Original Article

The attentional focus impact on tennis skills' technique in 10 and under years old players: Implications for real game situations

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ABSTRACT

The aim of the present study was to examine the effect of the internal and external focus of attention instructions on performance and learning of the service, forehand and backhand tennis skills at 8 – 9 years old tennis players. 68 participants of 8 – 9 years old (M=8.8, SD=0.54), were divided in three groups and followed a 6 weeks intervention program; the internal attentional focus group (N=21), the external attentional group (N=23) and the control group (N=24). Three measurements were implemented (pre, post, retention) in which the participants were video recorded: a) while performing each skill and b) while playing matches in real game situations. Due to the qualitative evaluation of the technique five assessment criteria were used, whilst due to performance outcome evaluation one part of the Game Performance Assessment Instrument (GPAI) was used. Repeated measures analysis of variance revealed significant interaction between groups and measurements and Bonferroni post hoc showed that the athletes of external focus of attention group had better scores in the post-test in the skills' technique and in real game condition. The findings are in line with those of previous studies, which proved the superiority of external focus of attention instructions in performance and learning of object manipulation skills. Moreover, the present research makes an initial attempt to extend the already existing research about attentional focus impact on real game performance.
Key words: FOCUS OF ATTENTION, INSTRUCTIONS, TENNIS' SKILLS, OUTCOME.

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INTRODUCTION

Sports scientists, physical education teachers and coaches have been trying for the last decades to understand the factors that influence motor skills learning. One of the most important parts of motor skills development is the attentional focus instructions. According to Wulf and Su (2007), the verbal instructions that focus ones' attention can have a major impact on the performance and learning of a motor skill. Instructions that aim to guide a performer's focus of attention internally concentrate on the body movements whilst cues that obvert the attention externally focus on the effects of the movement (Wulf, Höß, & Prinz, 1998). The external focus of attention has recently become more and more accepted by many scientists, because it has been found through a lot of studies to be more beneficial (Jackson, & Holmes, 2011; Chiviacowsky, Wulf, & Wally, 2010; Lohse, Sherwood, & Healy, 2010; Wulf, Landers, Lewthwaite, & Tollner, 2009; Bell & Hardy, 2009; Wulf, Tollner, & Shea, 2007; Wulf, Mercer, Mc Nevin, & Guadagnoli, 2004; Vance, Wulf, Tollner, McNevin, & Mercer, 2004; Wulf & Mc Nevin, 2003). This is due, according to the researchers, to the *Constrained Action Hypothesis* (Wulf, McNevin, & Shea, 2001). The up mentioned notion suggests that when the body tends consciously to adopt subconscious control (internal focus) then the actions are constrained and they become less effective and efficient. In contrast, the use of an external focus provides a subconscious motor control that results in an enhancement of greater movement automaticity.

The attentional focus research includes studies of various fields. A wide range of experiments have proved the superiority of the external focus of attention considering physiological aspects providing crucial information for maximizing the athletic performance. Several studies that have used electromyography measurements revealed greater force production, effortless muscular activity, more effective and efficient body movements, respiratory control and finally time, speed and accuracy enhancement (Greig, & Marchant, 2014; Lohse, 2012; Marchant, Greig, Bullogh, & Hitchen, 2011; Lohse, Sherwood, & Healy, 2011; Wulf, Dufek, Lozano, & Pettigrew, 2010; Hessler, & Amazeem, 2009; Marchant, Greig, & Scott, 2009; Zachry, Wulf, Mercer, & Bezodis, 2005).

In addition, researches in applied sports have come up with a performance, retention and transfer benefit in relation to an external focus of attention. The majority of studies has concerned either closed skills (An, Wulf, & Kim, 2013; Shafizadeh, Mc Morris, & Sproule, 2011; Wulf & Su, 2007; Poolton, Maxwell, Masters, & Raab, 2006), or individual techniques from more complex activities (Lawrence, Gottwald, Hardly, & Khan, 2011; Parr & Button, 2009), or throwing actions (Mc Kay & Wulf, 2012; Zarghami, Saemi, & Fathi, 2012; Southard, 2011; Zentgraf, & Munzet, 2009). Moreover, some studies have been conducted using closed continuous skills such as swimming (Stoate, & Wulf, 2011; Freudenheim, Wulf, Madureira, Pasetto, & Correa, 2010) and running (Ille, Selin, Do, & Thon, 2013; Schücker, Hagemann, Strauss, & Volker, 2009).

Racket sports provide a nice chance for assessing open skills and the first attempt was made by Maddox, Wulf and Wright (1999). The purpose of their experiment was the evaluation of the backhand accuracy under internal and external focus of attention conditions. Notwithstanding that the internal cues might was considered somehow vague, still the findings revealed that both accuracy and effective movement pattern was produced when the instructions given to the participants led their attention externally. Moreover, Wulf, Mc Nevin, Fuch, Ritter and Toole (2000) compared the impact of two different external focus instructions on the forehand tennis skill. The above researchers provided the trainees of their study with either information of focusing on the incoming ball (external instruction but not related to the outcome of the skill performance) or with a cue about concentrating in the flight of the outbound ball (direct effect of the moving action on the environment). The results didn't show significant differences between the two groups in the skills acquisition

phase, though an important contrast was recorded at the retention phase in favor of the group that was guided to shift the attention into the effect that was related to their movement action.

Subsequently, two more tennis studies took place. The one of Caserta, Young and Janelle, (2007) cannot be completely considered as a typical attentional focus research, still there are some parallels regarding the focus elements. In order to assessing the impact of the attentional focus on decision making in real scoring situations in relation to the impact on a technique domain, such as footwork, first group received perceptual and cognitive training and the second group received technical information. According to the results, the non-technique focus groups exceeded in performance of both technical and control ones, not only in accuracy but in decision making in live game play as well. More recently Guillot, Desliens, Rouyer and Rogowski (2013) observed, through their research, a significant improvement in service skill success rates under external focus instructions of attention. More specifically they concluded that the earned points in real match conditions were increased by 30% at service games.

In conclusion, the studies concerning focus of attention in tennis sport evaluated either only one skill performance (Maddox, Wulf, & Wright, 1999; Wulf, Mc Nevin, Fuch, Ritter, & Toole, 2000) or assessed only success rate in a single skill in real match conditions (Guillot, Desliens, Rouyer, & Rogowski, 2013) or their sample included older athletes (Caserta, Young, & Janelle, 2007). Thus, taking into consideration the fact that the extending of the attentional focus research into real tennis game conditions appears to offer many opportunities for further knowledge regarding young tennis athletes' performance outcome, the present study aimed to investigate the effect of type of focus of attention on the three basic tennis skills learning and the most important on the match performance as well, of athletes 8 - 9 years old. The main research hypothesis was: athletes of external focus of attention group will have better results in service, forehand and backhand technique and higher scores on the GPAI from athletes of internal focus of attention and control group in post and retention tests.

MATERIALS AND METHODS

Participants

Sixty-eight male and female tennis athletes, aged 8-9 years (M=8.8, SD=0.54), participated in the present study. All players had 1 year (M= 1.2, S.D=0.6) training experience. The athletes were randomly divided into three groups, the internal focus attention intervention group (IFG, n = 21), the external focus attention intervention group (EFG, n = 23) and the control group (CG, n = 24). Before participating in this study, all athletes and their parents were fully informed about the procedure and written consent was obtained before testing. Athletes were informed that participation was voluntary and they could stop whenever they wanted.

Intervention Program

The study was conducted in the "orange" court according to the International Tennis Federation rules for players 10 and under years old (ITF, 2012). According to these rules, the shape of the court was formed to 18m x 6.5m dimensions, the net to 80 cm height, the balls used were 50% less pressured than the normal ones and finally the rackets were 25 inches size, suitable for players of this age. The intervention program lasted 6 weeks and included 12 training sessions (2 practices / week x 6 weeks). Each training session was lasting 60 minutes totally and was started with a ten minutes coordination based warm up followed by 40 minutes practice of the three skills (forehand, backhand, and service). The number of verbal attention cues given to the players was equal for each experimental group (five instructions), were similar in content and were provided at the beginning and then every five repetitions (Uehara, Button, & Davids, 2008; Wulf, Mc Connel, Gartner, & Schwarz, 2002). In each practice session the athletes were performed two skills (there

was a combination of two skills in each session, for practicing the same amount of practice for each skill during intervention, ex: service and forehand, forehand and backhand, service and backhand, etc.). The players were executing 20 strokes of each skill so the same instruction for each one skill was being given four times. Participants of the control group received no attention instructions and practiced under the traditional teaching method where the augmented feedback from the coach was related to the technical elements of the skills (knowledge of performance).

Measures

The athletes of all groups participated in three measurements; before the intervention program (pre-test) in order to confirm that there were no significant differences among the groups and that all athletes started at the same level, after the completion of the intervention program (post-test) in order to note the effect of attentional instructions at each group and finally one week after the post-test, where the athletes had no practice, for ascertaining learning (retention test). One wide angle lens digital Panasonic VDR – M30 video camera, based on tripod, was positioned 7 meters behind the right base line. The camera was set up on a 3 meters height chair umpire aiming to 45 degrees fixed shot.

Technique evaluation

During these measurements the participants of each one of the three groups were video recorded while performing ten strokes at each skill. Two experienced tennis coaches evaluated the service technique based on the follow 5 basic elements: i) grip, ii) side-way stance, iii) shoulder over shoulder motion, iv) contact point and v) wrist manipulation. The forehand and backhand techniques were assessed according to the below 5 typical rudiments: i) grip, ii) balance, iii) racket circle movement, iv) contact point and v) follow through. A score was given to each athlete when the criteria were met for each trial. Thus, the maximum score per trial was 5 and for all trials were 50 (10 trials x 5 elements).

Performance outcome evaluation

In order to assess the execution of the skills in real game situations, the participants were video recorded while playing one short set match against each other (4 games; 3–3 up to 5 games, 4–4 up to 7 points tie-break), according to the official competition scoring system proposed by the International Tennis Federation for players under 10 years old (International Tennis Federation, 2012). GPAI (Mitchell et al., 2006; Oslin, Mitchell, & Griffin, 1998) was used to assess athletes' skills execution in the matches in three time periods. One of the tool's benefits is that the criteria can be adapted and thus the observers may select any of the components or all of them according to each sport's needs (see Hopper, 2007; Robinson & Foran, 2011). In the present study the chosen game performance factor was the skills execution. Finally, the scoring system of GPAI uses an index for every component of performance used. That means that the skill execution index (SEI) equals to the number of efficient skill executions divided by the number of inefficient skill executions.

Reliability of the observers

The observation and evaluation was held by two expert tennis coaches who did not intrude into the experiment, as proposed by Memmert and Harvey (2008). The two observers were trained and practiced on using the assessment instrument according to the directions of the creators of the observation tool. They observed four videotapes and coded four athletes while they were playing one short set match of four games the first day and evaluated the same athletes the next day. The aim of the above procedure was the assurance of condition that the coders were able to perform reliable evaluation with the assessment. The Inter-observer reliability using Cohen's kappa coefficient was 0.92, and 0.93 respectively and Intra-observer reliability was 0.89 indicated strong agreements (Potrac, Jones, & Cushion, 2007).

Analysis

Distribution normality with Kolmogorov-Smirnov test (K-S test) and homogeneity of variance (Bartlett test) were carried out prior to the repeated measures analysis of variance. Tests resulted in a non-significant value ($p < .05$), which indicates that the data do not differ significantly from the multivariate normality of variables, thus parametric tests can be applied. One way analysis of variance for examining differences in pre - test between the groups was used. In order to find differences between groups, Anova Repeated Measures was used, followed by Bonferroni post-hoc test. Significant differences between the means scores were tested at the 0.05 alpha levels. An effect size was computed for each analysis using the eta-squared statistic (η2) to access the practical significance of findings.

RESULTS

Skills technique

Preliminary analysis

One-way ANOVA revealed that there were no significant differences among groups ($p > .05$) in the pre-test. The means and standard deviations for the score of three tennis skills in the pre-test are shown in table 1.

Table 1. Means and standard deviations for the score of the three skills in the pre-test.

GROUPS		SERVICE		FOREHAND		BACKHAND	
	N	M	SD	M	SD	M	SD
IFG	21	15,10	1,34	14,33	2,24	13,57	2,97
EFG	23	15,04	1,26	14,04	1,84	12,91	2,05
CG	24	15,42	1,21	14,71	1,80	13,54	2,39
TOTAL	68	15,19	1,26	14,37	1,95	13,34	2,48

Post and retention analysis

Service

Repeated-measures analysis of variance was conducted to evaluate the hypothesis of the study. The results revealed that there was a significant interaction between group and measurement F (4.130) = 83.61, partial η^2 = 0.720, $p < .001$, main effect of measurement F (2. 130) = 367.105, partial η^2 = 0.850, $p < .001$ and there was also significant main effect of group F (2,65) =91.15, partial η^2= 0.737, $p<.001$, for service skill.

Post hoc Bonferroni revealed significant mean differences ($p<.001$) in the *service* scores at post between the athletes of external (M=23.78, SD=1.76) and internal focus of attention group (M=18.71, SD=1.34) and athletes of control group (M=17.71, SD=2.13), but there were not differences between athletes of internal focus of attention and athletes of control group (p=.207). The same results were also for the retention test; the athletes of external focus of attention were better than the athletes of two other groups. Therefore the results agree with the null hypothesis. The mean scores and standard deviations of each group across the three measurements are presented in table 2.

Table 2. Means and standard deviations on service skill in three groups.

GROUPS		PRE-TEST		POST-TEST		RETENTION	
	N	M	SD	M	SD	M	SD
IFG	21	15,10	1,34	18,71	1,34	18,81	1,63
EFG	23	15,04	1,26	23,78	1,76	26,04	1,43
CG	24	15,42	1,21	17,71	2,13	17,33	2,46
TOTAL	68	15,19	1,26	20,07	3,23	20,74	4,30

Forehand

Repeated-measures analysis of variance was conducted to evaluate the hypothesis of the study. The results revealed that there was a significant interaction between group and measurement F (4.130) = 60.051, partial η^2 = 0.649, p< .001, main effect of measurement F (2. 130) = 363.75, partial η^2 = 0.848, p< .001 and there was also significant main effect of group F (2,65) =49.17, partial η^2= 0.602, p<.001, for forehand skill.

Post hoc Bonferroni revealed significant mean differences (p<.001) in the *forehand* scores at post between the athletes of external (M=23.78, SD=1.95) and internal focus of attention group (M=18.29, SD=1.23) and athletes of control group (M=17.50, SD=2.38), but there were not differences between athletes of internal focus of attention and athletes of control group (p=.660). The same results were also for the retention test; the athletes of external focus of attention were better than the athletes of two other groups. Therefore the results agree with the null hypothesis. The mean scores and standard deviations of each group across the three measurements are presented in table 3.

Table 3. Means and standard deviations on forehand skill in three groups.

GROUPS		PRE-TEST		POST-TEST		RETENTION	
	N	M	SD	M	SD	M	SD
IFG	21	14,33	2,24	18,29	1,23	18,19	1,12
EFG	23	14,04	1,84	23,78	1,95	24,43	2,23
CG	24	14,71	1,80	17,50	2,38	17,62	2,16
TOTAL	68	14,37	1,95	19,87	3,42	20,10	3,66

Backhand

Repeated-measures analysis of variance was conducted to evaluate the hypothesis of the study. The results revealed that there was a significant interaction between group and measurement F (4.130) = 40.455, partial η^2 = 0.555, p< .001, main effect of measurement F (2. 130) = 345.35, partial η^2 = 0.842, p< .001 and there was also significant main effect of group F (2, 65) =21.72, partial η^2 = 0.401, p<.001, for backhand skill.

Post hoc Bonferroni revealed significant mean differences (p<.001) in the *backhand* scores at post between the athletes of external (M=23.61, SD=2.89) and internal focus of attention group (M=18.76, SD=1.84) and athletes of control group (M=17.21, SD=3.08), but there were not differences between athletes of internal focus of attention and athletes of control group (p=.837). The same results were also for the retention test; the athletes of external focus of attention were better than the athletes of two other groups. Therefore the results agree with the null hypothesis. The mean scores and standard deviations of each group across the three measurements are presented in table 4.

Table 4. Means and standard deviations on backhand skill in three groups.

GROUPS		PRE-TEST		POST-TEST		RETENTION	
	N	M	SD	M	SD	M	SD
IFG	21	13,57	2,97	18,76	1,84	18,57	1,78
EFG	23	12,91	2,08	23,61	2,89	23,65	2,90
CG	24	13,54	2,39	17,21	3,08	16,96	2,97
TOTAL	68	13,34	2,48	19,85	3,84	19,72	3,89

Performance Outcome

Repeated-measures analysis of variance revealed that there was a significant main effect of group $F(2, 65) = 6.60$, $\eta^2 = .170$, $p < .001$ and interaction effect between the group and the measurement $F(4, 130) = 6.156$, $\eta^2 = .159$, $p < .001$. There was also significant main effect of measurement $F(2, 130) = 15.816$, $\eta^2 = .196$, $p < .001$, in execution of game performance. The within subjects contrast analysis revealed that there were significant differences between pre and post scores and between pre and ret scores for three groups on the game performance. Post-hoc Bonferroni revealed significant mean differences at post in the game performance scores between the athletes of external ($M = 3.43$, $SD = 0.6$) and internal focus of attention group ($M = 2.38$, $SD = 1.07$) and internal and control group ($M = 2.08$, $SD = 0.72$), but there were significant differences between athletes of external focus of attention and athletes of control group. The same results were for the retention test; the athletes of external focus of attention were better than the athletes of the control group but they were also better than the athletes of the internal group. No significant difference was revealed between the athletes of internal and control group. Therefore the results did not agree with the null hypothesis. The mean scores and standard deviations of each group across the three measurements are presented in Table 5.

Table 5. Performance scores for each group in pre, post and retention tests.

GROUPS		PRE-TEST		POST-TEST		RETENTION	
	N	M	SD	M	SD	M	SD
IFG	21	4,47	1,63	6,80	1,69	6,57	1,56
EFG	23	5,26	2,39	10,08*	0,94	9,69	1,14
CG	24	5,08	2,61	6,12	2,02	5,79	1,76
TOTAL	68	4,95	2,27	7,67	2,37	7,35	2,27

*NOTE. *p<.01*

DISCUSSION AND CONCLUSIONS

The purpose of the present study was to examine the effect of the internal and external focus of attention instructions on the forehand, backhand and service skills technique in control conditions and in real game situations as well at 8 - 9 years old tennis players. The main research hypothesis was that the athletes of external focus of attention group would have better scores from athletes of internal focus of attention and control group both in post and retention measurements. The data analysis revealed a significant improvement of the athletes of the group that was instructed to an external focus of attention compared to the athletes of internal focus group and to the control group as well regarding only the technique development but not the performance outcome. Finally, no significant differences were revealed between internal focus and control group.

Skills technique

Trying to explain the superiority of external focus of attention cues on the learning of motor skills, some researchers have looked into the issue from a neurophysiological point of view and therefore from motor control. According to Poolton et al. (2006) instructions that obvert attention internally develop a conscious control of the motion with respect to the external attentional focus instructions resulting in reduced performance. The same researcher contended that external attention cues, even during the initial stage of learning, reduce the load of working memory. That means that practitioners look subconsciously for more adequate sources of information in order to find the most appropriate response to the motor problem.

Moreover, the requirements of the skills in the present study are also a determining factor in interpreting the positive effects of the external focus instructions. The two ground strokes, forehand and backhand, were performed in conditions that contained variability from one effort to the other. On one hand the feeding from the coach was relatively stable, but still the skills execution required body movement and adaptation to the incoming ball and object manipulation. Studies that haven't revealed differences between the internal and external attentional focus type concerned skills that were assessed in a more stable and therefore predictable environment with very little or even no effort-to-effort variability such as golf shot (Wulf, Wächter, & Wortmann, 2003) and soccer kick from a fixed ball position (Uehara, Button, & Davids, 2008). This may lead to the conclusion that instructions directing the attention externally may be more effective and beneficial in skills requiring movement and at the same time object manipulation, time coincidence and space orientation, such as the forehand and backhand in tennis.

Concerning service, it is considered a closed skill that is performed with the same way in a stable and foreseeable environment. But the important characteristic is that there is plenty of time before every execution. In the present study, the external focus cues had a greater impact on serve's performance and learning, a finding which is in line with the one of Wulf, McConnel, Gärtner, and Schwarz (2002) for the same skill in volleyball. Therefore, the sufficient time for the athletes to assimilate and to apply the providing instructions may be another factor of the superiority of the external focus type of attention.

Finally, the findings showed that the external focus group had better technique scores than the control group also and that the control group did not show differences with the internal focus group. These results are coincided with the ones of Castaneda and Gray research (2007) but are not consistent with those of Marchant, Clough, Crawshaw, and Lery (2009) and of Abdollahipour, Bahram, Shafizadeh, and Khalaji (2008). These two last studies evaluated also closed skills but the difference is that they estimated the accuracy of the movement and the completion time of the skill execution. Thus, it can be concluded that the provision of external attentional focus instructions is more beneficial when the skills technique is assessed, as in the particular study, rather than the precision and the time speed of the movement.

Performance outcome

According to the results of the present study differences were observed between the types of focus of attention in the game performance of the skills. This particular element was evaluated in real situations as opposed to the skills technique where the quality of the movements was observed in a more stable environment and the effectiveness of the external focus of attention cues was proved to be more effective. One possible explanation is that the realistic condition included the players' stress of performance. With regard to increased performance anxiety, Masters (1992) reported that it is a significant factor for non-automatic control. In addition, Masters and Maxwell (2008), in their "reinvestment theory", pointed out that when a skill is already learned, the already accumulated conscious rules can be activated again in the working memory and to interfere into the skill execution under demanding conditions, such as performance stress.

Consequently, a series of unexpected events that may have occurred during the match caused "reinvestment", resulting in a retreat into the conscious form of control followed by a reduced performance outcome.

Implications in tennis – Future recommendations

The findings of the present study show that providing external focus cues had better results on the performance and learning of the three basic tennis skills in young orange players 8 - 9 years old. Traditionally, tennis coaches relied on the instructions that induce an internal attentional focus for transmitting the skills proper technique. Taking into consideration the results of the specific research there is no benefit for young performers to adopt an internal focus of attention during tennis skills execution. The developing tennis players' procedure acquires a good level of executing technical skills, since this is considered necessary for an effective implementation of tactics later (Crespo & Reid, 2003) and thus the understanding the real character of the game. That means that the technical development is a very important and integral part, so the coaches owe to be aware of the effective methods for enhancing well shaped moving patterns.

Regarding the performance outcome, differences between the two attentional focus types were not proved. Taking into consideration the young age of the participants, the effects of internal and external instructions in realistic conditions should be examined further in older players with more training and playing matches experience. The results of this research are limited to the age of the players participated (8 – 9 years old). Thus, extending the specific study, especially into adolescents, seems to be very promising for further knowledge.

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