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THE IMPACT OF THE EDUCATIONAL PROCESS ON THE FORMATION OF ATTENTION

Abstract

This study investigates the dynamics of voluntary attention among undergraduate students, exploring its interaction with academic specialization, developmental stages, and psychophysiological states. Utilizing a sample size of 100 students (aged 17–20) from Western Caspian University, the "Arrangement of Numbers" test was employed to quantitatively assess attention capacity. The research spans across four distinct academic tracks: Natural Sciences, Humanities, Exact Sciences, and Economics. The results indicate that second-year students in Exact Sciences and Economics significantly exceed the established local norm (μ=9), with the highest overall stability observed within the Exact Sciences cohort ($\mathcal{M}$=11.6). Data analysis reveals a notable "peak" in attentional function during the second academic year, followed by a stabilization or decline in the third year, driven by the onset of evaluation stress and academic burnout. Furthermore, the study identifies a critical inverse relationship between high anxiety levels (State Anxiety: 41.0–49.0; Trait Anxiety: 43.0–55.0) and attentional efficiency under severe time constraints. These findings suggest that while academic rigor in quantitatively oriented fields enhances cognitive filtering and numerical manipulation skills, elevated psychophysiological strain remains a primary inhibitory factor. The study concludes that understanding these cognitive-ecological interactions is essential for optimizing pedagogical strategies and designing targeted mental health interventions for students.

Keywords: voluntary attention, academic specialization, state anxiety, trait anxiety, inhibitory factor.

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Introduction

The educational process is not merely the transmission of information but also the primary environment for the formation of the attention system, which lies at the center of human cognition [7]. The attentional system is organized into distinct functional networks of alerting, orienting, and executive control which are subserved by specific neural circuits [9]. Although attention within the classroom is often measured through behavioral indicators, such as a student's focus on a task, this process is grounded in complex cognitive mechanisms [5]. The pedagogical environment helps students filter through scattered sensory signals and organize them into a logical sequence [7]. This ability for selective attention, which develops particularly at an early age, enables a child to perceive digital symbols and quantities, becoming the most

powerful factor in determining their future academic success [5].

Theoretical framework

Classification of attention. Attention is not a single, unified mechanism but a collection of several subprocesses distributed across various regions of the brain [6]. Since this concept is used in a very broad and diverse sense within the scientific literature, researchers have developed a descriptive taxonomy that categorizes it into three primary dimensions: behavioral, phenomenal, and mechanistic attention [6].

(1) Behavioral attention: This approach explains attention through objective and measurable indicators, such as eye movements or the direct impact of stimuli on behavior [6].

(2) Phenomenal attention: This defines attention as an individual's subjective experience [6]. It encompasses salience (the prominence of stimuli signaling "pay attention to me"), clarity (characterized as a clearer perception of a thought), and fixity (referring to focusing within a narrow cognitive frame) [6].

(3) Mechanistic attention: More commonly encountered in cognitive sciences, this approach defines attention by its functional roles [6]. This category includes the processes of selection (a filter regulating information flow), access (the amplification of cognitive resources), and detection (the tracking of specific targets over time) [6].

Physiological mechanisms of attention. Attention is a complex system encompassing both objective neural activity and subjective experience [7]. At the physiological level, this process ensures the abundance and accessibility of cognitive resources, allowing the brain to allocate greater processing power to specific states [7]. This mechanism operates through the 'Biased Competition' model, where stimuli compete for limited neural resources, and the winning stimulus becomes the primary content of the individual's consciousness [7].

Subjectively, the clarity of the object in the focus of attention and the confidence of perception increase [7]. This state is often triggered by a 'Salience' signal and draws attention through top-down regulation [7]. These physiological mechanisms ensure the tracking of information over time and provide the necessary coherence for an individual's goal-oriented actions [7]. Stress influences several domains of cognition, including attention, memory. Depending on its intensity and duration, stress can either enhance or impair these processes.

Stress and attention. The relationship between stress and attention in academic settings, particularly within the framework of test anxiety, is characterized by the cognitive reaction’s individuals exhibit in response to evaluative pressure. Research indicates that exam stress triggers an acute attentional bias toward test-related threatening stimuli in individuals with high test anxiety [1]. Acute stress has been shown to impair top-down executive functions, specifically limiting the capacity for goal-directed voluntary attention [10]. This sensitivity is highly specific; while high-anxiety individuals demonstrate hyper-vigilance toward exam-related information, they do not exhibit the same bias toward negative factors unrelated to the test [1]. At the neural level, this process is accompanied by functional disruptions in rapid-response brain circuits and an enhanced N200 amplitude, indicating the detection of a threat within an extremely short duration [1]. However, this initial vigilance does not translate into sustained attention; high-anxiety individuals tend to rapidly disengage from the threat to alleviate internal distress [1]. Consequently, the excessive allocation of attentional resources to task-irrelevant threats diminishes cognitive efficiency and sets the stage for performance decline [1].

Attention and memory. The interaction between attention and memory is explained in modern cognitive psychology through the 'embedded-processes' framework [3]. According to this model, memory is not a passive storehouse of past experiences but a dynamic system constantly shaped by the selective filter of attention [3]. The Focus of Attention (FoA) is situated within the activated portion of long-term memory and can process

a limited number of information chunks (approximately 3–5 items) simultaneously [3].

For information to be transferred into permanent memory, it must necessarily pass through this narrow focus of attention and be 'bound' through new associations [3]. This process is bidirectional: attention determines what will be remembered, while existing memory traces dictate which stimuli, we should direct our attention toward [3]. At the neurobiological level, this integration primarily occurs in the intraparietal sulcus (IPS), demonstrating how attention indexes memory units [3]. Consequently, memory and attention constitute an inseparable cognitive unit, ensuring an individual's adaptation to their environment [3].

Methodology

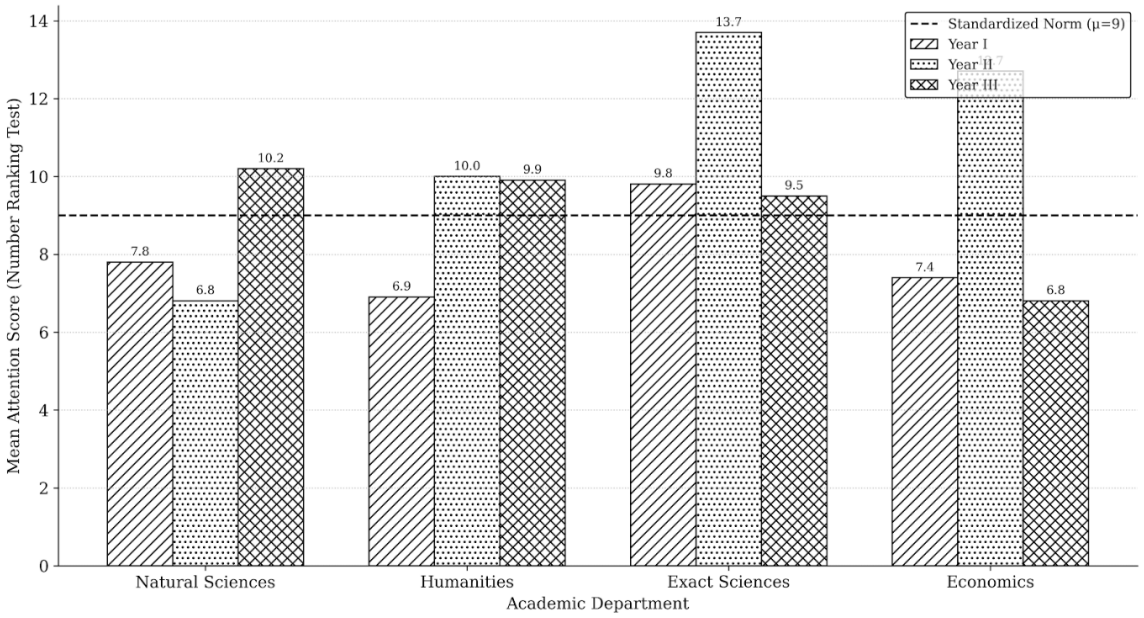
Participants. The study was conducted among students aged 17–20, currently enrolled in the first, second, and third years of undergraduate study at Western Caspian University. A total of 100 students were selected using a random sampling method. Participants were categorized according to their respective fields of study: Natural Sciences, Humanities, Exact Sciences, and Economics. To assess the capacity of the subjects' voluntary attention, the "Arrangement of Numbers" test was employed.

Structure of the test. The test consists of two grids, each containing 25 cells. The upper grid features numbers ranging from 1 to 90, distributed in a randomized (shuffled) order. The lower grid consists of empty cells. Individual differences in attentional scope and control determine the efficiency of information processing during complex cognitive tasks [11].

Procedure. The study was conducted in a paper-based (offline) format. Participants were required to identify the numbers in the upper grid starting from the smallest value and transcribe them into the lower empty cells in ascending order.

Timing and scoring. A duration of one minute was allotted for the completion of the task. Results were calculated based on the total number of digits correctly recorded prior to the first error (either a skipped number or a disruption in the sequence). The established mean norm for this test is considered to be 9 numbers.

Figure 1. Comparative analysis of voluntary attention across academic disciplines (N=100)



Source: Compiled by the authors based on experimental research data.

Analysis and interpretation of results

As illustrated in Figure 1, attention scores within the sample group of 100 participants range from 6.1 to 16.2, depending on the field of study and academic year. When compared against the established local mean norm of 9 numbers (indicated by the dashed line on the graph), several key points emerge:

- Exact Sciences and Economics (Year II) students significantly outperform this norm.
- Results for Natural Sciences students were generally recorded as near-norm or slightly below the threshold, ranging between 7.0 and 8.8.
- While Year I Humanities students recorded scores (6.1) below the established norm, this figure rose to 10.7 in Year II, effectively surpassing the baseline.

Comparative analysis by fields of study. The data indicate that the content of the curriculum directly influences the concentration speed of voluntary attention:

- The Exact Sciences Factor: The highest volume of attention was consistently observed among students majoring in the Exact Sciences (Overall Mean: 11.6). This suggests that these students possess a superior ability to adapt quickly to tasks involving numerical manipulation and visual search. Individuals in quantitative disciplines demonstrate enhanced cognitive flexibility and faster visual search speeds when dealing with numerical stimuli [2].
- The Field of Economics: Year II Economics students achieved the highest individual group score, reaching 16.2. However, the decline of this indicator to 7.1 in Year III may be attributed to factors such as academic burnout (overload) or shifts in student motivation. Increased academic pressure in higher education often leads to psychological distress and burnout, which significantly deteriorates cognitive persistence and academic engagement [8].

Dynamics of academic development. A comparison across academic years reveals how attentional functions evolve throughout the duration of study:

- **Year I:** During the adaptation period, the mean scores (M: 8.6 – 11.2) lack stability, with sharp discrepancies observed between different fields of study.
- **Year II:** This stage appears to be the "peak" of attentional function; specifically, a significant increase is observed in the Humanities (10.7) and Exact Sciences (15.3).
- **Year III:** A certain stabilization is observed in the scores, or in some groups (e.g., Economics), a decline; this may be attributed to examination stress during the research period or other psychological factors.

Impact of psychophysiological state. The high levels of State Anxiety (41.0 – 49.0) and Trait Anxiety (43.0 – 55.0) recorded among these students serve as the primary inhibitory factors affecting the attention test results. While high anxiety reduces processing efficiency, it may not always impair performance effectiveness if the individual applies compensatory effort [4]. The strict one-minute time constraint exacerbated tension among the subjects, which in turn restricted the distribution speed of voluntary attention (particularly within the Natural Sciences group).

In conclusion, the overall mean score of 9.1 obtained in the "Arrangement of Numbers" test confirms that, despite the pressure of limited time, the students possess a moderate-to-good level of attentional concentration.

Conclusion

This research underscores the dynamic nature of voluntary attention among undergraduate students, highlighting that cognitive performance is not a static trait but is significantly influenced by academic discipline and developmental stage. The *Arrangement of Numbers* test results demonstrate that students in quantitative fields,

particularly Exact Sciences, possess higher attentional efficiency ($\mathcal{M}$ =11.6), likely due to the nature of their specialized training. However, the study also reveals that high levels of state and trait anxiety act as primary inhibitors, especially under strict time constraints, which can suppress the actual cognitive potential of students. Ultimately, these findings suggest that pedagogical environments should account for both the cognitive demands of the curriculum and the psychophysiological well-being of students to foster optimal academic success.

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TƏDRİS PROSESİNİN DİQQƏTİN FORMALAŞMASINA TƏSİRİ

Xülasə

Bu tədqiqat bakalavr tələbələri arasında ixtiyari diqqətin dinamikasını, onun akademik ixtisaslaşma, inkişaf mərhələləri və psixofizioloji vəziyyətlərlə qarşılıqlı əlaqəsini araşdırır. Qərbi Kaspi Universitetinin 100 tələbəsindən (17–20 yaş) ibarət seçmə qrupun iştirakı ilə aparılan tədqiqatda diqqətin həcmini kəmiyyətcə qiymətləndirmək üçün "Ədədlərin düzülüşü" testindən istifadə edilmişdir. Tədqiqat dörd istiqaməti əhatə edir: Təbiət elmləri, Humanitar elmlər, Dəqiq elmlər və İqtisadiyyat. Nəticələr göstərir ki, Dəqiq elmlər və İqtisadiyyatın II kurs tələbələri müəyyən edilmiş yerli normanı (μ =9) əhəmiyyətli dərəcədə üstələyir, ən yüksək ümumi sabitlik isə Dəqiq elmlər qrupunda ($\mathcal{M}$ =11.6) müşahidə olunur. Məlumatların təhlili ikinci tədris ilində diqqət funksiyasında nəzərəçarpacaq bir "pik" nöqtəsinin olduğunu, üçüncü ildə isə qiymətləndirmə stresi və akademik tükənmənin təsiri ilə stabilləşmə və ya azalmanın baş verdiyini göstərir. Bundan əlavə, tədqiqat yüksək təşviş səviyyəsi (Vəziyyət təşvişi: 41.0–49.0; Şəxsi təşviş: 43.0–55.0) ilə ciddi vaxt məhdudiyyəti şəraitində diqqətin səmərəliliyi arasında kritik tərs mütənasib əlaqə müəyyən etmişdir. Bu nəticələr göstərir ki, kəmiyyət yönümlü sahələrdəki akademik gərginlik koqnitiv süzgəcləmə və rəqəmsal manipulyasiya bacarıqlarını artırsa da, yüksək psixofizioloji gərginlik əsas ləngidici faktor olaraq qalır. Tədqiqatın sonunda qeyd olunur ki, bu koqnitiv-ekoloji qarşılıqlı təsirlərin başa düşülməsi pedaqoji strategiyaların optimallaşdırılması və tələbələrin psixi sağlamlığına yönəlmiş müdaxilələr üçün zəruridir.

Açar sözlər: ixtiyari diqqət, akademik ixtisaslaşma, vəziyyət təşvişi, şəxsi təşviş, ləngidici və ya tormozlayıcı amil.

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ВЛИЯНИЕ ОБРАЗОВАТЕЛЬНОГО ПРОЦЕССА НА ФОРМИРОВАНИЕ ВНИМАНИЯ

Резюме

Данное исследование изучает динамику произвольного внимания среди студентов бакалавриата, анализируя его взаимодействие с академической специализацией, этапами развития и психофизиологическими состояниями. Оценка объема внимания проводилась количественно с использованием теста «Расстановка чисел» на выборке из 100 студентов (в возрасте 17–20 лет) Западно-Каспийского Университета. Исследование охватывает четыре различных академических направления: естественные, гуманитарные, точные науки и экономика. Результаты показывают, что студенты второго курса точных наук и экономики значительно превышают установленную локальную норму (μ =9), при этом наиболее высокая общая стабильность показателей наблюдается в когорте точных наук ($\mathcal{M}$ =11.6). Анализ данных выявляет заметный «пик» функции внимания на втором курсе обучения, за которым следует стабилизация или спад на третьем курсе, обусловленный развитием стресса перед оцениванием и академического выгорания. Кроме того, в исследовании выявлена критическая обратная связь между высокими уровнями тревожности (ситуативная тревожность: 41.0–49.0; личностная тревожность: 43.0–55.0) и эффективностью внимания в условиях дефицита времени. Полученные результаты позволяют предположить, что, хотя академическая нагрузка в дисциплинах с количественной направленностью улучшает навыки когнитивной фильтрации и манипулирования числами, повышенное психофизиологическое напряжение остается основным ингибирующим фактором. В заключении делается вывод о том, что понимание этих когнитивно-экологических взаимодействий необходимо для оптимизации

педагогических стратегий и разработки целевых программ психологической помощи студентам.

Ключевые слова: произвольное внимание, академическая специализация, ситуативная тревожность, личностная тревожность, ингибирующий фактор.

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