PERFORMANCE LEVEL, ABILITIES AND PSYCHOLOGICAL CHARACTERISTICS IN YOUNG JUNIOR RHYTHMIC GYMNASTS: THE ROLE OF SPORT EXPERIENCE

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Abstract

This study examined differences in selected cognitive, perceptual, motor abilities and psychological characteristics among elite rhythmic gymnasts aged 11 to 12 years (M=11.76 ± 0.62) of different performance levels. The contribution of gymnasts' experience years (M=5.22 ± 0.85) on these differences was also examined. The 33 gymnasts - the top scorers at the Hellenic national championship - were classified in three levels of performance (high, medium, low) according to their mean competitive performance score on the 2001 Hellenic National Championship semifinals and finals. They participated in a series of laboratory tests assessing memory (retention and grouping), analytic ability, simple visual and choice reaction time, selective attention, perception speed, two hand coordination, coincidence anticipation and wrist-finger dexterity. Intrinsic motivation was assessed using the Intrinsic Motivation Inventory (IMI). Self-confidence state was assessed using a subscale of Competitive State Anxiety Inventory-2 (CSAI-2) and self-confidence trait was assessed using the Vealey’s (1988) questionnaire. According to the results, gymnasts at the high level of performance outperformed gymnasts at the low level of performance only on memory grouping and self-confidence. Athletic experience, used as a covariate, significantly accounted for these differences. Differences on choice reaction time and coordination referred from previous studies were not found most probably due to the high level of gymnasts and to the recent changes in rhythmic gymnastics' code of points. Modest scores on intrinsic motivation were attributed to the fact that the study was conducted about three months before competitions. More research is needed to define the determinants of elite performance in rhythmic gymnastics. These findings however, can provide useful information for designing training schemes and new competitive combinations for rhythmic gymnasts.

Key words: rhythmic gymnastics, abilities, self-confidence, intrinsic motivation.

Introduction

Sport performance and factors affecting it is a main concern in the field of sport science. An area of research trying to identify such factors follows the individual
differences approach with the major focus on abilities. Abilities are considered relatively stable traits, probably genetically defined, not easily modified by practice or experience, which underlie performance of various skills (Fleishman, 1978). Abilities affecting motor performance are limited in number and might be distinguished as cognitive related to memory demands, perceptual associated with the facility for problem solving and speed of processing information, and motor related to speed and accuracy of movements with little or no cognitive demands (Magill, 1998). The type of abilities required for skilled performance, changes with practice and experience. Ackerman (1988), relating changes in ability requirements to skill acquisition, proposed that cognitive, perceptual, and psychomotor abilities are related to performance in the first (cognitive stage), second (motor stage), and last stage of learning (autonomous stage), respectively.

The individual differences approach has been implemented in two ways: the expert – novices or athletes – non-athletes comparison and the association of performance with measures of abilities. Such studies have shown that different abilities underlie performance in different sports. In a series of studies comparing expert-novices, (Kioumourtzoglou, Derri, Tzetzis, & Theodorakis, 1998; Kioumourtzoglou, Kourtessis, Michalopoulou, & Derri, 1997; Kioumourtzoglou, Michalopoulou, Tzetzis, & Kourtessis, 2000), it was found that elite athletes in volleyball were characterized by superiority in multilimb coordination, sense of rhythm, coincidence, perception speed, prediction, focused attention and movement detection. In basketball this superiority was noted in hand coordination, memory-retention, selective attention and prediction measures, while in water-polo elite players found to be superior to non-athletes in kinesthesis, decision making, visual reaction time, spatial orientation and retention of information in memory. In handball, Lidor, Argov and Daniel (1998) found that skilled handball players outperformed novices on measures of reaction time and motor abilities related to throwing tasks. Starkes (1987), using a multitask approach, noted that elite field hockey players have superior recall of game-structure information, take more accurate but not faster tactical decisions and use more efficiently advance visual cues to predict where a ball will be shot than non-athletes.

Following the performance prediction implementation Regnier and Salmela (1987) found that abilities related to the criterion success in gymnastics varied across age groups with perceptual variables (balance, kinesthesis and coordination) usually contributing the most at age groups from 14 to 16, while for age groups over 17 morphological variables were the most important for performance. In soccer, it has been found that processes associated with fast response selection as measured in a choice reaction time task, may play an important role in instep-kicking performance (Zisi, Derri, & Hatzitaki, 2003). Performance in archery was associated with reaction time and depth perception (Landers, Boucher, & Wang, 1986). Hudson (1985) indicated that performance in basketball could be predicted by biomechanical variables at percentages ranging from 76 to 100%.

Psychological characteristics are important determinants of performance too. There are several studies investigating the relation of sport performance with various psychological characteristics. Self-confidence and intrinsic motivation however, yield a good amount of scientific interest in this area. Self-confidence is a characteristic of elite athletes in various sports such as swimming (Psychountaki & Zervas, 2000), basketball (Parfitt & Pates, 1999), Tae Kwon-do (Chapman, Lane, Brierley, & Terry, 1997), archery (Landers et al., 1986) and gymnastics (Jones, Swain, & Hardy, 1993). In their meta-analysis Woodman and Hardy (2003) indicated that self-confidence had a great impact on performance, greater than that of cognitive anxiety. Assessment of intrinsic motivation includes several dimensions; among them are perceived competence and interest-enjoyment (McAuley, Duncan, & Tammen, 1989). McAuley and Tammen (1989) found that higher scores on the above two dimensions were associated with better
performance on a one-on-one basketball jump-shooting competition. Perceived competence and interest-enjoyment are also related with sport experience. Weigand and Broadhurst (1989) found that perceived competence was significantly correlated with years of athletic experience in soccer, while Boyd and Yin (1996) found that significant sources of sport enjoyment included perceived competence and years of participation in organized sport.

In rhythmic gymnastics research on the role of abilities and psychological variables in elite athletic performance is rather limited. Following the expert-novices implementation, Kioumourtzoglou, Derri, Mertzanidou and Tzetis (1997) found that elite gymnasts scored higher on measures of whole body coordination, dynamic balance, and static balance than non athletes. In another study, looking at variables predicting performance, Kioumourtzoglou, Derri, Tzetis and Kourtessis (1998) found that eye hand coordination, whole-body reaction time and depth perception explained 40% of the all around skill in rhythmic gymnasts aged 11-12 years, while dynamic balance, kinesthesis and depth perception explained 56% of the all-round skill in gymnasts aged 13-15 years old. Visuo-motor coordination was also significantly correlated with performance in rhythmic gymnastics in the study of Hume, Hopkins, Robinson, D., Robinson, S. and Hollings (1993). They also found that attainment was significantly correlated with some psychological characteristics such as mental preparation, motivation by creativity, and several dimensions of enjoyment. In a another study, conducted after the dramatic changes in the International Rhythmic Gymnastics' code of points that led to a new structure and perspective of the sport, Giannitsopoulou, Zisi and Kioumourtzoglou (2003) found that different abilities predict performance in each apparatus of rhythmic gymnastics. More specifically, they found that in junior gymnasts, aged 13-14 years, the amount of performance variance explained by two hand coordination and aiming was 73.6% in hoop and 65.7% in club. Two hand coordination and selective attention explained 43.7% of variance in ball performance, while performance in ribbon was predicted only by two hand coordination (13.4%). In young junior gymnasts, aged 11-12 years the only significant prediction was that of memory (grouping) and choice reaction time, which explained 18.5% of variance in ball performance.

In the studies described above athletic experience, which is the total time of participation in the sport, usually is not taken into consideration. The participation time might not be of great importance in team sports – where open skills are mainly involved – as the basic sport technique might be obtained in a rather short period of time. In such sports, training time in children aged 11-12 years is usually about 6 hours per week. In rhythmic gymnastics however, where the weekly training time is 18 to 24 hours on average, a few months of athletic experience might be important for the precision and mastery of performance, elements very important for athletic success. Besides rhythmic gymnastics is a sport highly demanding in skills' complexity. Working in such a technically demanding sport, coaches should have a lot to earn on selecting and leading gymnasts to success if they knew which abilities and psychological characteristics distinguish the top performers from other athletes; and it should be of great importance to know what might be improved through sport experience.

The purpose of the present study was to examine differences in cognitive, perceptual, motor abilities and psychological characteristics among rhythmic gymnasts with different performance level. The present study implemented a new way in classifying gymnasts according to their performance score in competition. In addition, the effect of years of experience was also studied. The age group (according to the official age classification of the Hellenic Gymnastics Federation) selected was young juniors aged 11-12 years. Assuming that gymnasts follow basic sport training, it is the age at which the selection of athletes for higher performance National teams is
realized. So this age is critical for the athletes' career as it signals the transition to the high performance stage.

It was hypothesized that the higher the gymnasts' performance level, the better the performance in measures of abilities and psychological characteristics should be. The greater differences however should be noted in cognitive and perceptual abilities which are important at the first stages of learning (Ackerman, 1998) as rhythmic gymnasts at this age learn many new complex skills following the basic sport training. Athletic experience was expected to account for the differences on those measures of abilities that were specific to the sport, as abilities are relative stable traits (Fleishman, 1978). Psychological characteristics should be affected by experience since they were measured specifically for the sport.

**Methods**

**Participants**

Thirty three (N=33) elite female junior rhythmic gymnasts, the top scorers at the Hellenic national championship, volunteered to participate in this study, following informed consent. Their age was recorded in day's approximation and ranged from 10.71 to 12.87 years (\(M=11.76 \pm 0.62\)). Their athletic experience was recorded in month's approximation and ranged from 3.83 to 7.01 years (\(M=5.22 \pm 0.85\)). Gymnasts were classified into one of three (high, medium, low) performance level groups according to their mean competitive performance score. This score was calculated as the mean total score of the 2001 Hellenic National Championship semifinals and finals in 4 apparatus: Free hand, rope, hoop and ball. Score ranged between 74.47 – 68.29 for the high, 68.19 – 63.12 for the medium and 62.12 – 54.73 for the low level of performance group. Means for competitive performance scores, athletic experience and age in each group, are depicted in Table 1.

The abilities and psychological variables tested in this study were selected by 35 rhythmic gymnastics experts (23 coaches and 12 judges) as the most critical in rhythmic gymnastics performance. The abilities tested were classified according to the literature into cognitive (memory – grouping and analytic ability), perceptual (simple and choice reaction time, selective attention and perception speed) and motor (two hand coordination, coincidence anticipation and wrist – finger dexterity). The psychological variables tested were sport self-confidence – state and trait – enjoyment and perceived competence.

<table>
<thead>
<tr>
<th>Level of performance</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>12.17 ± 0.64</td>
<td>11.48 ± 0.54</td>
<td>11.54 ± 0.46</td>
<td>11.73 ± 0.62</td>
</tr>
<tr>
<td>Athletic experience (yrs)</td>
<td>5.61 ± 0.71</td>
<td>5.04 ± 0.62</td>
<td>4.67 ± 0.76</td>
<td>5.12 ± 0.78</td>
</tr>
<tr>
<td>Competitive score (points)</td>
<td>70.65 ± 2.28</td>
<td>64.70 ± 1.68</td>
<td>59.58 ± 2.25</td>
<td>64.97 ± 0.76</td>
</tr>
</tbody>
</table>
Apparatus and testing

Cognitive abilities

Memory (grouping) test was developed with Super Lab psychological testing software (Cedrus Corporation, 1997) and has been used in the past in a series of previous studies (Giannitsopoulou et al., 2003; Kioumourtzoglou, Derri, Tzetzis, & Theodorakis, 1998; Kioumourtzoglou, Kourtessis, et al., 1997). Participants watched several digits (numbers and letters) presented on a computer monitor for 4 sec and afterwards they verbally recalled as much of the material as they could. There were 2 practice and 20 experimental items. In 10 items the digits were presented in a random arrangement and in the other 10 items the digits were displayed in an organized arrangement, while always a digit was placed at the outer borders of the display as an outlier. The percent of correctly recalled digits, which was presented on organized displays, on random displays and as outliers was recorded. Cronbach alpha calculated for this test was .87.

Analytic ability was assessed using the CPM (Colored Progressive Matrices) computerized test of the Vienna Test System (Schuhfried, 1996). This test included 4 practice and 36 experimental items of increasing difficulty. Each item included a series of four to nine schemes. A scheme had been removed from the series. Six schemes were suggested as possible solutions to complete the series. Participants analyzed the logical sequence of the schemes and selected their response using a light pen. The number of correct responses was recorded. Cronbach alpha for this test is 0.90.

Perceptual abilities

Simple reaction time was assessed using the Reaction Test software of the Vienna Test System (Schuhfried, 1996) which included 4 practice and 24 experimental trials. Participants were seated comfortably in front of a monitor with the index finger of the dominant hand resting on a touch sensitive key. As soon as a black circle turned to yellow, they had to press a button, located eight cm above the resting key, as soon as possible. The mean reaction time was recorded (sec). Cronbach alpha for this test is .90.

Choice reaction time was assessed using the “Determination Test” software of the Vienna Test System (Schuhfried, 1996). The test required a reaction to five different visual and two different auditory stimuli. The visual stimuli were colored circles (green, blue, white, yellow, red) appeared on the computer screen and corresponded to five round buttons of respective color arranged in a semicircle on the working panel. The auditory stimuli were a low and a high tone, presented via earphones and corresponded to two bar buttons, which were located in the middle of the colored buttons’ semicircle. Participants were allowed to use any finger of both hands for their responses. The frequency of stimulus presentation was controlled by the working speed of the participant. Practice consisted of three phases (reaction to: round circle, tones, and combination of the two). Test duration was four minutes and the variables recorded were the mean reaction time (sec) and number of incorrect responses. Cronbach alpha for this test is .99.

Selective attention test was especially developed for rhythmic gymnastics and it was similar to tests used for the assessment of selective attention in other sports (e.g. Kioumourtzoglou, Derri, Tzetzis, & Theodorakis, 1998). The experimental procedure was controlled by the Super Lab psychological testing software (Cedrus Corporation, 1997) and included 3 practice and 20 experimental items. In each item, participants
watched a photo showing a phase from rhythmic gymnastics presented on a computer monitor for 0.7 sec, followed by two questions concerning its contents. One of the questions referred to cues important for the situation, whereas the other referred to irrelevant cues. The gymnast had to press a button on the computer keyboard choosing an answer among the three possible: YES, NO, I DIDN’T SEE. The number of correct responses about the irrelevant and relevant cues was recorded. Cronbach alpha calculated for this test was .94.

Perception speed was also assessed using a test especially developed for rhythmic gymnastics. The experimental procedure was controlled by Super Lab (Cedrus Corporation, 1997) and was similar to that used for the assessment of perception speed in other sports (Kioumourtzoglou, Derri, Tzetzis, & Theodorakis, 1998; Kioumourtzoglou, Kourtessis, et al., 1997). There were 2 practice and 20 experimental items. In each item the text of a question regarding the content of the subsequent photo was presented on the computer monitor. Participants had all the time they need to read and comprehend the question. Next, they pressed two keyboard buttons simultaneously (marked as YES and NO) to view the photo. Then they had to look at the photo and answer the question, by pressing either the “YES” or “NO” button as fast as they could. The mean reaction time for the correct responses and the number of correct responses was recorded. Cronbach alpha calculated for this test was .94.

Motor abilities

Two-hand coordination was tested with the “2Hand” software of the Vienna Test System (Schuhfried, 1996). The experimental protocol included 2 practice and 4 test trials. In each trial, participants had to move a light dot along a given path shown on a computer monitor using two sticks located on a work board. The stick's movement was restrained to left-right for the left stick and up-down for the right stick. This path consisted of three sections – inverted L, V-shape and circular arc – imposing different demands on the co-ordination of the two hands during the trial. Any deviation of the dot’s movement out of the given path was recorded as an error. The mean time taken by the participant to complete the test trials (sec) and the percent of mean errors duration were recorded. Split-half reliability is between .93 and .98 for mean time taken for the total path, and .88 for percent error time.

Coincidence anticipation was assessed using the Bassin Anticipation Timer (Lafayette Instruments). This instrument has been described in a series of previous studies for the assessment of coincidence anticipation (e.g. Kioumourtzoglou et al., 1997; Kioumourtzoglou et al., 2000) and experiments on learning motor tasks (e.g. Magill, Chamberlin, & Hall, 1991). At the present study this instrument was a track-way module 160cm of length, containing 32 led and it was placed horizontally at eye level. Participants were seated 2 meters away of the track-way holding a switch button with the dominant hand. They had to press the button with their thumb as soon as the light stimulus arrived at the last led on the track-way. Each trial began with the illumination of a warning led, followed by the successive left-to-right illumination of the track-way led. After 3 practice trials, they performed 8 testing trials at three stimulus speeds: 3, 5, and 7 miles per hour (mph). The time elapsed between participant’s response and the actual time of stimulus arrival at the last led was recorded as a trial score. The mean score of testing trials in each condition was used for the statistical analysis.

Wrist-finger dexterity was assessed using the respective test of the Motor Performance Series of the Vienna Test System. Test-retest coefficients of this test series range between .52 and .92. Participants had to pick 25 long pins from a wooden base and put them in line on a horizontal work board, as fast as they could. The total time of trial completion was recorded.
Psychological variables

Three questionnaires were used to assess psychological variables, modified for rhythmic gymnastics. The Intrinsic Motivation Inventory (IMI) (McAuley et al., 1989) based on a 7-points scale was used for the assessment of enjoyment and perceived competence. In this study, Cronbach alpha for enjoyment was .53 and for perceived competence was .68. A subscale of the Greek version of the CSAI-2 (Tsorbatzoudis, Barkoukis, Kaissidis-Rodafinos, & Grouios, 1998), based on 4-points scale was used for the assessment of self-confidence state. Cronbach alpha was .71. For the assessment of self-confidence trait the Vealey’s (1988) questionnaire based on 7-points scale was used. Cronbach alpha was .93.

Statistical analysis

Data were analyzed using separate one-way ANOVAs and MANOVAs for each ability, depending on the number of variables used for assessment. When the main effect for level of performance was significant, further analysis of covariance was carried out using years of experience as covariate.

Results

Means and standard deviations of scores on all variables tested are presented in Table 2 for each of the three performance level groups. MANOVA analysis indicated a significant main effect of performance level on memory (grouping) (Wilks’s Λ=.575, p<.05). Test of between subjects effects indicated significant group differences on the percent of correctly recalled digits at random ($F_{2,30} = 5.16, p <.05$) and organized arrangements ($F_{2,30} = 4.11, p <.05$) but not on digits placed as outliers ($p>.05$). Bonferoni post hoc tests revealed that the high performance group performed significantly better than the low performance group on both variables (Table 2). When adjusted for sport experience the differences on the percent of correctly recalled digits at organized displays were eliminated ($p>.05$), however the differences on random displays were still evident ($F_{2,30} = 3.78, p <.05$). On analytic ability, differences among the three groups were small and not significant.

No significant main effects of performance level on perceptual abilities was found ($p>.05$). As shown in Table 2, a higher performance level was not necessarily accompanied by a better score on simple reaction time, selective attention and perceptual speed. A higher score on choice reaction time was noted in higher performance level but this was not confirmed by the statistical analysis.

On motor abilities, the high performance level group performed better than the two other groups on all variables measured, however none of these differences was significant ($p>.05$).
Table 2. Means and standard deviations on measures of cognitive abilities in three levels of competitive performance in young junior rhythmic gymnasts.

<table>
<thead>
<tr>
<th>Cognitive Abilities</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Level of performance</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52.51 ± 6.91*</td>
<td>44.36 ± 8.09</td>
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<tr>
<td></td>
<td>Memory (grouping)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Random Correct Responses (%)</td>
<td>50.94 ± 4.00*</td>
<td>48.08 ± 6.63</td>
</tr>
<tr>
<td></td>
<td>Organized Correct Responses (%)</td>
<td>53.25 ± 12.92</td>
<td>41.13 ± 13.35</td>
</tr>
<tr>
<td></td>
<td>Outliers Correct Responses (%)</td>
<td>29.64 ± 3.93</td>
<td>29.00 ± 6.81</td>
</tr>
<tr>
<td></td>
<td>Analytic Ability</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Correct Responses (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simple Reaction Time</td>
<td>319.27 ± 69.36</td>
<td>311.45 ± 71.85</td>
</tr>
<tr>
<td></td>
<td>Choice Reaction Time</td>
<td>892.27 ± 75.33</td>
<td>905.36 ± 99.58</td>
</tr>
<tr>
<td></td>
<td>Selective Attention</td>
<td>13.55 ± 1.51</td>
<td>13.00 ± 1.48</td>
</tr>
<tr>
<td></td>
<td>Perceptual Abilities</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Two hand coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coincidence Anticipation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wrist-Finger Dexterity</td>
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</table>

*A lower score indicates a better performance, *p<.05

Performance level significantly affected (Wilks’s Λ=.672, p<.05) the psychological variables tested (Table 3). Test of between subjects effects indicated significant group differences on both state (F_{2,30} = 4.16, p<.05) and trait (F_{2,30} = 4.74, p<.05) self-confidence but not on enjoyment and perceived competence (p>.05). Bonferoni post hoc tests revealed that the high performance group scored significantly better than the low performance group on both variables (Table 3). When adjusted for sport experience the differences on self-confidence trait were eliminated (p>.05), however the differences on self-confidence state were marginally significant (F_{2,30} = 3.28, p=.052).
Table 3. Means and standard deviations on measures of psychological variables in three levels of competitive performance in young junior rhythmic gymnasts.

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Confidence Trait</td>
<td>6.05 ± 0.70*</td>
<td>5.66 ± 0.93</td>
<td>5.04 ± 0.66*</td>
</tr>
<tr>
<td>Self-Confidence State</td>
<td>3.71 ± 0.33*</td>
<td>3.46 ± 0.34</td>
<td>3.29 ± 0.36*</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>5.49 ± 0.95</td>
<td>5.48 ± 0.92</td>
<td>6.00 ± 0.77</td>
</tr>
<tr>
<td>Perceived ability</td>
<td>5.80 ± 0.71</td>
<td>5.67 ± 0.68</td>
<td>5.80 ± 0.82</td>
</tr>
</tbody>
</table>

* p<.05

Discussion

According to the results of the present study, performance level affected only one of the abilities tested, memory grouping which is classified as a cognitive ability. This result confirms the hypothesis that the greater differences among gymnasts of different performance level should be noted in cognitive abilities as they learn many new complex skills at this age. Since there were no differences on measures of abilities specific to the sport among performance levels, the hypothesis that experience should account for the differences on those measures of abilities could not be tested. Such measures were conducted for perceptual abilities (selective attention and perception speed). On the contrary, experience significantly affected a non-specific to the sport ability, memory-grouping. Hypothesis for psychological characteristics was confirmed only in part. Performance level significantly affected only self-confidence and athletic experience accounted for these differences.

The significant effect of level of performance on memory-grouping is in accordance with the findings of a previous study (Giannitsopoulou et al., 2003), where grouping information in memory was significantly associated with rhythmic gymnastics attainment at the age group of 11-12 yrs. The importance of this ability for rhythmic gymnastics performance is probably attributed to the complex technical demands of the sport, as previous studies report no significant advantage of elite athletes in this ability (e.g. Kioumourtzoglou, Kourtessis, et al., 1997). The complexity of rhythmic gymnastics skills imposes greater working memory demands as this was reflected by the significant effect of performance level on memory grouping in the present study. Gymnasts at the high performance level recalled significantly more digits than low-level performers at both random and organized displays. The greater amount of information recalled immediately after presentation indicates a higher working memory capacity of high-level performers. Experience however only affected the recall on organized displays. This probably means that experience in rhythmic gymnastics enhances the strategies that children aged 11-12 yrs referred to use in order to group information in memory (Ornstein & Nauns, 1978), even though this information is not specific to the sport.

Perceptual abilities tested (simple and choice reaction time, selective attention, perception speed) were not affected by the performance level. This is not in agreement with findings of previous studies where choice and whole body reaction time found to be important for performance in rhythmic gymnastics at the age of 11-12 yrs
(Giannitsopoulou et al., 2003; Kioumourtzoglou, Derri et al., 1997). Rhythmic gymnastics is a closed skills based sport and therefore does not require rapid response selection unless a mistake interrupts the predetermined sequence of elements in a composition. In that case, a fast and correct reaction might save valuable points. The gymnasts participated in this study were the top scorers in the Hellenic championship. We hypothesize that choice reaction time was not affected by performance level, because elite athletes either do not make many mistakes or have developed sufficient mechanisms to compensate for the appearance of errors early in practice.

Level of performance did not affect significantly any of the motor abilities tested (two hand coordination, coincidence anticipation, wrist finger dexterity). According to previous studies, coordination is an important ability for performance in Rhythmic gymnastics (Kioumourtzoglou, Derri, Tzetzis, & Kourtessis, 1998). This ability was differentiated between elite athletes and non-athletes (Kioumourtzoglou, Derri et al., 1997) and among athletes with different level of performance (Hume et al., 1993) as well. These studies however were conducted before the changes of code points in Rhythmic gymnastics. It is hypothesized that as a result of the code changes, the importance of coordination probably shifted to older age groups. This was confirmed by a study conducted after the dramatic changes in Code of points (Giannitsopoulou et al., 2003), where coordination was important for performance of gymnasts aged 13-14 yrs but not for gymnasts aged 11-12 yrs.

Concerning the psychological characteristics, self-confidence was significantly affected by performance level. This result is in accordance with the literature findings suggesting a strong association of self-confidence with elite performance in various sports (Woodman & Hardy, 2003). Enhanced self-efficacy is probably a result of experience in the sport. According to the results of the present study, the contribution of sport experience in self-efficacy of gymnasts classified at the high performance level was significant at least for the trait variable. As shown in Table 1, a higher level of performance was accompanied by a longer experience time. Longer experience time in this sport does not mean only more practice time but also participation in more competitions. More experienced gymnasts were more confident about their selves since self-confidence is associated with previous performance (Lane, Terry, & Karageorghis, 1995). The marginal significance regarding the effect of experience on the state variable of self-efficacy might be due to the fact that this study was conducted about three months before the competitions. Matheson and Mathes (1991) found that female high school gymnasts experienced lower self-confidence at a dual meet than at the championship. They attributed this finding to the greater uncertainty of outcome in a competition and the fact that the dual meet occurred early in the season. The uncertainty about the outcome probably resulted to a limited effect of experience on rhythmic gymnasts' self-confidence.

Time distance from the competitions might be the reason for the modest scores on intrinsic motivation measures and consequently the non-significant effect of performance level on this characteristic. Time distance from the competition in rhythmic gymnastics means that gymnasts work less individually on the elements and exercises of their composition. They rather practice in groups on basic exercises. Such conditions of practice are likely to direct gymnasts to ego-involved achievement goals, comparing their performance and efforts to others, especially when the coach reinforces such a climate. An ego-involved prospective however, is more likely to lead to decreased intrinsic motivation (Duda, Chi, Newton, Walling, & Cately, 1995). The large volume of training at this time of the season might also negatively affect intrinsic motivation as elite performance in rhythmic gymnastics has been found to be negatively associated with enjoyment of training (Hume et al., 1993).

In conclusion, young junior rhythmic gymnasts at a high performance level show a superior ability to retain information in memory for immediate recall. Sport experience
enhances this ability in improving the organization or grouping of this information in memory. Contrary to other studies, fast response selection does not seem to be important for elite athletes’ performance and coordination is not affected by performance level at least for the age of 11-12 yrs. In accordance with the findings for other sports, a high level of performance enhances self-confidence and this enhancement is attributed to sport experience. Intrinsic motivation is not affected by level of performance but this might be due to the time distance from competitions.

Although the need for more research on the determinants of elite performance in rhythmic gymnastics is apparent, the findings of the present study could help coaches on providing more effective training to their gymnasts. Coaches should take into account differences among gymnasts in memory grouping when provide feedback. Elite athletes with a higher memory grouping ability are able to manage a larger amount of information. Enhanced ability of elite athletes to manage information memory allows coaches to put more elements in the competitive composition and earn valuable points for artistic value. Furthermore, coaches should take into account that elite gymnasts with fewer years of experience may suffer from a lack of self-confidence. They should also focus on a task-involved goal perspective in order to enhance gymnasts’ perceived competence.

References


