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Motivational clusters and performance in a real-life setting

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Abstract The present research investigated whether assessing adolescent elite athletes' motivational profiles at the beginning of the season would allow us to predict their subsequent performance over the course of a competitive season. In two studies, athletes completed the French version of the Sport Motivation Scale (Brière et al., Int J Sport Psychol 26:465–489, 1995) at the beginning of the season. Objective levels of performance were recorded for the following season, as well as for the season prior to questionnaire completion. In Study 1, the sample comprised a total of 170 French junior national tennis players ($M = 13.42$ years). Results revealed the presence of a four-cluster solution, reflecting different levels of autonomous and controlled motivations. Results revealed that controlling for past performance, athletes with the least self-determined motivational profile obtained lower levels of subsequent tennis performance than those in the three other (more self-determined motivational) clusters. In Study 2, there were a total of 250 French junior national fencers aged 15 years. Results revealed a three-cluster solution very similar to that of Study 1. In addition, in line with Study 1, results revealed that the least self-determined motivational profile led to the lowest level of performance. Overall, these findings suggest that cluster analysis is useful in the understanding of the complex relationship between motivation and performance in elite sport.

Keywords Motivation · Performance · Sport · Cluster analysis · Self-determination theory

Introduction

Motivation has been repeatedly reported as one of the most important contributors to high-level performance. For instance, in sport, athletes' success is often explained as a function of motivation (Gould et al. 2002; Williams and Krane 2001). In that light, it is not surprising that a considerable amount of research in the last 20 years has focused on sport motivation (see Chatzisarantis et al. 2003; Roberts 2001; Vallerand et al. 1987). Among the different theories proposed to explain motivated behavior and outcomes in sport, self-determination theory (SDT; Deci and Ryan 2000; Ryan and Deci 2007) has been found to be especially influential. Numerous studies have supported postulates from this theory in the sport setting (see Hagger and Chatzisarantis 2007; Vallerand 2007a).

Among the numerous postulates of the theory, SDT posits the existence of three major types of motivational constructs, namely intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation refers to engaging in activities for themselves, out of pleasure, fun, and enjoyment. On the other hand, extrinsic motivation refers to engaging in activities for outcomes that are separate from the activity. Four forms of extrinsic motivation have been proposed. First, external regulation involves engaging in an activity to obtain rewards or avoid punishment. Second, introjected regulation refers to behaviors performed to avoid guilt and internal pressure and entails the

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internalization of past external controls. Third, in identified regulation, individuals engage out of choice in the activity that is not interesting per se. Finally, the last form of extrinsic motivation is integrated regulation. It deals with behaviors that while not emitted out of fun, are nevertheless fully internalized in the individual's self and value system. In addition to intrinsic and extrinsic motivation, a third motivational construct described by Deci and Ryan (1985) is amotivation. When amotivated, individuals do not perceive contingencies between their actions and subsequent outcomes. Amotivation can be seen as the relative lack of motivation to engage in a certain behavior (Vallerand 1997).

Self-determination theory further posits that these different forms of motivation can be aligned on a continuum of increasing self-determination from amotivation to external, introjected, identified, and integrated regulations, and to intrinsic motivation. Furthermore, because self-determination is a prerequisite for adaptive functioning (Deci 1980), consequences should be increasingly positive as one moves from amotivation to intrinsic motivation. Much research supports this hypothesis in a variety of life contexts (see Deci and Ryan 2000; Vallerand 1997), as well as in sports (for reviews, see Vallerand 2007a, b; Vallerand and Losier 1999). Thus, the more autonomous or self-determined forms of motivation (intrinsic motivation as well as identified and integrated regulations) have been found to lead to a number of positive cognitive (e.g., concentration; e.g., Brière et al. 1995), affective (e.g., positive affect, flow; e.g., Kowal and Fortier 1999; Pelletier et al. 1995), and behavioral (e.g., persistence; e.g., Pelletier et al. 2001; Sarrazin et al. 2002) outcomes in sport settings. Conversely, forms of controlled or non self-determined motivation (introjected and external regulations) and especially amotivation have been found to typically yield negative outcomes (e.g., anxiety, distraction, dropping out, negative affect; e.g., Brière et al. 1995; McDonough and Crocker 2007; Pelletier et al. 2001).

Previous research examining the relationships between motivation and outcomes has used one of two strategies: (1) assessing the relationship of each type of motivation independently (e.g., intrinsic motivation) or (2) using the self-determination index which entails giving weights to each construct as a function of placement on the self-determination continuum and summing all products into one score (e.g., Fortier et al. 1995; Grolnick and Ryan 1987; Guay and Vallerand 1997; Ryan and Connell 1989; Sarrazin et al. 2002). While the first strategy is limited because a number of motives are typically at play in life settings (e.g., Pintrich 2003), the second one may not be optimal either as it imposes a unique profile based on theory where a high self-determined motivational profile is theoretically posited to be the ideal one. Indeed, SDT assumes that a truly self-determined motivational profile exists and that such a profile should lead to the most positive outcomes. Yet, as Vallerand (1997) suggested, a number of motivational profiles may exist in actual life domains such as sport (e.g., high levels of both autonomous and controlled motivation) and it is possible that in certain contexts, profiles that deviate from the one proposed by SDT, lead to equivalent or even more positive outcomes. It would thus appear important to better understand the different clusters that exist in certain life contexts such as in competitive sports, using SDT as a theoretical framework, and determine how each cluster relates to outcomes such as performance.

While increasing research has looked at the motivational clusters that emerge in sport (e.g., Harwood et al. 2004; Hodge et al. 2008; McNeill and Wang 2005), exercise (Cumming and Hall 2004; Matsumoto and Takenaka 2004; Wang and Biddle 2001), and physical education (Ntoumanis 2002; Wang et al. 2002) settings, researchers have typically used a mix of theoretical approaches in determining the clusters within the purview of the same study. Such a methodological strategy makes it difficult to determine how SDT constructs uniquely contribute to the clusters. Furthermore, other research has used both SDT constructs and outcomes to determine the nature of the clusters (e.g., Ntoumanis 2002). Because both motivation and outcomes are used in creating the clusters, it becomes impossible to determine from such clusters how motivation independently predicts outcomes.

One study that has looked at emerging clusters using strictly SDT constructs is that of Vlachopoulos et al. (2000). These authors examined motivational profiles with two samples of sport participants ($n = 590$ and $n = 555$). Cluster analysis results revealed the presence of two profiles. The first was characterized by a high self-determined motivational profile (high autonomous but low controlled motivation). The second comprised athletes who had both high autonomous and controlled motivation. Results with outcomes revealed that participants in the second cluster reported significantly higher levels of enjoyment, effort, positive affect, strength of intention to continue, and satisfaction but lower levels of negative affect than participants in the first cluster. These results do not fully corroborate SDT's predictions. Indeed, athletes characterized by a mixed motivational profile experienced more positive outcomes than those characterized by a self-determined motivational profile. SDT would have predicted just the opposite.

The above study by Vlachopoulos et al. (2000) is important because it would appear to be the only study to use strictly SDT motivational variables to identify clusters in sport and how these relate to outcomes. However, three points are in order with respect to this study. First, participants of this study were non elite sport participants. Thus, we do not know what types of clusters may exist with other populations such as elite athletes. More than two clusters might be expected with elite performers as a number of motivational patterns may explain participation in a competitive setting. Second, the outcomes used in the Vlachopoulos et al.'s (2000) study were self-reports of affect, cognition, and behavioral intentions. Objective levels of performance were not assessed in the Vlachopoulos et al.'s study. Finally, all variables were assessed at the same point in time. It is thus difficult to determine if motivational clusters can predict changes in outcomes, such as performance, that may take place over time.

We believe that it is important to study performance as it represents one of the key outcomes in sport, especially at the elite level and yet, performance has been sorely neglected in past motivation research (Roberts 1992; Vallerand 2001, 2007a; Vallerand and Rousseau 2001). Past research in other life contexts such as education has shown that high levels of autonomous motivation toward education lead to high academic performance (e.g., Boiché et al. 2008; Burton et al. 2006; Gottfried et al. 1994). For instance, in three studies, Ratelle et al. (2007) have investigated the nature of students' motivational profiles toward education and examined how these clusters differed on a variety of outcomes, including performance. Results of two studies with high school students (Studies 1 and 2) revealed three distinct clusters: (1) a low autonomous–high controlled motivation cluster; (2) a moderate autonomous–moderate controlled motivation cluster; and (3) a high autonomous–high controlled motivation cluster. Thus, a truly self-determined motivational cluster was not obtained with high school students. Results also showed that high school students with the least self-determined motivational cluster (i.e., low autonomous–high controlled motivation) had lower grades than those in the two other clusters that did not differ between them (Ratelle et al. 2007, Study 2). These findings with performance were replicated in Study 3 with college students (although a truly self-determined motivational cluster was found in this study).

In light of the above, there were three purposes to the present research. First, using cluster analysis, we sought to identify the motivational profiles that exist in elite junior tennis ("Study 1") and fencing ("Study 2"). We limited ourselves to fencing and tennis for homogeneity purposes and also because reliable objective performance data were available for these sport activities. This person-oriented approach is interesting because it also provides opportunities for researchers to determine the number of athletes characterized by distinct motivational profiles while correlation or regression analyses do not (Ratelle et al. 2007). Furthermore, it should provide additional information on motivational profiles as they actually exist in an achievement context such as sport and not simply as theoretically proposed by SDT and exemplified by the self-determination index that imposes the high autonomous–low controlled motivation configuration.

A second purpose was to relate the motivational clusters to indices of objective performance. Such a strategy should allow us to determine if certain motivational profiles are more conducive to performance than others. It should be underscored that research in sport has yielded equivocal findings, with both autonomous (e.g., Biddle and Brooke 1992) and controlled forms of motivation (e.g., Chantal et al. 1996) being positively related to performance. However, such research has typically used a cross-sectional design and has not used cluster analysis. Clearly, a prospective design would be necessary to more clearly determine the role of motivational clusters in the prediction of changes in subsequent objective sport performance. This constituted the third purpose of the present research.

Study 1

We first examined athletes' motivational profiles in a sample of junior elite tennis players. In line with past research using cluster analysis in education and sport (e.g., Ratelle et al. 2007; Vlachopoulos et al. 2000), it was expected that at least three clusters would be uncovered: (1) a high autonomous–low controlled motivation cluster; (2) a high autonomous–high controlled motivation cluster; and (3) a low autonomous–high controlled motivation cluster. We then examined the links between these motivational profiles and tennis performance. In line with SDT and past studies using cluster analysis in education (e.g., Ratelle et al. 2007), it was hypothesized that the least self-determined cluster would display the lowest level of performance. This is because research with athletes from a variety of sports (e.g., Brière et al. 1995; Pelletier et al. 1995) has shown positive relationships between autonomous forms of motivation and concentration which may represent one the most important predictors of performance (Vallerand 2007a). Furthermore, athletes who engage in sport and put forth effort mostly when told to do so by the coach (external regulation) or who only go through the motions with little conviction (amotivation) may not work as hard overall, and thus should improve and perform less, than those who engage in sports because they love it and feel that it is their personal choice to do so.

Method

Participants and procedure

The sample was comprised of 170 French junior national tennis players (71 females and 99 males). Participants were either 13 or 14 years of age, with a mean age of 13.42 years (SD = .49 year). The number of years that they had been practicing tennis ranged from 3 to 11, with a mean of 6.94 years (SD = 1.48 years). They also reported practicing tennis for an average of 9.33 hours a week (SD = 3.70 hours).

This study received ethical approval from the French Tennis Federation. Athletes and their family were told that they were completely free to participate or not. Parental consent was obtained and confidentiality was ensured. In order to ensure that the participants would be elite performers, only players who were among the top 150 of France for their respective age group were contacted. Out of the 300 athletes, 39 could not be reached. Thus, before the beginning of the tennis season, a total of 261 athletes received a questionnaire by mail to assess their motivation for the activity at the beginning of the season and were asked to complete it. A prepaid reply envelope was also provided. One hundred and seventy questionnaires were returned, for a 65% return rate. Objective performance was later secured from the French Tennis Federation.

Measures

Sport motivation

The French version of the Sport Motivation Scale (SMS; Brière et al. 1995) was used to measure athletes' motivation toward tennis. The SMS contains a total of 28 items, with four items per subscale. These items assess the constructs of intrinsic motivation to know, intrinsic motivation to experience stimulation, intrinsic motivation toward accomplishments, identified regulation, introjected regulation, external regulation and amotivation. Participants responded to items based on a seven-point Likert scale ranging from "Does not correspond at all" (1) to "Corresponds exactly" (7). Because, we did not have any specific hypotheses about the different types of intrinsic motivation, the three intrinsic motivation subscales were combined in an index of intrinsic motivation. While past research has confirmed the validity and reliability of the SMS (e.g., Li and Harmer 1996; Pelletier et al. 1995, 2007; Pelletier and Sarrazin 2007), some authors have criticized its factorial structure (e.g., Mallett et al. 2007b; Martens and Webber 2002; Reimer et al. 2002). Consequently, we have conducted a confirmatory factor analysis (CFA) with the present data. The results appear below.

Sport performance

Five objective performance indices were used in the present study. First, the ratio between the number of victories and the number of matches played during the tennis season following questionnaire completion was used as a performance measure (i.e., Performance 1). For example, the performance for a player who has won 4 of 10 matches would be equal to .40. This tennis performance was obtained via the French Tennis Federation. Participants played an average of 60.6 matches (SD = 21.2 matches). Second, we used the same method to calculate a total performance score for the two seasons following questionnaire completion (i.e., Performance 2; $M = 117.5$ matches; SD = 41.1). We also obtained two other measures of performance with respect to the scores as determined by the French Tennis Federation for the tennis season following data collection (i.e., Performance 3), and for the next two seasons (i.e., Performance 4). With the Federation scores, the higher the level of the opponent, the more points are won following a win, whereas losses against players ranked below are penalized. Finally, the ratio between the number of victories and the number of matches played ($M = 63.1$ matches; SD = 18.4) during the tennis season prior to data collection was used as a performance score for the previous season.

Data analysis

A two-stage cluster analysis procedure was used (Gore 2000; Hair et al. 1998) because it allows researchers to constitute clusters with high internal and external homogeneities (Hair and Black 2000). Whereas hierarchical cluster analysis represents a mean of obtaining the optimal number of clusters, non-hierarchical k-means cluster analysis is used as a way of further fine-tuning the preliminary cluster solution trough an iterative process by minimizing the within-cluster variance and by maximizing the between-cluster variance. Of importance is the fact that cluster analysis is more adaptive than the typical median- or mean-split procedures where much of the variance is lost in the process of creating groups. A better understanding of such motivational clusters is important because it underscores the role of motivational regulations considered jointly rather than in isolation (Ntoumanis 2002). We decided to use a cluster-analytic approach rather than testing for interaction effects in a multiple regression framework because we believe that it would have been difficult to analyze all potential configurations involving the different forms of motivation in a regression analysis.

Results

Preliminary analyses

The univariate distributions of the various variables were examined for normality (i.e., via skewness and kurtosis values and the Kolmogorov–Smirnov statistic). The performance variables were normally distributed except for Performance 1 (Kolmogorov–Smirnov statistic, $P < .05$; skewness = −1.29, kurtosis = 2.73). Similarly, the motivational variables were normally distributed in all instances, except for the amotivation variable (Kolmogorov–Smirnov statistic, $P < .01$; skewness = 3.24, kurtosis = 12.06). Past research has also revealed that the amotivation subscale often displays a skewed distribution where low means are reported. This is to be expected as individuals who engage in the activity should report low levels of amotivation. However, non-normality in the data does not pose problem as the amotivation subscale has been repeatedly found to be the best predictor of various outcomes, including behavioral persistence both in education (Vallerand and Bissonnette 1992; Vallerand et al. 1997) and sports (Pelletier et al. 2001). Furthermore, recent cluster analyses using the amotivation subscale (e.g., Ratelle et al. 2007, Studies 1–3) have revealed that results were not influenced by the non-normality of the data. In the present study, the correlations among the motivation variables ranged between −.21 and .53 (see Table 1). Thus, multicollinearity was not a problem because only correlation values of .90 and above display significant collinearity (Hair et al. 1998).

We next examined the factor structure for the French version of the SMS (Brière et al. 1995) via CFA. While the number of parameters relative to the number of participants imposes some limits on the model being tested, results of the CFA yielded acceptable fit indices, χ^2 (318) = 485.60, $P < .001$, CFI = .92, NNFI = .91, RMSEA = .052 [.041; .062]. All factor loadings were significant. Furthermore, the Cronbach alphas were all adequate (between .74 and .91) and inspection of the correlations among the SMS subscales provided support for the self-determination continuum. Specifically, all correlations among the SMS subscales revealed a simplex-like pattern, with stronger positive correlations between adjacent factors on the self-determination continuum and weaker correlations between more distal factors (see Table 1). The present results are in agreement with those obtained by Brière et al. (1995) and Pelletier et al. (1995) and provide additional support for the construct validity of the French version of the SMS.

Main analyses

To identify subgroups of athletes based on their motivation, a cluster analysis was conducted. Cluster analysis allows researchers to examine different solutions, and then select the solution that best fits the data (Cumming et al. 2002; Hodge and Petlichkoff 2000). First, a hierarchical cluster analysis using Ward's linkage method with the squared Euclidian distance measure was performed. Ward's hierarchical method was chosen because it trivializes the within-cluster differences found in other methods (Aldenderfer and Blashfield 1984). Hierarchical cluster analysis is an exploratory data reduction technique designed to create groups in such a way that participants in the same cluster display a similar motivational profile (Jobson 1992). The clustering variables were intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. We used the raw scores because all variables shared the same metric (i.e., a 7-point Likert scale). The agglomeration coefficient and dendrograms suggested that a four-cluster solution was the most appropriate.

In the second stage, a k-means cluster analysis using the cluster centers resulting from the hierarchical seed points was conducted to validate the four-cluster solution. The results of the hierarchical method were confirmed because the final centroids in the k-means analysis were similar to the initial seed points. Means of the motivation subscales for the four-cluster solution are reported in Table 2 and Fig. 1 displays the motivational subscales as a function of clusters. Results from chi-square analyses revealed that the proportion of gender in each cluster did not differ [(Cluster

Table 1 Correlations among the study variables ("Study 1")

Variables	1	2	3	4	5	6	7	8	9
1. Intrinsic motivation									
2. Identified regulation	.50**								
3. Introjected regulation	.36**	.53**							
4. External regulation	.14	.42**	.44**						
5. Amotivation	−.21*	.09	.13	.26**					
6. Previous performance	.10	−.05	−.08	−.07	−.16*				
7. Performance 1	.07	−.05	−.04	−.15*	−.16*	.33**			
8. Performance 2	.08	−.05	−.06	−.16*	−.19*	.38**	.83**		
9. Performance 3 (Log)	.10	−.01	−.02	−.09	−.26*	.31**	.77**	.58**	
10. Performance 4 (Log)	.13	−.05	−.04	−.10	−.26*	.41**	.67**	.75**	.69**

* $P < .05$, ** $P < .001$

Table 2 Means for the study variables as a function of clusters ("Study 1")

Cluster	Cluster 1 "High AU–high C" (n = 30)	Cluster 2 "Mod AU–low C" (n = 70)	Cluster 3 "High AU–mod C" (n = 47)	Cluster 4 "Mod AU–high C" (n = 23)	F	P	η^2
Intrinsic motivation	5.86_a	4.89_b	5.61_a	4.68_b	14.66	.001	.21
Identified regulation	5.49_a	2.89_b	3.87_c	4.15_c	60.62	.001	.52
Introjected regulation	6.04_a	3.26_b	5.35_c	4.42_d	87.40	.001	.61
External regulation	4.29_a	1.95_b	2.65_c	4.24_a	55.28	.001	.50
Amotivation	1.27_a	1.11_a	1.14_a	2.23_b	28.58	.001	.34
Self-determination index	9.50_a	7.84_b	8.82_a	4.73_c	15.25	.001	.22
Previous performance	$.56_a$	$.59_a$	$.60_a$	$.55_a$	1.67	.18	.03
Performance 1	$.57_a$	$.58_a$	$.57_a$	$.46_b$	5.89	.001	.10
Performance 2	$.57_a$	$.58_a$	$.57_a$	$.49_b$	5.61	.001	.09
Performance 3 (Log)	6.98_a	7.13_a	7.05_a	5.70_b	4.59	.01	.08
Performance 4 (Log)	7.61_a	7.95_a	7.93_a	6.35_b	7.63	.001	.12

Note For each dependent variable, means with different subscripts indicate a significant difference at $P < .05$ using Fisher's LSD test

AU autonomous, *C* controlled

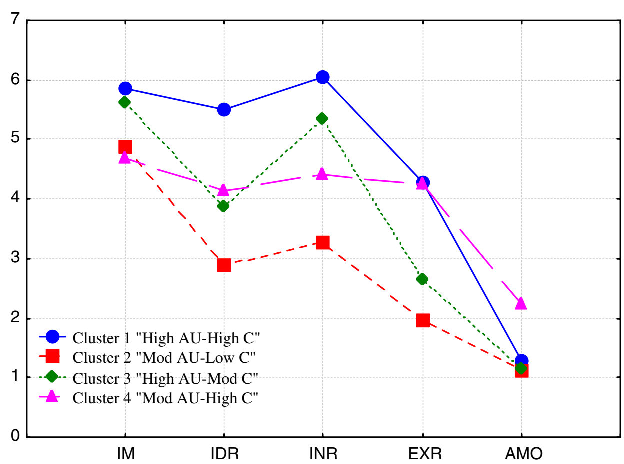

Fig. 1 Motivation subscales as a function of clusters ("Study 1"). *AU* autonomous, *C* controlled, *IM* intrinsic motivation, *IDR* identified regulation, *INR* introjected regulation, *EXR* external regulation, *AMO* amotivation

1 had 13 females and 17 males); (Cluster 2 had 31 females and 39 males); (Cluster 3 had 20 females and 27 males); and (Cluster 4 had 7 females and 16 males)].

A one-way multivariate analysis of variance (MANOVA) was conducted with the five types of motivation as dependent variables and the four clusters as the independent variable in order to identify the motivational content of each cluster. Results revealed significant differences among the four groups, $F(15, 448) = 36.92$, $P < .001$, $\eta^2 = .52$. A one-way ANOVA was conducted on each dependent variable as a follow-up to the MANOVA. The ANOVAs revealed a number of significant differences among the four clusters [for intrinsic motivation, $F(3, 166) = 14.66$, $P < .001$, $\eta^2 = .21$, identified regulation, $F(3, 166) = 60.62$, $P < .001$, $\eta^2 = .52$, introjected regulation, $F(3, 166) = 87.40$, $P < .001$, $\eta^2 = .61$, external regulation, $F(3, 166) = 55.28$, $P < .001$, $\eta^2 = .50$, and amotivation, $F(3, 166) = 28.58$, $P < .001$, $\eta^2 = .34$, see Table 2 for the complete picture of all significant differences among the four clusters]. Overall, these differences support the distinction among the four clusters.

Scores on the various motivation subscales allow us to label the four clusters. Participants in the first cluster represented 18% of the sample ($n = 30$) and included athletes who displayed high levels of intrinsic motivation, identified regulation, introjected regulation, and external regulation, but low levels of amotivation. Thus, this cluster was labeled the high autonomous–high controlled cluster (high AU–high C group). The second cluster represented 41% of the sample ($n = 70$) and included athletes whose motivational profile was characterized by relatively moderate levels of intrinsic motivation and identified regulation, but relatively low levels of controlled motivation and amotivation. This second cluster was thus labeled the moderate autonomous–low controlled motivation group (mod AU–low C group). The third cluster represented 28% of the sample ($n = 47$) and included athletes who displayed a high level of autonomous motivation, and low to moderate levels of controlled motivation and amotivation. This third cluster was thus labeled the high autonomous–moderate controlled motivation group (high AU–mod C group). Finally, the fourth cluster represented 13% of the sample ($n = 23$) and included participants who displayed moderate levels of autonomous motivation, but moderate to high levels of controlled motivation and amotivation. In fact, this group obtained the highest level of amotivation. Thus, this cluster was labeled the moderate autonomous–high controlled motivation group (mod AU–high C group).

For exploratory purposes, we next compared the four clusters on their scores on the self-determination index. Means for the clusters appear in Table 2. Results from an ANOVA, $F(3, 166) = 15.25$, $P < .001$, $\eta^2 = .22$, followed by post hoc tests using Fisher's LSD revealed that participants in the mod AU–high C group ($M = 4.73$, $SD = 3.72$) exhibited significantly lower scores on the self-determination index compared to those in the high AU–high C group ($M = 9.50$, $SD = 2.54$), the high AU–mod C group ($M = 8.82$, $SD = 2.03$), and the mod AU–low C group ($M = 7.84$, $SD = 2.89$). Furthermore, the mod AU–low C group was lower than the high AU–high C and high AU–mod C clusters which did not differ between them.

A series of ANOVAs and post hoc tests using Fisher's LSD were conducted to determine whether the motivational profile groups differed significantly with respect to subsequent performance. A prior analysis on performance during the previous season revealed no difference among clusters, $F(3, 166) = 1.67$, $P = .18$, $\eta^2 = .03$. The results of the ANOVA on Performance 1 (ratio of win/loss for the first season following questionnaire completion) revealed a significant effect for clusters, $F(3, 166) = 5.89$, $P < .001$, $\eta^2 = .10$. Post hoc tests indicated that the least self-determined cluster, the mod AU–high C group, obtained significantly lower levels of performance ($M = .46$) than all other clusters that did not differ among them. Overall, athletes in the mod AU–high C cluster lost between 11 and 12% more matches than those in the three other clusters during the following (first) tennis season.

Additional analyses were also conducted with the three other performance indices. We conducted ANOVAs in order to assess the difference among the four clusters with respect to (1) the ratio of victories to matches played in the following two seasons (Performance 2), (2) the scores as determined by the French Tennis Federation given to each athlete for the subsequent season (Performance 3; such scores take into consideration the ranking of opponents that the player has defeated, as well as lost to) and (3) and scores from the French Tennis Federation for the next two seasons (Performance 4). All results were the same as those mentioned above for Performance 1 (all ps $< .01$ and effect sizes varied from .08 to .12).[1] All the performance scores for each cluster appear in Table 2.

Furthermore, a series of ANCOVAs were conducted on all four performance variables controlling for the previous season's performance. The results were the same as those of the ANOVAs (all ps $< .05$ and effect sizes varied from .07 to .11). In addition, another series of ANCOVAs were conducted controlling for the previous season's performance, years of tennis experience, and hours of training per week. This is a highly conservative test as the number of hours of training can be influenced by motivation. Still, once again, all results were the same as those reported above (all ps $< .05$, except for Performance 3, $P = .08$; effect sizes varied from .05 to .08). Overall, these results provide support for the validity of the present findings and suggest that the motivational clusters allow us to explain a sizeable portion of variance in the change of objective performance that took place over time.[2]

Discussion

The purpose of this study was to use cluster analysis in order to examine the nature of motivational profiles that exist in elite sport and then assess the relationship between these clusters and changes in subsequent objective performance. The results revealed the existence of four readily interpretable clusters: a high autonomous–high controlled group (high AU–high C group), a moderate autonomous–low controlled group (mod AU–low C group), a high autonomous–moderate controlled group (high AU–mod C group), and a moderate autonomous–high controlled group (mod AU–high C group). Further, the present findings showed that athletes with the least self-determined motivational profile at the beginning of the tennis season (i.e., mod AU–high C profile), displayed the lowest level of subsequent performance. Athletes in this cluster lost between 11 and 12% more matches than those of the other three clusters. Over the course of a 60 match season, this amounts to winning 6 or 7 matches less than participants with a more self-determined motivational configuration. This result on the role of motivation in performance is particularly striking when one considers that these athletes were among the best of their respective age group in a country recognized for its high level of tennis development (for instance, the International Tennis Federation world men junior rankings for the year 2006 showed that France was the only country to have two athletes in the top 10).[3]

[1] It should be noted that because of the extremely high level of variance in the scores of the French Federation of Tennis, both the Performance 3 and Performance 4 scores were subjected to a log transformation.

[2] All Fs, Ps, and η^2 can be obtained through the authors.

[3] We also calculated the rank of each player relative to those within the present study (higher ranks = lower performance). Thus, based on the scores from the French Tennis Federation, each player was ranked from 1 to 170 for the first season, as well as for both the first and second seasons combined. Then the mean rank of each cluster was compared. Results for the first season revealed the following ranks: high AU–high C cluster = 77.4; mod AU–low C group = 70.3; high AU–mod C group = 70.2; mod AU–high C = 98.9. In line with the other results from this study, the least self-determined cluster (mod AU–high C cluster) was found to be

However, the present findings were obtained with 13 and 14 years old elite tennis players from France. Therefore, future research is needed to replicate the present findings with athletes from different sport activities because as suggested by Ratelle et al. (2007), athletes' motivational profiles might be context sensitive.

Study 2

While our first prospective investigation has provided us with important information regarding athletes' motivational profiles in elite sport, it seems imperative to conduct an additional study with elite athletes practicing another competitive activity. Thus, the purpose of this second study was twofold. First, we sought to verify that the motivational configurations found in "Study 1" could be generalized to another sample, this time elite fencers. Second, we examined the relationships between these motivational profiles and sport performance. According to SDT and results from "Study 1", it was hypothesized that athletes with the least self-determined motivational profile would obtain the lowest levels of subsequent fencing performance, controlling for athletes' prior performance.

Method

Participants and procedure

The sample was composed of 250 French junior national fencers (107 females and 143 males) aged 15 years. There were 88 epée fencers, 92 foil fencers, and 70 sabre fencers among the top 30 of France for their respective age and weapon group. As in "Study 1", this second investigation received ethical approval from athletes and the French Fencing Federation. Each participant volunteered to complete a questionnaire before the beginning of the fencing season. Data were collected before the beginning of the following seasons: 2001–2002, 2003–2004, 2004–2005, 2005–2006 and 2006–2007. At the end of each season, a measure of sport performance was obtained via the French Fencing Federation.

Measures

Sport motivation

The same scale as in "Study 1" was used.

Sport performance

Two objective measures of performance were used in the present study. The first performance score reflects the national ranking in fencing of each athlete at the end of the season following data collection (i.e., Performance 1). Second, the national ranking determined by the French Fencing Federation was also used as a performance measure for the previous season. The rankings were reversed so that high values were indicators of a high level of performance. Thus, the lower the national ranking (e.g., first), the worse the athletes' performance was during the fencing season.

Results

Preliminary analyses

The internal consistency for all the subscales of the French version of the SMS (Brière et al. 1995) was satisfactory (between .73 and .87). As in "Study 1", an inspection of the correlations among the SMS subscales provided support for the self-determination continuum with stronger positive correlations between adjacent factors on the self-determination continuum and weaker correlations between more distal factors (see Table 3). As in "Study 1", the study variables were normally distributed except for the amotivation variable (Kolmogorov–Smirnov statistic, $P < .01$; skewness = 1.60, kurtosis = 1.68). Treatment of outliers involved deleting four cases with a distance from the mean greater than three times the value of the standard deviation.

Main analyses

First, scores of each motivation subscale of the SMS (intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation) were included in an exploratory cluster analysis using Ward's method of linkage and a squared Euclidian distance. The agglomeration schedules and dendrograms suggested that a three-cluster solution was the most appropriate because the agglomeration coefficient showed a large increase from three to two clusters. Then, a k-means clustering method

Footnote 3 continued
ranked lower than the other three that did not differ among them, $F(3, 166) = 2.47$, $P = .06$, $\eta^2 = .04$. These results were replicated with performance for the two seasons combined with mean ranks of 75.7, 71.7, 75.7, and 104.3 for the four clusters in that order, $F(3, 166) = 2.80$, $P < .05$, $\eta^2 = .05$. What these results reveal is that national tennis players with the least self-determined motivational profile assessed before the beginning of the first season were ranked significantly lower (some 20 ranks lower after one season, and even 30 ranks lower after two seasons!) than other tennis players their own age who had a more self-determined motivational profile. Clearly motivation matters with respect to performance!

Table 3 Correlations between the study variables ("Study 2")

Variables	1	2	3	4	5	6	7
1. Intrinsic motivation							
2. Identified regulation	.44**						
3. Introjected regulation	.38**	.48**					
4. External regulation	.29**	.42**	.45**				
5. Amotivation	−.09	.11	.01	.17**			
6. Previous performance	.06	.07	−.02	.03	−.09		
7. Performance 1	.24**	.17*	−.05	.12*	−.11	.10	

* $P < .05$, ** $P < .001$

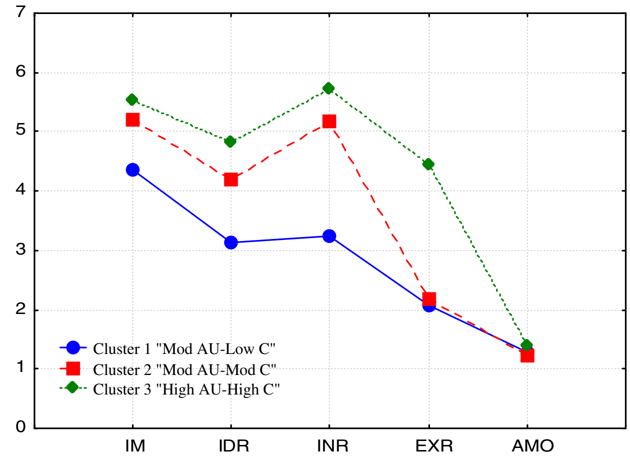

Fig. 2 Motivation subscales as a function of clusters ("Study 2"). *AU* autonomous, *C* controlled, *IM* intrinsic motivation, *IDR* identified regulation, *INR* introjected regulation, *EXR* external regulation, *AMO* amotivation

was used with the cluster centers resulting from the hierarchical seed points. The final centroids are shown in Table 4, and these were similar to the initial seed points. Figure 2 shows the three distinct motivational profiles.

A one-way MANOVA was carried out with the five forms of motivation as dependent variables and the clusters as the independent variable in order to identify the motivational content of each cluster. Results revealed significant differences among the three groups, $F(10, 464) = 67.47$, $P < .001$, $\eta^2 = .59$. A one-way ANOVA was conducted on each dependent variable as a follow-up to the MANOVA. The ANOVAs were all significant except for the amotivation subscale. Then, Fisher's LSD tests revealed that the three groups were significantly distinct from each other on intrinsic motivation, identified regulation, and introjected regulation. For external regulation, athletes in the high AU–high C displayed the highest score, while there were no significant differences between those in the two other groups (see Table 4 for more details). Chi-square analyses showed that there were no significant gender differences in the classification of athletes into the three clusters.

The first group (mod AU–low C) comprised 44% of the sample ($n = 108$) and entailed moderate levels of autonomous motivation as well as low levels of controlled motivation and amotivation. The second group (mod AU–mod C), which constituted 33% of the sample ($n = 81$), included athletes whose motivational profile was characterized by moderate levels of both autonomous and controlled motivation and low levels of amotivation. The third group (high AU–high C) included 57 athletes (23% of the sample) whose profile was characterized by high levels of both autonomous and controlled motivation and low levels of amotivation.

Results from an ANOVA on the self-determination index revealed a significant effect for clusters, $F(2, 243) = 14.98$, $P < .001$, $\eta^2 = .11$. Specifically, athletes in the mod AU–low C group ($M = 6.65$, SD = 2.48) exhibited significantly lower scores on the self-determination index compared to those in the high AU–high C group

Table 4 Descriptive statistics for the three-cluster solution ("Study 2")

Cluster	Cluster 1 "Mod AU–low C" ($n = 108$)	Cluster 2 "Mod AU–mod C" ($n = 81$)	Cluster 3 "High AU–high C" ($n = 57$)	F	P	η^2
Intrinsic motivation	4.37_a	5.21_b	5.52_c	41.35	.001	.25
Identified regulation	3.13_a	4.19_b	4.82_c	65.44	.001	.35
Introjected regulation	3.25_a	5.18_b	5.72_c	181.00	.001	.60
External regulation	2.07_a	2.18_a	4.44_b	177.75	.001	.60
Amotivation	1.28_a	1.22_a	1.39_a	2.84	.06	.02
Self-determination index	6.65_a	8.50_b	7.98_b	14.98	.001	.11
Previous performance (ranks)	17.15_a	18.27_a	10.46_a	1.21	.30	.01
Performance 1 (ranks)	28.25_a	39.48_{ab}	51.24_b	3.20	.05	.03

Note. For each dependent variable, means with different subscripts indicate a significant difference at $P < .01$ using Fisher's LSD test

AU autonomous, *C* controlled

($M = 7.98$, SD = 2.38) and the mod AU–mod C group ($M = 8.50$, SD = 2.27). No significant differences emerged between the high AU–high C cluster and the mod AU–mod C cluster.

We next examined the links between these three motivational profiles and sport performance. Thus, a first ANOVA and Fisher's LSD tests were conducted to determine whether the motivational profile groups differed significantly with respect to the fencing performance during the season prior to data collection (previous performance). The analysis was non significant, $F(2, 236) = 1.21$, $P = .30$, $\eta^2 = .01$. The results of a second ANOVA on the subsequent performance (i.e., Performance 1) revealed a significant effect for clusters, $F(2, 236) = 3.20$, $P < .05$, $\eta^2 = .03$. Specifically, athletes in the least self-determined cluster, the mod AU–low C group, performed lower than those in the high AU–high C. The mod AU–low C and the mod AU–mod C groups as well as the mod AU–mod C and the high AU–high C groups did not differ from each other on this performance variable. Finally, an ANCOVA was conducted on Performance 1 controlling for the previous season's performance. Results were the same as those mentioned above ($P < .05$, $\eta^2 = .03$).

Discussion

The first purpose of the present study was to identify athletes' motivational profiles in a sample of junior elite fencers. Contrary to the first study in tennis, the present results revealed the existence of three readily interpretable clusters. It is interesting that although we replicated two of the three motivational profiles found in "Study 1" (i.e., mod AU–low C and high AU–high C motivational profiles), we found one different motivational profile that combines moderate levels of autonomous and controlled motivations (labeled mod AU–mod C), sharing some similarities with the high AU–mod C group in "Study 1". We believe that there were two significant differences between these two studies that might explain these different results. First, the nature of the sport was different. Indeed, the present sample was composed of junior elite fencers, while the first study included junior elite tennis players. Second, participants in the first study were among the top 150 of France for their respective age group, while the sample in "Study 2" was composed of athletes who were even more elite, being among the top 30 of France for their respective age and weapon group. Thus, as mentioned above, it is possible that the development of motivational profiles may vary as a function of sport activities and levels of expertise. However, future research is needed on this issue.

Concerning the links between the three motivational profiles and sport performance, results from "Study 2" replicated those of "Study 1". Indeed, results from "Study 2" also revealed that athletes with the least self-determined profile (i.e., the mod AU–low C profile) obtained lower performances than those obtained by the other groups. In line with recent investigations (e.g., Ratelle et al. 2007, Study 3), the present findings suggest that having a motivational profile characterized by low to moderate levels of autonomous and controlled motivations toward an activity is counterproductive with respect to performance in this activity.

General discussion

The first aim of the present research was to examine adolescents' motivational profiles in a real-life setting, namely elite sport. The second aim was to study the potential influence of these motivational profiles on subsequent sport performance controlling for previous performance. In "Study 1" with junior elite tennis players, results revealed the existence of four motivational profiles: (1) a high autonomous–high controlled (high AU–high C) motivational profile, (2) a moderate autonomous–low controlled (mod AU–low C) motivational profile, (3) a high autonomous–moderate controlled (high AU–mod C) motivational profile, and (4) a least self-determined profile (mod AU–high C) characterized by moderate levels of autonomous motivation and high levels of controlled motivation. Results of "Study 2" conducted with junior elite fencers suggested a three-cluster solution to be suitable: (1) a moderate autonomous–low controlled (mod AU–low C) motivational profile, (2) a high autonomous–high controlled (high AU–high C) motivational profile (these two profiles were identical to those found in the sample of tennis players), and (3) a moderate autonomous–moderate controlled (mod AU–mod C) motivational profile, which shared some similarities with the high AU–mod C profile among the tennis players. The results of both studies showed that athletes characterized by the least self-determined profile obtained the worst sport performance during the subsequent season.

The present results thus provide support for the proposition on the relevant influence of motivation on sport performance (e.g., Roberts 1992; Vallerand 2001). By finding that the least self-determined profile was associated with the worst sport performance, the results of both studies provide support for SDT and past investigations that showed that non-self determined motivation was associated with negative sport outcomes such as distraction (e.g., Brière et al. 1995; Pelletier et al. 1995), dropout (e.g., Pelletier et al. 2001) and burnout (e.g., Cresswell and

Eklund 2005a, b; Lemyre et al. 2006). It is also interesting to note that the present findings are directly in line with those obtained by Ratelle et al. (2007) in education. In Studies 2 and 3, these authors showed that the cluster with the lowest level of self-determined motivation always yielded the lowest level of performance in education. However, Ratelle et al. did not use a prospective design in their research. What the present research adds to the Ratelle et al.'s results is that using a prospective design, a low self-determined motivation cluster was shown to predict *changes* (drops) in performance that took place over the course of one and even two seasons. However, future research is needed to better understand the nature of the psychological processes triggered by controlled motivation and amotivation that may undermine performance (see Ntoumanis et al. 2004; Pelletier et al. 1999).

Bearing in mind that introjected and external regulations are located toward the lower end of the self-determination continuum (Deci and Ryan 1985), one might have anticipated that the best performers would report high levels of autonomous motivation and low levels of controlled motivation. Unexpectedly, this was not the case in our research. In fact, in "Study 2", the best performance in fencing was obtained by the high AU–high C cluster. Of interest, Chantal et al. (1996) also found that higher performing athletes (i.e., title and medal holders in national and international events) exhibited high levels of both autonomous and controlled motivations. Although these results were obtained in a specific cultural context (Bulgaria was under the controlling communist regime when the Chantal et al. study was conducted in 1989), these findings suggest that sport performance may be related to high levels of both autonomous and controlled motivations. In the present research, it would thus appear that the relatively high levels of autonomous motivation that the high AU–high C cluster displayed may have served a protective function against controlled motivation. Such was not the case for the mod AU–high C cluster in "Study 1" whose autonomy level may have been too low to protect against the high level of controlled motivation. Alternatively, other authors (Amabile 1993; Lepper et al. 2005) suggest that under certain conditions (e.g., when autonomous motivation is high), controlled motivation may act in synergy with autonomous motivation in leading to positive outcomes. Future research is clearly needed on this issue.

What is striking in the present findings, is that a truly self-determined motivation cluster (i.e., a high autonomous–low controlled motivation group) was not obtained. As we mentioned above, it would thus appear that the prevailing context may have an important impact on the types of clusters or motivational configurations that are prevalent in a given life domain. Contexts that are highly competitive, achievement driven, and potentially controlling in nature (such as competitive sports and high school education) may not lend themselves to high levels of pure self-determined motivation (e.g., high autonomous–low controlled motivation). However, future research is needed to test this hypothesis in a variety of life contexts.

An alternative explanation for the fact that a true autonomous cluster was not found may have to do with the scale we used, namely the French version of the SMS (Brière et al. 1995). Indeed, although the present results provided support for the construct validity of this scale, some authors (e.g., Mallett et al. 2007a, b) have suggested that the SMS may not assess some of the SDT regulatory categories in a theory-consistent way. In particular, these researchers suggest that the external regulation subscale does not assess the more controlling dimensions of external rewards or punishments, but rather focus on elements dealing with seeking prestige and regard (e.g., "To show others how good I am at my sport.", "Because it allows me to be well regarded by people I know."). It is thus possible that high scores on the external regulation subscale may reflect the player's desire to be famous, rather than external control per se. While these items do reflect controlled motivation, the absence of highly controlling external regulation items (and the use of less controlling ones) may explain why we and other researchers who have used the SMS in cluster analyses (e.g., Vlachopoulos et al. 2000) have found the presence of a high AU–high C cluster that was associated with positive consequences (e.g., performance, enjoyment, effort, positive affect). Therefore, further investigations using other measures of athletes' motivation (e.g., the Behavioral Regulation in Sport Questionnaire; Lonsdale et al. 2008) are needed to provide some more definitive answers to the present issue.

This study has some limitations. First of all, while the present study used a very informative statistical technique, namely cluster analysis, in conjunction with a prospective design, it should be underscored that the design used was nevertheless correlational in nature. Consequently, we cannot infer causality from the findings. Future research using an experimental design should be conducted to reproduce the present findings under controlled conditions. Second, the present findings were obtained with 13–15 years old elite fencers and tennis players from France. Future research is needed to replicate the present findings with athletes from different ages, sports, levels (i.e., professional or Olympic athletes), cultures, and other achievement fields (e.g., music, work, dramatic arts). Third, a large number of athletes from the target population (35%) did not participate in our first study. We have no way of knowing if such athletes display a different motivational cluster and how such a cluster would relate to performance. Fourth, it should be noted that the number of athletes who participated in the present studies was rather low ($n = 170$ and $n = 250$). Future research is needed to determine if the motivational clusters uncovered in the present research can be replicated with a larger sample of adolescent elite athletes as well as in other achievement settings. Fifth, only the SMS was used to derive the motivational clusters in both studies. In light of some of the issues raised with respect to this scale (e.g., Mallett et al. 2007a, b), future research using other instruments is recommended to replicate the present findings. Finally, although the athletes in the various clusters did not differ with respect to prior performance in the two present studies and other control variables in "Study 1" (i.e., years of sport experience and hours of training per week), it is nevertheless possible that they differed with respect to other variables that could account for the different levels of performance as a function of clusters. Future research controlling for variables such as having a personal coach, experiencing injuries, etc. would appear in order.

In sum, the present findings represent what would appear to be the first to support the role of different motivational profiles in predicting changes in objective sport performance over time. Future research is needed, however, in order to replicate and extend these findings thereby allowing us to better understand the motivational processes underlying elite performance.

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