

# Relationship between motor learning and reaction capacity in motor task

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## ABSTRACT

The aim of the study is to measure the ability to react to a specific stimulus, which in this study can be acoustic or visual. The acquired data allowed us to evaluate two parameters, called: reaction time and action time. The test considers movement in its entirety, trying to identify the mechanisms that allowed the creation of the gesture, even going back to the sensitive phases of motor learning. The various capacities that contribute to the structure of a given motor gesture are considered as inseparable elements of a single project that, in a continuous and non-linear way, influence each other. The method is an experimental research through the recruitment of data with questionnaires and surveys prepared with the Google Forms platform and the evaluation of motor gestures with a technological tool: Optojump Next. The sample is represented by a group of 25 students of the three-year bachelor's degree in Exercise 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 enabled self-esteem. The results seem to confirm the close relationship between skills possessed and learned in the appropriate stages. In conclusion, the study can be useful to identify performance's area to be analysed in order to form the motor-sporting educational professional skills most dedicated to evaluation. **Keywords:** Self-perception; Reaction capacity; Optojump; Strength; Coordination; Complex systems.

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## INTRODUCTION

The Reaction Capacity allows us to react as quickly as possible to stimuli: visual, auditory, tactile ... (Anderlini, 2015). The Reaction Capacity is not limited to sports activities (Alminni et al, 2019, Cirillo et al, 2016) alone but is used constantly during daily actions (D'Isanto et al., 2019, Ferrara et al, 2019, Forte et al, 2019, Valentini et al, 2019, Raiola, 2017, 2014, 2013), just think of when we are driving and we have to brake or swerve suddenly or when a glass is about to fall at home, our ability to react avoid damage (Bobat, Bobat, 2015, Bosch, Cook, 2015, Bompa, Buzzichelli, 2014).

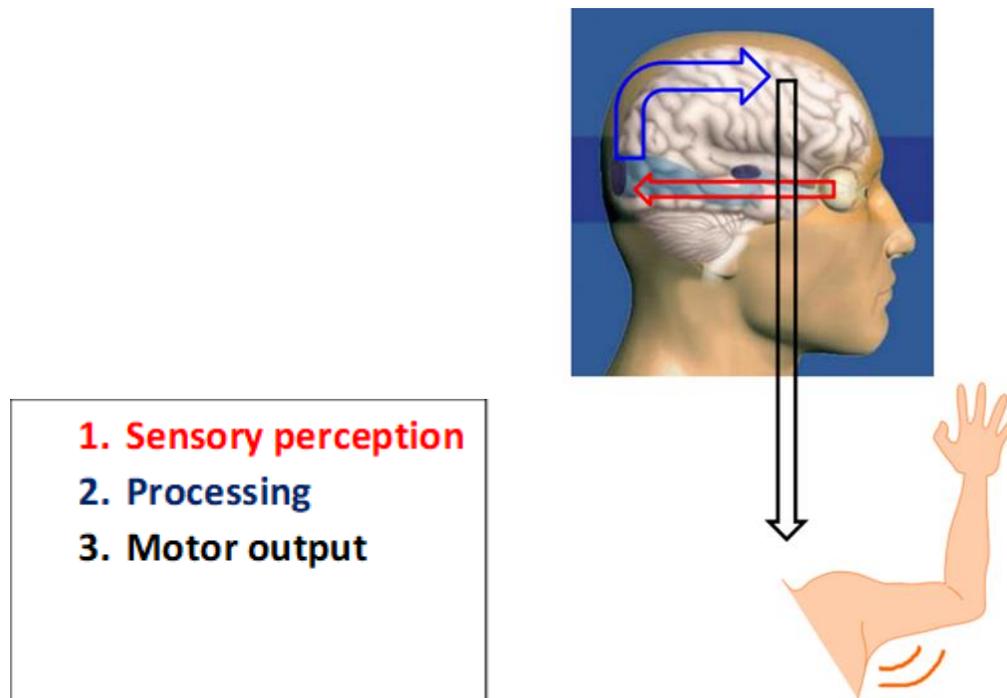


Figure 1. Action scheme.

The reaction time is composed of a total time during which there is the perception, identification and processing of an external stimulus and finally the motor response (Vealey, Chase, 2016, Weineck, 2009, Meraviglia, 2012); the total time is divided in turn into reaction time and movement time (Pisano et al, 2019, Pisapia et al, 2019, Bosch, Cook, 2015). There are simple and complex reactions (D'elia, 2019, D'elia et al 2019, Altavilla et al, 2018). By simple reactions we mean movements that are characterized by the movement of a very small part of the body; for example, pushing a button with the hand or foot. Complex reactions include movements that involve an important part or the whole body: this is the case, for example, of swift 5 m runs, short starting movements from various positions, and short snap movements connected with coordination tasks to be performed very quickly (Zatsiorsky, Kraemer, 2006) Paavo,1991, Invernizzi et al, 2019). Simple reactions are regulated for the most part by processes of genetic dominance, in complex reactions they mainly influence social factors such as training. In the study in question the acoustic reaction and the optical reaction, both single and combined, was evaluated. Acoustic Reaction: the stimulus is represented by a beep or a recorded sound. Optical reaction: the optical stimulus is represented by the change in the colour of the PC screen or by the variation of an external traffic light (Gambetta, 2011, Brown, Ferrigno, 2005). The aim of the study is that of evaluating the ability to react in a sample of students of the faculty of sport sciences of the University of Salerno (Sanseviero et al., 2019ab) in order to estimate the level

of these qualities and try to identify the determining factors for their development and improvement. By relating the results obtained with other qualitative and quantitative data obtained through a questionnaire drawn up with the Google Forms platform, it was possible to trace a possible learning path that led to the acquisition and consolidation of these skills.

## **METHODS, TOOLS AND RESEARCH SAMPLE**

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

- Sample selection;
- Sending the online questionnaire to find data on the current and past motor-sports habits of the evaluated subject (Caselli, 2005);
- 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;
- OptoJump Next instrumentation, supplied by the University;

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". In particular, we are talking about 25 students aged between 20 and 27 years. Anthropometric and personal data were collected on these subjects: age, height, weight. 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. The Google Forms platform allowed us to find qualitative and quantitative data on the previous and current motor experiences of the statistical units and, if athletes, the level of practice of the sport indicated (weekly training sessions, duration of training sessions, etc.)

## **DATA COLLECTION AND ANALYSIS. OPTO-ACOUSTIC REACTION**

### ***Aim***

The opto-acoustic reaction test has the objective of measuring the reaction times to a stimulus that can be both optical and acoustic.

### ***Procedure***

In the study in question we used the Opto-Acoustic Reaction test in which the Optical / Acoustic stimulus is not specified, and the athlete must react to both stimuli. The subject is positioned straddling a bar with one

foot out and the other inside the circumference circumscribed by the bars placed in parallel; at the signal the subject must lift the foot.

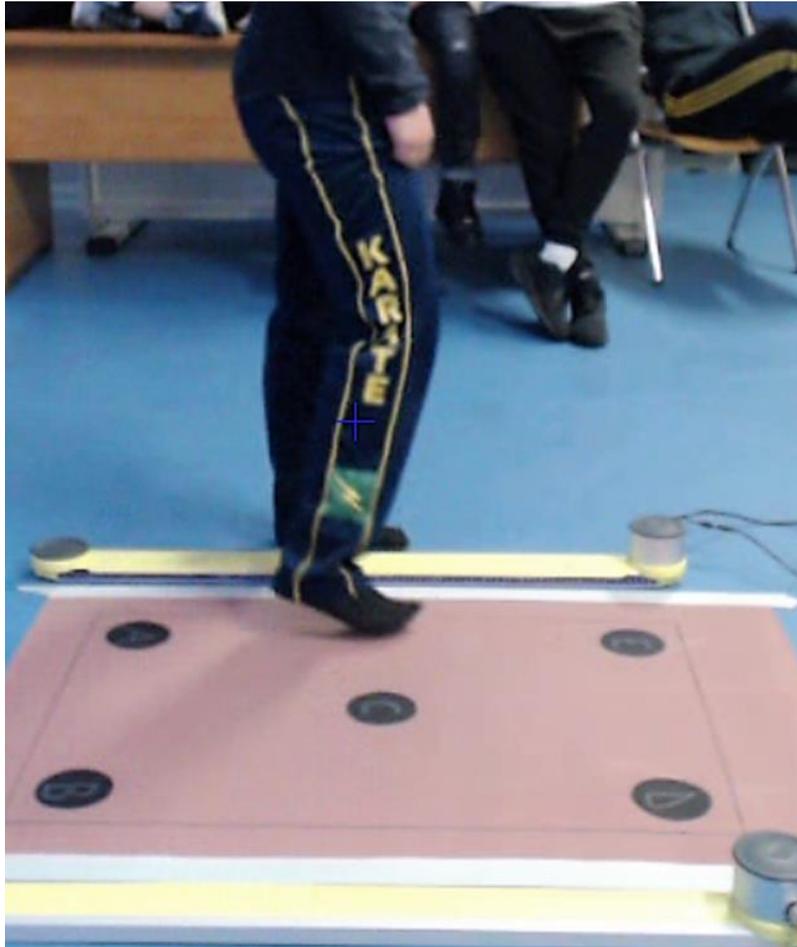


Figure 2. Opto-Acoustic Reaction test.

## RESULTS

From the analysis of the results of this test two types of information can be deduced, the first concerning the speed of reaction, the other pertaining to the speed of action.

The speed of reaction represents the capacity of the CNS to discriminate and elaborate the adequate response after having acquired and processed the stimuli of various nature coming from the environment. In consideration of this parameter, this test also indicates the efficiency of one analyser compared to another. The speed of action follows the reaction phase to quickly build a single intentional gesture in its entirety. The results obtained from the test are shown in a table below. The results obtained, the result of different anthropometric and athletic characteristics, gave interesting indications on the relationship between the motor experience and the physical characteristics of the tested subject and the result obtained.

Table 1. Speed of reaction and of action

#	ATHLETE	AGE	WEIG	SEX	SPORT	RIGHT LEG			LEFT LEG		
						RT	FT	HEIGHT	RT	FT	HEIGHT
1	469GI	20	53	F	None	0,471	0,417	21,5	0,583	0,381	17,8
2	483BA	22	78	M	Football	0,419	0,289	10,9	0,442	0,417	21,5
3	483EG	20	83	M	Football	0,473	0,228	6,4	0,426	0,343	14,5
4	494BR	20	54	M	Cycling	0,557	0,204	5,2	0,807	0,22	6
5	501DV	21	57	F	Volleyball	5,11	0,212	5,5	0,532	0,263	8,7
6	512PL	22	66	M	Swim/Karate	0,497	0,173	3,7	0,52	0,198	4,9
7	530DM	20	56	F	Dance	0,458	0,393	19,5	0,607	0,412	20,9
8	536LS	20	60	F	Volleyball	0,621	0,343	14,4	0,551	0,358	16,6
9	544IF	21	60	M	Football	0,448	0,126	2,1	0,453	0,134	2,3
10	548PV	24	75	M	Boxing	0,453	0,134	2,3	0,452	0,252	7,8
11	553IM	21	47	F	Futsal	0,447	0,16	3,2	0,452	0,192	4,6
12	560PC	20	70	M	Basket	0,466	0,095	1,1	0,493	0,113	1,6
13	562NC	21	105	M	Football	0,436	0,317	12,4	0,428	0,344	14,7
14	563MF	20	65	F	Volleyball	0,484	0,111	1,6	0,504	0,142	2,6
15	615IT	20	65	M	Soccer referee	0,444	0,128	2,1	0,537	0,181	4,1
16	624FM	26	78	F	Body building	0,484	0,311	12	0,427	0,389	18,6
17	635DN	20	62	M	Football	0,401	0,12	1,8	0,434	0,055	0,4
18	639CE	24	57	F	Volleyball	0,463	0,134	2,2	0,49	0,101	1,3
19	652FA	20	57	M	Athletics	0,616	0,151	2,8	0,567	0,151	2,8
20	656MG	20	82	M	Body building	0,633	0,349	15	0,606	0,364	16,2
21	786MR	22	84	M	Football	0,431	0,138	2,4	0,463	0,19	4,5
22	788LA	20	58	F	Basket	0,473	0,134	2,4	0,556	0,07	0,7
23	791AV	25	45	F	Athletics	0,551	0,218	6,1	0,649	0,251	7,8
24	798GA	20	64	F	Rugby/Karate	0,549	0,198	4,8	0,548	0,198	5
25	851VD	20	60	F	Volleyball	0,399	0,166	3,4	0,421	0,186	4,3
AVERAGE						0,502	0,225	7,6			
MINIMUM						#25 - 0,399	#17 - 0,055	#17 - 0,4	RT=REACTION TIME		
MAXIMUM						#4 - 0,807	#1 - 0,417	#1 - 21,5	FT=FLIGHT TIME		

## DISCUSSION

Analysing the reaction times, that is the time between the stimulus and the beginning of the motor task, the best results were obtained by 851VD, a female athlete who also distinguished herself in the previous test. His time was 0.399 seconds for the right leg and 0.421 seconds for the left leg. The reaction times of 635DN, a former 20-year-old male athlete, 183 cm tall and weighing 62 kg, should also be considered. His sport, played at a competitive level for 11 years, was football. He did 3 workouts a week that lasted 1-2 hours on average. During the age groups from infancy to adolescence he has always preferred to play "backyard games / outdoor activities" with weekly frequencies from 4-6 hours, up to 6 years, 7 hours and more, from 10 to 13 years. It is not in progress with university exams and its average is 23-26 / 30. The reaction times obtained in the test were 0.401 sec for the right leg and 0.434 sec for the left leg. The worst results, in terms of reaction times higher than the average of the participants, were obtained from 494BR, a male subject, 20 years old, 152 cm tall and weighing 54 kg. This is a non-competitive level cycling athlete for 6 years. On average, 3 training sessions per week of more than two hours are practiced for this activity. Previously, from 7 years to 14 years, he practiced Kung Fu at a non-competitive level. he practiced 2 weekly training sessions for this sporting activity. His motor experiences give us a fairly sedentary profile in the age group from 3 to 9 years, privileging as an activity "watching TV / playing video games", practicing them with a weekly frequency of 4-6 hours. From 10 to 13 years of age the privileged physical activity was "playground / outdoor activities" which he practiced every week for 4-6 hours. It does not appear to be in progress with university exams and

its average is 18-22 / 30. The reaction times obtained in the test were 0.557 sec for the right leg and 0.807 sec for the left leg.

The speed of action indicates the total time to make a complete movement and is expressed in distance / time. The determining factors for this parameter are the flight time, that is the time taken to complete the entire movement and the height of the lift, that is the amplitude of the movement. For the calculation of this parameter we refer to the definition of power, that is the speed with which the work is done. The formula is as follows:

$$\text{Power} = (\text{work done}) / (\text{time interval}) = L / t$$

The best results with respect to this parameter were found on 469GI and 530DM, which completed the excursion of their movement in the shortest possible time.

469GI is a female subject, 160 cm tall and weighing 53 kg, not practicing any sport. From 3 to 13 years he has always practiced "backyard games / outdoor activities" with a frequency of about 7 hours a week up to 9 years and 4-6 hours from 10 years. She is in compliance with university exams with an average of 27-30 / 30. The average flight time with the right leg was 0.417 seconds reaching a height of 21.5 cm, while with the left leg the flight time was 0.381 seconds for a height of 17.8 cm.

530DM is a 20-year-old female subject, 167 cm tall and weighing 52 kg. From 15 years, from the age of 5, he is a non-competitive level athlete in dance: he performs 5 weekly training sessions of an average duration of 1 hour. From the age of 3 to 5, he preferred to play "backyard games / outdoor activities" with a weekly frequency of 4-6 hours; from 6 to 9 years he preferred to devote himself to "watching TV / playing video games" with a weekly frequency of 4-6 hours; from 10 to 13 years he preferred to practice "activities in the countryside" with a weekly frequency of 4-6 hours. It turns out not to be underway with university exams, with an average of 23-26 / 30. His flight time was 0.393 seconds reaching a height of 19.5 cm with the right leg and 0.412 seconds reaching a height of 20.9 cm with the left leg. The worst results are found in 635DN, having obtained for the right leg a flight time of 1.8 seconds and a height of 0.8 cm, while, for the left leg, a flight time of 0.055 seconds and a height of 0.4 cm. 635DN is 20 years old, weighs 62 kg and is 183 cm tall. He is a former competitive level athlete. His sport was football, which he practiced for 11 years, from 6 years of age. On average, he performed 3 training sessions per week from 1-2 hours per session. From the age of 3 to 13 he has privileged "playground games / outdoor activities" with a weekly frequency that from 10 years was 7 hours and more. It is not in progress with university exams and its average is 23-26 / 30.

## CONCLUSIONS

From the analysis of the results obtained from the test protocol it has been highlighted how various factors of various nature contribute to the realization of a gesture of any kind. Therefore, we will have subjects that, in performing a given motor task, albeit for the first time, will achieve positive results because they have learned skills in the past that they can reuse by adapting them to the task (Andorlini, 2015). Motor development takes place incessantly throughout life. This mechanism is due to hereditary genetic heritage, experiences and the environment (Schmidt, Lee, 2012).

The development of good reaction skills can significantly influence the realization of a motor action, which can refer to simple actions of daily life, or to competitive actions. The study in question has shown that the

best results in terms of reaction times and flight times have been obtained by subjects who, in the sports they practice, solicit these abilities in a decisive manner.

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