

The Ability To Act Precisely During Various States of Body Arousal – Alternative Profiles of The Students

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ABSTRACT

Assessing the ability to perform precise tasks under conditions of fluctuating physiological arousal is currently one of the most pressing research topics, as it is a key component of many sports and occupational activities. The aim of this study is to propose profiles of precision abilities under conditions of increasing physical exertion based on a simple laboratory protocol. The accuracy of five basketball shots taken from a distance of 2 meters within 10 seconds was assessed. Measurements were conducted under five different conditions: before warm-up, after warm-up, and three times after 60 seconds of intense physical exertion, with three-minute periods of active rest. The analysis included two groups of students: those who were regularly physically active (A) and those who were inactive (P). Task performance accuracy and stability were assessed as indicators of precise movement during increasing physical exertion. In group “A,” the two most effective students (each with 92% throwing accuracy) differed in terms of the stability of their extreme scores. Leader’s score profile (%) from task 1 to task 5: 100/100/100/80/80. Performance profile of the inconsistent student: 100/80/100/80/100. Among the leaders of Group “A,” higher minimum performance stability was observed at the 80% (n = 3) and 60% (n = 2) levels. Regular physical activity helps maintain high performance and stability of motor skills during situations of increased exertion. The assessment protocol used can serve as a simple diagnostic tool, useful both in sports and in areas of activity related to safety and health education.

Keywords: Complementary research methodology, Personal security, Preventive medicine, Survival

INTRODUCTION

The ability to perform precise movements is most evident when casually observing many sports and competitions. However, competition in some sports involves the repetition of only specific manipulative and postural motor actions (sport shooting, archery, billiards, darts, etc.). In other sports, the degree to which precise manipulative movements involving various body parts must be combined with locomotor movements ranges from minimal muscular effort (bowling, golf, curling) to extreme exertion (biathlon, racket sports, many team sports, including basketball, hockey, handball, and, among combat sports, especially fencing). An open methodological issue is the establishment of simple criteria for studying the phenomenon of the ability to perform precise actions under various states of physical arousal,

which would be correlated with the broadest possible range of practical activities (athletes, soldiers, police officers, surgeons, musicians, etc.). The aim of this study is to recommend profiles of the ability to perform precise actions during increasing physical exertion based on a simple laboratory protocol incorporating 5 psychomotor tasks, as a reference framework for future research on this phenomenon.

MATERIAL AND METHODS

The secondary analysis included the results of undergraduate theses in which the accuracy of 5 basketball shots from a distance of 2 m within 10 seconds was observed, each performed individually in the same arbitrary manner, under five conditions: Task 1 before warm-up; Task 2 after warm-up; tasks 3 through 5 immediately following 60 seconds of intense exercise (an active rest period of 3 minutes followed each exercise). The analysis includes the results of the five most effective and consistent students in this regard from each of these groups—those physically active outside of PE classes (A) and those inactive in this regard (P). Effectiveness was analysed in conjunction with the stability of that effectiveness among the subjects as a comprehensive indicator of the ability to perform precise actions during increasing exertion.

RESULTS

Among the students in Group A, the two most effective students (92% accurate throws each) differed in the stability of their extreme scores. The leader's performance profile (%) from Task 1 to Task 5: 100/100/100/80/80. In contrast, the performance profile of the unstable student: 100/80/100/80/100 (Table 1).

Table 1: Profiles of the most effective 'active' and 'passive' students during the experiment of throwing five balls into a basket from a distance of 2 meters before (Task 1) and during repeated physical efforts (Tasks 2 to 5).

Student Code	Throwing Effectiveness: Total and Across Five Tasks (%)					Minimum Stability of Effectiveness (%)			
	Total max = 500	1	2	3	4	5	80	60	40
students who are physically active in their free time (n = 5)									
A1aTE ₉₂	460	100	100	100	80	80	X		
A1bTE ₉₂	460	100	80	100	80	100	X		
A2TE ₈₈	440	80	100	100	80	80	X		
A3TE ₈₀	400	80	100	80	80	60		X	
A4TE ₇₆	380	80	60	80	100	60		X	
students who are not physically active outside of PE (n = 5)									
P1TE ₈₄	420	80	80	100	60	100		X	
P2TE ₇₆	380	80	80	80	60	80		X	
P3aTE ₇₂	360	80	60	100	60	60		X	
P3bTE ₇₂	360	60	40	100	100	60			X
P3cTE ₇₂	360	80	80	60	40	100			X

A – active, P - passive, TE₉₂ - total effectiveness 92%

Among the leaders of the active students, higher minimum performance stability was found at the levels of 80% (n = 3) and 60% (n = 2). The highest performance among the leaders of ‘passive’ students was 84% performance, while the levels of minimum performance stability in this group were lower: 60% (n = 3) and 40% (n = 2), with a wide dispersion of results.

DISCUSSION

The results of the secondary analysis indicate that, among adolescents aged 14–17, physical activity undertaken beyond the school minimum (PE classes) is associated not only with higher performance on a precision task (basketball shooting) but also with greater consistency in that performance across subsequent trials involving increasing physical exertion (Bał, 2025). The interpretation of these observations finds strong support in the literature, which emphasizes not only the need to assess “fitness” or “motor competence” *per se*, but also “performance capacity” a construct encompassing psychomotor dispositions, motivation, and situational conditions, including effort and stress. This concept, derived from praxeology and agonology, emphasizes that the measurement of the ability to perform precise actions should reflect real-world contexts (‘simulations’ of task elements, variations in arousal), rather than solely isolated motor characteristics (Kalina, 2008).

Precision of Movement Under Load – A Motor Control Perspective

From the perspective of contemporary motor (movement) control theory, the differences between active and passive students can be explained by a more economical organization of degrees of freedom, better timing, and more effective anticipation in individuals who train more frequently elements that have been repeatedly verified empirically in combat sports and team sports. Borysiuk, drawing on the tradition of N. Bernstein and modern motion analysis tools, emphasizes the key role of reducing degrees of freedom, time, and anticipation in the process of learning and stabilizing movement patterns which should help maintain accuracy despite fatigue (Borysiuk, 2023).

At the expert level, studies of kendo (8th dan) show that common technical features coexist with individualized adjustments during critical phases of movement, while overall execution time and angular variability in specific joints remain low illustrating the stability of precise performance despite individual differences. This type of “stability within variability” provides a useful interpretive framework for shooting tasks in basketball as well, where maintaining the quality of the final parameter (ball trajectory) is expected despite changes in physiological state (Murase, 2025).

In turn, the latest meta-analysis on basketball confirms that moderate and severe physical fatigue significantly reduces shooting accuracy (especially for 3-point shots), while moderate mental fatigue reduces free-throw effectiveness, which the authors attribute to a decline in executive function. These data reinforce the conclusions regarding differences between active and passive students the former demonstrate greater resistance to the decline in precision parameters during increasing exertion (Li et al., 2025).

Arousal, Pressure, and Performance Stability

The relationship between arousal and performance is described by Yerkes-Dodson's law (the inverted U-curve): both too low and too high levels of arousal (stress) can impair performance on complex and/or less automated tasks, which include precision throws in adolescents. A recent review in *Trends in Cognitive Sciences* confirmed that peak cognitive performance occurs at moderate levels of arousal, which aligns with the greater 'tolerance for changes in arousal' observed in this study among more active individuals (Nieuwenhuis, 2024). It is also known from sports practice that situational pressure can cause so-called 'choking' (excessive conscious control or diversion of resources), which impairs free-throw performance; at the same time, a sense of control and established habits can protect against a decline in effectiveness. The results of experimental studies on free throws support these mechanisms, providing a psychological context for the observations of performance stability among 'active' leaders conducted for the purposes of this study (Otten, 2009; Worthy et al., 2009).

The Importance of Lateralization and Coordination Skills

The available literature also emphasizes the role of lateralization and specific coordination abilities in the precision of movements. In fencing, left-handedness was associated with greater precision of hits (when using the dominant hand), which suggests that a profile of traits (dominance, experience, specific sensorimotor competencies) may modulate performance stability in precision tasks among adolescents. In turn, balance studies in young karate practitioners indicate beneficial changes in postural and functional parameters after many years of training, which may translate into better control of body segments in tasks requiring accuracy (Krzykała et al., 2024; Słomka, et al. 2019).

Methodological and Tactical Implications

1. Training design: The profiles obtained suggest that it is appropriate to combine precision tasks with controlled loads (e.g., intervals of increasing intensity interspersed with series of throws), which is consistent with the complementary research approach and INNOAGON practice. This approach reflects the real-world dynamics of games and operational situations (sports, law enforcement, public health) (Kalina, 2023).

2. Team selection and roles: The stable performance profiles of individual leaders identified in the study can be used for tactical planning of roles and decision-making moments (e.g., taking shots during specific phases of the game or at specific levels of fatigue). The high repeatability observed among "active" students is comparable to findings in disciplines where precision

and timing are critical (e.g., among 8th-dan kendo masters stable technical characteristics with limited variability) (Murase et al., 2025).

3. Addressing the psychological component: Programs should include arousal regulation training (e.g., breathing techniques) aimed at maintaining performance within the “optimal zone” in accordance with Yerkes–Dodson’s law. Results of a meta-analysis in basketball indicate that managing both physical and mental fatigue is crucial for maintaining accuracy (Li et al., 2025; Nieuwenhuis, 2024).

Limitations and Directions for Future Research

The most significant limitation is the lack of information on the sequence of hits and misses within a series this prevents the analysis of the distribution of outcomes and phenomena such as the hot hand or cold hand (Haoran He, 2024). Future protocols should record each throw individually (time, ball trajectory, kinematic parameters), as well as physiological indicators (HR, RPE, and possibly pupil diameter as an indicator of arousal), which aligns with the principles of complementary research methodology and “reviews of residuals and omitted implications.” Expanding the protocol to include sensorimotor measurements (e.g., balance tests/RT) will facilitate the mapping of the components of ‘performance capacity’ (Słomka et al., 2019; Kalina, 2023; Kalina, 2025; Haoran He, 2024). Finally, comparing results with other precision tasks (e.g., shooting tasks, archery) and under situational pressure (audience, time pressure, point ranking) will allow us to verify to what extent the profiles identified in this simple throwing test generalize to more complex decision-making environments (Otten, 2009).

CONCLUSION

- 1. Main findings.** Among adolescents aged 14–17, regular physical activity beyond physical education classes is associated with greater accuracy and stability in performing precision tasks, both before exercise and under conditions of increasing workload.
- 2. Practical significance.** A simple protocol that combines precision tasks with controlled exertion can serve as a screening and diagnostic tool, as well as a basis for developing training tasks in sports and safety-related fields (e.g., precision tasks under fatigue).
- 3. Methodological recommendations**
 - documenting each attempt (successful/unsuccessful) while simultaneously measuring exertion and physiological markers;
 - incorporating coordination indicators (static/functional balance, rotational tests) and elements of movement control into the test profile;
 - testing psychoregulatory interventions to maintain performance within the optimal arousal zone.
- 4. The INNOAGON and public health perspective.** In line with the principles of innovative agonology (INNOAGON) and complementary research,

the proposed paradigm of combining precision with effort could become a simple component of “tests for personal use”—a tool for self-assessment and the development of competencies that promote safety and health (prevention, education). This aligns with broader calls for the profiling of functional competencies in schools and local communities (Kalina, 2024; Kalina, 2025).

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