

## THE FLOW STATE IN ELITE ROMANIAN FENCERS

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**Abstract.** Flow is the optimal psychological state in which an athlete achieves their best performance without effort but with total concentration and a sense of total control, without any such thoughts. Flow is often associated with high levels of performance, self-consciousness is diminished and attention is entirely focused on the activity at hand. The purpose of the study was to investigate the flow state and the levels at which Csikszentmihalyi's nine dimensions of flow are experienced by elite fencers. The research participants were 41 Romanian fencers who were distributed as follows: 13 fencers were medallists (over time) at the European, World or Olympic Games, and 28 did not have outstanding sports results. The Long Dispositional Flow Scale (DFS-2) measuring the nine dimensions of flow was applied. Data analysis (using the Independent Samples *t* Test) revealed that elite fencers experienced more during competition that the goals and feedback were clear, reached a higher level of awareness of their performance, experienced more the challenge-skill balance, were more focused on the immediate task, perceived more the automatic nature of flow state and the sense of control (however, no significant differences were observed compared to fencers without outstanding sports results). As regards the transformation of time, men fencers experienced more (with a marginally significant difference) time dilation or compression during competition compared to female fencers. Gender- and performance-related findings about athletes' experienced flow are also discussed.

**Keywords:** fencing, flow state, clutch state, sports performance.

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### Introduction

Fencing is one of the oldest combat sports included by the Greeks in the first Olympic Games of 776 BC as hoplomachia (one-to-one fight with weapons), which was later compared to a game of chess played at the speed of light (Evangelista, 1996). Physical exercise is beneficial for the mind, body and soul (Neely & Holt, 2014), but particularly fencing, which has been shown to be superior in various aspects (Vertopoulos et al., 2010), for example, it can be used to channel aggressive impulses (Allison et al., 1995) that might otherwise be discouraged by society at large. By playing this sport, athletes gain self-control

over their reactive nature and develop patience (Johnson & Rosen, 2000). At the same time, they develop special perceptual skills, as fencing requires cognitive processes that involve spatial localisation, perceptual anticipation and a good ability to make appropriate and quick decisions (Feng et al., 2010).

In fencing, there are three weapons: sabre, foil and épée. Considering the division of combat sports into forms of direct confrontation, fencing falls into the category of fight with weapons (Kalina, 2000) and can also be seen as part of striking combat sports disciplines (Predoiu et al., 2022a).

Fencing is popular in Romania due to coaches and athletes included in the Fencing Hall of Fame for their high sports achievements; for instance, the Men's Olympic Sabre Team won 5 medals at the Olympic, World and European sporting events between 2008 and 2013 (see, for example, Predoiu et al., 2020), or the silver medal won at the Tokyo 2021 Olympic Games in épée.

In an elite sports activity such as fencing, psychological training plays a very important role in achieving outstanding performance and is essential before, during (including existing breaks) and after a competition. Researchers also recommend the modified special endurance test (Hekiart et al., 2021) during the training process of top fencers, considering the psychophysical benefits of using this tool.

In the pursuit of secrets that turn an athlete into a great champion, the scientific world of sport has presented various theories about the characteristics of champions, highlighting their personality traits, mental and physical states, as well as their feelings experienced in the moment when they achieve extraordinary performance (Pelín et al., 2020).

Mental preparation is an essential component of the training process, and one of its most important objectives is the athletes' awareness (based on relevant information) of the biopsychological processes and phenomena that determine performance. During a competition, athletes can experience unique states of consciousness as a result of long training and intense concentration. The athlete can experience a changed perception of time, a sense of effortless and high-quality performance. In these moments, self-consciousness is diminished and the individual is "totally" immersed in the bout. It is therefore necessary to discuss what Csikszentmihalyi called, in 1975, the flow state (see, for example, Predoiu, 2018). Flow is an optimal psychological state related to exceptional sports performance and positive experience in competitions (Csikszentmihalyi, 2015). The researcher addressed various dimensions of the flow state such as: clarity of goals, balance between skills and challenges, extraordinary focus and awareness, autotelic experience, control paradox, immediate and clear feedback, transformation of time (subjective time, which generally dilates, and the athlete feels that they have enough time to position themselves correctly, hit the ball, jump, throw, etc.).

The self-regulating nature of flow state involves the prior existence of consistent psychophysical training. At least 25 years ago, Jackson (1996) pointed out that athletes, during their best competitive performance, experienced their movements as occurring automatically without having to think too much beforehand and also experienced a sense of thoughtless control with little perceived effort. Following the empirical studies belonging to the research topic entitled *High Performance Cognition: Information-Processing in Complex Skills, Expert Performance, and Flow*, Cowley et al. (2020) claimed that "flow and performance were maximal at moderate arousal levels"; "positive feedback on one task

imparts a positive effect upon performance and flow in subsequent tasks”; there is “a positive relationship between the self-reported value of experienced flow and the efficiency of spatiotemporal information processing”; “optimal performance was also associated with predominantly sympathetic autonomic activity” (p. 3).

In addition to the flow state discussed so far, it is also necessary to address the *clutch state*, after the emergence of new insights generated through ‘event-focused’ interviews (qualitative methods, athletes being interviewed within hours/days), suggesting that Csikszentmihalyi’s nine-dimension framework conflates the flow state with a second one, the *clutch state* (Swann et al., 2018). As Otten (2009) asserted, clutch states refer to athletes’ superior performance under pressure, but the athlete must be aware of this pressure (Hibbs, 2010).

Swann et al. (2019) present the characteristics of flow and clutch states as optimal exercise experiences:

- *Flow state*: effortless attention, enjoyment, absence of negative thoughts, motivation for more, sense of control, ease/low effort; as an outcome: an energising effect and intrinsic rewards.
- *Clutch state*: effortless concentration, intense effort, increased arousal and awareness, motivation for achievement, exercising control, analytical thoughts; as an outcome: exhaustion and intrinsic rewards.

There are also common elements between the flow and clutch states: automatic skill execution, absorption, confidence and altered perceptions. Although important phases may occur at any stage during competition, the context for the clutch state is linked to perceived pressure, end of activities and achievement, while the context for the flow state is related to novelty/variation, exploration and flexible outcomes. “Clutch states were reported to occur in important stages of a performance when an outcome was imminent. These important moments involved being in contention to win, to qualify, to achieve personal bests, or to achieve goals.” (Swann et al., 2017, pp. 389-390)

As Predoiu et al. (2019) emphasised, peak sports experiences (best moments) are not relaxing or passive. The muscles of a basketball player or martial artist may ache during their best match/fight. Also due to fatigue, an athlete may feel that they cannot stand on their feet, but these moments are perceived as being the most beautiful in their lives.

Considering Csikszentmihalyi’s framework, three dimensions are seen as essential conditions through which flow occurs: 1) challenge-skill balance; 2) unambiguous feedback; 3) clear goals (Nakamura & Csikszentmihalyi, 2002), while the other six conditions represent characteristics of the flow experience: 4) sense of control; 5) concentration on the task at hand; 6) loss of self-consciousness; 7) transformation of time; 8) merging of action and awareness; 9) autotelic experience (Csikszentmihalyi, 2002). In their systematic review on flow in elite athletes, Swann et al. (2012) highlight that some key factors can inhibit or induce flow occurrence, some flow dimensions are experienced more consistently (the authors talk about psychophysiological experiences, physiology being relevant to flow), and “flow experiences could be controllable to some extent, and are not merely coincidental” (p. 807). It is also worth mentioning the study by Sugiyama and Inomata (2005), who present the following psychological states that facilitate flow: self-confidence, relaxation, complete focus, high motivation, lack of negative thoughts and feelings, and positive thinking.

### *Purpose*

The current research aims to investigate the flow state and the levels at which Csikszentmihalyi's nine dimensions of flow are experienced by elite fencers.

### *Objectives*

- To identify the levels at which the nine components of flow state are experienced in competition by elite fencers (male and female);
- To know the differences between fencers with outstanding sports results and fencers who are not medallists at the European, World or Olympic Championships, in terms of flow experienced during competitions;
- To know gender differences in the flow state experience.

### *Research hypotheses*

*H1:* There are significant differences between European, World or Olympic medal-winning fencers and fencers without outstanding sports results in terms of experiencing the flow state.

*H2:* Investigation of specific flow state dimensions reveals significant differences between male and female fencers.

## **Methodology**

### *Participants*

The research participants were 41 Romanian fencers who were distributed as follows:

- 1) 13 fencers with outstanding sports performance aged 34-60 ( $M_{\text{age}} = 47.1$ ), 9 female and 4 male; by weapon: 4 in épée, 4 in sabre and 5 in foil.

It should be noted that 7 of the top athletes were gold, silver or bronze medallists at various editions of the Olympic Games in either individual or team events.

- 2) 28 elite fencers who did not win medals at the European, World or Olympic Games (up to the time of testing) and were aged 16-28 ( $M = 22.4$ ); by weapon: 4 in sabre, 19 in épée and 5 in foil; there were 21 female and 7 male athletes with at least 5 years of competitive experience.

### *Measures*

The Long Dispositional Flow Scale (DFS-2) (Jackson et al., 2010) was applied (in collaboration with psychologist Alina Gherghișan), which measures the nine dimensions of flow: Challenge-Skill Balance, Merging of Action and Awareness, Clear Goals, Unambiguous Feedback, Concentration on the Task at Hand, Sense of Control, Loss of Self-Consciousness, Transformation of Time, and Autotelic Experience. The DFS-2 contains 36

items that are designed to achieve the nine dimensions of flow state (there are four items for each dimension). Examples of items: “I was challenged, but I believed my skills would allow me to meet the challenge” (Challenge-Skill Balance); “I made the correct movements without thinking about trying to do so” (Merging of Action and Awareness); “I knew clearly what I wanted to do” (Clear Goals); “It was aware of how well I was doing” (Unambiguous Feedback), “My attention was entirely focused on what I was doing” (Concentration on the Task at Hand); “I had a sense of control over what I was doing” (Sense of Control); “The way time passed seemed to be different from normal” (Transformation of Time); “I really enjoyed the experience” (Autotelic Experience). Response options: Never, Rarely, Sometimes, Frequently, Always.

Responses indicate the frequency with which flow state dimensions were experienced in the target activity. As indicated in the test manual, responses were given at a time that was not directly associated with participation in competitions. Instruction provided: “These questions relate to the thoughts and feelings you may experience during participation in competitions. You may experience these characteristics some of the time, all of the time, or none of the time”.

### *Procedure*

The research was conducted between December 2021 and April 2022. The questionnaire used in this study was applied online via Google Forms. Athletes (and athletes’ parents, in the case of participants under 18) were informed about the study purpose and gave their informed consent to participate. All necessary measures were taken to protect data confidentiality.

### *Research design*

The dependent variables are represented by the results obtained by fencers in the nine dimensions of flow state. The variable playing the role of the independent variable refers to the athletes’ membership in one of the two groups (male and female fencers with top sports results and without outstanding performance).

## **Results**

As a first step, the results obtained by top athletes and athletes without outstanding sports performance were investigated in terms of flow state dimensions (Table 1 and Figure 1).

Table 1. Descriptive Statistics - Flow dimensions for fencers without outstanding results and top fencers

Flow	Min		Max		Range		Mean		SD		Standard Error		Coefficient of variation	
	A	T	A	T	A	T	A	T	A	T	A	T	A	T
D1	2.8	2.8	5	5	2.2	2.2	4.14	4.30	0.61	0.68	0.11	0.19	0.14	0.15
D2	1.5	1.8	5	5	3.5	3.2	3.27	3.60	0.82	1.04	0.15	0.29	0.25	0.29
D3	2.3	3.8	5	5	2.7	1.2	4.3	4.53	0.76	0.39	0.14	0.11	0.17	0.08
D4	2	2.5	5	5	3	2.5	3.84	4.22	0.74	0.67	0.14	0.18	0.19	0.15
D5	2.5	3	5	5	2.5	2	3.89	4.13	0.64	0.57	0.12	0.15	0.16	0.13
D6	1.8	3	4.8	5	3.7	2	3.72	3.95	0.70	0.56	0.13	0.15	0.19	0.14
D7	1	2.3	5	4.8	4	2.5	3.34	3.36	0.87	0.50	0.16	0.19	0.26	0.21
D8	1.8	2.5	5	5	3.2	2.5	3.62	3.57	0.90	0.90	0.17	0.24	0.24	0.25
D9	2.8	3.5	5	5	2.2	1.5	4.58	4.66	0.52	0.49	0.09	0.13	0.11	0.10
Total	2.0	2.8	4.9	4.9	3	2.1	3.85	4.03	0.72	0.64	0.13	0.18	0.19	0.16

Note. A: fencers without outstanding results; T: top fencers; Total: Flow - total score; D1: Challenge-Skill Balance; D2: Merging of Action and Awareness; D3: Clear Goals; D4: Unambiguous Feedback; D5: Concentration on the Task at Hand; D6: Sense of Control; D7: Loss of Self-Consciousness; D8: Transformation of Time; D9: Autotelic Experience.

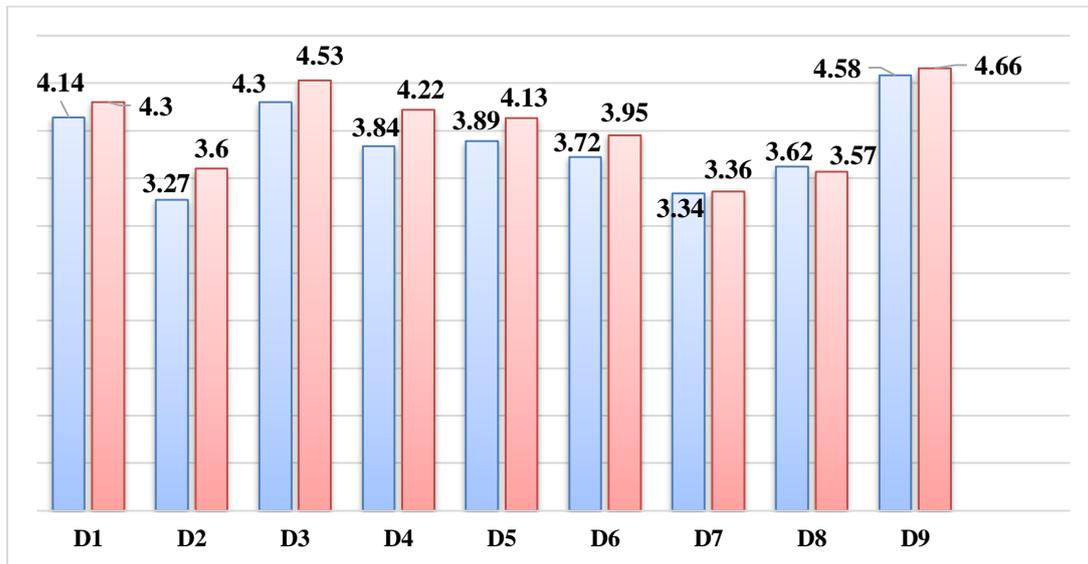


Figure 1. Athletes’ results for the nine dimensions of flow - Csikszentmihalyi’s framework (blue - fencers without outstanding performance and red - top fencers)

Top athletes experienced more during competition in terms of challenge-skill balance (D1) and automatic nature of flow state (D2), had clearer feedback and goals (D3 and D4), better concentration on the task at hand (D5) and a better sense of control over their own bodies and the movements performed (D6).

To test whether there were significant differences in flow state between the two groups of athletes, the Independent Samples *t* Test was used.

Table 2. *Inferential Statistics - Fencers without outstanding results vs. top fencers*

Flow	Skewness <  1.96		F test		t test – equal variances			t test – unequal variances		
	A	T	F	critical F	p	t	df	p	t	df
D1	-0.46	-1.08	0.80	> 0.46				0.478	-0.72	21
D2	0.13	-0.52	0.61	> 0.46				0.281	-1.09	39
D3	-1.27	-0.52	3.70	> 2.48				0.213	-1.26	38
D4	-0.89	-1.16	1.22	< 2.48	0.125	-1.56	39			
D5	-0.44	-0.43	1.23	< 2.48	0.253	-1.15	39			
D6	-1.15	0.16	1.58	< 2.48	0.320	-1.00	39			
D7	-0.58	0.40	1.48	< 2.48	0.956	-0.05	39			
D8	-0.56	0.34	1.00	< 2.48	0.874	0.15	39			
D9	-1.81	-1.70	1.15	< 2.48	0.649	-0.45	39			
Total	-0.51	-0.25	1.47	< 2.48	0.293	-1.06	39			

Note. A: fencers without outstanding results; T: top fencers; Total: Flow - total score; D1: Challenge-Skill Balance; D2: Merging of Action and Awareness; D3: Clear Goals; D4: Unambiguous Feedback; D5: Concentration on the Task at Hand; D6: Sense of Control; D7: Loss of Self-Consciousness; D8: Transformation of Time; D9: Autotelic Experience.

Analysing the results (Table 2), no significant differences were found between the two groups of fencers in terms of experiencing the nine dimensions of flow during competition ( $p > 0.05$ ). The null hypothesis is accepted. However, important differences between top athletes and fencers without outstanding performance can be observed, with top fencers experiencing more during competition when the goals and feedback are clear (alpha threshold is closest to 0.05); they are also more aware of how well they perform in competition and what they want to achieve at time  $t_0$ , showing better concentration on the task at hand.

Next, significant differences between male and female fencers were checked, based on flow state dimensions (Table 3 and Figure 2).

Table 3. *Descriptive Statistics - Flow dimensions: athletes' results by gender*

Flow	Min		Max		Range		Mean		SD		Standard Error		Coefficient of variation	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
D1	2.8	3	5	5	2.2	2	4.15	4.30	0.63	0.65	0.11	0.19	0.15	0.15
D2	1.5	1.8	5	5	3.5	3.2	3.27	3.68	0.90	0.84	0.16	0.25	0.27	0.22
D3	2.3	2.8	5	5	2.7	2.2	4.35	4.42	0.69	0.65	0.12	0.19	0.15	0.14
D4	2	3	5	5	3	2	3.88	4.18	0.79	0.53	0.14	0.16	0.20	0.12
D5	2.5	3	5	5	2.5	2	3.94	4.06	0.64	0.57	0.11	0.17	0.16	0.14
D6	1.8	3	4.5	5	2.7	2	3.69	4.1	0.67	0.57	0.12	0.17	0.18	0.14
D7	1	1.8	4.3	5	3.3	3.2	3.23	3.68	0.72	0.98	0.13	0.29	0.22	0.26
D8	1.8	2.5	5	5	3.2	2.5	3.44	4.05	0.89	0.73	0.16	0.22	0.25	0.18
D9	2.8	3.5	5	5	2.2	1.5	4.59	4.65	0.53	0.45	0.09	0.13	0.11	0.09
Total	2.0	2.7	4.8	5	2.8	2.2	3.83	4.12	0.71	0.66	0.12	0.19	0.18	0.16

Note. F: female athletes; M: male fencers; Total: Flow - total score; D1: Challenge-Skill Balance; D2: Merging of Action and Awareness; D3: Clear Goals; D4: Unambiguous Feedback; D5: Concentration on the Task at Hand; D6: Sense of Control; D7: Loss of Self-Consciousness; D8: Transformation of Time; D9: Autotelic Experience.

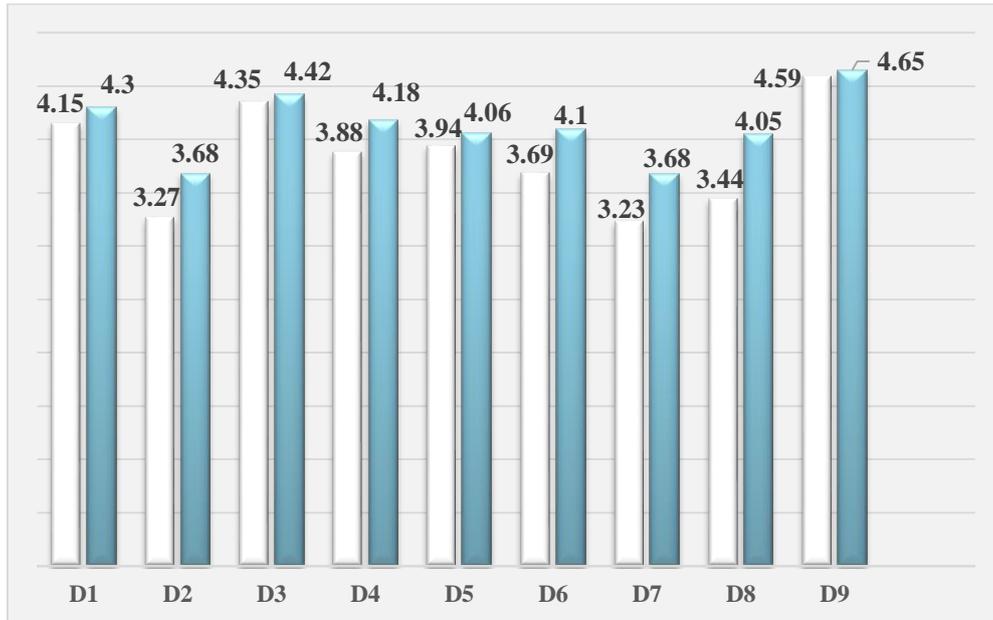


Figure 2. Comparison between female (white) and male fencers (blue)

Male athletes experienced more in competitions compared to female athletes: challenge-skill balance (D1); automatic nature of flow state (D2); unambiguous feedback (D4); sense of control (D6); loss of self-consciousness (D7); transformation of time (D8).

Table 4. Inferential Statistics - Flow dimensions: athletes' results by gender

Flow	Skewness <  1.96		F test		t test – equal variances			t test – unequal variances		
	F	M	F value	critical F	p	t	df	p	t	df
D1	-0.50	-1.09	0.95	> 0.45				0.514	-0.66	17
D2	0.20	-0.79	1.15	< 2.70	0.201	-1.29	39			
D3	-1.49	-1.64	1.11	< 2.70	0.760	-0.30	39			
D4	-0.78	-0.73	2.20	< 2.70	0.255	-1.15	39			
D5	-0.52	-0.06	1.29	< 2.70	0.581	-0.55	39			
D6	-1.17	-0.24	1.36	< 2.70	0.081	-1.79	39			
D7	-0.88	0.45	0.54	> 0.45				0.185	-1.39	14
D8	-0.05	-1.05	1.47	< 2.70	<b>0.051</b>	-2.01	39			
D9	-1.73	-1.86	1.40	< 2.70	0.724	-0.35	39			
Total	-0.64	-0.49	0.99	> 0.45				0.114	-1.65	18

Note. F: female athletes; M: male fencers; Total: Flow - total score; D1: Challenge-Skill Balance; D2: Merging of Action and Awareness; D3: Clear Goals; D4: Unambiguous Feedback; D5: Concentration on the Task at Hand; D6: Sense of Control; D7: Loss of Self-Consciousness; D8: Transformation of Time; D9: Autotelic Experience.

According to Table 4, no significant gender differences ( $p > 0.05$ ) were highlighted. The null hypothesis is accepted. However, for the *transformation of time* dimension, a marginally significant difference ( $p = 0.051$ ) was observed.

Also, the following important differences between the two groups of fencers (alpha threshold is closest to 0.05) could be noted: male athletes experienced more a sense of control (over their own bodies and the movements performed), while also scoring higher overall in terms of flow (total score) - the average of the nine investigated dimensions.

## Discussion and Conclusion

Flow is an optimal psychological state/experience when the best sports performance occurs (Nakamura & Csikszentmihalyi, 2014). Given these benefits, researchers have attempted to promote flow experiences through various interventions. In their systematic review (29 studies were examined), Goddard et al. (2021) emphasised that the most common strategies “reported in flow interventions to date included: mindfulness (30.03%), hypnosis (17.24%), and imagery (13.79%)” (p. 3). However, no studies have so far reported “conclusive evidence that flow was induced through an intervention” (Goddard et al., 2021, p. 2). Over time, researchers have used “tailored imagery script to target critical flow dimensions”, more exactly clear goals, sense of control, challenge-skill balance and concentration on the task (Koehn et al., 2014) in order to increase flow state in athletes. With respect to hypnotic interventions, it involved imagery, relaxation, an altered state of consciousness and “the conditioning of an unconscious trigger associated with the emotions of past peak performance” (Pates & Cowen, 2013).

Analysis of the data obtained from this study revealed that, in terms of experiencing the flow state during competition (Csikszentmihalyi’s framework with nine dimensions of flow was investigated), there were no significant differences between fencers who won medals at European, World or Olympic championships and fencers without outstanding sports results. Such data may encourage young athletes, in terms of levels at which the nine components of flow state are experienced during competitions, as there are no significant differences from athletes with outstanding sports performance. However, top fencers experienced more in competition that goals and feedback were clear, were aware at a higher level of how well they were performing and what they wanted to achieve at time  $t_0$  (in competition), experienced more the challenge-skill balance, concentration on the immediate task, on the present (*hic et nunc*), feeling that things happened by themselves (the automatic nature of flow state), and the sense of control (over their own bodies and the movements performed).

The results have also emphasised that there are no significant gender differences between fencers. However, a marginally significant difference was observed for the *transformation of time* dimension. Men experienced more, during competition, time dilation or compression (compared to female fencers) and felt more that things were moving in slow motion or stopping in place when they recorded their best athletic performance. The following differences between the two groups of fencers can also be pointed out: male athletes experienced more the feeling of control (over their own bodies and the actions performed), the challenge-skill balance (tasks were not perceived as too hard or too easy), the automatic nature of flow state (the appropriate/right movements came naturally, by themselves), clear feedback (male fencers were slightly more aware of how well they were performing in competitions), loss of self-consciousness (they were less concerned about performance and others’ perception), and obtained a higher total score in terms of perceived flow (the average of the nine dimensions of flow) compared to female fencers.

Systematic psychological training (developing cognitive, affective, volitional skills and personality traits) is the solution for athletes to be successful in competition, to enter the trance state altered by consciousness, the state in which things just happen or flow (Predoiu et al., 2019).

The findings provide valuable information to both coaches and sport psychologists in terms of flow state experienced by elite fencers. However, the research has some limitations. According to Makarowski et al. (2022), self-report measures may involve recall/memory bias. The aspect of possible desirable responses when talking about explicit measures (a survey applied) is also highlighted by the literature (e.g., Predoiu et al., 2022b). The results could be different if only junior fencers (or only seniors) were investigated, fencers from other countries, only female top athletes (or only male top fencers). In-depth interviews can be carried out in the future in order to complete, from an informational point of view, the states experienced by athletes when they achieved their best sports results.

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**Data Availability Statement:** Data are available upon request to the contact author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Allison, D. B., Faith, M. S., & Franklin, R. D. (1995). Antecedent exercise in the treatment of disruptive behavior: A meta-analytic review. *Clinical Psychology Science and Practice*, 2(3), 279-304. <https://doi.org/10.1111/j.1468-2850.1995.tb00045.x>
- Cowley, B. U., Dehais, F., Fairclough, S., Karran, A. J., Palomäki, J., & Lappi, O. (2020). High Performance Cognition: Information-processing in complex skills, expert performance, and flow. *Frontiers in Psychology*, 11: 579950, 1-3. <https://doi.org/10.3389/fpsyg.2020.579950>
- Csikszentmihalyi, M. (2002). *Flow: The psychology of optimal experience* (2nd ed.). Harper & Row.
- Csikszentmihalyi, M. (2015). *Flux. Psihologia fericirii* [Flow. The psychology of happiness]. Publica.
- Evangelista, N. (1996). *The art and science of fencing*. The McGraw-Hill Companies.
- Feng, Y., Zhou, C., & Zhang, T. M. (2010). Neural mechanisms of intuitive tactical decision-making predominance of high-level fencing athletes. *Journal of Medical and Biological Engineering*, 30(1), 47-56.

- Goddard, S. G., Stevens, C. J., Jackman, P. C., & Swann, C. (2021). A systematic review of flow interventions in sport and exercise. *International Review of Sport and Exercise Psychology*, 1-86. <https://doi.org/10.1080/1750984X.2021.1923055>
- Hekiert, B., Prokopczyk, A., Klimczak, J., & Sokołowski, M. (2021). Relationship of the results of the modified special endurance test in fencing with the indicators of training experience, aerobic capacity and motor skills of top female fencing athletes. *Archives of Budo*, 17, 341-347. WOS: 000752358700001
- Hibbs, D. (2010). A conceptual analysis of clutch performances in competitive sports. *Journal of the Philosophy of Sport*, 37, 47-59. DOI: 10.1080/00948705.2010.9714765
- Jackson, S. A. (1996). Toward a conceptual understanding to the flow experience in elite athletes. *Research Quarterly for Exercise and Sport*, 67, 76-90. DOI: 10.1080/02701367.1996.10607928
- Jackson, S., Eklund, B., & Martin, A. (2010). *The FLOW Manual. The Manual for the Flow Scales*. Mind Garden, Inc.
- Johnson, R. C., & Rosen L. A. (2000). Sports behavior of ADHD children. *Journal of Attention Disorders*, 4(3), 150-160. <https://doi.org/10.1177/108705470000400302>
- Kalina, R. M. (2000). *Teoria sportów walki* [Theory of combat sports]. Centralny Ośrodek Sportu.
- Koehn, S., Morris, T., & Watt, A. P. (2014). Imagery intervention to increase flow state and performance in competition. *The Sport Psychologist*, 28(1), 48-59. <https://doi.org/10.1123/tsp.2012-0106>
- Makarowski, R., Predoiu, R., Piotrowski, A., Görner, K., Predoiu, A., Oliveira, R., Pelin, R., A., Moanță, A. D., Boe, O., Rawat, S., & Ahuja, G. (2022). Coping strategies and perceiving stress among athletes during different waves of the COVID-19 pandemic - Data from Poland, Romania, and Slovakia. *Healthcare*, 10: 1770. <https://doi.org/10.3390/healthcare10091770>
- Nakamura, J., & Csikszentmihalyi, M. (2002). The concept of flow. In C. Snyder & S. Lopez (Eds.), *Handbook of positive psychology* (pp. 89-105). University Press.
- Nakamura, J., & Csikszentmihalyi, M. (2014). The concept of flow. In M. Csikszentmihalyi (Ed.), *Flow and the foundations of positive psychology* (pp. 239-263). Springer.
- Neely, K. C., & Holt, N. L. (2014). Parents' perspective on the benefits of sport participation for young children. *The Sport Psychologist*, 28(3), 255-268. <https://doi.org/10.1123/tsp.2013-0094>
- Otten, M. (2009). Choking vs. clutch performance: A study of sport performance under pressure. *Journal of Sport and Exercise Psychology*, 31(5), 583-601. DOI: 10.1123/jsep.31.5.583
- Pates, J., & Cowen, C. (2013). The effect of a hypnosis intervention on performance and flow state of an elite golfer: A single subject design. *International Journal of Golf Science*, 2(1), 43-53. DOI: 10.1123/ijgs.2.1.43
- Pelin, F., Predoiu, R., Mitrache, G., & Predoiu, A. (2020). Mental features of top level athletes. *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, 59(1), 5-14. <https://doi.org/10.35189/dpeskj.2020.59.1.1>
- Predoiu, R. (2018). *In mintea campionilor* [Inside the minds of champions]. Discobolul.
- Predoiu, R., Makarowski, R., Görner, K., Bota, A., Predoiu, A., Mitrache, G., & Grigore, V. (2020). Key personality traits of martial arts and world's top coaches – impact on future martial arts specialists. *Archives of Budo*, 16, 129-142. WOS: 000579413000001

- Predoiu, R., Makarowski, R., Piotrowski, A., Görner, K., Predoiu, A., Malinauskas, R., Bertollo, M., di Fronso, S., Vazne, Z., Boe, O., Oliveira, R., Miklósi, M., Kovács, K., Ciolcă, C., Badea, D., Vicente-Salar, N., Ciuntea, M. L., & Rawat, S. (2022a). Experienced stress among martial arts athletes from selected European Union countries during the 4th wave of the COVID-19 pandemic and the frequency of using coping strategies. *Archives of Budo, 18*, 211-226.
- Predoiu, R., Makarowski, R., Görner, K., Predoiu, A., Boe, O., Ciolacu, M. V., Grigoriu, C., & Piotrowski, A. (2022b). Aggression in martial arts coaches and sports performance with the COVID-19 pandemic in the background – a dual processing analysis. *Archives of Budo, 18*, 23-36. WOS:000834644000001
- Predoiu, R., Predoiu A., Gherghișan, A., Alexe, C. I., & Grigore, E. (2019). Psychic training and the flow state. *Discobolul – Physical Education, Sport and Kinetotherapy Journal, 55*(1), 29-33.
- Sugiyama, T., & Inomata, K. (2005). Qualitative examination of flow experience among top Japanese athletes. *Perceptual and Motor Skills, 100*(3), 969-982.  
DOI: 10.2466/pms.100.3c.969-982
- Swann, C., Crust, L., Jackman, J., Vella, S. A., Allen, M. S., & Keegan, R. (2017). Psychological states underlying excellent performance in sport: Toward an integrated model of flow and clutch states. *Journal of Applied Sport Psychology, 29*(4), 375-401.  
DOI: 10.1080/10413200.2016.1272650
- Swann, C., Jackman, P. C., Schweickle, M. J., Vella, S. A. (2019). Optimal experiences in exercise: A qualitative investigation of flow and clutch states. *Psychology of Sport and Exercise, 40*, 87-98. <https://doi.org/10.1016/j.psychsport.2018.09.007>
- Swann, C., Keegan, R. J., Piggott, D., & Crust, L. (2012). A systematic review of the experience, occurrence, and controllability of flow states in elite sport. *Psychology of Sport and Exercise, 13*(6), 807-819. <https://doi.org/10.1016/j.psychsport.2012.05.006>
- Swann, C., Piggott, D., Schweickle, M., & Vella., S. (2018). A review of scientific progress in flow research in sport and exercise: Normal science, crisis, and a progressive shift. *Journal of Applied Sport Psychology, 30*(3), 249-271.  
<http://doi.org/10.1080/10413200.2018.1443525>
- Vertopoulos, E., Tsolakis, C., & Remoundou, M. (2010). A preliminary study of visual memory and rule detection in fencing: A comparative study. *Biology of Exercise, 6*(1), 37-46.