THE IMPACT OF ORIENTEERING ON THE DEVELOPMENT OF COGNITIVE SKILLS AND MENTAL HEALTH: AN ANALYSIS OF STUDENT PERCEPTIONS

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Abstract:Orienteering is a sport that combines physical exertion with complex cognitive tasks, requiring participants to navigate unfamiliar terrain using maps and compasses. This study explores university students' perceptions regarding orienteering's impact on cognitive skill development and mental health, with a particular focus on recent findings linking vigorous physical exercise to increased levels of brain-derived neurotrophic factor (BDNF).

A sample of 217 students from the University of Craiova participated in an online survey assessing their perceptions of orienteering compared to other sports. The survey evaluated its contribution to key cognitive domains concentration, spatial navigation, planning, and problem-solving and its overall influence on mental well-being. Statistical analyses, including chi-square tests, were conducted to examine associations between demographic variables and perceived cognitive benefits.

Results indicated that 86.2% of participants viewed orienteering as significantly enhancing concentration and attention, while 64.5% perceived improvements in spatial thinking and navigation. Additionally, 40.7% reported benefits in memory and problem-solving. The study also integrated findings from recent literature, highlighting that vigorous-intensity orienteering may enhance cognitive functions and increase BDNF levels more effectively than exercises lacking cognitive engagement.

These findings emphasize the potential of orienteering as both an educational tool and a therapeutic activity. Incorporating orienteering into academic and recreational programs may support cognitive development and mental health, potentially mediated by physiological mechanisms such as increased BDNF production.

Keywords: *orienteering, cognitive development, mental health, brain-derived neurotrophic factor (BDNF), student perceptions*

Introduction

Orienteering is a multifaceted sport that uniquely integrates physical exertion with cognitive challenges, requiring participants to navigate unfamiliar terrains using maps and compasses. This dual demand fosters the development of critical cognitive skills such as spatial thinking, rapid decision-making, and strategic planning (Eccles et al., 2006). Moreover, the sport's interaction with natural environments contributes to enhanced mental well-being, aligning with research demonstrating the psychological benefits of outdoor activities (Korpela et al., 2014).

Recent advancements in neuroscience and exercise physiology have illuminated the role of vigorous physical activity in enhancing cognitive performance. In particular, the exercise-induced production of brain-derived neurotrophic factor (BDNF) - a key protein involved in neural plasticity - has been linked to improved memory, problem-solving, and overall cognitive flexibility (Marosi & Mattson, 2014). BDNF is primarily stimulated by lactate production during high-intensity exercise, a mechanism that orienteering effectively activates due to its dynamic and complex nature (El Hayek et al., 2019). Notably, Waddington et al. (2023) demonstrated that orienteering outperforms traditional physical activities in increasing BDNF levels and enhancing spatial memory due to the added cognitive engagement required by the sport.

Sports like orienteering also have the potential to develop broader life skills, as highlighted by Gould et al. (2011), who emphasize the pedagogical benefits of structured sports activities in fostering critical thinking and self-regulation. Furthermore, the World Health Organization (2013) underscores the importance of interventions that promote both physical and mental well-being, placing orienteering within a broader context of global health strategies.

Orienteering is an excellent addition to physical education classes because it combines physical activity with strategic thinking. Thus, from a physical point of view, it improves the capacity for effort, strength and endurance. From a mental point of view, it stimulates the skills of problem solving, map reading and decision-making. In this regard, Sirakov (2024) conducted a study in which his students improved their mental and physical qualities after orienteering practice.

Building confidence in their physical and technical abilities can encourage students to seek out more opportunities for growth and challenge. This positive reinforcement can motivate them to participate in future training sessions and competitions, encouraging them to practice outdoor sports. It is a powerful way to disconnect from technology, the daily stress that can be very beneficial.

The problem and justification

Despite the recognized benefits of physical activity on cognitive functions, there is limited research focusing specifically on orienteering and its unique contributions. Understanding university students' perceptions can provide valuable insights into how orienteering may serve as an effective intervention for cognitive skill development and mental health improvement. This study aims to fill this gap by analysing student perceptions and aligning them with recent scientific findings.

Objectives

This study explores the cognitive and psychological benefits of orienteering among university students, focusing on its effects on cognitive skill development and mental health. Specific objectives include:

- Evaluating perceptions of orienteering's influence on cognitive functions, including concentration, spatial navigation, planning, and problem-solving.
- Assessing the extent to which orienteering contributes to mental well-being.
- Investigating orienteering's unique cognitive benefits compared to other physical activities, based on participants' perceptions.
- Identifying demographic patterns influencing these perceptions through statistical analysis of associations between participant characteristics and reported benefits.

Materials and methods

Participant selection

The study included 217 students (168 males, 77.4%; and 49 females, 22.6%) aged between 18 and 35 years (M = 24.3, SD = 4.2) from various faculties of the University of Craiova. All participants had engaged in orienteering courses as part of their physical education curriculum.

Inclusion Criteria:

- Enrolled as a student at the University of Craiova.
- Participation in orienteering courses.
- Aged between 18 and 35 years.
- Willingness to participate in the study and provide informed consent.

Exclusion criteria:

- Previous diagnosis of cognitive impairments or mental health disorders.
- Incomplete or invalid questionnaire responses.

Technical information

A structured online questionnaire was developed using a secure platform. The questionnaire included:

1. Demographic information: Age, gender, and prior orienteering experience.
2. Cognitive impact assessment: Questions evaluating perceptions of orienteering's influence on concentration, spatial navigation, planning, and problem-solving.
3. Mental health assessment: Items exploring the perceived effects on emotional well-being.
4. Comparative analysis: Questions comparing the cognitive demands of orienteering to other physical activities.

Statistical methods

Data were analysed using SPSS version 29.0. The statistical methods included:

- Descriptive statistics: Frequencies, percentages, means, and standard deviations to summarize data.
- Chi-Square tests: To assess associations between demographic variables (age, gender) and perceptions of cognitive benefits.
- Effect size metrics: Phi and Cramér's V to measure the strength of associations.
- Significance level: A p-value of less than 0.05 was considered statistically significant.

Results

Participant demographics are presented below.

The distribution of participants by age and gender is presented in table 1.

Table 1. *Participant distribution by age and gender*

Age Category (Years)	Male	Female	Total
Under 20	44	18	62
20–22	65	15	80
23–25	12	2	14
26–30	9	4	13
Over 30	38	10	48
Total	**168**	**49**	**217**

In order to prove the cognitive and psychological benefits of orienteering among university students, focusing on its effects on cognitive skill development and mental health for this study, we analyse some items in relation to orienteering: perceptions of influence on cognitive functions, including concentration, spatial navigation, planning, and problem-solving.

Perceptions of cognitive benefits. The response distribution by age and gender is detailed in table 2.

1. Concentration and attention
   - Perceived improvement: 187 participants (86.2%)
   - No perceived improvement: 30 participants (13.8%)

Table 2. *Response distribution for concentration and attention by age and gender*

Age Category	Gender	Did Not Perceive Improvement	Perceived Improvement	Total
Under 20	Male	4	40	44
	Female	1	17	18
Total		**5**	**57**	**62**
20–22	Male	9	56	65
	Female	0	15	15
Total		**9**	**71**	**80**
23–25	Male	2	10	12
	Female	0	2	2
Total		**2**	**12**	**14**
26–30	Male	1	8	9
	Female	1	3	4
Total		**2**	**11**	**13**
Over 30	Male	11	27	38
	Female	1	9	10
Total		**12**	**36**	**48**
Grand Total		**30**	**187**	**217**

Chi-Square analysis for the item concentration and attention

No significant associations were found between age or gender and perceptions of improvement in concentration and attention ($p > 0.05$). The detailed chi-square results are presented in table 3.

Table 3. *Chi-square results for concentration and attention*

Age Category	Pearson Chi-Square	Phi	p-value
Under 20	0.215	0.059	0.643
20–22	2.340	0.171	0.126
23–25	0.389	0.167	0.533
26–30	0.410	-0.178	0.522
Over 30	1.516	0.178	0.218
Total	**3.152**	**0.121**	**0.076**

2. Spatial thinking and navigation
   - Perceived Improvement: 140 participants (64.5%)
   - No Perceived Improvement: 77 participants (35.5%)

Table 4. *Response distribution for spatial thinking and navigation by age and gender*

Age Category	Gender	Did Not Perceive Improvement	Perceived Improvement	Total
Under 20	Male	22	22	44
	Female	3	15	18
Total		**25**	**37**	**62**
20–22	Male	30	35	65
	Female	3	12	15
Total		**33**	**47**	**80**
23–25	Male	3	9	12
	Female	1	1	2
Total		**4**	**10**	**14**
26–30	Male	6	3	9
	Female	1	3	4
Total		**7**	**6**	**13**
Over 30	Male	16	22	38
	Female	2	8	10
Total		**18**	**30**	**48**
Grand Total		**87**	**130**	**217**

Chi-Square analysis for the item spatial thinking and navigation.

A significant association was found between age and perceived improvement in spatial skills, particularly in the "Under 20" age group ($p = 0.015$, Phi = 0.308). The chi-square results are shown in table 5.

Table 5. *Chi-square results for spatial thinking and navigation*

Age Category	Pearson Chi-Square	Phi	p-value
Under 20	5.898	0.308	0.015
20–22	3.440	0.207	0.064
23–25	0.525	-0.194	0.469
26–30	0.410	-0.178	0.522
Over 30	1.651	0.185	0.199
Total	**10.210**	**0.217**	**0.001**

3. Memory and problem-solving
   - Perceived Improvement: 88 participants (40.7%)
   - No Perceived Improvement: 129 participants (59.3%)

Chi-Square analysis for the item memory and problem-solving.

Significant associations were observed in the "Under 20" ($p = 0.025$) and "20–22" ($p < 0.001$) age groups, indicating stronger perceptions of improvement in these domains among younger participants. The detailed results are provided in table 6.

Table 6. *Chi-square results for memory and problem-solving*

Age Category	Pearson Chi-Square	Phi	p-value
Under 20	5.010	0.284	0.025
20–22	16.433	0.453	<0.001

Age Category	Pearson Chi-Square	Phi	p-value
23–25	2.333	0.408	0.127
26–30	1.935	0.386	0.164
Over 30	2.112	0.202	0.146
Total	**16.086**	**0.272**	**<0.001**

Study results on mental health perceptions for the 217 students from the University of Craiova participated in an online survey assessing their perceptions of orienteering compared to other sports.
• Positive impact on mental health was reported by 139 participants (64.1%)
• No significant impact was reported by 78 participants (35.9%)
No significant demographic associations were found regarding mental health perceptions.
Comparative cognitive demands.
• Orienteering more demanding than other sports was reported by 103 participants (47.5%)
• Similar demands as other sports was reported by 68 participants (31.3%)
• Less demanding than other sports was reported only by 46 participants (21.2%)

Discussion

In terms of cognitive enhancements, orienteering was perceived to significantly improve concentration, spatial thinking, and problem-solving skills, with younger participants demonstrating the greatest benefits.
The study's findings highlight the perceived benefits of orienteering on cognitive skills and mental health among university students. The high percentage of participants reporting improvements in concentration and attention (86.2%) aligns with previous research indicating the attentional demands of orienteering (Eccles et al., 2006). These results support the integration of orienteering into academic programs as a tool for cognitive skill development (Sigmundsson & Haga, 2016; Biehl-Printes et al., 2023; Notarnicola et al., 2012).
The significant association between age and perceived improvements in spatial thinking suggests that younger students may be more receptive to the spatial challenges presented by orienteering. This supports the notion that early engagement in cognitively demanding physical activities can enhance spatial abilities (Sigmundsson & Haga, 2016).
The observed improvements in memory and problem-solving, particularly among younger participants, may be attributed to the increased production of BDNF during vigorous physical activity (Marosi & Mattson, 2014). The dynamic nature of orienteering, which requires real-time decision-making and problem-solving, likely contributes to these cognitive benefits.
For the mental health benefits, the positive impact of orienteering on emotional well-being and stress reduction reinforces its value as a ***therapeutic activity***. Engaging with natural environments during orienteering further amplifies its psychological benefits, making it an effective intervention for promoting mental health (Korpela et al., 2014; World Health Organization, 2013). The positive perceptions of orienteering's impact on mental health align with studies demonstrating the psychological benefits of engaging with natural environments and participating in outdoor activities (Korpela et al., 2014).
When comparative advantages, participants identified orienteering as more cognitively demanding than other physical activities, emphasizing its unique ability to integrate physical exertion with complex cognitive tasks like it was reported in other studies (Król & Gruszka, 2023; Liu et al., 2021).

Limitations of this study

• The study relied on self-reported data, which may be subject to bias.
• The sample consisted of students from a single university, which may limit the generalizability of the findings.
• The cross-sectional design does not allow for causal inferences.

Conclusions

This study underscores the significant role of orienteering as a multifaceted sport activity or even *therapeutic activity* that fosters cognitive development and mental health among university students.
Future research should consider longitudinal studies and include objective measures of cognitive function and BDNF levels to substantiate these findings.
Results indicated that 86.2% of participants viewed orienteering as significantly enhancing concentration and attention, while 64.5% perceived improvements in spatial thinking and navigation. Additionally, 40.7% reported benefits in memory and problem-solving. The study also

integrated findings from recent literature, highlighting that vigorous-intensity orienteering may enhance cognitive functions and increase BDNF levels more effectively than exercises lacking cognitive engagement.

These findings emphasize the potential of orienteering as both an educational tool and a therapeutic activity. Incorporating orienteering into academic and recreational programs may support cognitive development and mental health, potentially mediated by physiological mechanisms such as increased BDNF production.

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