adequate when values are above .90 (Bentler, 1990). Cut off values for the

For Cohen's *d* an effect size of .2 to .3 is viewed as a small effect, .5 a medium effect, and .8 to infinity is a large effect (Cohen, 1988).

RMSEA and the SRMR are adequate if the values are below .10 (Browne & Cudeck, 1993). A summary of the results for formal athlete leadership are found in Table III, while results for informal athlete leadership are found in Table IV.

Formal Athlete Leadership

Measurement models. Prior to evaluating the structural models, a confirmatory factor analysis (CFA) was first conducted examining the fit of the appropriate subscales of the YSEQ LSS and ASQ to their hypothesized constructs for each test of mediation. All latent variables were allowed to correlate with one another and their variances were fixed at a value of one. It should be noted that the formal leadership dimension of *autocratic behaviour* was included in all initial measurement models for formal athlete leadership. However, the CFA indicated a less than desirable fit for the models. All factor loadings were significant except for the path from formal task athlete leadership and *autocratic behaviour*. Due to its non-significance within the models, *autocratic behaviour* was removed and the measurement models were reanalyzed. The revised measurement models displayed an improved and acceptable fit with the removal of *autocratic behaviour.* All of the factor loadings were significant indicating that each indicator was an important contributor to the latent variable. Given the positive improvement of the model, the revised measurement models were used in the subsequent testing for mediation.

Formal Task Athlete Leadership, Task Cohesion, & Team Task Athlete Satisfaction

Structural models. The combined effects model demonstrated the best fit to the data suggesting partial mediation (CFI = .98, NFI = .97, TLI = .97, RMSEA = .07, and SRMR = .03). This model predicted 31% of the variance in task cohesion and 68% of the variance in team task athlete satisfaction. The path from formal task athlete leadership to task cohesion was significant (SPE = .56) and the path from task cohesion to team task athlete satisfaction was significant (SPE = .74). Finally, the path from formal task athlete leadership to team task athlete satisfaction was reduced (SPE = .14) suggesting that partial mediation. The χ^2 difference test confirmed that this model was indeed significantly a better fit to the data ($\Delta\ \chi^2$ (-1) = -4.22). Thus, task

Table III
Mediation Models for Formal Athlete Leadership

Model	CFI	NFI	TLI	RMSEA	SRMR	χ^2 (df)
Formal Task Athlete Leadership, Task Cohesion, and Task Team Athlete Satisfaction						
1	.98	.96	.95	.08	.04	19.60 (8)
2	.98	.96	.95	.08	.05	28.66 (13)
3*	.98	.97	.97	.07	.03	24.44 (12)
Formal Task Athlete Leadership, Task Cohesion, and Individual Task Athlete Satisfaction						
1	.92	.91	.85	.14	.06	39.32 (8)
2*	.94	.92	.90	.11	.05	47.99 (13)
3	.94	.92	.89	.12	.06	46.27 (12)
Formal Social Athlete Leadership, Social Cohesion, and Social Athlete Satisfaction						
1	.98	.97	.95	.09	.02	10.88 (4)
2	.95	.93	.90	.13	.09	34.66 (8)
3*	.98	.97	.97	.07	.02	14.63 (7)

Note. * Indicates best fitting model for the data
Model 1 indicates direct effects model
Model 2 indicates mediation model (full mediation)
Model 3 indicates combined effects model (partial mediation)

Table IV
Mediation Models for Informal Athlete Leadership

Model	CFI	NFI	TLI	RMSEA	SRMR	χ^2 (df)
Informal Task Athlete Leadership, Task Cohesion, and Task Team Athlete Satisfaction						
1	.94	.93	.89	.12	.05	33.84 (8)
2	.95	.93	.92	.11	.07	44.48 (13)
3*	.96	.94	.93	.10	.04	39.28 (12)
Informal Task Athlete Leadership, Task Cohesion, and Individual Task Athlete Satisfaction						
1	.92	.91	.86	.13	.06	35.84 (8)
2*	.93	.91	.88	.11	.06	50.72 (13)
3	.93	.91	.88	.12	.06	48.76 (12)
Informal Social Athlete Leadership, Social Cohesion, and Social Athlete Satisfaction						
1	.99	.98	.97	.07	.02	7.53 (4)
2	.96	.94	.92	.10	.07	26.81 (8)
3*	.99	.98	.98	.05	.02	11.21 (7)

Note. * Indicates best fitting model for the data
Model 1 indicates direct effects model
Model 2 indicates mediation model (full mediation)
Model 3 indicates combined effects model (partial mediation)

cohesion partially mediated the relationship of formal athlete leadership and team task athlete satisfaction.

Formal Task Athlete Leadership, Task Cohesion, & Individual Task Athlete Satisfaction

Structural models. The mediation model demonstrated the best fit for the data (CFI = .94, NFI = .92, TLI = .90, RMSEA = .11, SRMR = .05) and predicted 31% of the variance in task cohesion and 61% of the variance in individual task athlete satisfaction. The path from formal task athlete leadership to task cohesion was significant (SPE = .55) as well as the path from task cohesion to individual task athlete satisfaction (SPE = .78) suggesting full mediation. The results of the χ^2 difference test yielded a non-significant difference of $\Delta\ \chi^2$ (-1) = -1.72. Thus, task cohesion fully mediated formal task athlete leadership and individual task athlete satisfaction.

Formal Social Athlete Leadership, Social Cohesion, & Social Athlete Satisfaction

Structural models. The combined effects model demonstrated the best fit for the data (CFI = .98, NFI = .97, TLI = .97, RMSEA = .07, SRMR = .02) and predicted 20% of the variance in social cohesion and 62% of the variance in social athlete satisfaction. The paths from formal social athlete leadership to social cohesion (SPE = .44), and social cohesion to social athlete satisfaction (SPE = .59) were significant. The path from formal social athlete leadership to social athlete satisfaction was reduced (SPE = .32) thus suggesting partial mediation. Results of the χ^2 difference test showed a significant difference of $\Delta\ \chi^2$ (-1) = -20.03, confirming that the combined effects model was the best fit for the data. Thus, social cohesion partially mediated formal social athlete leadership and social athlete satisfaction.

Informal Athlete Leadership

Measurement models. Measurement models were again tested for the appropriate constructs of the YSEQ, LSS, and ASQ. It should be noted that the informal athlete leader dimension of *autocratic behaviour* was omitted from initial analysis due to poor internal consistency. The measurement models demonstrated acceptable fit indices and all factor loadings were significant suggesting that the subscales of the latent variables were important components in the model. Given that the measurement models showed an adequate fit, the structural models were tested without any additional modifications.

Informal Task Athlete Leadership, Task Cohesion, & Team Task Athlete Satisfaction

Structural models. The combined effects model demonstrated the best fit for the data. (CFI = .96, NFI = .94, TLI = .93, RMSEA = .10, SRMR = .04) and predicted 30% of the variance in task cohesion and 69% of the variance in team task athlete satisfaction. The paths were significant from informal task athlete leadership to task cohesion (SPE = .55) and from task cohesion to team task athlete satisfaction (SPE = .73). The path from informal task athlete leadership to team task athlete satisfaction was reduced (SPE = .17), suggesting partial mediation. The χ^2 difference test yielded a significant difference of $\Delta \chi^2$ (-1) = -5.20, indicating that the combined effects model was the best fit to the data, and that task cohesion partially mediated the relationship of informal task athlete leadership and team task athlete satisfaction.

Informal Task Athlete Leadership, Task Cohesion, & Individual Team Athlete Satisfaction

Structural models. The mediation model provided the better fit to the data (CFI = .93, NFI = .91, TLI = .88, RMSEA = .11, SRMR = .06) and predicted 28% of the variance in task cohesion and 61% of the variance in individual task athlete satisfaction. The paths were significant from informal task athlete leadership to task cohesion (SPE = .53) and from task cohesion to individual task athlete satisfaction (SPE = .78). Results of the χ^2 difference test yielded a non-significant difference of $\Delta \chi^2$ (-1) = -1.96. Thus, task cohesion fully mediated the relationship between informal task athlete leadership and individual task athlete satisfaction.

Informal Social Athlete Leadership, Social Cohesion, & Social Athlete Satisfaction

Structural models. The combined effects model demonstrated the best fit to the data (CFI = .99, NFI = .98, TLI = .98, RMSEA = .05, SRMR = .02) and predicted 28% of the variance in social cohesion, and 60% of the variance in social athlete satisfaction. The path from informal social athlete leadership to social cohesion was significant (SPE = .53) and the path from social cohesion to social athlete satisfaction was significant (SPE = .57). The path from informal social athlete leadership to social athlete satisfaction was reduced (SPE = .31), suggesting partial mediation. The χ^2 difference test has a significant difference of $\Delta\ \chi^2$ (-1) = -15.60. Thus, social cohesion partially mediated informal social athlete leadership and social athlete satisfaction.

Discussion

The purpose of this study was to determine if cohesion served as a mediator between athlete leadership and athlete satisfaction in youth sport. The overall findings suggested that both task and social cohesion are potent mediators in this relationship pertaining to both task and social aspects of formal and informal athlete leadership and task and social satisfaction in the youth sport setting. Furthermore, a combination of partial and full mediational relationships were demonstrated which may have implications on current cohesion conceptualization.

It has been suggested that one of the benefits of mediational research is that it helps to test theoretical models (Frazier et al., 2004). The results of this study add further support that Carron's (1982) model is mediational in nature. In addition, the results from this study also expand Carron's theoretical model in two ways. First in his original conceptualization, Carron highlighted that the antecedent of *leadership factors* was related to cohesion. This however was in reference to coaching. The present study offers some empirical evidence that athlete leadership is another source of leadership that warrants inclusion as a leadership factor. Second, Carron's model implies that cohesion serves to fully mediate the relationship between the antecedents and outcomes specified in the model. That is, the antecedents must first pass through cohesion before they can influence the outcomes. However, it should be noted that it is more common in the social sciences to yield findings that indicate the presence of partial mediation as opposed to full mediation (Baron & Kenny, 1986). The results of the present study support this proposition with four of the six models showing cohesion as a partial mediator. As such, group dynamic theoreticians may consider modifying Carron's model to determine whether a direct link should be established between the antecedents and the outcomes. It appears that no other published work (e.g., Loughead & Carron, 2004; Loughead et al., 2001; Loughead et al., 2008; Spink, 1998) has examined the mediational nature of cohesion in this manner; hence these findings are unique and provide new directions for future research.

The results of this study are supported by what has been found in previous research in that athlete leadership is related to both cohesion (e.g., Vincer & Loughead, 2010), and athlete satisfaction (e.g., Eys et al., 2007), and that cohesion is related to athlete satisfaction (e.g., Spink et al., 2005). However, it has also improved on previous research examining athlete leadership and cohesion (Vincer & Loughead, 2010) by assessing both formal and informal athlete leadership behaviours. Results have also improved on the previous work examining cohesion and satisfaction (Spink et al. 2005) as they only assessed task cohesion and task satisfaction through *team integration.* The present study expanded the knowledge by assessing multiple facets of athlete satisfaction. In terms of the mediational nature of cohesion, results are supported through previous research in both sport (e.g., Spink, 1998) and exercise settings (e.g., Loughead & Carron, 2004; Loughead et al., 2001; Loughead et al., 2008). However, the results of the present study also help to improve on some of the limitations in previous cohesion mediation research. First, the results of this study expand the knowledge base by examining cohesion as a mediator in youth sport. These findings are important given that satisfaction in the youth sport context has been shown to have implications on adherence in sport and on the development and socialization of youth (Fraser-Thomas et al., 2008). Second, it expands on previous cohesion mediation research by exploring multiple mediational relationships. For example, the present study examined a number of different leader behaviours with both task and social cohesion. Previous research in sport (e.g., Spink, 1998) focused only on one leader behaviour (i.e., *training and instruction*) and on one dimension of cohesion (i.e., social cohesion). Thus these relationships have been tested to further depth and have shown that multiple leader behaviours can influence both task and social cohesion, which in turn has implications for an athlete's level of satisfaction.

One point worth discussing however in regards to athlete leader behaviours is that of *autocratic behaviour* and its apparent non-significance within the athlete leadership context. In addition, the results from the mean scores for *autocratic behaviour* for both formal and informal athlete leaders was ranked the lowest by the participants indicating that athlete leaders use this type of leadership behaviour the least. This finding is consistent with previous athlete leadership research examining varsity athletes (e.g., Loughead & Hardy, 2005; Vincer & Loughead, 2010) and youth sport athletes (Paradis & Loughead, 2009). Furthermore, in a study examining athlete leader effectiveness, *autocratic behaviour* did not predict leader effectiveness in either formal or informal leaders (Paradis & Loughead, 2010). It may be that this behaviour is simply not relevant in the measurement of athlete leadership or in the context youth sport. Thus, further research is warranted to determine if *autocratic behaviour* is relevant in these domains.

Results of the present study highlight the importance of the interdependence amongst these group dynamic constructs; in that leadership is related to cohesion, leadership is related to satisfaction, and cohesion is related to satisfaction. As such, the findings further support the notion that groups are the multifaceted and complex by nature having task and social concerns (e.g., Hersey & Blanchard, 1969). Future research should assess Carron's (1982) framework with other correlates to determine whether cohesion partially or fully mediates these relationships.

Finally, no study is without limitations and a few should be addressed. One limitation is related to the correlational research design, therefore causality cannot be inferred. Another limitation is that the causal steps approach to testing for mediation has been criticized for some limitations. It has been suggested that this approach can lack in statistical power (Fritz & Mackinnon, 2007). Another criticism of the approach is that it is not based on the quantification of the intervening effect, but rather the indirect effect is determined by a series of hypothesis tests. That is, hypothesis tests may carry a possibility of decision error (Hayes, 2009). However, the noted limitations notwithstanding, our adequate sample size (Tabachnick & Fidell, 2007) and conceptually driven approach supports the adoption of this method to test for mediation. One final limitation pertains to the issue of assessing individual versus nested data. Given the fact we collected in-tact teams, we could have conducted Hierarchical Linear Modeling. However, given that our mediator variable was individual perceptions of cohesion and our outcome variable was individual perceptions of satisfaction, the choice of performing the analysis at the individual level (Carron, Brawley, & Widmeyer, 2002) via Structural Equation Modeling was undertaken.

In summary, the results of the present study confirmed that Carron's (1982) model is mediational in nature. Consequently, the results of this study have made three contributions to the cohesion mediation literature. First, the findings demonstrated that cohesion serves as a mediator in youth sport. Second, both task and social cohesion serve as mediators. Third, cohesion can serve as both a partial and full mediator. Based on these findings, research should continue to examine other antecedents and outcomes within Carron's model.

REFERENCES

Arbuckle, J. L. (2009). *Amos* (18.0). Crawfordville, FL: Amos Development Corporation.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Bentler, P. M. (1990). Comparative fit indices in structural equation modelling. *Psychological Bulletin, 98,* 588-606.
Bentler, P. M. (1995). EQS *structural equation programs manual.* Enchino, CA: Multivariate Software, Inc.
Bentler, P. M., & Bonett, D. G. (1980). Significance tests and the goodness-of-fit in the analysis of covariance structures. *Psychological Bulletin, 107,* 238-246.
Bray, S. R., Beauchamp, M. R., Eys, M. A., & Carron, A. V. (2005). Does the need for role clarity moderate the relationship between role ambiguity and athlete satisfaction? *Journal of Applied Sport Psychology, 17,* 306-318.
Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A.
Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage Publications.
Carron, A. V. (1982). Cohesiveness in sport groups: Interpretations and considerations. *Journal of Sport Psychology*, *4*, 123-138.
Carron, A. V., & Brawley, L. R. (2000). Cohesion: Conceptual and measurement issues. *Small Group Research, 31,* 89-106.
Carron, A. V., Brawley, L. R., & Widmeyer, W. N. (1998). The measurement of cohesiveness in sport groups. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp. 213-226). Morgantown, WV: Fitness Information Technology.
Carron, A. V., Brawley, L. R., & Widmeyer, W. N. (2002). *The Group Environment Questionnaire test manual.* Morgantown, WV: Fitness Information Technology.
Carron, A. V., & Chelladurai, P. (1981). The dynamics of group cohesion in sport. *Journal of Sport Psychology, 3,* 123-139.
Carron, A. V., Colman, M. M., Wheeler, J., & Stevens, D. (2002). Cohesion and performance in sport: A meta-analysis. *Journal of Sport & Exercise Psychology*, *24*, 168-188.
Carron, A. V., Widmeyer, W. N., & Brawley, L. R. (1985). The development of an instrument to assess cohesion in sport teams: The Group Environment Questionnaire. *Journal of Sport Psychology*, *7*, 244-266.
Chelladurai, P. (1978). *A contingency model of leadership in athletics.* Unpublished doctoral dissertation, University of Waterloo, Waterloo, Ontario, Canada.
Chelladurai, P. (1984). Discrepancy between preference and perception of leadership behaviour and satisfaction of athletes in varying sports. *Journal of Sport Psychology, 6,* 27-41.
Chelladurai, P. (2007). Leadership in sports. In G. Tenenbaum & R. C. Eklund (Eds.), *The sport psychology handbook* (pp. 113-135). Hoboken, NJ: Wiley.
Chelladurai, P., & Carron, A. V. (1981). The applicability to youth sports of the Leadership Scale for Sports. *Perceptual and Motor Skills, 53,* 361-362.
Chelladurai, P., & Riemer, H. A. (1994, June). *A model of athlete satisfaction*. Presented at the annual conference of the North American Society of Sport Management, Pittsburgh, PA.
Chelladurai, P., & Riemer, H. A. (1997). A classification of facets of athlete satisfaction. *Journal of Sport Management*, *11*, 133-159.
Chelladurai, P., & Saleh, S. D. (1980). Dimensions of leader behaviour in sports: Development of a leadership scale. *Journal of Sport Psychology*, *2*, 34-45.
Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology, 78,* 98-104.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cumming, S. P., Smith, R. E., & Smoll, F. L. (2006). Athlete perceived coaching behaviours: Relating two measurement traditions. *Journal of Sport & Exercise Psychology, 28,* 205-213.
Eys, M. A., & Carron, A. V. (2001). Role ambiguity, task cohesion and task self-efficacy. *Small Group Research*, *32*, 356-373.
Eys, M. A., Carron, A. V., Bray, S. R., & Brawley, L. R. (2007). Item wording and internal consistency of a measure of cohesion: The Group Environment Questionnaire. *Journal of Sport & Exercise Psychology*, *29*, 395-402.
Eys, M. A., Loughead, T. M., & Hardy, J. (2007). Athlete leadership dispersion and satisfaction in interactive sport teams. *Psychology of Sport and Exercise, 8,* 281-296.
Eys, M. A., Loughead, T. M., Bray, S. R., & Carron, A. V. (2009). Development of a cohesion questionnaire for youth: The Youth Sport Environment Questionnaire. *Journal of Sport & Exercise Psychology*, *31,* 390-408.
Fraser-Thomas, J., Côté, J., & Deakin, J. (2008). Understanding dropout and prolonged engagement in adolescent competitive sport. *Psychology of Sport and Exercise, 9,* 645-662.
Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counselling psychology research. *Journal of Counselling Psychology, 51,* 115-134.
Fritz, M. S., & Mackinnon, D. P. (2007). Required sample size to detect the mediated effect. *Current Directions in Psychological Science, 18,* 16-20.
Golembiewski, R. (1962). *The small group*. Chicago, IL: University of Chicago.
Hayes, A. F. (2009). Beyond Barron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76,* 408-420.
Hersey, P., & Blanchard, K. H. (1969). *Management and Organizational Behaviour*. Englewood Cliffs, NJ: Prentice-Hall.
Heuzé, J. P., Raimbault, N., & Fontayne, P. (2006). Relationships between cohesion, collective efficacy, and performance in professional basketball teams: an examination of mediating effects. *Journal of Sports Sciences, 24,* 59-68.
Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65,* 599-610.
Jeffery-Tosoni, S. M., Eys, M. A., Schinke, R. J., & Lewko, J. (2011). The effect of youth sport status on physical activity and sport participation. *Journal of Sport Behavior, 34,* 150-159.
Jowett, S., & Chaundy, V. (2004). An investigation into the impact of coach leadership and coach athlete relationship on group cohesion. *Group Dynamics: Theory, Research, and Practice*, *8*, 302-311.
Loughead, T. M., & Carron, A. V. (2004). The mediating role of cohesion in the leader behaviour-satisfaction relationship. *Psychology of Sport and Exercise*, *5*, 335-371.
Loughead, T. M., Colman, M. M., & Carron, A. V. (2001). Investigating the mediational relationship of leadership, class cohesion, and adherence in an exercise setting. *Small Group Research*, *32*, 558-575.
Loughead, T. M., Patterson, M. M., & Carron, A. V. (2008). The impact of fitness leader behaviour and cohesion on an exerciser's affective state. *International Journal of Sport and Exercise Psychology*, *6*, 53-68.
Loughead, T. M., & Hardy, J. (2005). An examination of coach and peer leader behaviours in sport. *Psychology of Sport and Exercise*, *6*, 303-312.
Loughead, T. M., Hardy, J., & Eys, M. A. (2006). The nature of athlete leadership. *Journal of Sport Behaviour*, *29*, 142-158.

Lott, A. J., & Lott, B. E. (1965). Group cohesiveness as interpersonal attraction: A review of relationships with antecedent and consequent variables. *Psychological Bulletin*, *64*, 259-309.
MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. New York: Taylor & Francis.
Paradis, K. F., & Loughead, T. M. (2009, November). *Follow the (athlete) leader: Examining factorial validity of two leadership inventories in youth sport*. Presented at the Canadian Society for Psychomotor Learning and Sport Psychology conference, Toronto, ON.
Paradis, K. F., & Loughead, T. M. (2010). Perceptions of formal and informal athlete leader effectiveness in youth sport. *Journal of Sport & Exercise Psychology, 32,* S204-S205.
Price, M. S., & Weiss, M. R. (2000). Relationships among coach burnout, coach behaviours and athletes' psychological responses. *The Sport Psychologist, 14*, 391-409.
Riemer, H. A., & Chelladurai, P. (1995). Leadership and satisfaction in athletics. *Journal of Sport & Exercise Psychology*, *17*, 276-293.
Riemer, H. A., & Chelladurai, P. (1998). Development of the Athlete Satisfaction Questionnaire. *Journal of Sport & Exercise Psychology*, *20*, 127-156.
Riemer, H. A., & Toon, K. (2001). Leadership and satisfaction in tennis: Examination of congruence, gender, and ability. *Research Quarterly*, *72*, 243-256.
Rubin, K. H., Bukowski, W., & Parker, J. (2006). Peer interactions, relationships and groups.
In N. Eisenberg (Ed.), *Handbook of child psychology: Social, emotional, and personality development* (6th ed., pp. 571-645). New York: Wiley.
Schutz, R. W., Eom, H. J., Smoll, F. L., & Smith, R. E. (1994). Examination of the factorial validity of the Group Environment Questionnaire. *Research Quarterly for Exercise and Sport*, *65*, 226-236.
Senécal, J., Loughead, T. M., & Bloom, G. A. (2008). A season-long team building intervention: Examining the effect of team goal setting on cohesion. *Journal of Sport & Exercise Psychology, 30,* 186-199.
Spink, K. S. (1995). Cohesion and intention to participate of female sport team athletes. *Journal of Sport & Exercise Psychology*, *17*, 416-427.
Spink, K. S. (1998). Mediational effects of social cohesion on the leadership behaviour-intention to return relationship in sport. *Group Dynamics: Theory, Research, and Practice, 2*, 92-100.
Spink, K. S., Nickel, D., Wilson, K., & Odonokon, P. (2005). Using a multilevel approach to examine the relationship between task cohesion and team task satisfaction in elite ice hockey players. *Small Group Research, 36,* 539-544.
Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon.
Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika, 38,* 1-10.
Vincer, D. J. E., & Loughead, T. M. (2010). The relationship between athlete leader behaviours and cohesion in team sports. *The Sport Psychologist*, *24*, 448-467.
Weiss, M. R., & Friedrichs, W. D. (1986). The influence of leader behaviours, coach attributes and institutional variables on performance and satisfaction of collegiate basketball teams. *Journal of Sport Psychology*, *8*, 332-346.
Westre, K. R., & Weiss, M. R. (1991). The relationship between perceived coaching behaviours and group cohesion in high school football teams. *The Sport Psychologist*, *5*, 41-54.

Manuscript submitted March 2011- Accepted for publication February 2012.

Int. J. Sport Psychol., 2012; 43: 137-152

Motor expertise influences strike and ball judgements in baseball

ROUWEN CAÑAL-BRULAND*, CHRISTOPH KREINBUCHER**
and RAÔUL R.D. OUDEJANS*

(*) MOVE Research Institute Amsterdam, Faculty of Human Movement Sciences, VU University, Amsterdam, The Netherlands
(**) Department of Sport Psychology, Faculty of Sport and Health Sciences, TU University, Munich, Germany

There is initial evidence to suggest that next to perceptual experience motor experience might also contribute to anticipatory judgements in sports. In the current paper, we further examined this intriguing issue by testing whether motor experience influences ball and strike judgements in baseball. To this end, experienced players, umpires and novices group were presented with video-clips of baseball pitches projected on a large screen and were asked to judge whether the observed pitches were strikes or balls. In two blocked conditions, participants either provided their response verbally or they indicated their repsonse motorically by actually swinging (or not swinging) the bat. Our results showed that independent of response mode experienced players were significantly more accurate than novices and also tended to outperform the umpires, indicating that motor experience seems to contribute to perceptual judgements. These differences could not be accounted for by the tendency to favor strike over ball judgements as this tendency seemed to be prevalent in all groups, particularly in the motor response condition when compared to the verbal response condition. We conclude that motor expertise may have beneficial effects on umpiring performance in baseball.

KEY WORDS: Expertise, Action, Perception, Judgements, Umpiring.

1. Introduction

Over the last three decades abundant evidence has been accumulated across several fast ball sports showing that experts are superior in making anticipatory judgements when compared to their less skilled counterparts

---

Correspondence to: Rouwen Cañal-Bruland, PhD, MOVE Research Institute, Faculty of Human Movement Sciences, VU University Amsterdam, Van der Boechorststraat 9. 1081 BT Amsterdam, The Netherlands (e-mail: r.canalbruland@vu.nl).

and novices (see Abernethy, 1990; Land & McLeod, 2000; Müller, Abernethy & Farrow, 2006; Williams, Ward, Knowles & Smeeton, 2002). A common explanation for this superiority of experts is that expert athletes have been more often exposed to the corresponding sport-specific situations as a result of which they are perceptually better attuned to the task-relevant information (e.g., Abernethy & Zawi, 2008; Jackson, Warren & Abernethy, 2006; Mann, Williams, Ward & Janelle, 2007; Van der Kamp, Rivas, Van Doorn & Savelsbergh, 2008).

However, recent empirical findings cast doubt on whether only the better perceptual attunement to task-specific information accounts for superior anticipation skills. In fact, Aglioti, Cesari, Romani and Urgesi (2008) provided initial evidence to suggest that motor expertise also contributes to expert anticipation skills. In their study, expert basketball players, expert coaches and journalists who were assumed to possess comparable visual experience (but no motor expertise), and a control group without any basketball experience predicted the outcome of progressively occluded video clips of basketball free-throws. Results revealed that skilled basketball players predicted the outcome of free throws earlier and more accurately than coaches, sports journalists and the control group. Consequently, Aglioti et al. (2008) concluded that motor expertise contributes to anticipating the outcome of others' actions. On the one hand, the findings reported by Aglioti and colleagues are consistent with both behavioral studies (Casile & Giese, 2006; Knoblich & Flach, 2001; Loula, Prasad, Harber & Shiffrar, 2005) and neuro-scientific evidence (Calvo-Merino, Glaser, Grèzes, Passingham & Haggard, 2005; Calvo-Merino, Grèzes, Glaser, Passingham & Haggard, 2006) that support the idea that individuals are perceptually better attuned to actions that are part of their own motor repertoire (see also Schütz-Bosbach & Prinz, 2007). On the other hand, the conclusions drawn by Aglioti et al. (2008) would be weakened if it appeared that coaches and/ or sports journalists had accumulated considerable motor expertise as players in the past (Cañal-Bruland, van der Kamp & van Kesteren, 2010). Indeed, in this respect, one of the most acknowledged problems in sports-related studies is that perceptual experience is often closely linked to (in terms of experimental approaches one might say "is confounded with") motor experience (Cañal-Bruland & Schmidt, 2009; Cañal-Bruland et al., 2010; Sebanz & Shriffrar, 2009).

In an attempt to disentangle and examine the involvement of motor and perceptual experience in detecting deceptive intentions, Cañal-Bruland et al. (2010) recently manipulated viewing perspective as an additional demarcation. Cañal-Bruland and colleagues (2010) invited handball goalkeepers, field players, and novices to watch video clips of a player performing penalty shots and to judge whether the player would actually throw the ball or just fake a throw. The video clips of normal and deceptive shots ended just before the ball left the hand of the penalty taker. To dissociate the contributions of perceptual and motor experience, Cañal-Bruland et al. (2010) adopted two viewing perspectives, a frontal view and a side view perspective. They predicted that if motor experience had an added value to perceptual judgements, then field players who were considered to be motor experts should outperform the keepers independent of viewing perspective, whereas if perceptual experience is crucial for perceptual judgements, then goalkeepers should be more accurate in judging deceptive movements from the frontal view because they gained much more familiarity with this view than the players (cf. Prasad & Shiffrar, 2009). Results indicated that expert players and goalkeepers outperformed novices in detecting deceptive intentions. However, there were no differences between field players and goalkeepers across viewing perspectives. In general, the detection of deceptive actions was more accurate from the goalkeeper's front view than from a side view. Cañal-Bruland et al. (2010) concluded that the manipulation of viewing perspective does not seem to allow for a clear-cut dissociation of the individual contributions of motor and perceptual experience and highlighted that alternative experimental manipulations are needed to unravel the respective contributions of motor and perceptual experience.

In the present paper we aimed to provide such an alternative approach to disentangle the contributions of motor and perceptual expertise to anticipatory judgements. One of the experimental problems of the approach taken by Cañal-Bruland et al. (2010) is that not only motor but also perceptual experience, in terms of visual familiarity with specific viewing perspectives, differed between the experimental groups (i.e., the players and the goalkeepers). Hence, to identify the possibly additional impact of motor expertise, a situation must be sought in which two groups that differ in motor expertise do not differ in quantity (amount of experience) and visual familiarity (i.e., viewing perspective) regarding their perceptual experience. A natural setting that fulfills these criteria is *baseball*. In baseball both umpires and batters view pitches from nearly the same vantage point. That is, umpires are positioned a few centimeters behind and in alignment with the batter both viewing straight to the pitcher, thereby ruling out viewing perspective differences. Umpires and players have thus very similar visual experience, while only players possess considerable motor expertise.

With the aim to examine whether motor expertise has an additional impact on anticipatory judgements, in the current study, we therefore invited expert baseball players, expert umpires, and a control group to make “ball” and ”strike” judgements based on baseball pitches presented as video clips on a large screen (for a similar design, see MacMahon & Starkes, 2008). In baseball, balls that are pitched towards the batter are judged as to whether they enter the ‘strike zone‘ (referred to as a strike) or not (referred to as a ball). The strike zone is a virtual zone defined by the height of the batter (from knee to shoulder) and the dimensions of the home plate (see Figure 1 in the Method section).

In addition, we used two experimental conditions that differed in response mode: While umpires typically verbalize strikes, players have to swing their bat. We therefore applied a verbal judgement condition (saying out loud whether the pitch was a strike or a ball) and a task-specific motor response (swinging the bat in case the pitch was judged a strike or not swinging the bat if it was a ball). We applied these two conditions for two main reasons:

First, in contrast to earlier studies that asked for task-unspecific button press responses (Aglioti et al., 2008; Cañal-Bruland et al., 2010), we sought to provide a representative task design by asking for task-specific reactions (see Araújo, Davids, & Passos, 2007). The importance of representative task designs (Brunswik, 1956) has recently received further empirical support by studies showing that dependent on the task design different information may be relied upon when making anticipatory judgements. For example, Dicks, Button and Davids (2010) found that goalkeepers applied different gaze strategies in experimental conditions in which movements were limited or constrained (i.e., verbal response conditions, simplified body movement conditions) when compared to an in situ interception condition, in which goalkeepers were able and required to move as in the on-field situation. Going beyond its methodological merits, this research also seems to provide further support for the two-visual systems model (Milner & Goodale, 1995) in that perception and action may rely upon different sources of information dependent on the task (Van der Kamp et al., 2008).

Second, if motor expertise generally (and thus response-mode-independently) adds to perceptual expertise – as can be hypothesized based on the theoretical and empirical grounds that argue that individuals are perceptually better attuned to actions that are part of their own motor repertoire (see also Schütz-Bosbach & Prinz, 2007) – then expert players should not only outperform the umpires in the motor response task, but also in the verbalization task.

2. Method

2.1. Participants

A total of 44 participants[1] (one female) took part in the experiment. 16 skilled baseball players (*M* = 25.6 years; *SD* = 6.6), 16 experienced baseball umpires (*M* = 42.5 years; *SD* = 9.9) and 12 novices (*M* = 25.8 years; *SD* = 8.7) participated voluntarily. From the 16 experienced baseball players, nine played in the highest, four in the second highest league in the Netherlands and three in an equivalent league abroad. The mean playing experience was 17.8 (*SD* = 5.9) years and on average they played 9.0 games a month (*SD* = 3.6). The baseball referees had an experience in umpiring of 13.3 (*SD* = 9.4) years and on average they umpired 5.0 games per month as home plate umpire (*SD* = 1.6). They also had gained playing experience in lower divisions (*M* = 14.3 years; *SD* = 11.5). As the motorically experienced umpires never achieved higher proficiency levels, in contrast to the players, we did not consider them as motor experts. Concerning the watching experience, players watched more live games either on TV and on the internet (*M* = 7.3 hours a week; *SD* = 7.5) or in the stadium (*M* = 1.4 hours a week; *SD* = 2.5) when compared to the umpires (TV/internet: *M* = 2.4 hours a week; *SD* = 2.8; live: *M* = 0.6 hours a week; *SD* = 0.7). Given the amount of participation and watching reported, it seems reasonable to argue that both the umpire group as well as the baseball players posses a high degree of perceptual experience. The novices had no active baseball experience, no experience in live watching and hardly any experience watching baseball on TV or internet (*M* = 0.1 hours a week; *SD* = 0.3). All participants had normal or corrected to normal vision. The experiment was conducted in accordance with the Institution's ethical guidelines and informed consent was obtained prior to participation.

2.2. Apparatus and stimulus production

One left- and one right-handed skilled baseball pitcher from the highest national league were asked to perform several pitches to record the

[1] Note that originally 48 participants took part in the experiment. We had to exclude four participants in the novice group from further data analysis because after the experiment they reported to have significant watching experience with baseball (i.e., 1 hour or more per week).

video footage. A digital video camera (Canon XM1, 25 Hz) was positioned three meters behind the home plate at a height of 1.5 meters, which is about the height of an umpire standing ready to judge. Whereas the camera height closely matches the normal viewing perspective of umpires, the distance between the batter and the umpire, who is typically directly positioned behind the catcher at the home plate, may be closer on the field than is represented in the video (see Figure 1). Despite this potential limitation, the actions were captured from this viewing perspective to simulate the perspective players and umpires share during a game as close as possible. Moreover, to avoid any influences of the judgements by the catcher's reaction, the angle of the camera was adjusted so that the catcher ducking in front of the camera was not visible in the clips (see Figure 1).

Figure 1. - View of a video clip with the left-handed pitcher as projected on a screen. For clarification, the dimensions of the strike zone are illustrated. Note that the strike zone is a virtual zone defined by the height of the batter (from knee to shoulder) and the dimensions of the home plate. A ball thrown in this zone is called a "strike", and outside the zone a "ball".

In this way we were able to control for the sources of information used for the judgements. Yet, it needs to be acknowledged that umpires may be influenced by catchers' reactions in real games. The two pitchers were advised to aim as close as possible to the side edges of the strike zone. While one pitcher was throwing his pitches the other one was standing as a right-handed batsman at the home plate ready to make a swing. The batter was only used as reference point to appraise the strike zone and did not make any movements other than normal movements in preparation of batting (see Figure 1).

To evaluate whether the pitches presented in the video clips were "balls" or "strikes", three experienced referees who did not participate in the experiment were individually presented with 120 clips two times. From the total number of clips, finally 60 clips were selected for the experiment. The minimum inclusion criterion was that five from six judgements (each referee gave two judgements per clip) were congruent (note that actually for 50 clips judgements were a 100% congruent). In total, 30 clips of each pitcher were used for the experimental setting, with half of the clips being "balls" and half of them being "strikes". The duration of each clip was approximately 2.5 seconds (range 2.16 - 2.76 sec, $M = 2.46$; $SD = 0.15$). The clips started with a prepatory movement of the pitcher to make his pitch (i.e., when he lifted his foot) and stopped at the moment the catcher caught the ball. Between clips there were five second intertrial-intervals. The order of the blocked response modes (i.e., motor and verbal response) were counterbalanced. Within each of the response modes left and right-handed pitches were presented in blocks. The video clips within the blocks were presented at random.

To measure response times, for the verbal and motor response modes two different sets of equipment were used. In the verbal response condition, response times were measured using a microphone which was directly connected to a computer automatically registering the sound of the response. In the motor condition, we used an accelerometer that was positioned on the players' bat to determine the response times. This method provided us with three signals (i.e., for the x, y, z – axis) that allowed to monitor whether there was a swing, whether a swing was stopped as well as the moment of the initiation of a swing. Signals of the microphone and the accelerometer were collected with the help of LabVIEW 2010 and synchronized to the beginning and end of the projection of a video clip which served as reference points for the calculation of response times.

2.3. Procedure

The participants were tested individually. Video clips were projected on a large screen (dimensions of projection = 2 x 2.3 meters) to simulate the real-world scenario. The distance between screen and the participant was approximately 2.5 meters, providing a viewing angle of the pitcher that closely resembled the viewing angle in a real baseball game. The participants were told that they would be shown a total of 120 video clips of baseball pitches in two blocks of 60 video clips each. They were also informed that the player standing at the bat served as a reference for the strike zone (but would not respond to the pitch), and that no catcher would be visible. Participants were informed that there were two different conditions: In the verbal condition participants were instructed to call out loud and as fast as possible whether the pitch was a "ball" or a "strike". For the motor response task participants were given a standard baseball bat and they were asked to perform a real swing and simulate to hit the ball if they classified the pitch to be a "strike" and stand still or stop swinging to indicate a "ball". Prior to data collection, the participants were presented with six examples (three "balls" and three "strikes") for every condition and pitcher. The familiarization clips were not included in the main experiment. For the practice trials the experimenter indicated whether it was a "ball" or a "strike". Finally, they also completed a questionnaire about their experience with baseball and sociodemographic data. An entire experimental session took approximately 35 minutes. The two experimental conditions as well as the clips of the right or left-handed pitcher were counterbalanced.

2.4. Data analysis

As dependent variables we analysed both response accuracies and response times. First, we subjected the percentage scores for correct responses to a mixed-design ANOVA with response mode (verbal vs. motor response) as the within-subject factor and the degree of experience (skilled players, umpires and novices) as the between-subject factor. Second, we analysed the number of strike judgements (independent of whether they were accurate or not) to examine whether a tendency for strike judgements may have influenced the accuracy scores.[2] Therefore, for each group we per-

[2] Note that analyses on the number of ball judgments are redundant with analyses on number of strike judgments. That is, if there are significantly more strike judgments than chance, that would imply significantly less ball judgments than chance.

formed one-sample *t*-tests to determine whether the number of strike judgements in the verbal and motor conditions were significantly different from 30, which would be the prediction on the basis of chance. Finally, the reaction times were analysed with a 2 (verbal, motor) x 3 (skilled players, umpires and novices) ANOVA.

Post-hoc (Bonferroni-corrected) pairwise comparisons were administered to further explore differences between means. The alpha level for significance was set at .05. Effect sizes were calculated as partial eta squared values ($\eta_p{}^2$).

3. Results

Response accuracy

A 2 (verbal vs. motor response) x 3 (skilled players, umpires and novices) ANOVA revealed significant main effects for response condition, $F(1, 41) = 89.94$, $p < .001$, $\eta_p{}^2 = .69$, and group, $F(2, 41) = 6.35$, $p = .004$, $\eta_p{}^2 = .24$. Participants responded significantly more accurate in the verbal

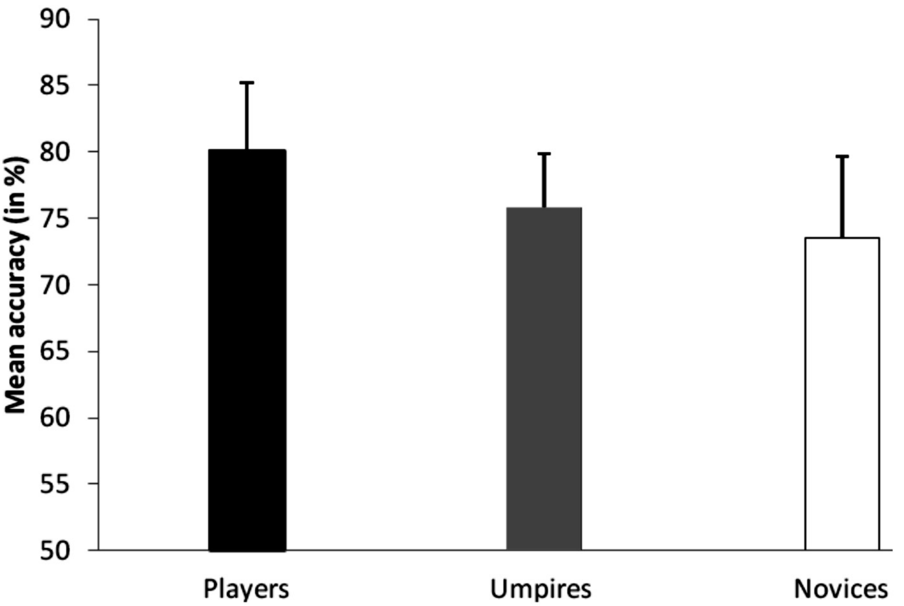

Figure 2. - Mean accuracy scores (in %) for the groups (players, umpires and novices). Note that the y-axis starts at 50%.

response condition (M = 82.54%; SD = 6.12%) than in the motor response condition (M = 70.98%; SD = 7.89%). Bonferroni-corrected post-hoc comparisons of the main effect for group revealed that skilled players (M = 80.16%) were significantly more accurate than novices (M = 73.54%, p = .004) and also tended to outperform the umpires (M = 75.78%, p = .056; see Figure 2). There was no significant difference between the umpires and the novices. There was no interaction effect for response condition x group, $F(2, 41) = 2.15$, $p = .13$, $\eta_p^2 = .10$.

Tendencies: strike vs. ball judgements

To examine whether a bias for either ball or strike judgements may have influenced the accuracy scores between groups, we further subjected the absolute number of strike judgements (independent of whether they were accurate or not) to separate one-sample t-tests. Results revealed that in the motor condition all groups judged significantly more pitches as strikes than would be predicted on the basis of chance, for players $t(15) = 4.6$, for umpires $t(15) = 3.9$, for novices $t(11) = 4.0$, all ps < .005. (see Figure 3). In the

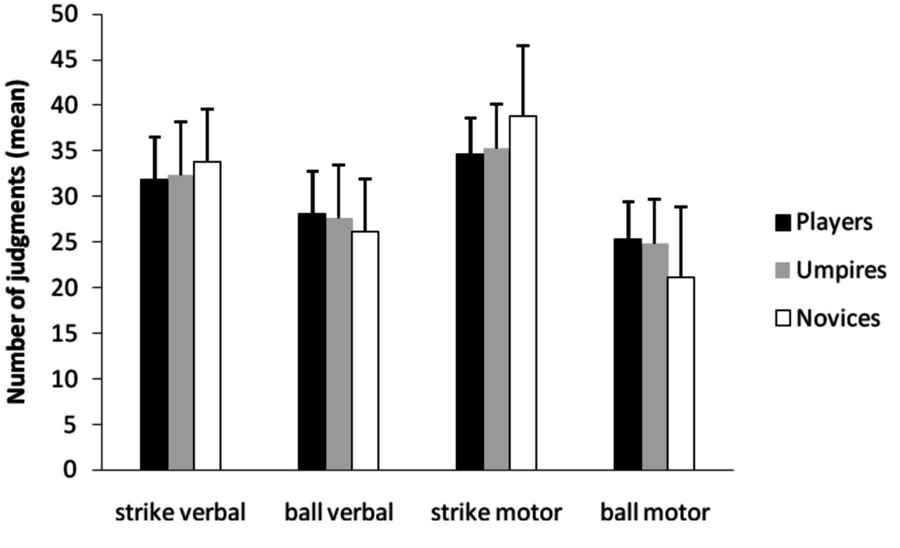

Figure 3. - Mean number of ball and strike judgements across the verbal and motor response conditions and groups (players, umpires and novices).

verbal condition this was only the case for the novices, $t(11) = 2.3$, $p < .05$ (for players and umpires, ts < 1.7, ps $> .16$). Thus, overall the bias for strike judgements seemed to be evident to a similar degree in all three groups, particularly players and umpires.

Response times

Finally, we subjected the response times to a 2 (verbal vs. motor response) x 3 (skilled players, umpires and novices) ANOVA. Results revealed a significant main effect for response condition, $F(1, 37) = 348.31$, $p < .001$, $\eta_p{}^2 = .90$ (see Figure 4).

Participants reacted significantly faster in the motor response (i.e., before the video-clips ended) than in the verbal response condition. There was neither a significant main effect for group, nor was there an interaction between response condition and group.

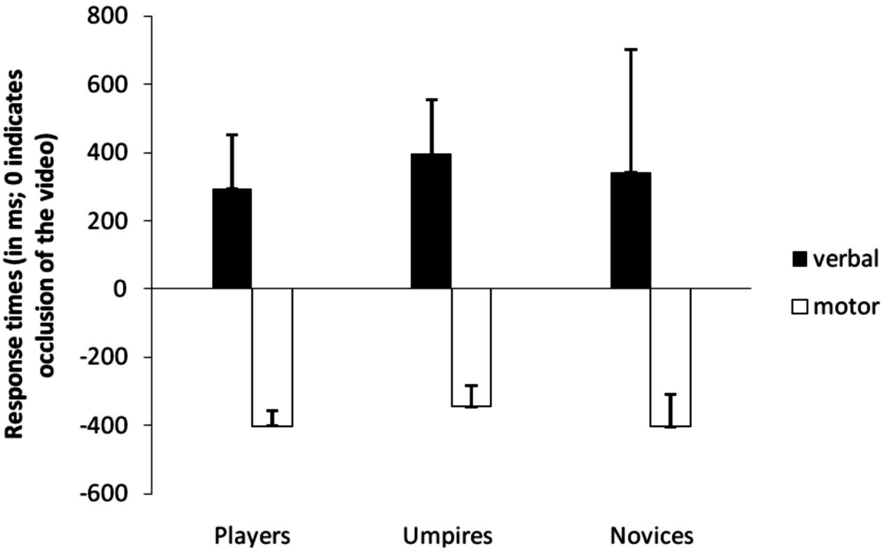

Figure 4. - Response times (in ms) for the experimental conditions (verbal vs. motor) and groups (players, umpires and novices). 0 indicates the moment of occlusion of the video clip.

4. Discussion

Recent findings in the domain of sport seem to suggest that motor expertise influences cognitive processes such as when making anticipatory judgements about the outcome of basketball free-throws (e.g., Aglioti et al., 2008), thereby confirming the idea that individuals are perceptually better attuned to actions that are part of their own motor repertoire (see e.g., Schütz-Bosbach & Prinz, 2007). Yet, several authors examining the influence of motor expertise on anticipatory judgements critically highlight that disentangling motor from perceptual expertise is somewhat troublesome (e.g., Cañal-Bruland et al., 2010; Sebanz & Shiffrar, 2009). One particular concern is that the perceptual experience – which is often (erroneously) considered as comparable between certain experimental groups such as players and coaches (Aglioti et al., 2008) or players on different positions (Cañal-Bruland & Schmidt, 2009) – differs between experimental groups as regards, for example, viewing perspective. To examine this issue, Cañal-Bruland and colleagues (2010) recently manipulated viewing perspective in a deception detection task in handball. However, their results did not lead to clear-cut conclusions. In fact, they concluded that the manipulation of viewing perspective may not be suitable to dissociate the individual contributions of motor and perceptual expertise. Consequently, to identify an additional impact of motor expertise, it seems more promising to examine a situation in which two groups that differ in motor expertise but do not differ in quantity (amount of experience) and visual familiarity (i.e., viewing perspective) regarding their perceptual experience. Baseball provides such a setting as batters and umpires view the pitches from nearly the same vantage point.

Therefore, in the current paper we asked baseball expert umpires and batters as well as a control group without baseball experience to judge baseball pitches as balls or strikes (see also MacMahon & Starkes, 2008). In accordance with the hypothesis that motor expertise influences perceptual judgements, results revealed that baseball players tended to be more accurate than umpires ($p = .056$) and significantly outperformed the novices in judging whether a pitch was a ball or a strike. Hence, our results seem to confirm earlier findings that motor expertise contributed to cognitive processes involved in anticipatory judgements in basketball (Aglioti et al., 2008). In the same vein, our findings do also seem to support the idea that individuals are perceptually better attuned to actions that are part of their own motor repertoire (see also Schütz-Bosbach & Prinz, 2007).

Importantly, the superiority of the players (i.e., the motor experts) was independent of the response mode and was not influenced by response biases, as all three groups showed a slight – but overall not different – tendency to favor strike judgements over ball judgements (see also MacMahon & Starkes, 2008, who reported a similar bias towards strike judgements in umpires). This general tendency to favor strike over ball judgements may be accounted for by the umpires normative rule to 'hasten the game' (see MacMahon & Starkes, 2008). MacMahon and Starkes argue that umpires desire to hasten the game and are thus likely to call strikes. We are not aware of any statistics that may support this claim. However, if true, then this may at least explain why umpires and also expert players (who are then actually more often confronted with strike judgements) showed this tendency.

In addition, results revealed that participants were more accurate in the verbal than in the motor response condition. While this would be generally expected for umpires it may come as a surprise for the baseball players who are motor experts. Yet, this finding can be explained by the response times that significantly differed between the two conditions. In the verbal response condition participants responded later, that is, after the videosclips had ended. By contrast, in the motor response condition, participants swung their bats significantly earlier in order to simulate hitting the ball. That is, for the verbal response more and later information of ball flight could be used to judge whether the pitch ended up in the strike zone, whereas for the motor response less and earlier information was used, thereby explaining the lower accuracy scores in the batting response condition across groups. Note that as such judgements in the verbal response condition may not have been entirely anticipatory in nature.

In addition to this compelling methodological explanation, and from the view of the two-visual systems model, one could also question whether our motor response task may not have triggered the use of optical information sources that typically come with 'vision for action', but rather still tapped into 'vision for perception' (Milner & Goodale, 1995). This line of reasoning would be supported by recent findings showing that if participants are required to simulate a motor-task in the lab different sources of information may be used than when actually performing the task in situ (see Dicks et al., 2010). In fact, we critically acknowledge that our attempt to provide a representative task design using a simulated batting response compared to verbal responses is not equivalent to the on-field situation. In line with this argument, we reason that independent of the response mode, that is, in the motor and verbal response conditions the task remained a visual judgement task (i.e., 'vision for perception'). Therefore, we clearly support the call for more in situ research to acquire knowledge about which sources of optical information are exploited for vision for action. Such research may overcome some of the methodological limitations of our experiment. First, if the study was conducted in the field then the umpire's exact positioning, including the view of the catcher, could be guaranteed. Second, 3D rather than 2D visual information would be provided. Note however that in our experiment 2D information did not have a crucial impact on the results as it is well known that in 2D scenarios, it is easier to visually pick-up throwing or shooting direction than depth information (Cañal-Bruland, Mooren & Savelsbergh, 2011; see also Isaac & Finch, 1983). Notably, the strike or ball judgement task asked to judge directional deviations of ball flight rather than deviations in depth.

Despite these limitations, based on our current findings, we may conclude that within vision for perception the use of information does not seem to depend on the nature of the response (see also Dicks et al., 2010). Nevertheless, and in keeping with previous findings (e.g., Aglioti et al., 2008), our results seem to provide further empirical support for the idea that motor expertise facilitates cognitive processes involved in making anticipatory judgements. While certainly more empirical work is needed to support these initial findings, the practical implications may have impact on future selection and trainings of umpires. Given our findings, it may be wise to not only consider video trainings for improving judgements in umpires, but to make sure that umpires generate motor proficiency in batting. This increase in motor proficiency may help to inform visual judgements when umpiring. Finally, while the superior performance of baseball players when compared to umpires and novices seems to support the idea that motor expertise may facilitate perceptual and cognitive processes such as when umpiring and judging whether a baseball pitch is a ball or a strike, there was no significant difference in judging performance between the umpires and the novices. One possible explanation for the quite high performance of the novice group may be that most of them had experience with playing racket sports such as tennis. We cannot rule out that the experience with tennis may have caused transfer effects to the baseball task, as tennis players also have to predict ball trajectories and make sure that a fast approaching ball will end up in a rather small area (i.e., the surface of the racket). On the one hand, future studies should carefully pre-examine motor experiences across a wider range of physcial activities and, if necessary, de-select participants to rule out possible unwanted transfer effects. On the other hand, the issue of transfer from one motor skill to another is clearly underresearched. More research is needed to examine in how far motor experience in one task transfers to the execution of another.

To conclude, in keeping with the proposal that observers are perceptually better attuned to actions that form part of their own motor experience (see e.g., Schütz-Bosbach & Prinz, 2007), our results show that baseball players were more accurate in judging pitches as strikes or balls than motorically and perceptually unexperienced control participants and also tended to outperform motorically less experienced, but perceptually equivalently experienced umpires. While future work is needed to corroborate and support our initial findings, it seems that motor experience may have beneficial effects on umpiring performance in baseball.

REFERENCES

Abernethy, B. (1990). Anticipation in squash: Differences in advance cue utilization between expert and novice. *Journal of Sports Sciences, 8*, 17-34.

Abernethy, B. & Zawi, K. (2008). Pick-up essential kinematics underpins expert perception of movement patterns. *Journal of Motor Behavior, 39*, 353-367.

Aglioti, S. M., Cesari, P., Romani, M. & Urgesi, C. (2008). Action anticipation and motor resonance in elite basketball players. *Nature Neuroscience, 11*, 1109-1116.

Araújo, D., Davids, K., & Passos, P. (2007). Ecological validity, representative design, and correspondence between experimental task constraints and behavioral setting: Comment on Rogers, Kadar, and Costall (2005). *Ecological Psychology, 19*, 69-78.

Brunswik, E. (1956). *Perception and the representative design of psychological experiments* (2nd ed.). Berkeley: University of California Press.

Calvo-Merino, B., Glaser, D. E., Grèzes, J., Passingham, R. E. & Haggard, P. (2005). Action observation and acquired motor skills: An fMRI study with expert dancers. *Cerebral Cortex, 15*, 1243-1249.

Calvo-Merino, B., Grèzes, J., Glaser, D. E., Passingham, R. E. & Haggard, P. (2006). Seeing or doing? Influence of visual and motor familiarity in action observation. *Current Biology, 16*, 1905-1910.

Cañal-Bruland, R., van der Kamp, J. & van Kesteren, J. (2010). An examination of motor and perceptual contributions to the recognition of deception from other's action. *Human Movement Science, 29*, 94-102.

Cañal-Bruland, R., Mooren, M. & Savelsbergh, G.J.P. (2011). Differentiating experts' anticipatory skills in beach volleyball. *Research Quarterly for Exercise and Sport, 82*, 667-674.

Cañal-Bruland, R. & Schmidt, M. (2009). Response bias in judging deceptive movements. *Acta Psychologica, 130*, 235-240.

Casile, A. & Giese, M. A. (2006). Non-visual motor learning influences the recognition of biological motion. *Current Biology, 16*, 69-74.

Dicks, M., Button, C., & Davids, K. (2010). Examination of gaze behaviors under in situ and video simulation task constraints reveals differences in information pickup for perception and action. *Attention, Perception & Psychophysics, 72*, 706-720.

Green, D. M. & Swets, J. A. (1966). *Signal detection theory and psychophysics*. New York: Wiley.

Isaacs, L. D. & Finch, A. E. (1983). Anticipatory timing of beginning and intermediatetennis players. *Perceptual and Motor Skills, 57*, 451-454.

Jackson, R. C., Warren, S. & Abernethy, B. (2006). Anticipation skill and susceptibility to deceptive movements. *Acta Psychologica, 123*, 355-371.

Knoblich, G. & Flach, R. (2001). Predicting the effects of actions: Interactions of perception and action. *Psychological Science, 12*, 467-472.
Land, M. F. & McLeod, P. (2000). From eye movements to actions: how batsmen hit the ball. *Nature Neuroscience, 3*, 1340-1345.
Loula, F., Prasad, S., Harber, K. & Shiffrar, M. (2005). Recognizing people from their movement. *Journal of Experimental Psychology: Human Perception & Performance, 31*, 210-220.
MacMahon, C. & Starkes, J. L. (2008). Contextual influences on baseball ball-strike decisions in umpires, players and controls. *Journal of Sports Sciences, 26*, 751-760.
Mann, D. T., Williams, A. M., Ward, P. & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: A meta-analysis. *Journal of Sport & Exercise Psychology, 29*, 457-478.Milner, A.D., & Goodale, M.A. (1995). *The visual brain in action*. Oxford: Oxford University Press.
Müller, S., Abernethy, B. & Farrow, D. (2006). How do world-class cricket batsman anticipate a bowler's intention? *Quarterly Journal of Experimental Psychology, 59*, 2162-2186.
Prasad, S. & Shiffrar, M. (2009). Viewpoint and the recognition of people from their movements. *Journal of Experimental Psychology: Human Perception & Performance, 35*, 39-49.
Schütz-Bosbach, S. & Prinz, W. (2007). Perceptual resonance: action-induced modulation of perception. *Trends in Cognitive Sciences, 11*, 349-355.
Sebanz, N. & Shiffrar, M. (2009). Bluffing Bodies: Inferring intentions from actions. *Psychonomic Bulletin & Review, 16*, 170-175.
Van der Kamp, J., Rivas, F., van Doorn, H. & Savelsbergh, G. J. P. (2008). Ventral and dorsal contributions in visual anticipation in fast ball sports. *International Journal of Sport Psychology, 39*, 100-130.
Williams, A. M., Ward, P., Knowles, J. M. & Smeeton, N. J. (2002). Anticipation skill in a real-world task: Measurement, training, and transfer in tennis. *Journal of Experimental Psychology: Applied, 8*, 259-270.

Manuscript submitted May 2011. Accepted for publication April 2012.

Int. J. Sport Psychol., 2012; 43: 153-175

Chinese translation of the Flow State Scale-2 and the Dispositional Flow Scale-2: Examination of factorial validity and reliability

WEINA LIU*, XUETAO LIU*, LIU JI**, JACK C WATSON II***, CHENGLIN ZHOU****, *and* JIAXIN YAO*

(*) Tianjin University of Sport, Popular Republic of China
(**) East China Normal University, Popular Republic of China
(***) West Virginia University. USA
(****) Shanghai University of Sport, Popular Republic of China

The purpose of this study was to examine the factorial validity and reliability of Chinese versions of the Flow State Scale-2 (CFSS-2) and the Dispositional Flow Scale-2 (CDFS-2). Within this study, 948 Chinese undergraduate students completed the 36-item Chinese versions of the CFSS-2 and the CDFS-2. Thirty three items were identified for each instrument. Following these initial analyses, another 1223 participants completed the 33-item revised scales. Results of a series of confirmatory factor analyses from this round of assessment revealed that the data for the CFSS-2 and CDFS-2 were represented appropriately by the hypothesized nine-factor first-order model. For both scales, internal consistency estimates for all factors were satisfactory; and the stability of the CDFS-2 (n=182) over time was medium to high. The findings provide support for the validity and reliability of the CFSS-2 and CDFS-2 in assessing flow in physical activities for Chinese participants.

KEY WORDS: Factorial validity, Reliability.

Based on the premise that participation in sport is inherently pleasurable (Fournier et al., 2006), interest in the study of flow experiences in physical activity has grown as the field of sport and exercise psychology has come to recognize the importance of the positive side of sport experiences (Jackson & Eklund, 2002). As an optimal psychological state, flow represents those moments when everything comes together for the performer; it is of-

Special thanks to Dr. Amanda Visek, Heather Deaner, Jessica Creasy, Katherine Cowan, Justine Vosloo, and Jamie Shapiro for their help with the data collection in America.

Correspondence to: Weina Liu (e-mail: weina1978@126.com). Liu Ji (e-mail: lji@tyxx.ecnu.edu.cn), and Jack Watson (e-mail: jack.watson@mail.wvu.edu).

ten associated with high levels of performance and a very positive experience (Jackson & Eklund, 2004). In accordance with other psychological concepts employing a state-trait distinction, Jackson, Kimiecik, Ford, and Marsh (1998) proposed that flow is a specific psychological state, amendable to state-based assessments (state flow), and also that people differ in their propensity to experience flow on a regular basis (trait flow).

Csikszentmihalyi (1990) presented nine characteristics of flow state, each representing a distinctive conceptual dimension of the flow experience: challenge-skills balance, action-awareness merging, clear goals, unambiguous feedback, total concentration on the task at hand, sense of control, loss of self-consciousness, transformation of time, and autotelic experience. Qualitative studies have indicated that athletes experience these nine characteristics during flow (Fournier et al., 2006).

A great challenge in flow research, as with any research involving subjective experiences, is finding ways to accurately and reliably assess the constructs of interest. Believing that flow is too important to ignore, and to provide a measurement instrument that can be applied easily in physical activity settings, Jackson (2000) has attempted to develop ways to research flow in sport that may help to define the experience and make it more accessible to both researchers and practitioners. Based on the above-mentioned nine dimensions of flow, Jackson and colleagues (Jackson & Eklund, 2002; Jackson & Marsh, 1996) developed the Flow State Scale (FSS) and Dispositional Flow Scale (DFS) as alternative self-report instruments to assess flow experience at the state and dispositional levels in physical activity. Overall, good support was presented for the construct validity of the state and dispositional measures. Item loadings on first-order factors ranged from .43 to .89 for the FSS (M = .78) and from .29 to .86 for the DFS (M = .74); internal consistency estimates ranged from .72 to .91 ($M\ \alpha$ = .85) for the FSS and from .70 to .88 ($M\ \alpha$ = .82) for the DFS (Jackson & Eklund, 2002).

The hierarchical model of the FSS and DFS provides an acceptable fit to the data but it nonetheless possesses some important conceptual and/or statistical limitations (i.e., low second-order loading for time transformation and loss of self-consciousness; see Jackson & Eklund, 2004). Jackson and Eklund (2002) consequently revised both instruments by replacing the problematic items and developing new versions of the flow scales: the Flow State Scale-2 (FSS-2) and Dispositional Flow Scale-2 (DFS-2). The results of confirmatory factor analyses (CFA) demonstrated good fit of the data to the revised scales. Reliability estimates for the FSS-2 in the Jackson and Eklund (2002) study ranged from .80 to .92 and in the Jackson, Martin, and Eklund (2008) study ranged from an acceptable .76 to .90; coefficient alpha estimates of reliability for the DFS-2 ranged from .78 to .90 in the Jackson and Eklund (2002) validation study and in the Jackson et al. (2008) study ranged from an acceptable .80 to .89. To date, these two scales are the only multidimensional measures of flow of which the authors are aware with satisfactory psychometric properties and which can be used without disrupting performance (Jackson & Eklund, 2002).

Certainly flow is grounded in a North American perspective of activity, consequently most sport psychology research on flow state has been conducted with English-speaking participants (Fournier et al., 2006). Duda and Hayashi (1998) argued that, "if research on the psychological dimensions of sport and exercise behavior is delimited to the mainstream group only, such studies are running contrary to the very essence of scientific inquiry" (p. 473). It is therefore crucial to extend the investigation of flow to non-Western and minority cultures.

There are a few studies that have examined the validity of the flow scales with non-English-speaking samples (Doganis, Iosifidou, & Vlachopoulos, 2000; Fournier et al., 2006; Kawabata & Harimoto, 2000; Kawabata, Mallett, & Jackson, 2007; Stavrou & Zervas, 2004). In China, although there are several studies in which the FSS was translated into Chinese for use with Chinese athletes (e.g., Sun, Li, Jiang, Hu, & Cai, 2003; Wang & Fu, 2005), the factor structure of the translated instrument has not been clearly demonstrated. Exploratory factor analysis rather than CFA was used for all of the above-mentioned studies. Additionally, the revised FSS was used as a measurement tool rather than the examination of validity and reliability. Chen et al. (2003) stated that their translated version of the FSS-2 was acceptable for their Chinese samples, but their reported CFA results did not provide strong support to their conclusions (e.g., some poor goodness-of-fit indices and low as for some subscales). To date, neither the DFS nor the DFS-2 has been translated into Chinese.

Chinese researchers have been interested in comparisons of flow characteristics based upon factors such as gender, years of specialized training, competitive level, and sport event type (e.g., Hu, Zhang, Liu, Sun, & He, 2002; Zhou & Wang, 2009), but their similar subgroup analyses yielded inconsistent results partly due to the lack of efficient and/or identical measurement tools. Therefore, it is necessary to provide efficient instruments for measuring the flow experience of Chinese participants.

Cross-cultural validation is an important step to ensure the equivalence of measurement instruments across languages and cultures (Fournier et al., 2006), thus providing a direct test for their external validity is an important step to take. Because the FSS-2 and DFS-2 appear to be the only sound multidimensional scales to measure flow experience in physical activity settings, it is important to examine their generalizability to non-Western samples (Kawabata et al., 2007). Therefore, the primary purpose of this study is the cross-cultural translation and validation of the Chinese versions of the FSS-2 and DFS-2. It is hypothesized that, with appropriate adaptation of the FSS-2 and DFS-2, the moderately strong psychometric properties obtained with the original English versions of the instruments would be replicated in the present study.

Method

Participants

Chinese participants were recruited from sport teams, and undergraduate classes at sport universities. A college age sample was used in order to be confident that the respondents understood the concepts being assessed by the items. It has been suggested that a minimum age of 15 may provide a rough guide to suitability of populations for the scales; there is no upper age range limit for use of the flow scales (Jackson & Eklund, 2004). Eligibility for inclusion in the current study included minimum participation in physical activities of twice per week. In order to best validate these instruments within China, two separate stages of data collection took place for the Chinese data collection; one for item identification, and the other for calibration.

Item identification samples. For the item identification portion of this project, the sample consisted of 948 participants, 508 of whom provided CFSS-2 responses (44.9% men) and another 440 contributed CDFS-2 responses (46.1% men). Participants ranged in age from 15 to 32 years (M = 20.2, SD = 2.3) for the CFSS-2 and from15 to 24 years (M = 18.4, SD = 2.3) for the CDFS-2. Participants completing the CFSS-2 took part in 23 different types of physical activities; participation levels were recreational (16.1%), university (48.2%), prefecture/regional (18.9%), national (15.0%) and international (1.8%). Particpants completing the CDFS-2 identified involvement in 42 different types of physical activities. Their participation was at the recreational (25.7%), university (30.9%), prefecture/regional (28.9%), national (13.9%) and international (0.7%) levels.

Calibration samples. A cross-validation of the Chinese versions of the flow scales models was conducted to ensure that the results observed in the first study were not sample specific. This cross-validation procedure was used to ensure that the items behaved appropriately in the context of the final measurement presentation format.

The samples used in the calibration stage consisted of 1223 participants, 536 of whom provided CFSS-2 responses (70.5% men) and another 687 contributed CDFS-2 responses (56.2% men). Participants ranged in age from 15 to 28 years (M = 20.5, SD = 1.9) for the CFSS-2 and from15 to 28 years (M = 20.7, SD = 2.1) for the CDFS-2. The participants completing the CFSS-2 reported involvement in 27 different types of physical activity, and participation was reported to be at the recreational (32.3%), university (50.2%), prefecture/regional (12.7%), national (4.1%) and international (0.7%) levels. Those participants who completed the CDFS-2 reported involvement in 37 different types of physical activities, with their level of involvement being at the recreational (29.0%), university (50.8%), prefecture/regional (15.4%), national (4.4%) and international (0.4%) levels.

INSTRUMENTS

Situational measure. The FSS-2 is a 36-item questionnaire designed as a post-event assessment of flow and has nine subscales (four items each) corresponding to the nine flow dimensions. Respondents of the FSS-2 are asked to indicate the extent to which they agree with each statement on a 5-point Likert scale, ranging from "1" (strongly disagree) to "5" (strongly agree). It is recommended that the FSS-2 responses be collected within one hour of activity completion, with the aim of gathering the data as close to the finish of an activity as possible, while minimizing intrusion on the participants (Jackson & Eklund, 2004).

*Dispositional measure***.** The DFS-2 is designed as a dispositional assessment of flow. The 36 items in the DFS-2 correspond to the FSS-2 with changes in the wording and tense of phrases (Jackson & Eklund, 2002). The DFS-2 assesses the general tendency to experience flow within a particular setting. Respondents are directed to think about how often they generally experience the characteristics described in the statements within a particular activity and to rate their responses on a 5-point Likert scale, ranging from "1" (never) to "5" (always). While the dispositional version is designed for grounding in a particular activity, it should be completed at a time separate from immediate involvement in this activity.

*Convergent validity measure***.** The Chinese version of the Psychological Skills Inventory for Sports-5 (PSIS-5) was used to assess the convergent validity of the CDFS-2. Mahoney (1989) revised the original PSIS, cutting it to 45 items and replacing the "True" or "False" with a 5-point scale, ranging from "1" (strongly disagree) to "5" (strongly agree). The whole inventory includes six subscales: Anxiety control (AX), Concentration (CC), Confidence (CF), Mental Preparation (MP), Motivation (MV), and Team Emphasis (TM). Yang (1995) translated and revised the PSIS-5, and her study showed acceptable reliability and validity for the Chinese version of the PSIS-5.

PROCEDURES

To accomplish the primary aim of this study, a multi-staged approach for test translation was used (Duda & Hayashi, 1998; Tanzer & Sim, 1999). In the first stage, the DFS-2 and FSS-2 were adapted from English to Chinese for use with Chinese participants. In the second stage, the translated versions of the flow scales were completed by a sample of Chinese participants; a CFA was then used to identify the optimal items for each instrument using the previously collected data. During the third stage, the validity and reliability of the CDFS-2 and CFSS-2 were examined based on the results of CFA and reliability coefficients.

Stage 1: Adaptation Of The Instruments. Both scales (i.e., FSS-2 and DFS-2) were translated into Chinese, followed by a back-translation procedure (Tanzer & Sim, 1999). For each scale, the Chinese items were translated to maximize their conceptual and linguistic equivalence with the original items in the FSS-2 and DFS-2. This procedure involved several steps. First, every item on both scales was translated from English into Chinese. The first author executed this task, because she was bilingual and familiar with flow theory. Although back-translation is a necessary step to ensuring linguistic equivalence, this procedure may not be sufficient to eliminate cultural bias (Duda & Hayashi, 1998). Thus, the Chinese items were carefully adapted to minimize cross-cultural/cross-linguistic bias.

In the following step, all translated items in the previous step were checked by a bilingual faculty member with expertise in the area of sport and exercise psychology. This team approach was used to strengthen the search for linguistic equivalence in the translation process (Duda & Hayashi, 1998). Some of the translated words in the first version were identified by the bilingual faculty member as not meeting Chinese expressive habits, so changes of the wording of these Chinese words were made based upon the professor's feedback.

As a final step in the back-translation procedure, a professional translator, whose native language was English and who had not seen the English version of the flow scales, translated all Chinese items back into English. The original and back-translated versions of both scales were compared. This double translation procedure was continued until conceptual and linguistic equivalence achieved corresponding items in the DFS-2 and FSS-2 (Duda & Hayashi, 1998).

Data analyses. Data collected from the participants were entered into an EQS 6.1 database, and double checked by a trained research assistant. Statistical analyses were conducted for the second and third stages using EQS 6.1 (Bentler, 2006), which is described concretely below.

Stage 2: Item Identification. To identify the optimal items for each Chinese version of the flow scales, the analysis of covariance structure within the framework of CFA was conducted using robust maximum likelihood estimation procedures. In the iterative process of CFA for the nine-factor first-order model, the optimal set of items for each scale was decided by evaluating: (a) overall goodness-of-fit to the data for the hypothesized model; (b) standardized factor-loading weights of items; (c) standardized residuals; and (d) modification indices. Items were considered to be stronger indicators of their factor if they had (a) larger standardized factor loadings; (b) small standardized residuals; and (c) no modification indices suggesting re-specification of the hypothesized model (Kawabata et al., 2007).

Several criteria were used for assessment of model fit as a whole (Hoyle & Panter, 1995). The chi-square (χ^2) test assesses the magnitude of discrepancy between the hypothesized covariance matrix and the sample covariance matrix, and a significant test result indicates a poor fit. However, when the sample size is large, the χ^2 value is a very conservative estimate of model fit (Byrne, 2006). Values on the Non-Normed Fit Index (NNFI) and the Comparative Fit Index (CFI) that are .90 or greater have generally been considered indicative of an adequate fit. However, Hu and Bentler (1999) suggested a value of .95 might be more preferable. For the Root Mean Square Error of Approximation (RMSEA), values of .05 or less indicate a close fit, and .08 or less indicate an adequate fit (Browne & Cudeck, 1993). For completeness, the 90% confidence interval was also provided for RMSEA. Finally, values on the Standard Root Mean-square Residual (SRMR) that are less than .08 indicate an adequate fit (Hu & Bentler, 1999). In a well-fitting model, this value should be .05 or less (Bollen, 1989). Although the more stringent cutoff criteria and the two-index strategy proposed by Hu and Bentler (1998; 1999) have been popular, it may be difficult for scales with numerous factors and items to reach Hu and Bentler's (1999) revised standards

Stage 3: Validity And Reliability Assessments. For the revised or simplified questionnaires, it is necessary to reassess the validity and reliability among another representative samples (Wang, 1999). Hence, the factorial validity of responses to the Chinese flow scales was reexamined with Chinese samples by adopting a nine-factor measurement model, which was consistent with the multidimensional flow scales (Kawabata et al., 2007).

Results

Stage-2 analyses

*Identify the optimal items***.** Within the framework of CFA, item 2, 6, and 21 were deleted from the original 36-item versions because of their low factor loadings (< .40; See Table I). Finally, the identified optimal set of 33 items was used for the third stage. Consistent with the English versions of the flow scales, the Chinese dispositional items corresponded to the situational items with changes in the wording and tense of phrases.

Internal consistency & Stability. Cronbach's a was computed for internal consistency and stability reliability. As shown in Table II, internal consistency estimates for all factors of both scales for the Chinese participants were at acceptable levels. Coefficient as for the CFSS-2 ranged from .64 to .92 (M = .77) and the CDFS-2 corresponding as ranged from .65 to .92 (M = .78). Stability coefficients (test-retest correlations) for the CDFS-2 were calculated for each factor from test-retest data collected from 104 participants. Stability coefficients ranged from .60 to .80 (M =.70) over a four-week period. As presented in Table II, five of the nine flow factors were above .70 and considered to be fairly stable.

Confirmatory Factor Analysis. As described previously, the linguistically (meeting the Chinese expressive habits) and psychometrically optimal set of

Table I
Content and Factor-Loading of the Deleted Items

Scale	Item	Content	Loading
CFSS-2[1]	02	I made the correct movements without thinking about trying to do so.	.34
	06	I had a sense of control over what I was doing.	.37
	21	I knew what I wanted to achieve.	.29
CDFS-2[2]	02	I make the correct movements without thinking about trying to do so.	.11
	06	I have a sense of control over what I am doing.	.39
	21	I know what I want to achieve.	.34

TABLE II
Reliability Coefficients for the Flow Sub-Scales

Study		F1	F2	F3	F4	F5	F6	F7	F8	F9
Internal consistency coefficients										
Item identification samples	CFSS-2 (n=508)	.86	.64	.92	.72	.89	.73	.74	.69	.77
	CDFS-2 (n=440)	.86	.65	.92	.77	.90	.73	.76	.67	.78
Calibration samples	CFSS-2 (n=536)	.71	.67	.74	.78	.78	.71	.76	.70	.77
	CDFS-2 (n=687)	.72	.67	.76	.78	.78	.71	.77	.72	.78
Stability coefficients										
Item identification samples	CDFS-2 (n=104)	.74	.64	.64	.60	.72	.71	.80	.76	.65
Calibration samples	CDFS-2 (n=182)	.68	.63	.53	.53	.61	.60	.66	.70	.65

Note. F1 = Balance; F2 = Merging; F3 = Goals; F4 = Feedback; F5 = Concentration; F6 = Control; F7 = Consciousness; F8 = Time; F9 = Autotelic.

33 items were identified through an iterative process of covariance structure analyses within the framework of CFA. Substantial multivariate kurtosis was observed with the samples based on Mardia's (1974) normalized coefficient estimate (19.29 for the CFSS-2 and 37.70 for the CDFS-2). As presented in Table III, the hypothesized measurement model provided acceptable fit for the final Chinese set of 33 items that were identified in the item identification analyses for both the CFSS-2 and the CDFS-2. For the CFSS-2, NNFI and CFI values were well above .90; RMSEA, 90% CI, and SRMR values were less than .05. For the CDFS-2, NNFI and CFI values were nearly .90; although RMSEA, 90% CI, and SRMR values were greater than .05, they were still less than .08. As shown in Table IV, the size of estimated correlations ranged from .02 to .51 (M = .16) for the CFSS-2 and from .04 to .52 (M = .26) for the CDFS-2, and none were excessively high (e.g., >.70; Kline, 2005).

STAGE-3 ANALYSES

Internal consistency & Stability. As shown in Table II, internal consistency estimates for all factors of both scales for the Chinese participants were

TABLE III
Goodness-of-Fit for CFSS-2 and CDFS-2 (nine First Order Factors)

Study		n	χ^2	df	NNFI	CFI	RMSEA	90% CI	SRMR
Item identification samples	CFSS-2	50	938.222	459	.921	.931	.045	.041-.049	.044
	CDFS-2	44	1177.604	459	.879	.895	.060	.055-.064	.060
Calibration samples	CFSS-2	53	1008.714	459	.905	.917	.047	.043-.051	.045
	CDFS-2	68	1274.731	459	.887	.902	.051	.048-.054	.050

Note. χ^2 = chi-square; NNFI = non-normed fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standard root mean-square residual.

Table IV
Correlations among CFSS-2 and CDFS-2First-Order Factors

	F1	F2	F3	F4	F5	F6	F7	F8	F9
CFSS-2									
F1	—	.55	.58	.52	.65	.66	.41	.44	.67
F2	.03	—	.39	.47	.44	.44	.42	.42	.48
F3	.36	.04	—	.67	.61	.53	.28	.34	.52
F4	.02	.24	.04	—	.56	.52	.37	.36	.49
F5	.35	.06	.30	.04	—	.62	.38	.38	.57
F6	.50	.07	.38	.02	.51	—	.41	.36	.52
F7	.02	.25	.05	.21	.03	.05	—	.36	.30
F8	.02	.23	.02	.10	.11	.09	.21	—	.48
F9	.03	.33	.04	.36	.03	.02	.20	.37	—
CDFS-2									
F1	—	.45	.53	.54	.60	.63	.20	.20	.62
F2	.40	—	.35	.38	.38	.45	.22	.25	.42
F3	.36	.10	—	.60	.59	.56	.07	.10	.46
F4	.39	.29	.48	—	.52	.55	.10	.12	.46
F5	.35	.24	.31	.40	—	.68	.16	.16	.58
F6	.51	.29	.37	.51	.50	—	.18	.13	.55
F7	.24	.27	.04	.08	.06	.19	—	.27	.14
F8	.07	.16	.05	.15	.09	.16	.08	—	.31
F9	.52	.29	.28	.30	.34	.35	.12	.17	—

Note. F1 = Balance; F2 = Merging; F3 = Goals; F4 = Feedback; F5 = Concentration; F6 = Control; F7 = Consciousness; F8 = Time; F9 = Autotelic. Intercorrelations from the item identification samples analyses are below diagonals and intercorrelations from the calibration samples analyses are above diagonals.

on acceptable levels. Coefficient αs for the CFSS-2 ranged from .67 to .78 (M = .74) and the CDFS-2 corresponding αs ranged from .67 to .78 (M = .75). Only one dimension (Merging of Action and Awareness) of the estimates was less than .70, with α = .67 for both the CFSS-2 and the CDFS-2. Stability coefficients for the CDFS-2 (n = 182) ranged from .53 to .70 (M = .62) over a four-week period, all but two dimensions (Clear Goals, and Unanimous Feedback) of the estimates were above .60.

Confirmatory Factor Analysis. Within the framework of CFA, substantial multivariate kurtosis was observed with the samples based on Mardia's (1974) normalized coefficient estimate (63.39 for the CFSS-2 and 68.94 for the CDFS-2). As presented in Table III, the hypothesized measurement model provided acceptable fit for the final set of 33 items that are identified in the item identification analyses for both the CDFS-2 and the CFSS-2. For the CFSS-2, NNFI and CFI values were above .90; RMSEA and SRMR values were less than .05 and 90% CI value was nearly .05. For the CDFS-2, the NNFI value was nearly .90, while the CFI value was above .90; moreover, RMSEA, 90% CI, and SRMR values were nearly .05. As shown in Table IV, the size of estimated correlations ranged from .28 to .67 for the CFSS-2 (M = .48) and from .07 to .68 for the CDFS-2 (M = .37), and none were excessively high (e.g., >.70; Kline, 2005).

*Convergent validity***.** In order to confirm the validity of the CDFS-2, the present study measured its convergent validity using the Chinese version of the Psychological Skills Inventory for Sports-5 (CPSIS-5). As showed in Table V, the size of estimated correlations ranged from .00 to .45 (M = .20).

Discussion

Identify the optimal items

Chen (2005) put forward several principles for item identification: (a) items whose factor-loading on the first-order factor is less than .40 should be deleted; and (b) items with a large modified index should be deleted. Wang (1999) suggested that other principles should be followed: (a) rerun the CFA procedure once an item is deleted; (b) item deletion should be interpreted from both the statistical and conceptual perspectives; and (c) at least three items for each dimension should be reserved. Following the above principles, and because of the acceptable factorial validity and reliability of the Chinese set with 33 items, three items (i.e., 2, 6, 21) from both the CFSS-2 and the CDFS-2 were eliminated. It should be noted that another option would have been to reword the items and make a second administration before the final factor analysis. Consistent with the theoretical underpinnings of the model, the items deleted from the two scales were the same. In contrast, the factor loadings of these three items deleted in the Chinese versions were relatively higher in the original English versions (See Jackson & Eklund, 2004). The following discussion will assess these differences based on the lingual description and cross-culture context.

Table V
Correlations Among CDFS-2 And CPSIS-5 (N = 121)

CPSIS-5 **CDFS-2**	**AX**	**CC**	**CF**	**MP**	**MV**	**TM**	**PS**
Balance	.03	.03	.30**	.35***	.45***	.34***	.38***
Merging	.01	.02	.09	.22*	.31**	.15	.20*
Goals	.06	.07	.23*	.25**	.45***	.32***	.35***
Feedback	.08	-.00	.37***	.25**	.34***	.38***	.36***
Concentration	-.11	-.16	.18	.19*	.40***	.29**	.20*
Control	-.07	.02	.14	.27**	.41***	.25**	.25**
Consciousness	-.01	-.04	-.06	.09	-.04	-.13	-.05
Time	.15	.12	.12	.08	.09	.19*	.20*
Autotelic	-.00	.02	.25**	.26**	.38***	.41***	.33***
Flow	.03	.01	.27**	.32***	.45***	.37***	.37***

Note. AX = anxiety control; CC = concentration; CF = confidence; MP = mental preparation; MV = motivation; TM = team emphasis; PS = global psychological skills.
* $P < .05$. ** $P < .01$. *** $P < .001$.

Item 2, along with items 11, 20, and 29 comprise the Action-Awareness Merging dimension of flow. Based upon the literal description, the latter three items are much nearer each other, with the same word “automatically”; while the expression of item 2 is similar with that of items 20 and 29, with the same phrase “without thinking”. Respondents might be more sensitive to the word “automatically” than to the phrase “without thinking”. Hence, based on the first impression, respondents may have been inclined to look at the other three items as homogenous and therefore, tended to respond accordingly.

Item 6, along with items 15, 24, and 33 comprise the Sense of Control dimension of flow. These four items are very similar in terms of wording. As shown in Table I, the factor-loadings of item 6 were nearly .40 (.370 for the CFSS-2, and .388 for the CDFS-2). The possible reason for the lower factor-loadings of item 6 maybe that the latter three items were much nearer each other, with the same word “feel/felt”.

Item 21, along with items 3, 12, and 30 comprise Clear Goals dimension of flow. A possible reason for the lower factor-loadings of item 21 maybe that the Chinese respondents perceived the word “achieve” as indicative of a competitive goal (i.e., outcome), while the other three items may have been perceived as indicative of mastery goals (i.e., mastery of the skill). The two kinds of perception might give rise to perceived separation between the items.

Reliability and validity of flow scales

Construct validation of flow responses is an ongoing process (Marsh & Jackson, 1999). It is important to cross-validate the Chinese versions of the flow scales model to ensure that the results observed in the first study were not sample specific. Data for the first study was collected with the original 36-item versions of the scales. Cross-validation with the final 33-item versions of these scales was considered important to ensure that items behaved appropriately in the context of the final measurement presentation format. The second study was conducted to address this issue.

The factor structure of the 33-item CFSS-2 and CDFS-2 was tested and cross-validated based on the covariance structure within the framework of CFA. Provided with evidence of a sound factor structure, the psychometric properties of the Chinese flow scales were evaluated based on the internal consistency and stability coefficients. Although the average coefficient as for the Chinese versions were lower than those of the corresponding English versions (See Jackson & Eklund, 2004), all but two dimensions (Merging of Action and Awareness, and Time Transformation) of the Chinese versions were above .70. The internal consistency estimates indicated that all subscales were internally consistent. The stability of each factor over time was examined to assess the constancy of the nine-first-order factors of the CDFS-2 across time (Byrne, Stewart, & Lee, 2004). Following recommendations by Marsh and Hau (1996), error covariances were included between the same items across time. The stability over a four-week interval of the CDFS-2 was on the acceptable level, although the value was lower than that of Kawabata et al. (2007). Their findings demonstrated the medium to high stability of single flow factors over time, but it cannot be determined whether or not these features are sample-specific. Further research needs to be conducted over several different time periods before any conclusions can be drawn about the stability of the dispositional flow responses (Kawabata et al., 2007).

The Goodness-of-fit for the CFSS-2 was better than that of the corresponding English version, while the Goodness-of-fit for the CDFS-2 was not as favorable as that of the corresponding English version (See Jackson & Eklund, 2004). Taken together, the goodness-of-fit of the CFSS-2 was better than that of the CDFS-2. While the average size of estimated correlations for the Chinese versions were lower than that of the corresponding English versions (See Jackson & Eklund, 2004), the nine flow factors in both scales seemed to measure reasonably unique constructs. The values indicated that the nine flow factors, while sharing common variance as expected, measured reasonably unique constructs.

Substantively, the results of this study extend support for the construct of psychological flow in non-English-speaking samples. Because flow is a hypothetical construct, its usefulness must be established by investigations of construct validity incorporating within- and between-network studies (Shavelson, Hubner, & Stanton, 1976; Marsh, 1990). The above-mentioned within-network studies explore the internal structure of flow, addressing such issues as the dimensionality of flow through factor analysis, or multitrait-multimethod (MTMM) analysis. Between-network studies attempt to establish a logical, theoretically consistent pattern of relations between measures of flow and other constructs (Marsh & Jackson, 1999). Campbell and Fiske (1959) suggested that it was necessary to assess the construct validity of a measurement using the correlation among the measurement and other measurements with the same constructs or traits. This study demonstrated a good convergent validity for the CDFS-2 using the CPSIS-5. Jackson et al. (1998; 2001) also reported between-network construct validity results. Specifically, theoretically expected patterns of relationship between flow and the psychological constructs logically related to flow were observed between flow and perceived ability, anxiety, and intrinsic motivation (Jackson et al., 1998). Relationships between flow and dimensions of athletic self-concept, as well as with athletes' use of psychological skills, have also been reported (Jackson et al., 2001). In both studies, dispositional flow demonstrated stronger relationships with the various psychological constructs than did the state flow measures; this was an expected finding, given that all of the non-flow constructs were also assessed at a dispositional level.

In summary, both the CFSS-2 and the CDFS-2 demonstrated acceptable factorial validity and reliability for assessing state and dispositional flow, respectively. Through this study, sound adaptations of the FSS-2 and DFS-2 for use in sport with Chinese participants were established.

Limitations and Future Directions

Although the findings from this study provide strong support for the validity and reliability of the CFSS-2 and CDFS-2 in assessing flow experience in physical activities for Chinese participants, it should be acknowledged that several salient limitations apply. First, this study deleted the items with low factor-loadings, instead of replacing these items with new items. Although the final Chinese set of 33 items replicated moderately strong psychometric properties obtained with the original instruments, the original scales were disrupted because of item deletion. Second, only a nine-factor first-order model was used to examine the factor structures of the CFSS-2 and CDFS-2. One methodological issue related to the flow scales is the relative utility of first- and higher-order representations of the flow responses (Jackson & Eklund, 2002; Jackson & Marsh, 1996; Marsh & Jackson, 1999). The higher-order model is more of "a hybrid model than just a measurement model" (Bollen, 1989, p. 316). Although Marsh and Jackson (1999) rigorously evaluated the relative usefulness of alternative models using a multitrait–multimethod approach and clearly demonstrated the superiority of the multidimensional representation to a single second-order model, debate continues about alternative representations of flow responses (e.g., Jackson & Eklund, 2002; Stavrou & Zervas, 2004; Vlachopoulos, Karageorghis, & Terry, 2000). Lastly, neither the relation between the CFSS-2 and CDFS-2 nor the convergent validity of the CFSS-2 was studied. Recently, Jackson et al. (2008)

developed new brief counterparts to the FSS-2 and DFS-2, each with nine items. The relation between the long 36-item flow scales, the short nine-item flow scales, and other psychological constructs (e.g., intrinsic motivation, anxiety, and psychological distress) were examined by Jackson. These relationships were not examined in the present study.

Despite these limitations, the present study revealed that the data from the Chinese participants was represented appropriately by the nine-factor structure model. Nonetheless, further studies examining the validity of the Chinese versions of the FSS-2 and DFS-2 are necessary. For example, possible directions for future studies are to examine (a) criterion-related validity employing self-report instruments of other psychological constructs (e.g., motivation, self-esteem, and anxiety) or variables (e.g., participation and skill levels) and (b) more cross-validation within a variety of specific Chinese samples. In addition, the issue of the relative usefulness of first- and higher-order representations of the flow responses should be comprehensively examined based on theoretical and empirical grounds in the cross-cultural context (Kawabata et al., 2007). Moreover, unraveling the relative relevance of the nine flow dimensions to different individuals in different activity settings would be an important area to address. Csikszentmihalyi and other flow researchers (Csikszentmihalyi & Csikszentmihalyi, 1988) have proposed that individual differences exist in the capacity to attain optimal experience. He (1990) suggested that certain types of people might be better psychologically equipped to experience flow, regardless of the situation. Lastly, one should not place too much weight on any empirical measure of flow, so as not to lessen or lose the experience by reducing it to scores on questionnaires (Csikszentmihalyi, 1992). Although using flow study adapting measurement tools are the most popular paradigm to study flow, it is important to extend practical methods to study flow. A moderately strong relationship exists between flow dispositions and goal setting (Kee & Wang, 2008). This relationship is likely a function of the cognitive influence of goal setting (Latham, 2003). Hence, it may be possible to increase flow occurring through the cognitive intervention of goal setting (e.g., goal orientation, and goal difficulty). Approaching the study of flow creatively and from a multidisciplinary perspective offers the greatest promise of developing a better understanding of the experience of this optimal psychological state in physical activity (Jackson & Eklund, 2002).

Appendix I

状态流畅量表-2（CFSS-2）

请根据你在刚刚结束的竞赛或活动中的体验回答下列问题。这些问题与你在刚刚完成的竞赛或活动过程中可能体验到的各种想法和感受有关。答案无对错之分。思考一下你在竞赛/活动过程中的感受，然后采用下面的等级划分回答问题。每个问题都在与你的体验最匹配的数字上画圈。

完全不同意　不同意　等级划分　寸　同意　完全同意

1　2　3　4　5

请圈选答案

在____________________（运动项目）竞赛过程中：

1. 刚刚我遇到了挑战，但我相信自己的技能能够应付这一挑战。

1　2　3　4　5

2. 刚刚我清楚地知道自己想要做什么。

1　2　3　4　5

3. 刚刚我的确很清楚自己的表现如何。

1　2　3　4　5

4. 刚刚我的注意力完全集中于正在进行的活动上。

1　2　3　4　5

5. 刚刚我不关心别人可能会怎样看待自己。

1　2　3　4　5

6. 刚刚时间似乎改变了（要么是减慢了，要么是加快了）。

1　2　3　4　5

7. 刚刚我真的很享受那种体验。

1　2　3　4　5

8. 刚刚我的能力与情境的高要求相匹配。

1　2　3　4　5

(Segue)

9. 刚刚行动似乎是自然而然发生的。

1	2	3	4	5

10. 刚刚我清楚地意识到自己想要做什么。

1	2	3	4	5

11. 刚刚我知道自己的表现如何。

1	2	3	4	5

12. 刚刚我可以毫不费力地使自己的注意力集中于正在进行的活动上。

1	2	3	4	5

13. 刚刚我感觉自己能够控制正在进行的活动。

1	2	3	4	5

14. 刚刚我不关心别人可能会如何评价自己。

1	2	3	4	5

15. 刚刚时间过得和平常不一样。

1	2	3	4	5

16. 刚刚我爱那种完成动作的感受，想再次体验它。

1	2	3	4	5

17. 刚刚我感觉自己的能力足够满足情境的高要求。

1	2	3	4	5

18. 刚刚我的动作是自动化的，没有想太多。

1	2	3	4	5

19. 刚刚完成动作时，我很清楚自己的表现如何。

1	2	3	4	5

20. 刚刚我完全聚精会神。

1	2	3	4	5

21. 刚刚我有完全的控制感。

1	2	3	4	5

22. 刚刚我不关心自己的表现如何。

1	2	3	4	5

(Segue)

23. 刚刚我感觉到时间比平时过得快。

1	2	3	4	5

24. 刚刚那种体验让我感到欣喜若狂。

1	2	3	4	5

25. 刚刚挑战和我的技能都处于同等的高水平上。

1	2	3	4	5

26. 刚刚我的行动是出于本能和自动的，而不必去想。

1	2	3	4	5

27. 刚刚我的目标界定明确。

1	2	3	4	5

28. 刚刚我能够根据正在完成的动作判断自己的表现如何。

1	2	3	4	5

29. 刚刚我全神贯注于那一刻的任务。

1	2	3	4	5

30. 刚刚我感觉完全能够控制自己的身体。

1	2	3	4	5

31. 刚刚我不担心别人可能会怎样看待自己。

1	2	3	4	5

32. 刚刚我失去了正常的时间感。

1	2	3	4	5

33. 刚刚我发现那种体验是一种最好的奖励。

1	2	3	4	5

Appendix II

特质流畅量表-2（CDFS-2）

请根据你在选定活动中的体验回答下列问题。这些问题与你在参与活动过程中可能体验到的想法和感受有关。你可能有时、总是或者从未体验到过这些特征。答案无对错之分。回想你在活动过程中体验每一特征的频率，在与你的体验最匹配的数字上画圈。

等级划分

从未	很少		经常	总是
1	**2**	**3**	**4**	**5**

请圈选答案

当参与________________（活动名称）时：

1. 我遇到了挑战，但我相信自己的技能能够应付这一挑战。

1 2 3 4 5

2. 我清楚地知道自己想要做什么。

1 2 3 4 5

3. 我的确很清楚自己的表现如何。

1 2 3 4 5

4. 我的注意力完全集中于正在进行的活动上。

1 2 3 4 5

5. 我不关心别人可能会怎样看待自己。

1 2 3 4 5

6. 时间似乎改变了（要么是减慢了，要么是加快了）。

1 2 3 4 5

7. 我真的很享受这种体验。

1 2 3 4 5

8. 我的能力与情境的高要求相匹配。

1 2 3 4 5

9. 行动似乎是自然而然发生的。

1 2 3 4 5

(Segue)

10. 我清楚地意识到自己想要做什么。

1	2	3	4	5

11. 我知道自己的表现如何。

1	2	3	4	5

12. 我可以毫不费力地使自己的注意力集中于正在进行的活动上。

1	2	3	4	5

13. 我感觉自己能够控制正在进行的活动。

1	2	3	4	5

14. 我不关心别人可能会如何评价自己。

1	2	3	4	5

15. 时间过得和平常不一样。

1	2	3	4	5

16. 我爱这种完成动作的感受，想再次体验它。

1	2	3	4	5

17. 我感觉自己的能力足够满足情境的高要求。

1	2	3	4	5

18. 我的动作是自动化的，没有想太多。

1	2	3	4	5

19. 完成动作时，我很清楚自己的表现如何。

1	2	3	4	5

20. 我完全聚精会神。

1	2	3	4	5

21. 我有完全的控制感。

1	2	3	4	5

22. 我不关心自己的表现如何。

1	2	3	4	5

23. 我感觉到时间比平时过得快。

1	2	3	4	5

(Segue)

24. 这种体验让我感到欣喜若狂。

1	2	3	4	5

25. 挑战和我的技能都处于同等的高水平上。

1	2	3	4	5

26. 我的行动是出于本能和自动的，而不必去想。

1	2	3	4	5

27. 我的目标界定明确。

1	2	3	4	5

28. 我能够根据正在完成的动作判断自己的表现如何。

1	2	3	4	5

29. 我全神贯注于当前的任务。

1	2	3	4	5

30. 我感觉完全能够控制自己的身体。

1	2	3	4	5

31. 我不担心别人可能会怎样看待自己。

1	2	3	4	5

32. 我失去了正常的时间感。

1	2	3	4	5

33. 这种体验是一种最好的奖励。

1	2	3	4	5

REFERENCES

Bentler, P. M. (2006). *EQS 6 structural equations program manual*. Encino, CA: Multivariate Software.

Bollen, K. A. (1989). *Structural equations with latent variables*. New York: Wiley.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing structural equation models* (pp.445-455). Newbury Park. California: Sage.

Byrne, B. M. (2006). *Structural equation modeling with EQS: Basic concepts, applications, and programming* (2nd Ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Byrne, B. M., Stewart, S. M., & Lee, P. W. H. (2004). Validating the Beck Depression Inventory-II for Hong Kong community adolescents. *International Journal of Testing*, *4*, 199-216.

Campbell, D. T., & Fiske, D. (1959). Convergent and discriminate validation by the multi-trait-multimethod matrix. *Psychological Bulletin*, *56*, 81-105.

Chen Y.-J. (2005). *Study on personal optimal zone of athletes' emotion*. Doctorial dissertation, Beijing Normal University, Beijing, China.

Chen, Y.-J., Hung, T.-M., Lin, T.-C., Li, C.-L., Chang, C.-W., & Lin, S.-C. (2003). Confirmatory factor analysis of the Chinese version of Flow State Scale-2. *Journal of Sport & Exercise Psychology*, *25* (Suppl.), 40.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York: Harper & Row.

Csikszentmihalyi, M. (1992). A response to the Kimiecik & Stein and Jackson papers. *Journal of Applied Sport Psychology*, *4*, 181-183.

Csikszentmihalyi, M., & Csikszentmihalyi, I. (1988). *Optimal experience: Psychological studies of flow in consciousness*. New York: Cambridge University Press.

Doganis, G., Iosifidou, P., & Vlachopoulos, S. (2000). Factor structure and internal consistency of the Greek version of the Flow State Scale. *Perceptual and Motor Skills*, *91*, 1231-1240.

Duda, J. L., & Hayashi, C. T. (1998). Measurement issues in cross-cultural research within sport and exercise psychology. In J. L. Duda (Ed.), *Advances in sport and exercise psychology measurement* (pp.471-483). Morgantown, WV: Fitness Information Technology.

Fournier, J., Gaudreau, P., Demontrond-Behr, P., Visioli, J., Forest, J., & Jackson, S. (2006). French translation of the Flow State Scale-2: Factor structure, cross-cultural invariance, and associations with goal attainment. *Psychology of Sport and Exercise*, *8*, 897-916.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 158-176). London: Sage Publications.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*, 424-453.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1-55.

Hu, Y.-M., Zhang, J., Liu, S.-P, Sun Y.-L., & He, P. (2002). The Main Characteristics of Flow State of Baseball and Softball Athletes in China. *Journal of Tianjin Institute of Physical Education*, *17*, 27-29.

Jackson, S. A. (2000). Joy, fun, and flow state in sport. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 135-155). New Zealand: Human Kinetics.

Jackson, S. A., & Eklund, R. C. (2002). Assessing flow in physical activity: The Flow State Scale-2 and Dispositional Flow Scale-2. *Journal of Sport & Exercise Psychology*, *24*, 133-150.
Jackson, S. A., & Eklund, R. C. (2004). *The flow scale manual*. Morgantown, WV: Fitness Information Technology.
Jackson, S. A., Kimiecik, J. C., Ford, S. K., & Marsh, H. W. (1998). Psychological correlates of flow in sport. *Journal of Sport & Exercise Psychology*, *20*, 358-378.
Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport & Exercise Psychology*, *18*, 17-35.
Jackson, S. A., Martin, A. J., & Eklund, R. C. (2008). Long and short measures of flow: The construct validity of the FSS-2, DFS-2, and new brief counterparts. *Journal of Sport and Exercise Psychology*, *30*, 561-587.
Jackson, S. A., Thomas, P. R., Marsh, H. W., & Smethurst, C. J. (2001). Relationships between flow, self-concept, psychological skills, and performance. *Journal of Applied Sport Psychology*, *13*, 129-153.
Kawabata, M., & Harimoto, F. (2000). Evaluation of the Japanese version of the Flow State Scale: Analyzing with confirmatory factor analyses. In *Proceedings of the 27th annual meeting of the Japanese Society of Sport Psychology* (pp.8-9). Sapporo, Japan: Japanese Society of Sport Psychology.
Kawabata, M., Mallett, C. J., & Jackson, S. A. (2007). The Flow State Scale-2 and Dispositional Flow Scale-2: Examination of factorial validity and reliability for Japanese adults. *Psychology of Sport & Exercise*, *5*, 1-21.
Kee, Y. H., & Wang, C. K. J. (2008). Relationships between mindfulness, flow dispositions and mental skills adoption: A cluster analytic approach. *Psychology of Sport and Exercise*, *9*, 393-411.
Kline, R. (2005). *Principles and practice of structural equation modeling*. New York: Guilford.
Latham, G. P. (2003). Goal Setting: A five-step approach to behavior change. *Organizational Dynamics*, *32*, 309-318.
Mahoney, M. J. (1989). Psychological predictors of elite and non-elite performance in Olympic weightlifting. *The Sport Psychologist*, *20*, 1-20.
Mardia, K. V. (1974). Applications of some measures of multivariate skewness and kurtosis for testing normality and robustness studies. *Sanklá*, *B*, *36*, 115-128.
Marsh, H. W. (1990). A multidimensional, hierarchical self-concept: Theoretical and empirical justification. *Educational Psychology Review*, *2*, 77-171.
Marsh, H. W., & Hau, K. T. (1996). Assessing goodness of fit: Is parsimony always desirable?. *Journal of Experimental Education*, *64*, 364-390.
Marsh, H. W., & Jackson, S. A. (1999). Flow experience in sport: Construct validation of multidimensional, hierarchical state and trait responses. *Structural Equation Modeling*, *6*, 343-371.
Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (l 976). Self-concept: Validation of construct interpretations. *Review of Educational Research*, *46*, 407-441.
Stavrou, N. A., & Zervas, Y. (2004). Confirmatory factor analysis of the Flow State Scale in sports. *International Journal of Sport and Exercise Psychology*, *2*, 161-181.
Sun, Y.-L., Li, S., Jiang, M.-H., Hu, Y.-M., & Cai, K.-R. (2003). The research on the flow state of athletes. *Journal of Tianjin Institute of Physical Education*, *15*, 12-15.
Tanzer, N. K., & Sim, C. Q. E. (1999). Adapting instruments for use in multiple languages

and cultures: A review of the ITC guidelines for test adaptations. *European Journal of Psychological Assessment*, *15*, 258-269.
Vlachopoulos, S. P., Karageorghis, C. I., & Terry, P. C. (2000). Hierarchical confirmatory factor analysis of the Flow State Scale in exercise. *Journal of Sports Science*, *18*, 815-823.
Wang, H., & Fu, M.-Q. (2005). Research on flow state's characters of elite athletes. *Journal of Xi'an Institute of Physical Education*, *22*, 127-129.
Wang, X.-D. (1999). *Rating scales for mental health*. Beijing, China: Chinese Mental Health Journal Press.
Yang, X.-C. (1995). Examination of the Psychometric Characteristics of the PSIS R-5. *Journal of Capital Normal University* (Natural Science Edition), *16*, 93-98.
Zhou, H., & Wang, J. (2009). Relations among metal health and college students' flow in the physical activities and net games. *China Sport Science and Technology*, *45*, 87-93

Manuscript submitted October 2010. Accepted for publication April 2012.

GUIDELINES FOR CONTRIBUTORS

1. General

The I*nternational Journal of Sport Psychology* publishes empirical and theoretical contributions in the human movement sciences from all over the world. Manuscripts related to psychology, sport pedagogy, exercise and sport performance are suited to the Journal's scope.

IJSP's aims are to disseminate results of rigorous and relevant studies, to expose positions and commentaries regarding the development of theory and confirmation or contradiction of previous findings. IJSP entertains various methodologies, encompassing coherence among epistemology, research questions, tools, statistical or clinical analyses and discussion or potential applications. Qualitative and quantitative analyses as well as case studies are of interest when appropriately used. IJSP is comprised of the following sections related to human movement sciences.

1. Motor learning and control
2. Cognition
3. Health and exercise
4. Social psychology
5. Intervention / Clinical / Counseling psychology

2. Manuscript guidelines

Manuscripts should be written in English, and conform to the Publication Manual of the American Psychological Association (5th Edition, 2001).

Manuscripts must be original and not submitted for publication to any other journal at the same time. Authors of manuscripts accepted for publication must transfer copyright to Edizioni Luigi Pozzi.

1. Position statements, theoretical re-interpretations and multi-experiment papers should not exceed 30 pages inclusive.
2. Brief reports (empirically-based communications or commentaries) should not exceed 15 pages.
3. Research notes. These submissions should not exceed 5 pages. They may present some initial findings, methodological issues or stimulating data from initial pilot work.
4. Letters to the editors.

Authors should strive to make their contribution as precise and concise as possible.

While in reviewing process, the manuscript should not be submitted for publication to another source at the same time. When published, the article can not be published again in another book or journal.

3. How to Prepare the Manuscript

Manuscript should be submitted to the editor by the website to: **www.ijsp-online.com** Telephone, facsimile and E-mail addresses (if available) should be noted on the 1st page of the manuscript. Keywords 3-5 according Index Medicus should be included at the end of the abstract. It is advisable that authors should keep a copy of the manuscript to themselves since the original copies will not be returned.

Theoretical manuscripts do not follow this format. However, a logical development of the issues discussed should be followed, and appropriate «section titles» be given.

Since the review process is blind, **DO NOT** forget to attach the title page to the manuscript, *excluding* names and addresses after the first page.

Multiple authors should be listed in order. For each of the authors, the following information should be given: Department/Institution or Company, Full Address, Telephone/Facsimile/Email (if available). A special note to whom the editors correspond should be clearly stated on the first page. Grants or special thanks associated with the work should also be included on the bottom of the first title page.

Any change of address should be notified immediately. Plase give your name and new and old address.

4. Reprints

The publisher provides reprints to authors at cost. The cost depends on the number of pages in the final publication and the number of reprints asked by the authors. An order form with a price-table is attached to the galley proofs submitted to authors for correction. Reprints should be ordered prior to publication. Post-publication orders cannot be filled at regular reprint rates.

5. Labelling Subjects & Use of Terms

Protection & Labelling of Research Participants

The IJSP Editorial Board requires that all appropriate steps be taken to obtain the informed consent of all human subjects participating in the research of investigators submitting manuscripts for review and possible publication. The author need not describe in the manuscript the specific steps taken to obtain informed consent; however, the author must indicate by a phrase that «informed consent was obtained from the participants», or similar statement.

Descriptive categories such as male-female, black-white, Jewish-Christian,high achievers-low achievers, and emotionally disturbed-normals are sometimes used to label participants. Authors must be careful that the construct label selected to identify a group of human subjects is a valid, descriptive term that can be documented as accepted, current, professional terminology.

6. Tables and illustrations

The number of figures and tables is to be kept to a minimum.

Each *table* should be typed on a separate page. Tables should be self-explanatory, supplementing but not duplicating the text. A brief title should be provided for each. Abbreviations used in tables should be defined.

Illustrations should be numbered in the order in which they are first mentioned in the text and included in the text sent by the website. They should be marked on the back to indicate the first author's name, the figure number and the top edge.

7. Ethics

The IJSP Editorial Board requires that authors strictly follow ethical guidelines from their country or state.

Submissions must comply with appropriate inoffensive language standards.

8. Checklist for submission

1. Cover letter
2. Original manuscript - First page [Title of article, Name of Author(s), affiliation, running head, e-mail address of lead author, grant and thanks]
   Each section should be separated by a page break:
   – Abstract (150 words)
   – Body of the manuscript
   – References
   – Tables and figures
   – Captions
3. Blind copy of the manuscript (delate first page, remove authors' information from the properties box of the electronic document)