Journal of Physical Education and Sport ® (JPES), Vol.19 (Supplement issue 5), Art 271, pp. 1836-1842, 2019
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Role of speed and agility in the effectiveness of motor performance

FELICE DI DOMENICO[1], TIZIANA D'ISANTO[2]
[1,2] University of Salerno, ITALY

Published online: October 22, 2019
(Accepted for publication: October 15, 2019)
DOI:10.7752/jpes.2019.s5271

Abstract:
The study of movement is increasingly oriented towards a global vision that considers all the elements that contribute to its realization. Human movement represents the synthesis of a complex concatenation of events that take place within the body (both conditional and neurological in nature) in relation to a reference environment in order to achieve a goal in the most effective way possible. The following study aims to evaluate some very important features for the realization of a precise and fast and therefore effective movement: speed and agility. The method is experimental research through the recruitment of data with questionnaires and surveys prepared with the Google Forms platform and the evaluation of motor gestures with technological tools: Optojump Next. The sample is represented by a group of 25 students of the bachelor's degree in Sport Science from the University of Salerno, aged between 20 and 27 years. The results of the initial data confirm the impossibility of breaking down the movement into simpler parts in order to understand how it works because it emerges that the movement must be considered in its entirety. The integrated use of quantitative biomechanical and qualitative educational evaluation can be achieved with self-assessment and enabling self-esteem. In conclusion, the study can be useful for identifying the areas of performance to be analysed in order to form the motor-sporting educational professional skills most dedicated to evaluation.
Key words: speed and agility; Optojump Next; evaluation tests.

Introduction

Rapidity and agility are components that significantly influence a sporting gesture, making it effective and precise with respect to the situation. It is a capacity that, to be expressed in an optimal manner, needs a correct and unavoidable integration of the nervous system with the musculoskeletal system which, by cooperating, allows the construction of the movement in its entirety (Valentini M. et al.,2018).

A new approach aimed at understanding the complex mechanism of construction of the movement is distanced from obsolete concepts of classification of abilities in a reductionistic manner.

The multitude of classifications of motor skills, adopted for decades, has tried to make simple phenomena that, in reality, show extremely complex characteristics, since human movement is governed by numerous variables that cannot always be separated to be studied (Raiola, 2013). In the field of sports preparation, the holistic approach is more suitable for the study of the phenomena related to it, as it considers the whole as more than the sum of the parts (Tiziana et al, 2017). According to the supporters of this approach in the sports field, the various aspects of the training processes influence each other, therefore the separation of the various aspects is not applicable (as happens in the reductionist approach), as in biological processes, each variable creates changes in the evolution of the process itself. On the basis of this definition, the various basic motor properties can hardly exist in isolation: strength and coordination, as well as speed and agility, are closely related as they continuously interact with each other for the realization of the motor act, and therefore, they should be treated as a single unit. For these reasons, the evaluation of components such as speed and agility will take into consideration the movement as a whole.

The aim of this study is the evaluation of rapidity and agility as integral components of the motor gesture in its totality; furthermore, attempts were made to investigate how learning processes in the right stages helped develop these skills.

Rapidity

Rapidity is one of the main forms of motor stress that can be attributed to both conditional and coordinative skills (Grosser, 1991, Martin, Carl, Lehnertz 1991, Weineck 1992, Schnabel, Thiess 1993). It manifests itself in different ways in various sports. For Grosser (1991) "... in sport, rapidity means the ability to reach, under certain conditions, the maximum speed of reaction and movement possible, based on cognitive processes, maximum effort of will and the functionality of the system neuro-muscular". According to Schiffer (1993) rapidity can occur in pure or complex forms. Among the pure forms there are:

• motor reaction capacity: reacting to a stimulus in the shortest time;

Corresponding Author: GAETANO RAIOLA, E-mail: graiola@unisa.it

• rapidity of the single movement: perform acyclic movements at maximum speed against poor resistance;

• frequency of movements: perform cyclic movements at maximum speed against poor resistance.

The concept of rapidity of a simple motor act differs from that of speed. The speed of movement and locomotion concerns the mobilization of whole complex of biological systems: explosive strength of muscles, ability to accelerate muscles and ability to resist for the duration of the movement. To reach a high-speed level, it is not enough to be quick, but there is a need for strength, coordination, psychic, technical, etc. (Voss 1993).

Agility

Based on an extensive review of scientific literature, there appears to be a great deal of ambiguity regarding a clear and coherent definition of agility in the sports science community.

Source - Strength and conditioning journal 35 (3): 2-11 · June 2013

Classically, agility has been defined as the ability to depart, stop and change direction quickly, or the ability to change direction quickly and accurately.

According to Challendurai, while there is general agreement on the importance of agility in many sports, it has been defined in many ways. Challendurai also noted that these definitions fail to recognize the perceptual and decision-making factors that are needed in many sports. It is interesting to note that the author suggests that this classification of 'generality of agility' can lead to misunderstandings about what constitutes a task of agility. In fact, most research studies and coaching articles involving agility tests have apparently applied the term agility to describe any sporting action that involves a dynamic change in body position.

A diagram is provided below to classify agility so that tasks can be considered simple (no uncertainty), time (no spatial uncertainty, but temporal uncertainty), spatial (no temporal uncertainty, but spatial uncertainty), or universal (temporal and spatial uncertainty). This classification system provides a unique framework to understand the agility needs needed in many sports.

Agility Classification	Definition	Example of sports skills
Simple	No spatial or temporal uncertainty	The routine of a gymnast's floor: planned activity, started when the athlete wishes, with movements that the athlete has planned in advance.
Temporal	Time uncertainty, but the movement is pre-planned (spatial security)	Athletics Sprint Start: pre-programmed activity, started in response to a stimulus (starting gun) in which you do not have confidence in what moment exactly when the gun will fire.
Spatial	Spatial uncertainty, but the timing of the movement is pre-programmed (temporal trust)	Volleyball reception service or racket sport: the referee determines a narrow window of time in which the server must serve the ball to the opponent. However, the receiver does not trust where the service will go.
Universal	Spatial and temporal uncertainty	Ice hockey or soccer sport: during offensive and defensive play, athletes have no confidence at the time and at the point where the opponent will change direction.

Source - Challendurai , "Broadening the View of Agility: A Scientific Review of the Literature", Journal of Australian Strength and Conditioning, vol. 22, 2014, pag. 7

Methodology, tools and research sample

The realization of the study has developed through the succession of some procedures:

- sample selection;
- sending an online questionnaire to find data on the current and previous motor-sports habits of the evaluated subject;
- identification of the statistical units with assignment of an identification code;
- test execution with specific instrumentation;
- data recording;
- data analysis;
- conclusions.

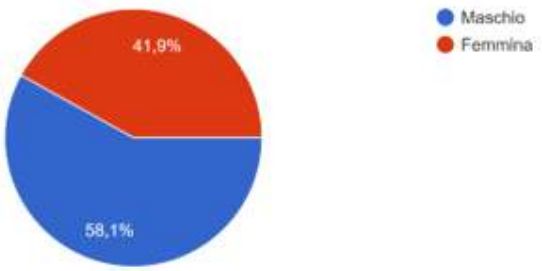
The tools used for the realization of this work have been carefully selected:

- informed consent signed by the students undergoing the study;
- questionnaire written on Google Forms administered before the actual evaluation;
- Opto Jump Next instrumentation supplied by the University. It is an optical detection system consisting of two bars (one transmitter, the other receiver) that allows to assess the contact times within the perimeter circumscribed by the bars;

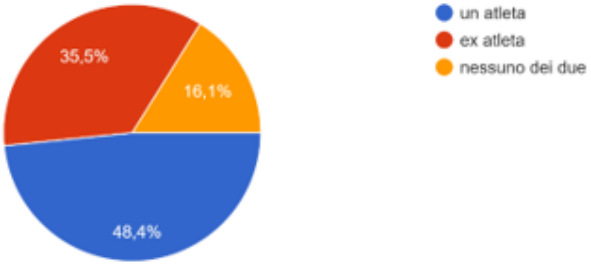
Other accessory tools used in the tests were: chronometer, pc, cameras.

The research sample is represented by a group of students from the University of Salerno, attending the second year of the three-year degree in "Sciences of physical activity, sports and psychomotor education" (L-22).

In particular, we are talking about 25 students aged between 20 and 27 years. The data collected on these subjects have been recorded as personal and anthropometric data: age, height, weight. In particular, the sample is made up of 58,1% of male subjects and 41.9% of female subjects.



At the time of the test 48.4% of the sample declared to be an athlete, 35.5% a former athlete and 16.1% neither.



Furthermore, for each of them an identification code was generated consisting of five digits obtained from the last three digits of the university matriculation number and the first initial of the surname and name. These data were obtained by submitting the statistical units, after signing the informed consent, to a questionnaire prepared by the Google Forms platform.

Through the Google Forms platform, we have been able to find data about the motor and sports experience of the subjects, both past and present. This allowed to identify the probable causes that determined the level of qualities investigated through the instrumental tests. Subjects who have had sporting experiences or who at the date of the test practiced sports have had better results than those who have not had important motor or sports experiences neither in the fundamental stages of motor learning nor at the time of the test (Raiola, 2017).

Data collection and analysis

BFS 5 jump Five Dot Drill protocol test

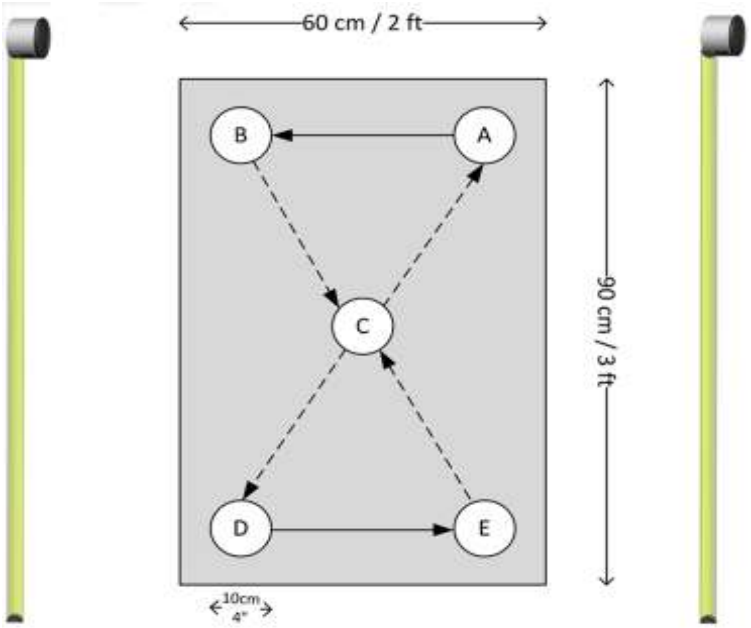
Aim of the test

The Five Dot Drill protocol (Exercise with 5 circles) is a test well known and in vogue in the United States for the assessment of agility, understood as the ability to quickly change position with precision, in a rapid and reactive manner.

Preparation of the test area

It is necessary to draw on the floor a rectangle of 60x90 cm inside which we will have five circles of 10 cm of diameter arranged as in the figure.

Outside the long side of the rectangle we are going to position the two bars of OptoJump Next with the turret at the test entry point.



Execution methods

The protocol consists of 5 different exercises to be performed 6 times each consecutively and non-stop. The final main output of the test, in fact, is the total time of the 5 exercises which therefore must be carried out in the shortest possible time. For the purposes of this research we have chosen to perform only one of the protocol exercises. The exercise is the "Up & back" and is carried out in this way:

1. Start with your feet on A and B;
2. Quickly jump with both feet to C;
3. Jump, dividing the feet, over D and E;
4. Return to the start in the same way by jumping backwards;
5. Repeat 5 more times (6 times in total).

The goal is always to perform the exercise as quickly as possible.

Data acquired

This test highlights the close correlation between elements of a conditional and a coordinative nature. The subject, to have good results in this test, must possess a considerable ability to manage rapid strength and a high agility. The level of these abilities is given by some basic elements: muscle strength, intermuscular coordination, intramuscular coordination.

Another parameter that can be evaluated with this test is the reactive force, that is the ability to quickly perform a concentric action after an elongation phase.

The Reactive Strength Index, from the English "Reactive Strength Index" (RSI) was developed as a mechanism to monitor stress on the muscle-tendon complex during plyometric exercises. CSR describes an individual's ability to rapidly develop muscle contraction after eccentric lengthening and expresses the explosive abilities of athletes in jumping activity (McClymont, 2005; Young, 1995). The index can be used to provide recommendations on the optimal fall height in plyometric exercises, to compare athletes' plyometric abilities or to monitor plyometric training progress. The RSI is calculated by dividing the height jumped into a jump for the time on the ground by developing the forces necessary to make that jump. The components of RSI, the height of jump and the time of contact on the ground (CT), also provide usual information to the coaches. Jump height is a simple outcome measure that can be used by coaches to evaluate plyometric performance. Contact time provides key information on how jumps are performed. Flanagan and Harrison presented reliability data suggesting that RSI is a reliable measure during dynamic jump activity.

Results

The results, shown in the graph generated by the software (table 10), provide numerous information such as contact time, flight time, height, power and pace. Each of this information gives different indications on the motor.

Table. 1 - .....

#	ATHLETE	AGE	WEIGHT	SEX	SPORT	CONTACT TIME	FLIGHT TIME	HEIGHT	POWER	RHYTHM	RSI
1	469GI	20	53	F	None	0,24	0,198	5	8,75	2,38	0,2
2	483BA	22	78	M	Football	0,229	0,109	1,5	3,96	3,02	0,07
3	483EG	20	83	M	Football	0,25	0,133	2,3	4,9	2,68	0,09
4	494BR	20	54	M	Cycling	0,462	0,14	2,5	4,65	1,77	0,07
5	501DV	21	57	F	Volleyball	0,233	0,196	4,7	8,65	2,36	0,2
6	512PL	22	66	M	Swim/Karate	0,231	0,136	2,7	5,16	2,98	0,1
7	530DM	20	56	F	Dance	0,272	0,177	3,9	7,26	2,26	0,15
8	536LS	20	60	F	Volleyball	0,299	0,101	1,3	3,44	2,55	0,05
9	544IF	21	60	M	Football	0,294	0,126	2,2	5,12	2,52	0,1
10	548PV	24	75	M	Boxing	0,218	0,169	3,5	7,44	2,58	0,17
11	553IM	21	47	F	Futsal	0,211	0,141	2,6	5,6	2,94	0,12
12	560PC	20	70	M	Basket	0,256	0,117	1,7	4,17	2,85	0,07
13	562NC	21	105	M	Football	0,235	0,084	0,9	2,61	3,27	0,04
14	563MF	20	65	F	Volleyball	0,24	0,172	3,7	6,82	2,51	0,14
15	615IT	20	65	M	Soccer referee	0,247	0,14	2,5	5,51	2,61	0,11
16	624FM	26	78	F	Body building	0,425	0,169	3,6	5,74	1,85	0,09
17	635DN	20	62	M	Football	0,299	0,081	0,9	2,68	3,14	0,04
18	639CE	24	57	F	Volleyball	0,2	0,128	2,3	5,38	3,17	0,11
19	652FA	20	57	M	Athletics	0,275	0,196	4,8	8,76	2,11	0,19
20	656MG	20	82	M	Body building	0,348	0,114	1,6	4,01	2,54	0,06
21	786MR	22	84	M	Football	0,218	0,118	1,7	4,21	3,14	0,08
22	788LA	20	58	F	Basket	0,227	0,123	1,9	4,68	2,96	0,09
23	791AV	25	45	F	Athletics	0,248	0,172	3,7	7,22	2,41	0,15
24	798GA	20	64	F	Rugby/Karate	0,286	0,143	2,5	5,53	2,44	0,1
25	851VD	20	60	F	Volleyball	0,201	0,149	2,9	6,26	3,01	0,14
					AVERAGE	0,265	0,14	2,7	5,49	2,65	
					MINIMUM	#18 - 0,2	#17 - 0,081	#17 - 0,9	#13 - 2,61	#4 - 1,77	
					MAXIMUM	#4 - 0,462	#1 - 0,198	#1 - 5	#19 - 8,76	#13 - 3,27	

Table. 2 - T-test difference between the group male and female on Contact time

	Differenze accoppiate							
			Media errore	Intervallo di confidenza della differenza di 95%				
	Media	Deviazione std.	standard	Inferiore	Superiore	t	gl	Sign. (a due code)
VAR00013 VAR00014	,01950	,08726	,02519	-,03594	,07494	,774	11	,455

Table. 3 - T-test difference between the group male and female on Flight time

	Differenze accoppiate							
			Media errore	Intervallo di confidenza della differenza di 95%				
	Media	Deviazione std.	standard	Inferiore	Superiore	t	gl	Sign. (a due code)
VAR00015 VAR00016	-,02958	,03363	,00971	-,05095	-,00822	-3,047	11	,011

Table. 4 - T-test difference between the group male and female on Height

	Differenze accoppiate							
			Media errore	Intervallo di confidenza della differenza di 95%				
	Media	Deviazione std.	standard	Inferiore	Superiore	t	gl	Sign. (a due code)
VAR00017 VAR00018	-,98333	1,36704	,39463	-1,85191	-,11476	-2,492	11	,030

Livello di significatività p>0.05 – C'è una differenza significativa tra i due gruppi per la variabile Height (0.030)

Table. 5 - T-test difference between the group male and female on Power

	Differenze accoppiate							
				Intervallo di confidenza della differenza di 95%				
	Media	Deviazione std.	Media errore standard	Inferiore	Superiore	t	gl	Sign. (a due code)
VAR00019 VAR00020	-1,47167	2,00963	,58013	-2,74852	-,19481	-2,537	11	,028

Significance level p> 0.05 - There is a significant difference between the two groups for the variable power (0.028)

Table.6 - T-test difference between the group male and female on Rhythm

	Differenze accoppiate							
				Intervallo di confidenza della differenza di 95%				
	Media	Deviazione std.	Media errore standard	Inferiore	Superiore	t	gl	Sign. (a due code)
VAR00021 VAR00022	,14667	,42847	,12369	-,12557	,41890	1,186	11	,261

Significance level p> 0.05 - There is a significant difference between the two groups for the variable rhythm (0.261)

In detail, the person who performed the test in the shortest time was 562NC, male athlete, 21 years old, practicing soccer at a competitive level. It is 180 cm tall and weighs 105 kg. He has been playing soccer for 13 years and trains 3 times a week for 1-2 hours. Before starting to play football, he practiced other competitive sports for several years, from 6 to 10 years (he did not specify in the answers of the questionnaire which sports they were). From the age of 3 to 13, he has always preferred to play "backyard games / outdoor activities" with a weekly frequency that has intensified from 10 years onwards (4-6 hours). It does not appear to be in compliance with university exams and has an average of 23-26 / 30. The actual time, from the first jump on C to the end of the exercise, was 4.88 sec. at an average rate of 3.27 steps per second.

The subject that took the most time to finish the test was 494BR, a non-competitive cycling athlete, male, aged 20, which we have already discussed previously. He completed the test in an actual time of 6.08 seconds with a pace of 1.77 steps / second.

Another person who completed the test in more time was 624FM. It is a female athlete, aged 27, 171 cm tall and weighing 75 kg, practicing body building. Practice this activity for 5 years and train 3 times a week for about 1-2 hours. His previous motor experiences are characterized by a preference, from the age of 3 up to the age of 9, for the "playground / outdoor activities" which took place up to 7 hours and more per week in the range from 3 to 5 years and for 4-6 hours per week from 6 to 9 years; from 10 to 13 years he preferred "watching TV / playing video games" with a weekly frequency of 4-6 hours. He is in compliance with university exams with an average of 23-26 / 30. He completed the test in 6.07 seconds with a pace of 1.85 steps per second.

Conclusions

From the analysis of the results obtained we have been able to investigate some data of considerable importance of both a qualitative and quantitative nature. One of these is the level of motor skills and abilities possessed by the sample of students of the Faculty of Motor Sciences of Salerno. The questionnaire drawn up with Google Forms had the role of tracing the hypothetical learning path of the various skills.

Motor development takes place incessantly throughout life. This mechanism is due to hereditary genetic heritage, experiences and the environment. In fact, the purpose of this research was to evaluate the efficiency, in terms of force production, of the execution of a motor gesture by investigating the possible factors that contribute directly or indirectly to the final result, from the skills acquired in the past to motor experiences at the time of the test. In particular, in most cases, the result of a test was motivated by previous motor experiences or at the time of the test. The subjects who have achieved good results are represented by those who have had, in certain periods, the opportunity to learn and develop a good store of skills that can be used at the right time, adapting them for the purpose.

References

Abernethy B., Hanrahan S. J., Kippers V., Mackinnon L. T., Pandy M. G., (2005). The Biophysical Foundations of Human Movement, Human Kinetics, UK.

Alberti G. Selvaggi N., (2006). Aspetti metodologici per il miglioramento della forza e della potenza muscolare, Atleticastudi.

Andorlini A., (2015). Allenare il movimento, dall'allenamento funzionale all'allenamento del movimento, Calzetti Mariucci, PG.
Beachle T.R., Earle R.W., (2010). Manuale di condizionamento fisico e di allenamento della forza, Calzetti Mariucci, PG.
Bompa T., Buzzichelli C. A., (2017). Periodizzazione dell'allenamento sportivo, Calzetti Mariucci, PG.
Bosch F, Cook K., (2015). Strength training and coordination: an integrative approach, Uitgevers
Bosco C., Vitasalo J., (1982). "Potentiation of myoelectric activity of human muscle in vertical jump", Electromyogr. Clin. Neurophysiol.
Boyle M., (2018). Allenamento funzionale applicato allo sport, Olympian's, FI.
Brown L. E., Ferrigno V., (2005). Training for Speed, Agility, and Quickness, Human Kinetics, UK.
Buonaccorsi A., (2000). Manuale di standardizzazione dei test, C.O.N.I.
Calabrese L., (2001). L'apprendimento motorio tra i cinque e i dieci anni, Editore Armando, Roma.
Conti, Mongiat, (2006). Schemi motori di base, Selekta.
DeLisa J.A., (1998). Gait Analysis in the Science of Rehabilitation, Diane Publishing.
Enoka R. M., (1988). Neuromechanical basic of kinesiology, Human Kinetics.
Flanagan, Eamonn, Ebben, William,Jensen, Randall, (2008). "Reliability of the Reactive Strength Index and Time to Stabilization During Depth Jumps", Journal of Strength and Conditioning Research, Volume 22 - Issue 5
Gambetta V., (2011). Following The Functional Path, MomentumMedia.
Gratton C., Jones I., (2010). Research Methods for Sports Studies, Taylor & Francis.
Jones I., (2014). Research Methods for Sports Studies: Third Edition, Routledge.
Paavo K. (1991). Strenght and power in sport.
Payne A., Slater W., Telford T., (1968). "The use of a force platform in the study of athletic activities", Ergonomics.
Puglisi F., (2009). Biomeccanica. Introduzione alle misure strumentali di postura e movimento, Marrapese editore, Roma.
Raiola, G. (2013) Body knowledge and motor skills, Knowledge Cultures, 1 (6), pp. 64-72.
Raiola, G. (2017) Motor learning and teaching method, Journal of Physical Education and Sport, 17, art. no. 236, pp. 2239-2243.
Rouse W. B., (2015). Modeling and Visualization of Complex Systems and Enterprises: Explorations of Physical, Human, Economic, and Social Phenomena, John Wiley & Sons,
Schmidt R., Lee T., (2012). Controllo motorio e apprendimento, Calzetti Mariucci, PG,
Sheppard J. M., Dawes J, Jeffreys I, Spiteri T., (2014). Nimphius S., "Broadening the View of Agility: A Scientific Review of the Literature", Journal of Australian Strength and Conditioning, volume 22.
Shumway-Cook A., Woollacott M. H., (2007). Motor Control: Translating Research into Clinical Practice, Lippincott Williams & Wilkins, USA.
Tiziana, D., Antonetta, M., Gaetano, A. (2017) Health and physical activity, Sport Science, 10 (1), pp. 100-105.
Valentini, M., Riccardi, F., Raiola, G., Federici, A. (2018). Educational research: Motor area and relational area during children's personality development, Journal of Physical Education and Sport, 18, 2157-2174.
Vealey R. S., Chase M. A. (2016). Best Practice for Youth Sport, Human Kinetics, UK.
Verkhoshansky J., (1996). Il ruolo della velocità nelle discipline dell'atletica leggera, Atleticastudi 3-4-5/
Weineck J., (2009). L'allenamento ottimale, Calzetti Mariucci, PG.
Zatsiorsky V. M., Kraemer W. J., (2006). Science and Practice of Strength Training, Human Kinetics.