Activitas Nervosa Superior Rediviva Volume 65 No. 2 2023

ORIGINAL ARTICLE

Study of the Attentional Process and Spatial hemineglect and their Impact on Motor Performance in Moroccan Adolescents in school

Jaouad Rouane [1], Taher Moussa Ahmadou [1], Abdelmajid Ouaddou [2], Ahmed Omar Touhami Ahami [1]

[1] Cognitivo-Behavioral Neuroscience and Applied Nutrition Laboratory, Clinical Neuropsychology Team, Department of Biology, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco. [2] Psychological, sociological and cultural studies, Faculté de lettres et des sciences humaines Dhar Mahrez Fès, Université sidi Mohammed ben Abdellah, Morocco.

Correspondence to: Jaouad Rouane, Cognitivo-Behavioral Neuroscience and Applied Nutrition Laboratory, Clinical Neuropsychology Team, Department of Biology, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco. Adress: University campus, BP 133.
TEL: (+212)0662243026, E-MAIL: jaouad.rouane@uit.ac.ma

Submitted: 2023-05-06 Accepted: 2023-06-14 Published online: 2023-08-05

Key words: **attention; adolescent; hemineglect; Motor performance**

Act Nerv Super Rediviva 2023; **65**(2): 55–62 ANSR65223A03

Abstract

OBJECTIVES: Athletes must possess the necessary technical, physical, and mental attributes. One of these mental abilities is attention, a neurocognitive skill required for the accomplishment of any motor task and of motor performance.
METHODS: A study was conducted over four months, including Moroccan adolescents enrolled in school from February 7 to May 28, 2022. A comparative and predictive method is used, the D2-R test and the Bells test, to assess attention and hemineglect in these students. In addition, we chose long jump as a physical and sports activity to assess motor performance.
RESULTS: 250 students participated, including (152 girls (60.4%) and 98 boys (39.6%), the average age is 16.77± 1.23 years, range: 14-21. Divided into three school levels: common core (TC) 27.6%, 1st year baccalaureate (1BAC) 50.8%, and 2nd year baccalaureate (2BAC) 21.6%. The results showed a strong relationship between attention levels (CC,CCT) and motor performance (r = 0,575 and r = 0,756 respectively) and showed that gender does not influence the attentional process of school adolescents (CC (F = 9,076, $p < 0,005$), CCT (F = 8,480, $p < 0,005$), E% (F = 03,998, $p < 0,005$)), as well as the scores of the Bell tests dealing with unilateral spatial neglect (NSU) show no relationship with motor performance in individual long jump activities (r = 0,014, p-value = 0.829).
CONCLUSION: Attention, including its selective and sustained aspects, determines sports performance in young school-going adolescents.

Introduction

For athletes, the possession of mental, physical, and technical qualities is necessary (Vallerand & Losier, 1999).

Attention is a primary neurocognitive function that is a prerequisite for performing more complex cognitive tasks (Cooley & Morris, 1990).

The concept of executive functions refers to a term encompassing an entire system of high-level mental processes whose primary function is to enable a subject to confront new situations and achieve their goal (Roy *et al.* 2012).

Attention can then be defined as our brain's ability to focus on an object or a person for a longer or shorter period. It is "the attentional focus effect on learning, such as the focus (internal or external) that changes the performance also learning." (Wulf *et al.* 1998).

As attention is a "major cognitive process that conditions access to learning", (Floch *et al.* 2013) there is no learning without attention (Giroux, 2009).

We differentiate between selective, divided/shared attention, and sustained/focused attention. These distinct aspects of attention are essential in school, as they allow the child to grasp relevant information in class (selective attention) since we speak of "attention as a selection process that allows us to encode the information necessary for movement, to concentrate on a task (sustained attention) and to do several things at the same time (divided attention) (Posner & Boies, 1971).

Visual attention is also a facet of the attentional process that allows controlling all the stimuli found in the visual area of the learner (Posner, 1980); in physical education and sports, it is primordial for motor learning and correct execution of motor tasks.

Many indications confirm the existence of a spatial attentional process that detects and selects information precisely according to the spatial location of objects and events (selective attention). Much research has confirmed this existence (Posner *et al.* 1980 ; Treisman, A.1986).

Any attentional process can be defective. We speak of attentional deficits such as that caused by unilateral spatial neglect (USN), defined as a spatial disorder characterized by "the inability to verbally describe, respond to, and orient to stimuli contralateral to the hemispheric lesion, without this disorder being attributable to a sensory or motor deficit" (Heilman & Valenstein, 1979).

Acquiring motor or intellectual and executive skills in the motor task involves attention. For this reason, the attentional process is at the center of interest in experimental psychology, whose research of the link between the process and the performance in physical activity and sport is the primary goal.

In this perspective, we sought to evaluate the association between attentional processes and motor performance from motor learning in physical education and sport and to evaluate the degree of the impact of attentional level on sports performance on the other hand, in a group of school teenagers.

Materials and methods

Design and context of the study

This is a comparative and predictive study aiming to evaluate the relationship between attentional processes, spatial hemineglect and sports performance in Moroccan adolescents attending school The study was administered in two Moroccan high schools, Salman Elfarissi and Cheikh Ibn Taymia, located in the Skhirat Témara province of the Salé Rabat Kenitra region in central Morocco. The study duration is 4 months, from February 7 to May 28, 2022.

The subject of the study

Inclusion and exclusion criteria were established to provide a representative sample of the general population.

- **The inclusion criteria**

Students in qualifying secondary education between 14 and 21 studies in a public educational institution. Physically fit for physical and sports activities; they had sufficient vision to discriminate the stimuli (some of them had corrective glasses).

- **The exclusion criteria**

Uncorrected visual impairment, history of neurological disease (stroke or head injury), use of medication that may cause attention deficit and/or drowsiness, severe depression, or unstable mental illness.

Tools used

- **d2-R Test of Attention - Revised**

We administered the revised version of the d2-R test (Brickenkamp *et al.* 2010) to classes of approximately 38 students, each in quiet classrooms at school. All students were informed that participation in the test was voluntary and that they could stop whenever they wished. Then, they were given a double-sided sheet of paper (containing some questions about their profile, instructions on one side, and the d2-R test on the other); the test was taken with a red ballpoint pen (adapted to the optical reading system). The test consisted of 798 items divided into 14 lines of 57 characters. Each line included the letters "d" or "p" with or without dashes (0 to 4). The task was to cross out the target objects of the test ("d" with two dashes "3 types"), the others serving as distractors. A processing time for each line was allowed 20 s, and the test was performed without pause (4 minutes 40 seconds). Participants were reminded to work from left to right, to start working on the following line as soon as they received the instruction "stop, next line," and to work as fast as possible without making mistakes. When participants crossed out the incorrect objects (non-target objects),

they were allowed to cross them out again (by making a choice). The whole experiment, including instructions, exercises, and the task, lasted about 20 minutes. The data were processed according to the following scoring indices:

- cct = number of correctly barred target characters.
- Errors of omission (EO): target characters that were not marked appeared before the last character processed (cct).
- Confusion errors (CE): These are the marked distracting characters.
- The concentration capacity (CC): index determined from the subtraction of the number of correctly crossed out target characters (cct) and the number of confusion and omission errors (CC = cct - EO - EC).
- The processing rate (CCT): It is obtained from the number of the last target character to be processed; it includes the correct answers (cct) and the errors of omission (EO+EC).
- Exactitude (E%): The percentage of errors (E%) is the division of the number of errors (of omission and confusion) by the number of target characters processed (CCT).

• Sports Performance

We have chosen the long jump as an individual physical activity and sport. The choice of this school's physical activity is based on the solicitation of mental capacities, particularly the cognitive process for realizing a performance.

The students learn the different steps of the long jump (run-up, impulsion, suspension, landing) during 8 learning sessions technically. All students perform an equal jump in the pit (landing area) following the long jump rules (*Le juge-arbitre, 2012.*). Scoring is based on a school-based scale that links each jumped distance to a score, respecting the gender and grade level of the learner (*OP, 2007*).

• Bells Test

The test involves the detection of targets placed among several stimuli on an A4 sheet of paper. The test consists of 315 stimuli, 280 of which are distracters (house, horse, tree, car, etc.) and 35 bell figures. The latter are target stimuli. Before the test starts, the subject sits comfortably in front of the examiner, who demonstrates the test to the subject by showing him the distractors and a circled bell; then the examiner places the sheet horizontally in front of the subject; the page is placed on the subject's midline, and the examiner asks the subject to circle all the bells on the sheet with a pen (Gauthier *et al.* 1989). The bells are distributed randomly within the set of stimuli, divided into 7 columns, each containing 5 bells and 40 other stimuli. Columns 1,2, and 3 are noted on the left, column 4 in the center, and columns 5, 6, and 7 on the right.

The examiner announces the beginning of the test and asks the subject not to stop until he or she has surrounded all the bells. The examiner holds the correction sheet and notes the sequence numbers of the bells circled by the subject; if the subject stops before all the bells are circled, the examiner asks him to check if he is sure he has circled all the bells. After this announcement, the test is over if the subject stops again.

At the end of the test, the following variables are scored: **1**) the number of omissions of the targets on the left side, **2**) the number of omissions of the targets on the right side, **3**) the total number of omissions, **4**) the time of the test (Gauthier *et al.* 1989).

Statistical analysis

The statistical analysis is based on two aspects: one descriptive and one analytical.

Descriptive statistics

the results were expressed as mean ± standard deviation.

Analytical statistics

The Student's T-test was used to compare the mean scores of the different variables concerning gender.

ANOVA (analysis of variance) and Tukey's test was used to compare the mean scores of the different variables with age group.

The Pearson coefficient was used to evaluate the relationship between D2-R test parameters, Bells test, and sports performance. A p-value <0.05 was considered significant at the 95% confidence interval.

Results

A total of 250 students participated in the study, with (152 girls (60.4%) and 98 boys (39.6%), the mean age is 16.77± 1.23 years, range: 14-21, with {16-17} (65,60%), (Figure 1). The classes studied were chosen randomly, without discrimination. Divided into three educational levels: common core (TC) 27.6%, 1st-year baccalaureate (1BAC) 50.8%, and 2nd year baccalaureate (2BAC) 21.6% (Figure 2).

Focused Attention Test-Revised D2-R

Table 1 shows the total mean scores of the different d2-R test parameters: 156.86 ± 42.78 for concentration capacity (CC), 12.86% ± 8.78 for accuracy (E%), and 198.30 ± 37.92 for processing rate (CCT).

• By gender :

Analysis of the mean scores of the different d2-R test parameters with gender (Table 1) shows that:

- For the ability to concentrate (CC), the average score of boys is higher than the average total score. In comparison, that of the girls is lower.
- For accuracy (E%), the average score for boys is lower than the overall average score, but the average score for girls is higher.

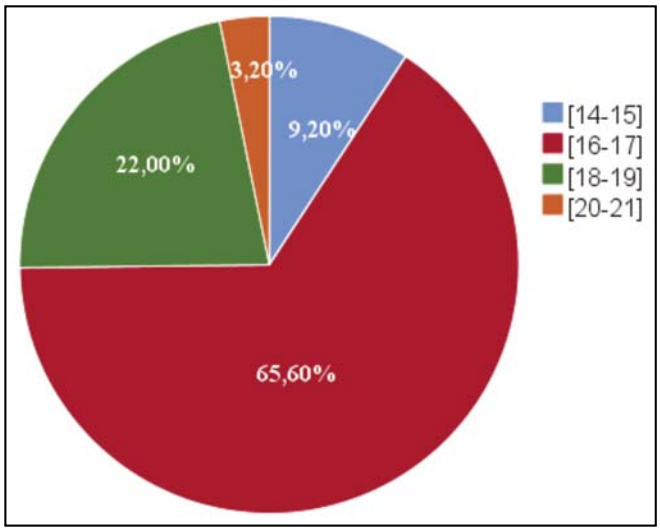

Fig. 1. Distribution of sample averages by age

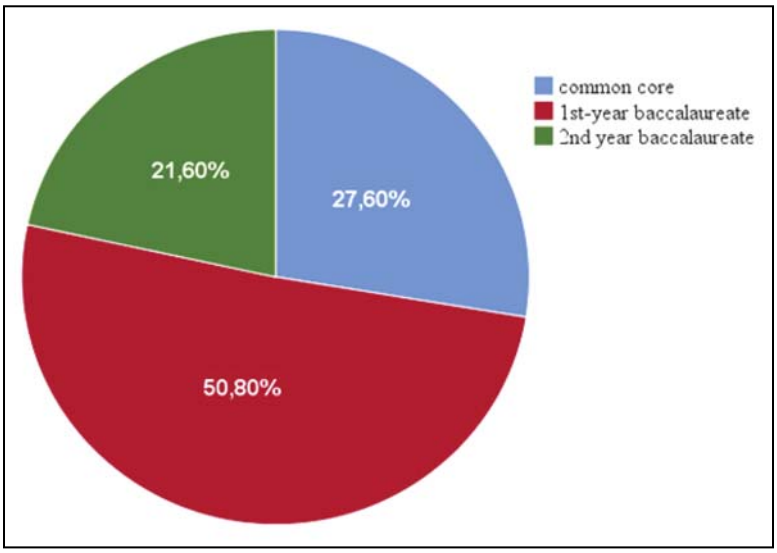

Fig. 2. Distribution of sample averages by educational level

- For the treatment rate (CCT), the average score for boys is lower than the average for girls, while the average score for girls is higher.

According to the Student T-test (Table 1), all results showed no significant difference between girls and boys in concentration scores (CC) (p = 0.380) and treatment rate (CCT) (p = 0.316), accuracy (E%) (p = 0.059).

• By Age:

Analysis of the mean scores of the different d2-R test parameters with age categories shows that (Table 2):

- For the ability to concentrate (CC), the average score of the age group {14-15} is higher than the other average scores of the other age groups.
- For accuracy (E%), the average score for the age group {20-21} is higher than the other average scores for the other age groups.
- For the treatment rate (CCT), the average scores of the age group {14-15} are higher than the other average scores of the other age groups.

According to the ANOVA test (Table 2), the results showed a significant difference between the age categories in concentration scores (CC) (F = 9.076; $p < 0.05$), accuracy (E%) (F = 8.480; $p < 0.05$), and treatment rate (CCT) (F = 3.998; $p < 0.05$). This was also confirmed by the Tukey test, which consists of the means having the same letter not differing significantly; in our case, we find 2 categories (a) and (b) or (ab).

Bell's test

The average score of the Bells test was 33.54 ± 1.66 (Table 1).

• By gender

The distribution of the average Bells test scores (Table 1) according to gender shows that the average is higher for females with an average of 33.65 ± 1.665, compared to males with an average of 33.37± 1.665.

According to the Student's T-test (Table 1), all results showed no significant difference between girls and boys in the Bells test scores (p = 0.189).

Tab. 1. Distribution of means of sports performance scores, Bells test, and D2-R focused attention test by gender

		SPORTS PERFORMANCE *(MEAN ± SD)*	BELLS TEST *(MEAN ± SD)*	D2-R TEST		
				CONCENTRATION CAPACITY (CC) *(MEAN ± SD)*	EXACTITUDE (E%) *(MEAN ± SD)*	RYTHME DE TRAITEMENT (CCT) *(MEAN ± SD)*
SEXE	**M** (N =98)	12,78 ± 2,383	33,37 ± 1,665	159,827 ± 42,4658	12,0946% ± 7,17040%	195,30 ± 40,224
	F (N=152)	12,44 ± 2,315	33,65 ± 1,665	154,954 ± 43,0232	13,0092%± 10,38970%	200,24 ± 36,370
TOTAL MEANING (N=250) (MEAN ± SD)		12,572±2,34	33,54 ± 1,66	156,86 ± 42,786	12,556% ± 8,78005%	198,30 ± 37,925
***p* VALUE**		$p = 0,271$	$p = 0,189$	$p = 0,380$	$p = 0,059$	$p = 0,316$

M: male, F: female, SD: standard deviation

Tab. 2. Distribution of the means of the sports performance scores, Bells test, and D2-R focused attention test according to age

AGE CATEGORY	SPORTS PERFORMANCE *(MEAN ± SD) (Min, Max)*	BELLS TEST *(MEAN ± SD) (Min, Max)*	D2-R TEST		
			CONCENTRATION CAPACITY (CC) *(MEAN ± SD) (Min, Max)*	EXACTITUDE (E%) *(MEAN ± SD) (Min, Max)*	RYTHME DE TRAITEMENT (CCT) *(MEAN ± SD) (Min, Max)*
{14-15}	(a) 13,00 ± 2,714 (8, 17)	(a) 31,91 ±2,172 (26,35)	(b) 178,261 ± 35,872 (113, 270)	(a) 10,134% ± 5,762% (2,29%, 26,14%)	(b) 216,09 ± 34,730 (151,298)
{16-17}	(a) 12,52 ± 2,330 (7, 18)	(b) 33,53 ± 1,652 (28,35)	(a, b) 162,262 ± 39,744 (67, 267)	(a, b) 11,388% ± 7,628% (0,51%,39,20%)	(a, b) 200,05 ± 37,440 (111,319)
{18-19}	(a) 12,35 ± 2,196 (8, 18)	(b) 34,09 ± 1,005 (31,35)	(a) 135,055 ± 47,385 (35, 286)	(b, c) 17,435% ± 12,928% (3,32%,76,19%)	(a) 185,60 ± 38,652 (110,308)
{20-21}	(a) 14,00 ± 2,268 (11, 18)	(b) 34,63 ± 0,518 (34,35)	(a) 134,635±21,960 (100, 170)	(c) 19,613% ± 8,519% (8,13%,38,27%)	(a, b) 198,63 ± 28,745 (166, 244)
FICHER (*p* value)	1,454	11,791	9,076	8,480	3,998
Sig.	0,227	0,000	0,000	0,000	0,008

*(a), (b), (c), (ab), (bc) are groups of means.
*(min, max) is the minimum and maximum value of the means in the age category.
(Means, SD) represent the mean and the standard deviation.

• By Age

The analysis of the average scores with the age groups (Table 2) shows that the average score of the age group {20-21} is the highest, followed by the age group {18-19}, {16-17} as well as the lowest average is the age group {14-15}.

According to the ANOVA test, the results showed a significant difference between the age categories regarding Bells test scores ($F = 11.791$; $p < 0.05$). This was also confirmed by the tuky test, which consists of the means having the same letter do not differ significantly. In our case we find 2 categories {14-15} (a) and {16-17} (b), {18-19} (b), {20-21} (b) (Table 2).

Sports performance

The study of sports performance in the group showed a mean score of 12.572±2.34 (Tables 1).

The distribution of the mean scores of the sports performance according to gender shows that the means are higher in the male gender with a mean of 12.78±2.383, compared to the female gender with a mean is 12.44±2.315 (Table 1).

Using the Student's T-test, all results showed no significant difference between girls and boys in sports performance scores ($p = 0.271$) (Tables 1).

The analysis of the mean scores with the age groups (Tables 2) shows that the mean score of the age group {20-21} is the highest, followed by the age group {14-15}, {16-17} as well as the lowest mean is the age group {18-19}.

Tab. 3. Internal correlation of different d2-R test parameters

		CONCENTRATION CAPACITY (CC)	EXACTITUDE (E%)	RYTHME DE TRAITEMENT (CCT)
CONCENTRATION CAPACITY (CC)	Coefficient de corrélation	1,000	-,656**	,802**
	Sig. (Bilatéral)	.	,000	,000
EXACTITUDE (E%)	Coefficient de corrélation	-,656**	1,000	-,154*
	Sig. (Bilatéral)	,000	.	,015
RYTHME DE TRAITEMENT (CCT)	Coefficient de corrélation	,802**	-,154*	1,000
	Sig. (Bilatéral)	,000	,015	.

Tab. 4. Correlations between d2-R, Bells test score, and sports performance score

		SCORE BELLS TEST	SPORT PERFORMANCE
CONCENTRATION CAPACITY (CC) [D2-R]	*Correlation Coefficient*	-,007	,575**
	Sig. (bilateral)	,909	,000
RYTHME DE TRAITEMENT (CCT) [D2-R]	*Correlation Coefficient*	,001	,756**
	Sig. (bilateral)	,991	,000
SCORE BELLS TEST	*Correlation Coefficient*		,014
	Sig. (bilateral)		,829

Internal correlation of d2-R test

An internal correlation between the d2-R test parameters (Tables 3) shows a strong positive correlation between concentration capacity (CC) and processing rate (CCT) with an (r = 0.802), while a negative correlation is observed between accuracy (E%) and (CC) with (r = -0.656), and the (E%) and (CCT) with (r = -0.154).

These results show that a strong positive relationship exists between CC and CCT since a high concentration capacity (CC) leads to fast and accurate test processing (we talk about an intense processing speed and accuracy). However, the negative relationship is expected between concentration capacity (CC), processing speed (CCT), and the exactitude (E%) since a high score of E% indicates a weak performance in the test (low concentration as well as processing speed defective by an inaccuracy (high number of errors).

Correlation of d2-R, Bells test, and sports performance

The correlation analysis (Tables 4) shows a significant correlation between the different D2-R test items (CC, CCT) and the sports performance score (r = 0,575. r = 0,756). However, there is no significant correlation between the Bells test and sports performance and the different D2-R test items, namely CC and CCT.

The graph (figure 3) is also known as the correlation graph of sports performance, processing pace (CCT), concentration capacity (CC), exactitude (E%), and the Bells test score. It shows the relationships between them.

- The positively correlated sports performance, processing speed (CC), and concentration capacity (CC) are grouped.
- The negatively correlated exactitude (E%) is positioned on opposite sides of the graph's origin (opposite quadrants).
- The correct distance between the CC, CCT, sports performance, exactitude (E%), and the origin measure the excellent quality of the representation.

Discussion

The present study was designed to evaluate attention, one of the most solicited cognitive functions in sports practice, and to assess its association with sports performance in Moroccan high school students, as well as to evaluate unilateral attention and spatial neglect disorders in them.

Several studies have shown that the revised d2-R focused attention test (Rolf, 2015) has satisfactory internal consistency. According to the results of the present study, a strong positive correlation between concentration capacity (CC) and processing rate (CCT) (processing speed) and a negative correlation between these and accuracy (E%). In the present study, the positive relationship between the concentration capacity, the processing speed, and the score of the student's sports performance indicate that the more the student pays attention (concentration), maintains it, and controls it, the more he processes stimuli and information to succeed in the learning task and the greater the processing speed, the faster the task is deconstructed and the easier it is to assimi-

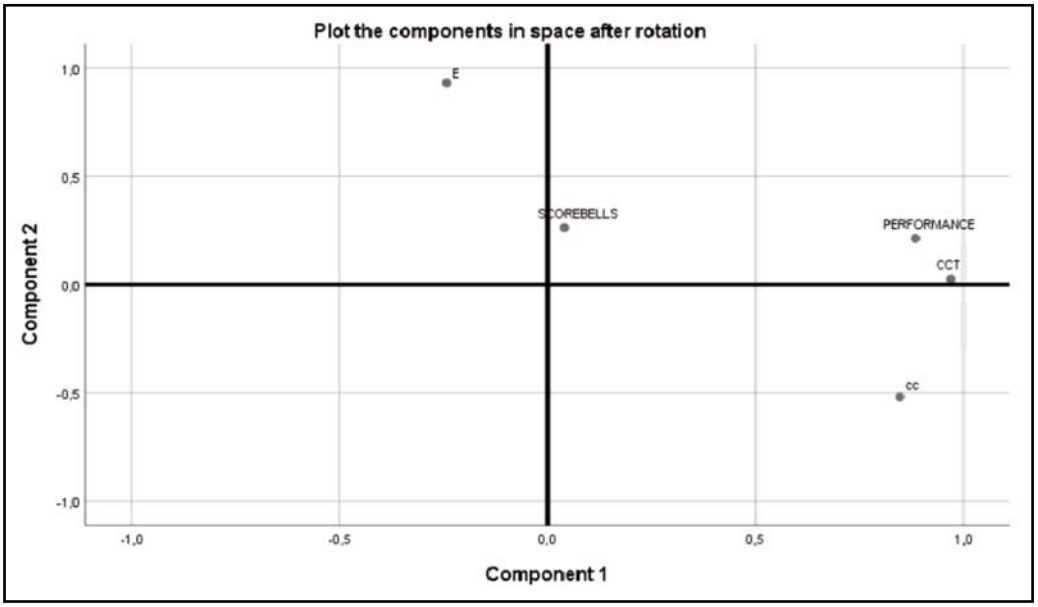

Fig. 3. Correlation graph of sports performance, processing rate (CCT), concentration capacity (CC) and exactitude (E%), and the Bells test score

late its components, which favors rapid learning in long jumping activity. We note that visual attention is essential for the task's success since it is related to a visual proficiency in jumping (crossing the take-off board without touching the plasticine board) (*Le juge-arbitre, 2012*).

Also, no sex differences were found for any of the items of the d2-R test, which concord with the data of the standardized d2-R test of Brickenkamp (Rolf, 2015). On the other side, the statistical study shows the non-significance of sex effects on the Bells test score, which is consistent with later studies (Gauthier *et al.* 1989) and (Rousseaux *et al.* 2001). The effect of age appeared significant, which is not consistent with the study's results (Gauthier *et al.* 1989). Such an effect is also marked for sports performance with sex and age, which shows that there are no effects of sex and age range on the sports performance of students. These results are consistent with the scale of evaluation of these sports performances (*OP, 2007*).

Our analysis showed no correlation between the score of the Bells test, which evaluates spatial negligence, and the sports performance; this is the result that the execution of the jumping task in length requires only straight and unidirectional vision ahead. No influence or interference of contralateral stimulation on the learner's execution of the task and their sports performance.

Our results did not find any correlation between the Bells test and the d2-R test of concentrated attention; since the d2-R does not allow us to observe the visual exploration strategy, the instruction is very explicit at this level (forced scanning from left to right). Contrary to the d2-R, the Bells test does not measure attentional variability; the norms only include a global number of processed items, allowing a clinical analysis of the learner's visual scanning (Gauthier *et al.* 1989).

In all motor learning, and during any motor task, the solicitation of the attentional process is primordial; according to the cognitive theory describing that learning in the cognitive stage solicits attention for the adjustment of gestures and imprecision of the gesture, we speak of non-efficiency of control (Fitts & Posner, 1967).

These results are supported by studies about the effect of attentional focus on learning, such as focus modifies performance and learning (internal, external focus) (Wulf *et al.* 1998).

Conclusion

Our study has proved that motor performance depends significantly on the degree of attention given to the task during learning. Indeed, for any learning, mental and cognitive skills are essential next to physical skills, which is why the Moroccan educational system must put more light on the cognitive side and its development to achieve good learning in physical education and sports.

REFERENCES

1 Brickenkamp, R., Schmidt-Atzert, L., & Liepmann, D. (2010). *d2-R Test d2—Revision; Aufmerksamkeits- und Konzentrationstest ; Manual.*
2 Cooley, E. L., & Morris, R. D. (1990). Attention in children: A neuropsychologically based model for assessment. *Developmental Neuropsychology.* **6**(3): 239–274.
3 Treisman, A. (1986). Caractéristiques et objets dans le traitement visuel. *Scientifique américain.* **255**(5): 114B–125.
4 Fitts, P. M., & Posner, M. I. (1967). *Human performance.*
5 Floch, N. L., Clarisse, R., Faget-Martin, E., & Riedel, M. (2013). *Evaluation et auto-évaluation des niveaux et des variations de l'attention de l'enfant à l'adulte : Approche chronopsychologique.* **73**.
6 Gauthier, L., Dehaut, F., & Joanette, Y. (1989). The Bells Test: A quantitative and qualitative test for visual neglect. *International Journal of Clinical Neuropsychology.* **11**(2): 49–54.

7 Giroux, P. (2009). Étude de facteurs liés à l'attention d'apprenants universitaires en contexte de vidéocommunication. *Revue internationale des technologies en pédagogie universitaire / International Journal of Technologies in Higher Education*. **6**(2–3): 34–46.
8 Heilman, K. M., & Valenstein, E. (1979). Mechanisms underlying hemispatial neglect. *Annals of Neurology*. **5**(2): 166–170.
9 Le juge-arbitre, IAAF Athletics,13éme Edition. Juin 2012.
10 Orientations pédagogiques et programme d'enseignement de l'EPS dans le cycle secondaire qualifiant.édition 2007.
11 Posner, M. I. (1980). Orienting of attention. *The Quarterly Journal of Experimental Psychology*. **32**(1): 3–25.
12 Posner, M. I., & Boies, S. J. (1971). Components of Attention. *Psychological Review*. **78**(5): 391–408.
13 Posner, M. I., Snyder, C. R., & Davidson, B. J. (1980). Attention and the detection of signals. Journal of Experimental Psychology: General. **109**(2): 160–174.
14 Rolf, B. (2015). d2-R: Test attention concentrée. Éditions Hogrefe France.
15 Rousseaux, M., Beis, J. M., Pradat-Diehl, P., Martin, Y., Bartolomeo, P., Bernati, T., Chokron, S., Leclercq, M., Louis-Dreyfus, A., & Marchal, F. (2001). Présentation d'une batterie de dépistage de la négligence spatiale [Presentation of a screening battery for spatial neglect]. *Rev Neurol.(Paris)*. **157**: 1385–1400.
16 Roy, A., Le Gall, D., Roulin, J.-L., & Fournet, N. (2012). Les fonctions exécutives chez l'enfant : Approche épistémologique et sémiologie clinique. [Executive fonction in children : Epistemological approach and clinical semiology.]. *Revue de Neuropsychologie, Neurosciences Cognitives et Cliniques*. **4**(4): 287–297.
17 Vallerand, R. J., & Losier, G. F. (1999). An integrative analysis of intrinsic and extrinsic motivation in sport. *Journal of Applied Sport Psychology*. **11**(1): 142–169.
18 Wulf, G., Höß, M., & Prinz, W. (1998). Instructions for motor learning: Differential effects of internal versus external focus of attention. *Journal of Motor Behavior*. **30**(2): 169–179.