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AI-Based Intervention to Enhance Self-Control in Adolescents Studying Drama—A Pilot Study

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Abstract: (1) Background: Self-control is an essential capacity in educating young generations for the good management of personal resources and a healthy life adapted to the constantly changing demands of technological society. Artificial intelligence is an economical and efficient solution for designing medical education programs aimed at optimizing this capacity, which can be personalized according to each personal needs and characteristics. (2) Methodology: This research is a sequential intervention study that aims to investigate if the level of impulsivity decreases and consequently the self-control in adolescents studying drama can be improved by using an online program designed for this purpose. The program's effectiveness is evaluated by analyzing its impact on vocational performance and the reduction in unhealthy lifestyle habits. A sample of 90 subjects aged between 14 and 17 years, enrolled in the compulsory vocational education system was included in this study. The study was conducted over a five-month period and was organized in three stages: 1. The preparatory stage in which the Barratt Impulsiveness Scale was initially applied (pre-test scores); 2. Selecting the tasks for the online self-control education program and uploading the artificial intelligence network; the application of the program lasted for three months; 3. Applying Barratt Impulsiveness Scale (post-test scores). (3) Results: The results indicated both a statistically significant decrease in self-reported impulsivity and an improvement in the self-control of the sample of adolescents after three months of training on the online platform, compared to the pretest scores of impulsivity. (4) Conclusion: A comparative analysis between the initial and the final BIS scores showed a statistically significant decrease in teens' impulsivity, suggesting that the program was effective for this sample of adolescents. Consequently, the study findings indicate significant improvements in adolescents' self-control after completing the three-month training program, which included cognitive-behavioral games.

Keywords: artificial intelligence (AI); impulsivity; self-control; teenagers; drama; Barratt Impulsivity Scale (BIS)

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1. Introduction

Adolescence is the ontological period that marks the transition from childhood to adulthood and is characterized by significant neural changes in the brain, which are reflected in a low self-control and specific boundary-pushing behaviors.

Given this context, self-control is the ability to inhibit or delay immediate reactions to facilitate the intervention of critical thinking, which plays an important role in adapting behavior to the situation adequately. This ability is essential for shaping the social behavior of adolescents and, subsequently, in both adapting to social demands and in building resilience to the rapid changes in the society as well.

During this developmental phase, the brain is characterized by an uneven development of the prefrontal cortex, which reaches maturity at the age of 25 [1] and is involved in critical thinking and decision-making processes. The limbic system is already developed by this period. This predisposes adolescents to immediate reward-seeking behavior and a heightened reactivity to emotional stimuli [2]. The imbalance in the maturation of the two cortical structures leads to adolescents' tendency to seek momentary pleasure regardless of the consequences, with the prefrontal cortex still being incapable of fully inhibiting impulsive reactions triggered by the limbic system.

In addition, there is a continuous increase in dopamine levels in the prefrontal cortex, with evidence showing that levels of this neuromodulator peak at the onset of adolescence [3,4]. Dopaminergic projections to the prefrontal cortex, still under development during this phase, are essential for cognitive functions such as working memory, emotional processing, reasoning, planning, attention, and inhibitory control [5]. As a result, delayed dopamine connectivity in the prefrontal cortex during adolescence can negatively affect self-control capacity and increase the risk of engaging in risky behaviors [6]. Thus, a dual neural system for managing self-control is outlined: the "hot" system, characterized by the dominance of the limbic system that modulates the emotional response to stimuli, and the "cold" system, associated with the prefrontal cortex, which is essential for the reaction control [7]. These systems interact with the mesolimbic and mesocortical dopaminergic pathways, which are crucial for self-control regulation [8]. The mesolimbic pathway projects from the ventral tegmental area (VTA) to the nucleus accumbens (NAcc) and has a key role in processing rewards and emotional responses. It is primarily activated in "hot" situations, where immediate rewards or emotional stimuli drive impulsive behaviors. In contrast, the mesocortical pathway extends from the VTA to the prefrontal cortex and is involved in higher cognitive functions, such as planning, decision-making, and inhibitory control, thus activating the "cold" system. This pathway regulates self-control by modulating impulsivity and guiding future-oriented decision-making based on past experiences and expected outcomes [9].

Therefore, self-control results from the balance between these two systems. However, during adolescence, as the prefrontal cortex is not yet fully matured, the hot system is more likely to be activated when confronted with various situations. During adolescence, due to the characteristics of cognitive development, the activity of the "hot" system predominates in behavioral modulation, especially in the response to stimuli that are predominantly emotional [10].

Given the neurobiological and psychological profile of adolescents, there is a clear need for accessible tools and applications that can help develop their self-control capacity. Inhibitory control is measured applying tasks that require voluntary interruption of responses or suspension of distracting stimuli, such as: anti-saccade tasks assess inhibitory control by directing eye movements away from visual stimuli [11]; the serial method tests restrained of incongruent items and requires the selection of relevant stimuli among distractors [12]; "go/no go" tests suppress responses associated with a different set, focusing on more frequent stimuli [13]; the "stop signal" method stimulates a response to a stimulus followed by a stop signal [14]; puzzles help train attention focus and executive control [15]. Building on this need, recent advances in educational technologies suggest that artificial intelligence (AI) can support the design and implementation of personalized intervention

strategies for adolescents. In this context, the current study proposes an AI-managed online platform designed to offer tailored self-control training programs for adolescents studying drama. The AI network predicts personalized interventions based on results from the Barratt Impulsiveness Scale and the Big Five Inventory. For example, participants with high scores in attentional impulsivity are assigned tasks such as sequencing and go/no-go exercises. In doing so, the system adapts the program to the specific impulsivity profile of each adolescent, enhancing both engagement and outcomes.

Moreover, the use of AI was particularly relevant during the COVID-19 pandemic, when schools in Romania operated online. The only way to carry out research was through methods that excluded direct contact between researchers and subjects. In this context, the present study had to carry out this research within the virtual space. Therefore, an online platform was created, on which all the needed instruments were uploaded. The work on the platform had to be designed as a limited period of 30 min daily to avoid affecting eye health or favoring monotony in task solving. The artificial intelligence network was the appropriate tool for managing the collected data, adapted to the unique conditions of the pandemic. On the other hand, its introduction aimed to test the effectiveness of this tool for personal development programs for adolescents in restrictive social contact conditions. Recent developments in the field support this approach. In recent years, more and more universities and research institutions have developed such applications or educational programs that use artificial intelligence to help adolescents develop their personality. Some of the most recent studies on this topic highlight the activities of prestigious educational institutions: Stanford University (2023) [16] created an AI-managed platform that offers emotion management exercises, Carnegie Mellon University (2022) [17] developed an AI-based virtual assistant to help adolescents manage their emotions and stress and the California Institute of Technology (2022) [18] demonstrated that using an online learning platform can optimize students' self-control and attention capacity. Concerning the use of AI in educational programs, a systematic literature review was provided in an article by Shan Wang and his colleagues, in which the main directions AI has been used in education so far are presented as follows: 1. Intelligent tutoring systems; 2. student assessment; 3. chatbots and virtual assistants; 4. STEM education, primarily focused on studying mathematics and sciences [19].

Focusing on adolescents involved in dramatic arts, their personality is special, with features such as spontaneity, creativity, expansiveness, and a strong focus on the present, all of which are valuable for their vocation. However, these qualities, along with the specific characteristics of adolescence, can make them prone to impulsive, emotion-driven behavior and momentary reactions. Thus, given their high emotional expressiveness and constant search for new experiences, it is essential to educate self-control in these adolescents to help them manage impulses and strengthen self-control, make more rational decisions, and balance creativity with discipline. These will enhance their overall evolution both personally and professionally. Currently, no interventions have been specifically designed for adolescents studying dramatic arts.

Addressing this gap, the present study investigates the impact of a personalized, AI-managed intervention platform designed to support self-control development in adolescents studying dramatic arts in a public school in Bucharest, Romania.

2. Materials and Methods

The study included a sample of 90 adolescents (gender ratio 1:1), aged between 14 and 17 years, all of whom were enrolled in the first year of high school at the dramatic arts section of the National College of Arts Dinu Lipatti in Bucharest, Romania. The participants were selected based on two criteria: their voluntary agreement to participate in the study

and their representation of the entire cohort of first-year students in the dramatic arts section. Parental consent was obtained for all participants involved in the study. In this regard strict data protection measures were implemented, such as anonymizing participant data, securing all digital records with encryption, and adhering to relevant data protection regulations, such as GDPR. The AI-based platform used in the study was designed to protect personal information, with access restricted to authorized researchers only. Before conducting the research, approval had been obtained from the Ethics Committee of the Francisc Rainer Institute of Anthropology of the Romanian Academy (609/2020, 255/14 May 2021) and informed consent was obtained.

An online work platform was designed for students, where each subject created a personal account to run the proposed program. This virtual space uploaded the following data before starting the research:

The Barratt Impulsiveness Scale (BIS) is widely used in psychiatry and psychology. It is an instrument based on self-reporting impulsivity, created by the American psychologist Ernest Barratt in 1965 and revised over time to the present [20]. It consists of 30 items, 11 of which are reversed-scored, organized into two subscales: a six-factor scale (attention, motor activity, self-control, cognitive complexity, perseverance, and cognitive instability) and a three-factor subscale (attentional impulsivity, motor impulsivity, and non-planning impulsivity). The Italian psychologist Fossati (2002) made the first adaptation of this scale for adolescents in Italy, adjusting the items to the specifics of Italian culture. The psychometric properties of the instruments are well established. The Barratt Impulsiveness Scale for Adolescents (BIS-11-A) demonstrates good internal consistency (Cronbach's α = 0.78–0.80) and construct validity, with significant correlations to behavioral indicators of impulsivity [21]. This research is a pilot study that uses the Barratt Impulsivity Scale experimentally, without prior validation on the Romanian population, as its primary objective is to assess the scale's applicability in a specific context. This exploratory approach enables the use of an internationally recognized tool while offering valuable insights into its potential relevance and effectiveness in evaluating impulsivity among Romanian adolescents studying dramatic arts.

The Big Five personality test assesses five key personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism [22]. This test was selected to calibrate the artificial intelligence network on the online platform, as research has identified significant correlations between the items of the Big Five and the Barratt Impulsivity Scale. The Big Five Inventory was used to calibrate the AI system by providing personality trait profiles that inform the selection and sequencing of self-control training tasks. The Big Five Inventory (BFI) shows high reliability and factorial validity in adolescent populations, supporting its use in this context [23]. Specifically, Patton, Stanford, and Barratt (1995) found notable associations between motor impulsivity items from the Barratt scale and the extraversion and conscientiousness dimensions of the Big Five [24]. Furthermore, Whiteside and Lynam (2001) demonstrated significant correlations between neuroticism and conscientiousness in the Big Five and both motor and non-planning impulsivity items from the Barratt scale, while Miller and Lynam (2001) identified correlations between neuroticism, extraversion, conscientiousness from the Big Five, and various impulsivity items from the Barratt scale [25,26]. Specifically high scores in extraversion and neuroticism, along with low scores in conscientiousness, are strongly correlated with high scores on the Barratt Impulsivity Scale, mainly in the domains of motor impulsivity and non-planning impulsivity, when evaluating the level of impulsivity in adolescents studying dramatic arts. These provide the basis for developing the training program through the AI network by combining the games, based on the main needs identified by these assessment instruments.

The five types of games selected for the platform were anti-saccade, sequences, go-no-go, Stroop, and puzzle, with graded difficulty levels. The level is gradually adjusted based on the results obtained, so that when the number of correctly completed items exceeds the set threshold within 60 s, the program increases the difficulty level of the game.

The methods and techniques for delaying undesirable habits chosen are used in cognitive-behavioral therapy and were selected by the artificial intelligence network depending on the type of habit mentioned by the subject.

Additionally, each subject's personal account contained a space for organizing the self-supervision during the transfer period and a space for storing the results.

The research was carried out during the pandemic period, which imposed restrictions on direct interaction between researchers and participants, leading to the selection of the sequential interventional study design. This type of study was selected because it is particularly suitable for investigating the optimization of self-control in the same sample of adolescent students studying dramatic arts at two different time points: before and after the implementation of the program. The research took place over a period of 5 months from October 2021 to March 2022 and was structured as follows: 1. Pretest stage: adolescents completed the Barratt impulsivity scale in their online account on the platform; 2. Training stage: subjects applied for two months the self-control training program predicted by the artificial intelligence network based on the Barratt score; 3. Transfer stage: for six weeks, adolescents applied techniques for delaying undesirable habits they want to change and recorded weekly the latency time between the moment of impulse initiation and the moment of action; 4. Feedback or post-test stage: the research subjects completed the Barratt impulsivity scale a second time. The initial scores stored in the subjects' personal accounts were analyzed in comparison with the final ones, and the results were statistically processed (Shapiro–Wilk normality tests, Wilcoxon test to identify significant differences between initial and final scores, rate of change to determine the size of variable changes after the program application period) and interpreted psychologically to identify the effectiveness of the applied program.

Data processing was carried out using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, NY, USA) and Excel 2021, version 16 (Microsoft Corp., Redmond, WA, USA).

3. Results

In the training stage, adolescents applied personalized programs by AI on the platform, including games and exercises (the level of difficulty increases gradually when the number of correct responses exceeds the set threshold within a 60 s time frame per task), for 15–20 min, four times a week, for a month and a half. Each week, the scores were recorded in a personal account and, at the end, we analyzed the final weekly results and consequently interpreted them from a psychological perspective.

The research used online versions of the Barratt scale and Big Five, which were configured in such a way that they do not allow the submission of an incomplete form, thus reducing the probability of missing data.

For anti-saccade tasks, we applied a Wilcoxon test, as the distribution of the data was asymmetrical, with a significance level set at $\alpha = 0.05$. The test identified there were significant differences between the initial median (Mi = 40.00) of the time recorded during the first week of training and the final median (Mf = 55.00) of the time recorded at the end of the program. The results ($Z = -8.260$, $p < 0.001$) indicated a significant increase in the number of correct answers at the end of the program (Table 1). The effect size was calculated using the formula $Z/\sqrt{N}$, and the result ($r = 0.87$) suggests a significant improvement in the final results of the anti-saccade tasks after the training period. This

suggests the anti-saccade tasks were efficient for improving the inhibitory control for all the adolescents who ran the program.

Table 1. Statistical data for all tasks.

	Anti-Saccade Tasks	Sequence Task	Stroop Tasks	Go-No-Go Tasks	Puzzle Tasks
The first week (median scores per minute)	40.00	48.00	36.00	41.00	39.00
The fourth week (median scores per minute)	55.00	58.00	48.00	51.00	47.00
Wilcoxon—Z	−8.260	−8.309	−8.357	−8.314	−8.258
Sig. *p*	<0.001	<0.001	<0.001	<0.001	<0.001
Positive ranks	90	90	90	90	90

In analyzing the scores obtained at the sequence tasks, we compared the median of the initial time (Mi = 48.00) recorded by the adolescents and the median of the final time scored at the end of the program (Mf = 58.00) (Table 1). The significance level is set at $\alpha = 0.05$. The results ($Z = -8.309$, $p < 0.001$) indicate a significant increase in the number of correct answers at the end of the program. The number of positive ranks is 90, which means that all the students registered a higher number of answers for this task at the end of the training. The effect size was calculated using the formula $Z/\sqrt{N}$, and the result ($r = 0.88$) suggests a significant improvement in the final results of the sequence tasks after the training period.

We analyzed the scores obtained from Stroop tasks to compare the median of the initial time recorded (Mi = 36.00) during the first week of training by the adolescents and at the end of the program (Mf = 48.00) (Table 1). The significance level is set at $\alpha = 0.05$. The results ($Z = -8.357$, $p < 0.001$) indicated a relevant increase in the number of answers after the subjects ran the program. The number of positive ranks ($n = 90$) indicated that all the students had better results after the training program. The effect size was calculated using the formula $Z/\sqrt{N}$, and the result ($r = 0.88$) suggests a significant improvement in the final results of the stroop tasks after the training period.

For go-no-go tasks, the test compared the median of the initial time recorded at the beginning of the program (Mi = 41.00) and the median at the end of the program (M = 51.00). The significance level is set at $\alpha = 0.005$. The results ($Z = -8.314$, $p < 0.001$) and the number of positive ranks ($n = 90$) indicated that all the students recorded a higher number of correct answers at the end of the program. This suggests that the tasks go-no-go were efficient for improving the inhibitory control for all the subjects (Table 1). The effect size was calculated using the formula $Z/\sqrt{N}$, and the result ($r = 0.88$) suggests a significant improvement in the final results of the go-no-go tasks after the training period.

We analyzed the results obtained by adolescents at puzzle tasks (Table 1). The test compared the median of the time recorded initially (Mi = 39.00) and the median at the end of the program (Mf = 47.00). The significance level was set at $\alpha = 0.05$. The results ($Z = -8.258$, $p < 0.001$) indicated that the number of correct answers increased relevantly at the end of the program. The effect size was calculated using the formula $Z/\sqrt{N}$, and the result ($r = 0.87$) suggests a significant improvement in the final results of the puzzle tasks after the training period. This means the training was efficient for improving the executive control for the adolescents from the target group.

4. Discussion

During the transfer stage, adolescents recorded in their personal account the latency time between the moment they felt the impulse to engage in the undesirable habit and the moment they actually acted on it. For six weeks, they used cognitive-behavioral techniques to delay impulses and recorded the latency time once a week. To assess progress, we applied a non-parametric statistical method to compare the initial and final latency times.

The significance level was set at $\alpha = 0.05$. The results showed a statistically significant difference between the medians of the two groups ($Z = -8.270$, $p < 0.001$).

In the feedback stage, we statistically analyzed the median of the initial Barratt scores (M = 75.00) and the median of the final ones (M = 67.00) using the Wilcoxon test. The results indicated a statistically significant difference between the two variables ($Z = -8.184$ and $p < 0.001$) with the median final scores decreasing significantly after the implementation of the self-control training program. This suggests a relevant reduction in impulsivity among the adolescents in the target group. These findings are aligned with recent research supporting the impact of structured self-control interventions in adolescents.

The results found are similar and supported by other recent studies [18,27]. Brain mapping activity carried out by California Institute of Technology, revealed distinctive, classifiable activity in the dorsolateral prefrontal cortex in good self-controllers (DLPFC) and ventromedial prefrontal cortex (vmPFC). According to a study carried out by UCL and University of Florida researchers showed that teenagers who take part in arts (drama, dance) and cultural activities are less likely to engage in antisocial and criminalized behavior up to two years later [28]. A longitudinal study over a 23-year time span highlighted positive associations between self-control development in adolescence and love and work outcomes in adulthood [29]. For adolescents in dramatic arts, optimizations in self-control are crucial. Emotional regulation and impulse control are essential for role interpretation, managing stressful vocational situations, and effective collaboration with peers during roleplay. Training inhibitory control and executive function is especially important for young actors, as it enables them to manage emotional expression with greater balance and professionalism. Progress in inhibitory control and executive function development will help future young actors manage impulsive behaviors and express emotions in a balanced way. These cognitive outputs can contribute to better performance by integrating self-control into drama techniques and improving emotional management during performances.

There are several key psychological mechanisms that emphasize the effectiveness of using a platform managed by an AI network for optimizing self-control in teens studying drama, as follows: 1. Personalized learning programs are particularly effective because they are tailored to individual differences in cognitive abilities and learning styles. Thus, the platform ensures that the challenges remain optimal for each user. This personalized approach stimulates intrinsic motivation, as adolescents are more likely to engage in tasks that are challenging for them. In drama, actors need to manage their emotional expression and responses and that is why personalization helps them develop skills at their own rhythm, increasing their confidence and performance abilities; 2. The immediate feedback is an appropriate psychological tool for reinforcing learning. In real-time, individuals can optimize their behavior based on the feedback provided, leading to quicker improvements. This is beneficial in drama, as immediate emotional and behavioral adjustments are essential for adjusting performance. Therefore, real-time feedback helps actors improve their reactions, regulate their expressions, and, as a result, enhance both their emotional regulation and improvisational skills. The real-time feedback optimizes self-awareness and helps individuals to control their impulses and reactions mor efficient during performances; 3. Gamification as a technique to improve self-control stimulates the brain's reward system and engages sustained voluntary effort through for improving scores, accessing higher levels, and solving challenges. In drama, gamification simulates performance scenarios and motivates adolescents to 'level up' by correctly solving emotional and cognitive tasks within a set time. This technic keeps them focused on the tasks, and encourages them to optimize their acting skills, such as impulse control and emotional expression.

On the other hand, implementing AI platforms in optimizing self-control in teens studying drama can reveal several issues: 1. Access to necessary technology (e.g., comput-

ers, tablets, internet connection) can be a problem for some adolescents from disadvantaged families, as it involves resources that are limited in some cases; 2. Teachers who implement this program should be trained to use the platform and monitor the students' activity; 3. Some students may present low motivation in gaming, probably if they do not see immediate results or if the tasks on the platform are perceived to be too difficult or not relevant to their interests; 4. There is a possibility that the AI platform may experience bugs, crashes, or connectivity issues, leading to interruptions in learning that could cause frustration for adolescents; 5. Regarding privacy and data security, these platforms should be secure and regularly checked by cybersecurity specialists; 6. Although AI personalization of the program is an advantage, it should not be a reason to reduce face-to-face interaction. During the pandemic, when social interactions were limited, this was the only way to achieve the research objectives. However, under normal conditions, this technique should be an instrument to complement a strategy that emphasizes face-to-face connections between the researcher and the subjects.

Since this is a topic that is not yet well studied, and in which there is not enough literature to form a broad consensus, further research and platform development is needed considering our findings. Studies concur, however, that self-control can be improved. The development of such platforms and their widespread use could stimulate neural mechanisms of self-control. A mix of drama classes and an AI-supported platform for self-control training could be integrated into standard support therapy programs for adolescents.

5. Conclusions

The article studies the efficiency of a platform managed by an artificial intelligence network for developing self-control in adolescents studying dramatic arts. Considering the initial self-reported impulsivity assessment using the Barratt scale, the training program consisting of cognitive-behavioral games demonstrated significant improvements in the adolescents' self-control over a period of almost 4 months. These were subsequently applied in the transfer stage to delay undesirable habits, with the latency time between the moment of impulse onset and the actual performance of the habit increasing significantly after six weeks of applying cognitive-behavioral techniques and self-monitoring. A comparative analysis between the initial and the final BIS scores showed a significant decrease in impulsivity, suggesting that the program was effective for the sample of adolescents. Therefore, the obtained results highlight the potential of educational programs assisted by artificial intelligence networks for developing self-control in adolescents studying dramatic arts and suggest that this method is effective, accessible, and ergonomic for managing emotions and behaviors in various life and artistic situations. In this regard, to further implement this method, we consider the following aspects: 1. To expand the sample size for more robust statistical analysis and a better generalization of the findings across different populations and, thus, enhance the validity; 2. To extend the method for other categories of teens studying informatics and social sciences; 3. To develop applications that use AI networks for optimizing self-control in adolescents that make the technology more accessible for teens.

On the other hand, the research has emphasized some limitations as follows: 1. While the research has been run on a sample of adolescents who study drama, the conclusions of the study extend only for this group; 2. The goal of the research was to optimize the self-control of this sample, thus, for more insights regarding the topic it should be considered the introduction of a different control group of adolescents; 3. The instrument that is a self-report scale could limit the results, but, due to the pandemic conditions, it was appropriate at that time.

For future work, the research will expand in several directions: 1. To extend the research on self-control to other categories of adolescents studying informatics and social sciences; 2. To develop longitudinal studies on self-control in teens to identify the effects of implementing programs aimed at optimizing this capacity in the further evolution of their personalities; 3. To create additional programs that implement AI networks to help adolescents manage stress or anxiety; 4. To test the psychometric characteristics of the Barratt scale for the Romanian adolescent population.

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Abbreviations

The following abbreviations are used in this manuscript:

AI	artificial intelligence
BIS	Barratt Impulsiveness Scale
DLPFC	dorsolateral prefrontal cortex in good self-controllers
nACC	nucleus accumbens
vmPFC	ventromedial prefrontal cortex
VTA	ventral tegmental area

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