The Role of Self-Regulatory Skills in Sport and Academic Performances of Elite Youth Athletes
Laura Jonker1*, Marije T. Elferink-Gemser1,2 and Chris Visscher1,2

Abstract: Success in sport and school is related to self-regulation. Additionally, sport experts are high academic achievers. We examined the role of 6 self-regulatory skills in the sport and academic performances of elite youth athletes (12-16 years) and compared their scores with age-matched controls in 2 academic secondary school systems (pre-university vs. pre-vocational). Pre-university students outscored pre-vocational students on 5 self-regulatory skills in the control group while 2 skills were significant in an athletes’ population. When comparing elite athletes to controls within each academic system, 3 self-regulatory skills were significant. Moreover, pre-vocational athletes outscored pre-university controls on 1 skill. These results expand theories of transfer by suggesting that self-regulation may help elite youth athletes to combine a sport career with education.

Keywords: talent development, metacognition, motivation, sport, academics

Even though elite youth athletes are frequently under excessive time pressure as a consequence of having to juggle their academic careers with their extensive investment in sports, they still tend to be high academic achievers (Brettschneider, 1999; Durand-Bush & Salmela, 2002). Student athletes generally have superior graduation rates (Watt & Moore, 2001) and are also more frequently in the pre-university system than fellow students who are less athletic (Jonker, Elferink-Gemser, & Visscher, 2009). In The Netherlands, students can enter two academic systems; the pre-university system or the pre-vocational system. The former prepares students for a university career and students are granted admission based on their test scores, while the latter prepares students for later vocational education. The academic system students enter thus determines their level of graduation and thereby their future career prospects. Within each academic system students can fail classes, which in The Netherlands means that students have to re-take the entire year.

Self-regulation is important in both sports and secondary education. Expert athletes exhibit more self-regulatory skills than non-experts in sports (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002), and at the higher academic levels typically more students can be found with superior self-regulatory skills (Zimmerman, 1986; Zimmerman & Martinez-Pons, 1986). It has, therefore, been suggested that the possession and use of self-regulatory skills predicts academic achievement (Nota, Soresi, & Zimmerman, 2004; Zimmerman & Martinez-Pons). The question arises whether self-regulatory skills may contribute to elite youth athletes’ academic performances as well as to their sport performance.

There is a long history of debate regarding the generality vs. domain-specificity of self-regulation and the possibilities for learners to use self-regulatory skills gained in one domain to progress in another (i.e., possibility for transfer). There is evidence for transfer failure and transfer success (e.g., Boekaerts & Corno, 2005; De Corte, 2003; Veenman, Elshout, & Meijer, 1997; Veenman & Spaans, 2005). This inconsistency in data may be due

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to how a successful transfer is conceptualized (De Corte; Veenman & Spaans). The traditional approach takes a narrow view for evidence of transfer (i.e., independent and instant use of knowledge and skills obtained in one domain transferred to another domain), whereas more recent conceptualizations emphasize a broader view (i.e., knowledge, skills and motivations obtained in one domain foster the use of skills in another domain) in which self-regulatory skills play a role (De Corte). Nevertheless, it is assumed that successful transfer is related to a similarity and to familiarity with the elements of a task (De Corte; Eccles & Feltovich, 2008; Pressley, 1995; Zimmerman, 1995).

Based on the broader conceptualization of transfer, the idea was to investigate the use of self-regulatory skills as potential moderators between excellent sport achievement and academic achievement in elite youth athletes (Jonker et al., 2009). Even though there seems to be little overlap between the respective elements of sport and academic performances, the factors that contribute to success in both domains may be highly correlated and have a common basis, namely a general set of self-regulatory skills. It has been proposed that elite athletes are familiar with the use of self-regulatory skills because of their familiarity with the domain-specific knowledge (i.e., declarative and procedural) that serves as a basis for self-regulatory skills. Additionally, elite youth athletes understand that they must be self-aware, goal-oriented and problem-focused to study and achieve their goals within various performance domains (Ericsson, Krampe, & Tesch-Römer, 1993; Kirschenbaum, 1984; Winne, 1995). These characteristics are consistent with the top-down approach of self-regulation in which students adopt their learning goals (Boekaerts & Corno, 2005). From the bottom-up perspective, it is suggested that students develop self-regulation by continuous instruction and feedback from their environment (e.g., coaches, trainers and teachers) to adapt their learning styles (Boekaerts & Corno; Pintrich & Zusho, 2002). In this perspective, the sport domain may form a suitable environment in which to develop self-regulatory skills. Athletes are forced to set personal improvement goals and they continually receive feedback from the action itself (i.e., success or failure) and from coaches on the performance process. Therefore, the present study focused on the role of self-regulatory skills in the sport and academic performances of elite youth athletes.

In the present study we relied on Zimmerman’s self-regulated learning theory (1989, 2000, 2006) and the expert learning model of Ertmer & Newby (1996). Zimmerman (1986, 1989, 2006) defined self-regulation as the degree to which learners are metacognitively, motivationally and behaviourally proactive participants in the learning process. As a result, metacognition is defined as awareness of and knowledge about one’s own thinking and the skills of planning, self-monitoring, evaluation and reflection were adopted (Ertmer & Newby, 1996; Zimmerman, 1986, 2006). Zimmerman’s (2000) self-regulation theory distinguishes three cyclical phases of self-regulation: a forethought phase (i.e., goal setting and planning), a performance phase (i.e., use of strategies to improve the quality and the quantity of learning) and a reflection phase (i.e., strategies that include evaluating different parts of the performance after learning). The expert learning model of Ertmer & Newby was based on Zimmerman’s work, but emphasizes the importance of reflection. These authors describe reflection as the active process of individuals learning from past experience and applying prior knowledge and experience to improve current or future actions (Ertmer & Newby).

Students or athletes not only have to possess the above mentioned metacognitive skills, they also need to be motivated to use them (Zimmerman, 1989, 2006). Motivation is defined as the degree to which learners are self-efficaciously, autonomously, and intrinsically motivated to achieve a specific goal and includes effort and self-efficacy (Hong & O’Neil Jr., 2001). Furthermore, learners not only need metacognition and motivation, they must also use these skills within particular situations (Hong & O’Neil Jr.; Zimmerman, 1990).

In sum, previous studies report that elite youth athletes are not only high athletic performers, but are also high academic achievers. Sport experts outperform non-experts
on self-regulation, which is a prerequisite for success at school as well (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002; Nota et al., 2004). Therefore, our aim was to examine the role of self-regulatory skills in the sport and academic performances of elite youth athletes. We compared elite youth athletes and non-athletes on six self-regulatory skills (i.e., planning, self-monitoring, evaluation, reflection, effort and self-efficacy) in the pre-vocational and pre-university systems. We hypothesized that students in the pre-university system would outscore their pre-vocational peers in self-regulatory skills (Cleary & Zimmerman; Kitsantas & Zimmerman; Nota et al.). Furthermore, because sport participation seems to promote self-regulatory skills (Pintrich & Zusho, 2002), and because international elite youth athletes are more reflective when compared with those at national level (Jonker, Elferink-Gemser, & Visscher, 2010), we expected elite youth athletes to score high on self-regulation, including reflection, independent of the academic system. We also wished to determine whether elite youth athletes in the pre-vocational system displayed higher levels of self-regulation than their pre-university non-athletic peers. Personal characteristics such as age, gender and socioeconomic status (SES) were taken into account. Prior research showed that older students are generally more self-regulatory than their younger counterparts (Al-Hilawani, 2003; Pintrich & Zusho; Zimmerman & Martinez-Pons, 1990). Furthermore, inconsistent findings have been reported in the use of self-regulatory skills between males and females (Anshel & Porter, 1996; Zimmerman & Martinez-Pons), and students lower in SES are associated with lower levels of sports participation, lower levels of self-regulation and more academic problems (Nota et al.; Sirin, 2005).

Assessing the role of self-regulatory skills in the sport and academic performances of elite youth athletes may provide insight regarding the possibility that these athletes utilize self-regulatory skills not only in sports, but also in the academic setting. This insight may help elite youth athletes to combine sport with educational responsibilities, and the combination of these two factors is especially important for athletes aged 12 to 16 years. At this age, athletes have to improve most to reach senior elite levels of competition, but this age is also a period of immense pressure at school (Brettschneider, 1999).

**Method**

**Participants**

A total of 160 male and 178 female students (n=338) aged between 12 and 16 years participated in this study. Altogether, 170 were classified as elite youth athletes (77 male and 93 female; age: M=14.18 yrs, SD=1.17) on the basis of their participation in a talent development program in The Netherlands. This means that they were considered to belong to the best 2.5% of athletes in their age category. About half (n=83) played team sports (i.e., baseball, basketball, handball, field-hockey and volleyball) while the other half (n=87) took part in individual sports (i.e., gymnastics, judo, speed-skating, swimming, and tennis). The elite youth athletes had approximately 4000 hours of accumulated sport experience (M=4084.45, SD=1576.45). This is equal to approximately 560 hours of training practice per year (M=588.30, SD=185.25). Additionally, 78.8% of the athletes (n=134) were part of the pre-university system and 21.2% of them (n=36) were in the pre-vocational system.

The other 168 students (83 male and 85 female; mean age=14.26 yrs, SD=1.18) were designated as non-athletes based on their self-reported activities (i.e., they reported that they were not active in sports at the time of measurement and had a maximum of four years of sport experience in the past). Within this population of non-athletes, 47.6% of them (n=80) were part of the pre-university system and 52.4% of them (n=88) were in the pre-vocational system. Table 1 shows the general characteristics of the study groups.
Table 1. Mean Age, Number of Training Hours per Week, Number of Games per Week (and Standard Deviations), Gender, Socioeconomic Status (SES), and Re-taking an Entire Year of Study (n [%]) for the Elite Youth Athletes and the Non-Athletes in the Pre-University or Pre-Vocational Academic System

<table>
<thead>
<tr>
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<th>Pre-university</th>
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<th>Pre-vocational</th>
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<tbody>
<tr>
<td></td>
<td>Elite youth</td>
<td>Non-athletes</td>
<td>Elite youth</td>
<td>Non-athletes</td>
</tr>
<tr>
<td></td>
<td>(n=134)</td>
<td>(n=80)</td>
<td>(n=36)</td>
<td>(n=88)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>14.19 (a)</td>
<td>14.39 (a)</td>
<td>14.14 (a)</td>
<td>14.05 (a)</td>
</tr>
<tr>
<td></td>
<td>1.21</td>
<td>1.22</td>
<td>0.96</td>
<td>1.13</td>
</tr>
<tr>
<td>Training (hrs/week)</td>
<td>10.91 (a)</td>
<td>0.00 (b)</td>
<td>10.08 (a)</td>
<td>0.00 (b)</td>
</tr>
<tr>
<td></td>
<td>3.74</td>
<td>0.00</td>
<td>2.73</td>
<td>0.00</td>
</tr>
<tr>
<td>Games (hrs/week)</td>
<td>3.84 (a)</td>
<td>0.00 (b)</td>
<td>5.02 (a)</td>
<td>0.00 (b)</td>
</tr>
<tr>
<td></td>
<td>3.09</td>
<td>0.00</td>
<td>4.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Male</td>
<td>62</td>
<td>46.3 (a)</td>
<td>15</td>
<td>41.7 (a)</td>
</tr>
<tr>
<td>Female</td>
<td>72</td>
<td>53.7</td>
<td>21</td>
<td>58.3</td>
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<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Low</td>
<td>6</td>
<td>4.5 (a)</td>
<td>7</td>
<td>19.4 (b)</td>
</tr>
<tr>
<td>Middle or high</td>
<td>128</td>
<td>95.5</td>
<td>29</td>
<td>80.6</td>
</tr>
<tr>
<td>Re-take an entire year</td>
<td></td>
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<tr>
<td>(n [%])</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>123</td>
<td>91.8 (a)</td>
<td>28</td>
<td>77.8 (b)</td>
</tr>
<tr>
<td>Once or more</td>
<td>11</td>
<td>8.2</td>
<td>8</td>
<td>22.2</td>
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</tbody>
</table>

Note. Within each row, means having the same letter in their superscripts are not significantly different from each other at the .05 level.

**Instruments**

To obtain the demographic details of the participants and to assess their involvement in sports and their self-regulatory skills, all participants completed a questionnaire specially compiled for this study.

**General Questions.** Participants noted their date of birth, gender, and the 4-digit zip code of their place of residence. The 4-digit zip code was compared to a list published by the Dutch Ministry of Housing, Spatial Planning and the Environment specifying Dutch neighbourhoods low in socioeconomic status (SES). SES refers to an aggregate standard for the household family income, education, occupation and residential neighbourhood. As it is assumed that people with a middle or high SES are sufficiently able to participate in sports and have similar academic propositions, we used SES as a dichotomous variable (i.e., low vs. middle or high in SES). Participants also stated which sports they were involved in, the number of hours spent on training and games, the number of years they had been active in sports and whether they have ever had to re-take a full year of study. Whether the participants were registered in the pre-university or pre-vocational system was recruited from the schools' databases.

**Self-Regulation Items.** The six aspects of self-regulation were assessed using subscales from several existing questionnaires (Herl et al., 1999; Hong & O'Neail Jr., 2001; Howard, McGee, Sia, & Hong, 2000; Peltier, Hay, & Drago, 2006; see below). The subscales were translated from the originals in accordance with the procedures described by Pelletier and colleagues (1995). First, two native speakers of Dutch proficient in English translated the original English subscales into Dutch. The Dutch translations were then back-translated into English by two other bilingual individuals who had no knowledge of the original subscales. The resultant translations were evaluated by all translators and a Professor in Human Movement Sciences, which led to seven minor linguistic modifications. This version was tested on 48 children aged 11 to 14 years, the youngest age band in our target group, who were asked to express what was too difficult. Based on their comments we made some final linguistic modifications to increase the intelligibility of the items.
With respect to the reliability and validity of the questionnaire, we performed a confirmatory factor analysis among 601 adolescents who were between 11 and 17 years of age. Multiple conventional criteria were used to evaluate our results (i.e., comparative fit index [CFI] and non-normed fit index [NNFI]>.90, root mean square error of approximation [RMSEA]<.08, and standardized root mean residual [SRMR]<.08; Byrne, 1998; Hu & Bentler, 1999). The results of our factor analysis were: CFI=.95, NNFI=.94, RMSEA=.060, SRMR=.063, and we concluded that the factor analysis showed satisfactory results for an adjusted six-factor model. A second confirmatory factor analysis (n=600) cross validated these results. Additionally, Cronbach’s alphas for each scale in the current study ranged from α=.76 on self-monitoring to α=.88 on effort which is considered acceptable (i.e., >.70; Nunally, 1978), and consistent with the original studies (i.e., Cronbach’s alphas between α=.72 and α=.85; Herl et al., 1999; Hong & O’Neil Jr., 2001; Howard et al., 2000; Peltier et al., 2006).

Planning, Self-Monitoring, Effort, and Self-Efficacy. The subscales for planning, self-monitoring, effort and self-efficacy were adapted from Hong and O’Neil Jr. (2001) and Herl and colleagues (1999). All subscales consisted of 6 to 10 items and participants needed to rate each item on a 4-point Likert type scale ranging from 1 (almost never) to 4 (almost always). High scores on these four self-regulation subscales indicated a high level of metacognitive and motivational self-regulation in general task situations. The planning scale gauges the respondent’s awareness of the demands of a task prior to its execution, and an example of a question reads, “I determine how to solve a problem before I begin”. The self-monitoring scale evaluates the awareness the respondent has of his or her actions during task execution (e.g., “I keep track of my progress”), while the effort scale measures the respondent’s willingness to apply himself or herself to attaining the set goal (e.g., “I work as hard as possible on all tasks”).

Self-efficacy, which is how the respondent judges his or her capabilities to organize and execute the required actions, was assessed using the Generalized Self-Efficacy scale. An example response on this scale would be “No matter what comes my way, I am usually able to manage it” (Hong & O’Neil Jr, 2001; Schwarzer & Jerusalem, 1995). While the authors are aware that there are separate domain-specific self-efficacy scales for sports and academic performance (Bandura, 1997), we used a general measure to be consistent with the other subscales. Using a general measure for self-efficacy is less accurate but can be valuable as well (Bandura).

Evaluation. The eight-item Inventory of Metacognitive Self-Regulation (IMSR) subscale, developed by Howard and colleagues (2000), was used to examine evaluation. Evaluation is the ability to assess both the processes employed and the finished product after task completion. An example question is, “I go back and check my work”. Participants responded to each item on a 5-point Likert scale that ranged from 1 (never) to 5 (always). A high score on the evaluation scale indicated that the respondent often evaluated his or her performance.

Reflection. The five-item Reflective Learning Continuum (RLC), by Peltier and colleagues (2006), was used to measure the extent to which respondents are able to appraise what they have learned and to adapt their past knowledge and experiences to improve performance. An example of a question is, “I often reappraised my experiences so I can learn from them”. Because the items in the original subscale were written in the simple past tense, we changed the subscale into the simple present tense in order to maintain consistency with the other five subscales. Items were rated on a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Accordingly, low scores on the RLC indicated a high level of reflection. We reversed the scores for our analyses, such that high scores on this subscale indicated a high level of reflection.
Procedure

All of the participants were informed about the study's procedures and provided their verbal consent to participate. Written informed consent was obtained from their parents and the schools the participants attended. The participants filled out the questionnaire in a group setting during their regular school activities while in the presence of test leaders. The assessment occurred during the competitive season (i.e., March to May). The procedures were in accordance with the standards of the local medical ethics committee at the leading institution.

Analyses

Analysis of the data was conducted using SPSS 17.0. Descriptive statistics were calculated for the six self-regulatory skills (planning, self-monitoring, evaluation, reflection, effort and self-efficacy) for the elite youth athletes and the non-athletes according to the academic system they are involved in (pre-vocational or pre-university). To interpret the scores, effect-size correlations ($r$) were calculated. An effect size of approximately .100 was considered small, .243 moderate, and .371 large (Rosenthal & Rubin, 2003).

Five separate Hotelling’s $T^2$ tests were performed. Hotelling’s $T^2$ tests have been shown to be more powerful in detecting small reliable changes when compared to the power of adjusted univariate techniques (Davidson, 1972). The first Hotelling’s $T^2$ test compared the pre-university non-athletes to their pre-vocational non-athletic peers and was performed to assess the role of being part of the pre-university or pre-vocational system. The scores on the six self-regulatory subscales served as dependent variables and academic system as independent variable.

The second Hotelling’s $T^2$ test compared the elite youth athletes in the pre-university system to their non-athletic counterparts in this type of education. A similar Hotelling’s $T^2$ test was conducted to assess differences in self-regulation between elite youth athletes in the pre-vocational system and their pre-vocational non-athletic peers. In both analyses, self-regulation served as the dependent variable and competitive level as the independent variable. These analyses were performed to assess the role of competitive level in the self-reported use of self-regulation, given that all athletes were part of the same academic system.

The fourth Hotelling $T^2$ test, was performed to evaluate the role of academic performance in a population of elite youth athletes. The scores on self-regulation served as the dependent variables while academic system served as the independent variable. The final Hotelling’s $T^2$ test was performed to assess possible differences in self-regulation between the elite youth athletes in the pre-vocational system and the non-athletes in the pre-university system. Again, scores on the six subscales of self-regulation were considered the independent variables while the combined sports and academic levels were the independent variables.

In all five analyses, age, gender, SES and re-taking a year of study served as covariates. Correlational analyses (Pearson’s $r$) revealed a weak positive relationship between competitive level and repeating class, $r(336)=-.176; p=.001$, and between academic system and SES, $r(336)=.265; p<.001$. A weak negative relationship existed between academic system and repeating class, $r(336)=-.128; p=.018$. When the Hotelling’s $T^2$ tests yielded significant effects, the univariate results were interpreted. For all tests of significance, an alpha level of .05 was adopted and the Bonferroni method was used to correct for multiple testing.

Results

Mean scores and standard deviations on the six self-regulatory skills for competitive level and academic system are presented in Table 2 as well as the corresponding effect sizes ($r$).
Table 2. Adjusted Mean Scores ($M$), Standard Errors ($SE$) and Effect Sizes ($r$) in Order of the Hotelling $T^2$ Tests on the Six Self-Regulatory Skills for the Elite Youth Athletes and the Non-Athletes in the Pre-University or Pre-Vocational Academic System

<table>
<thead>
<tr>
<th>Pre-university</th>
<th>Pre-vocational</th>
<th>Effect sizes for $T^2$ analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elite youth</td>
<td>Non-athletes ($n=134$)</td>
</tr>
<tr>
<td></td>
<td>athletes</td>
<td>($n=96$)</td>
</tr>
<tr>
<td>Planning</td>
<td>$M$</td>
<td>$SE$</td>
</tr>
<tr>
<td>(Range 1-4)</td>
<td>2.88$^a$</td>
<td>.045</td>
</tr>
<tr>
<td>Self-monitoring</td>
<td>2.80$^a$</td>
<td>.045</td>
</tr>
<tr>
<td>(Range 1-5)</td>
<td>4.17$^a$</td>
<td>.043</td>
</tr>
<tr>
<td>Reflection</td>
<td>3.04$^a$</td>
<td>.045</td>
</tr>
<tr>
<td>(Range 1-4)</td>
<td>2.98$^a$</td>
<td>.037</td>
</tr>
</tbody>
</table>

Note. $r$=around .100 (small$^a$), $r$=around .243 (moderate$^b$), $r$=around .371 (large$^c$)

Within each row, means having the same letter in their superscripts are not significantly different from each other at the .05 level.

$ab$ The pre-university non-athletes are not significantly different from the pre-university elite youth athletes and from the pre-vocational elite youth athletes.

Self-Regulatory Skills and Academic System

The results of the first Hotelling’s $T^2$ test revealed that the pre-university non-athletes had higher scores on self-monitoring, $F(1,162)=15.294$, $p=.001$, $r=.290$, evaluation, $F(1,162)=16.684$, $p<.001$, $r=.302$, reflection, $F(1,162)=9.106$, $p=.003$, $r=.228$, effort, $F(1,162)=10.299$, $p=.002$, $r=.242$, and self-efficacy, $F(1,162)=10.339$, $p=.002$, $r=.242$ than their non-athletic peers in the prevocational system. The corresponding effect sizes were considered moderate. No significant result was found on planning ($p> .05$) and the effect size was considered small (Table 2). In addition, no significant effects were found for the covariates age, gender, SES and re-taking a year of study ($p> .05$).

Self-Regulatory Skills and Competitive Level

The results of the second Hotelling’s $T^2$ test showed that the pre-university elite youth athletes outscored the non-athletes in this educational system on planning, $F(1,208)=7.245$, $p=.008$, $r=.182$, reflection, $F(1,208)=19.473$, $p<.001$, $r=.290$, and effort, $F(1,208)=18.989$, $p<.001$, $r=.287$. The corresponding effect sizes were considered small-to-moderate on planning and moderate on reflection and effort. No significant differences were found on self-monitoring, evaluation and self-efficacy ($p>.05$), as well as small effect sizes (Table 2). In addition, the covariate age turned out to be significant, showing that older participants reported lower scores on effort than their younger counterparts, $F(1,162)=9.106$, $p=.003$. The covariates gender, SES and re-taking a year of study yielded no significant results ($p>.05$).

Within the pre-vocational system, the results of the third Hotelling $T^2$ test revealed that the pre-vocational elite youth athletes outscored the pre-vocational non-athletes on self-monitoring, $F(1,118)=12.313$, $p=.001$, $r=.303$, reflection, $F(1,118)=24.570$, $p<.001$, $r=.409$, and effort, $F(1,118)=18.315$, $p<.001$, $r=.361$. The effect sizes were considered large. No significant effects were found on planning, evaluation and self-efficacy ($p>.05$). The effect sizes ranged from small to small-to-moderate (Table 2). The covariates age, gender, SES and repeating class yielded no significant results.
Self-Regulatory Skills, Competitive Level x Academic System

When assessing the value of the academic system the athletes are participating in (fourth Hotelling $T^2$ test), the results showed that the pre-university elite youth athletes had higher scores on planning, $F(1,164)=8.994$, $p=.003$, $r=.225$, and self-efficacy, $F(1,164)=5.392$, $p=.021$, $r=.176$ than the pre-vocational elite youth athletes. The effect sizes were considered moderate for planning and small-to-moderate for self-efficacy. No significant results were found on self-monitoring, evaluation, reflection and effort ($p>.05$), as well as small effect sizes (Table 2). In addition, the covariate age yielded a significant result; older athletes had lower scores on effort than younger athletes, $F(1,164)=3.582$, $p<.001$. The covariates gender, SES, and re-taking a year of study were not significant ($p>.05$).

The results of our fifth Hotellings $T^2$ test showed that the pre-vocational athletes had higher scores on reflection than the non-athletes in the pre-university system, $F(1,110)=5.692$, $p=.019$, $r=.218$ (Figure 1). The corresponding effect size was considered moderate. No significant effects were found on the other five aspects of self-regulation ($p>.05$) and the effect sizes were small (Table 2). The covariates yielded no significant effects ($p>.05$).

Discussion

We examined the role of six self-regulatory skills (i.e., planning, self-monitoring, evaluation, reflection, effort and self-efficacy) in the sport and academic performances of elite youth athletes. Insight into the value of sports participation at high competitive level and being involved in either the pre-university or pre-vocational system, may clarify the possibility that elite youth athletes utilize their well-developed sense of self-regulation not only in sports, but also in the academic setting.

![Figure 1. Interaction between competitive level and academic level on reflection.](image-url)
That non-athletes in the pre-university system outscore their pre-vocational non-athletic counterparts on five out of six self-regulatory skills is in line with previous studies reporting that academically successful students are more likely to monitor, evaluate, and reflect upon their performances, that they have a better developed sense of self-efficacy and that they are more willing to exert themselves than their less academically successful peers (Bandura, 1993; Ertmer & Newby, 1996). Within a population of elite youth athletes on the other hand, only two self-regulatory skills (i.e., planning and self-efficacy) are significant when pre-university athletes are compared to their pre-vocational counterparts. These combined findings suggest that participation in junior elite sports may play a role in the self-reported use of self-regulatory skills of elite youth athletes since smaller differences between the academic systems are found when students participate in junior elite sports.

We also observed that the elite youth athletes in the pre-university system outscore their pre-university non-athletic counterparts on three self-regulatory skills (i.e., planning, reflection, and effort). A similar pattern was found when comparing elite youth athletes to non-athletes within the pre-vocational system (i.e., self-monitoring, reflection, and effort). These results further emphasize the significance of the relationship between sports participation at junior elite level and scores on self-regulation. More specifically, even when the non-athletes are part of the pre-university academic system, in which they are suggested to have above average levels of self-regulation (Nota et al., 2004; Zimmerman, 1986; Zimmerman & Martinez-Pons, 1986), the elite youth athletes in this academic system report more frequent use of their planning and reflective skills and also report to make more effort to succeed. More practically this means that the elite youth athletes have an increased awareness of a task’s demands prior to its execution and are more conscious of their previous performances from which they are able to learn (Ertmer & Newby, 1996; Peltier et al., 2006). Furthermore, they make more effort to succeed in achieving their goals (Hong & O’Neil Jr., 2001; Jonker et al., 2010; Toering, Elferink-Gemser, Jordet, & Visscher, 2009).

Within the broader concept of transfer, the results may suggest that elite youth athletes are able to use their well-developed self-regulatory skills in an academic setting as well. This may be reflected by the relatively high ratio of elite youth athletes in the pre-university system (i.e., 78.8%), whereas the percentage of the Dutch national average is far lower (i.e., 44.0%; CBS, 2008). Additionally, the percentage of elite youth athletes who have ever had to re-take a year of study is also significantly lower than for the non-athletes (i.e., 11.2% vs. 23.8% respectively; Table 1). This is consistent with previous research showing that approximately 70% of the elite youth athletes are in higher academic systems without other difficulties in class (Jonker et al., 2009). The relationship between self-regulation and involvement in junior elite sports seems to become more evident in the pre-vocational system. To elaborate, even though not all aspects reached values of significance, the effect sizes at this lower academic level are considerably larger than the effect sizes found in the higher pre-university system (Table 2). Again, these results provide support for the role of junior elite sports in the self-reported use of self-regulatory skills, irrespective of academic system. This verifies existing theories proposing that the sporting environment may form a suitable environment for the development and use of self-regulation due to its goal-directedness and richness of feedback (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002).

Given the fact that the scores of the pre-vocational elite youth athletes are similar to those of the pre-university non-athletes, and that elite youth athletes in the pre-vocational system even display higher levels of reflection (Table 1), our results further emphasize the relationship between junior elite sports and increased use of self-regulatory skills. That the pre-vocational elite youth athletes outscore their pre-university non-athletic peers specifically on reflection was not unexpected. Two recent studies have emphasized the importance of reflection in talent identification and talent development (Jonker et al., 2010;
Reflection is referred to as a key characteristic in expert learning, enabling learners to change knowledge into action, which makes it possible for them to apply what they have learned in the past to new situations (Ertmer & Newby, 1996; Peltier et al., 2006). More specifically, the pre-vocational elite youth athletes are more involved in their learning processes and are trying to learn from past experiences to improve their future performances than their pre-university non-athletic counterparts are. As a consequence of the frequent use of reflective skills (i.e., mean scores above 4 on a 5-point Likert scale; Table 2), the elite youth athletes may profit more from the time they have spent in learning than non-athletes do (Ericsson, 2003; Jonker et al.; Toering et al.). Jonker and colleagues showed that the use of reflection may be particularly important at the highest levels of excellence in sports. We therefore recommend that future studies assess whether reflection may be a predictor for which elite youth athletes have the best potential to attain senior elite status.

Although our findings may suggest that involvement in junior elite sports may play a role in the development of self-regulation, it would be too ambitious to draw conclusions solely based on the result that elite youth athletes outscore non-athletes regardless of academic system, and that pre-vocational elite athletes are more reflective than pre-university non-athletes. While the sporting environment is rich in feedback and instruction and highly goal-directed, which can support the development of self-regulatory skills (Boekaerts & Corno, 2005; Pintrich & Zusho, 2002), it may also be the case that the elite youth athletes compete at these high competitive levels as a result of their frequent use of self-regulation, i.e., that they have an inborn ability to use their self-regulatory skills. We therefore suggest that future research examines this question of causality by using a longitudinal design or by intervention studies.

There are several limitations to this study. First, a self-report questionnaire was used which may be susceptible to socially desirable answers (Ericsson et al., 1993). Additionally, researchers also question the ability of individuals to report their cognitions accurately. However, the existence of valid self-report measurements has also been emphasized by others (Eccles, in press). With regard to the purpose of the present study, (i.e., to examine self-regulation in sport and academic performances of elite youth athletes), we consider the use of a questionnaire as most appropriate. Second, previous studies have shown that expertise in other domains such as music is also related to increased self-regulation (Nielsen, 2001). Although it would be interesting to assess the relationships between, for example, music, self-regulation and academic performance, we did not control for the role of other domains of expertise.

In conclusion, our results show that elite youth athletes possess well-developed self-regulatory skills, especially reflection, and support the value of participation in junior elite sport. More specifically, within either the pre-university or pre-vocational system, elite youth athletes reflect more on their past performance in order to learn and are making more effort to accomplish their tasks successfully. Moreover, the elite youth athletes in the pre-vocational system outscored their pre-university non-athletic counterparts on their ability to learn efficiently by means of reflection. As a consequence, they may benefit more from the time they spend on learning. Given that the ratio of elite youth athletes in the pre-university system is relatively high, we suggest that the use of self-regulatory skills may help elite youth athletes to combine their extensive investments in sports with their educational purposes. It is, however, not yet clear whether these levels of self-regulation are a result of being active in sports or that elite youth athletes are people who were born with those skills. Nonetheless, our findings have some preliminary implications for people directly or indirectly involved with young athletes. Encouraging athletes to apply their self-regulatory skills both inside and outside their sports may help them to balance their sports and academic activities in a better way and also support their education.
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