

The Effects of Lavender Aromatherapy on Stress, Concentration, and Academic Performance in Adolescents

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Introduction

Academic stress has become a notable issue among adolescents in all parts of the world. Students in secondary school undergo several academic pressures in the form of exams, hefty assignments, time limits, and competitive performance pressure on a routine basis. All these pressures are linked to increased psychological distress, reduced concentration, and poor academic performance. Current literature shows that teenage children are more likely to experience stress and lower levels of satisfaction with school life than younger children, with academic pressure being one of the key factors (Seo, 2009).

Adolescence is a critical stage of development that is marked by ongoing neurological, emotional, and mental development. At this phase, brain structures involved in executive functions, emotional evidence, and attention control are underdeveloped. Chronic stress or inadequately dealt with stressors in adolescence can disrupt these developmental processes and negatively impact the results of learning. Higher stress levels have been associated with concentration difficulties, memory lapses, emotional dysregulation, and declining academic interest.

Due to the rising rates of academic stress in adolescents, educators and researchers have been turning to effective, accessible, and low-cost strategies to promote student well-being. Despite the demonstrated efficacy of psychological counselling and structured stress-management programs, their application can be costly in terms of resources and trained staff on the one hand, and access in most educational settings is restricted. This has led to a move towards divergent interventions that can be incorporated into the classroom environments with minimal interference to teaching operations.

Scent stimulation, through aromatherapy, is one of those interventions. Aromatherapy is the practice of using essential oils derived from plants to affect psychological or physiological conditions with inhalation. The limbic system, the center of emotion, memory, and attention, is directly neurally related to the olfactory system. This specific neurological pathway allows

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scents to cause the quick changes in mood and cognitive performance without undergoing any conscious kind of processing.

One of the essential oils that is most widely studied in the field of aromatherapy is lavender (*Lavandula angustifolia*). It has been proven to have calming, anxiolytic, and cognitive-enhancing effects on a variety of populations based on empirical evidence. Inhalation of lavender was positively linked to decreased academic stress and anxiety (Ahmad et al., 2019; Enwright et al., 2022), better attentional control and cognitive flexibility (Afghan et al., 2024), and greater control over emotions (Malloggi et al., 2021). There is also meta-analytic evidence indicating that aromatherapy measures have the potential to diminish test anxiety and enhance academic-related changes, especially when used in student groups (Luan et al., 2023).

Although the amount of evidence in support of aromatherapy is growing, cutting-edge studies focusing on the adolescent demographic in the context of academic tasks are scarce. A significant part of the current literature has been based on university students or clinical samples, which resulted in a gap that necessitates the need to understand the impact of scent stimulation on younger learners during normal scholarly practices. In addition, the results regarding the stress-reducing effect have been discrepant, with certain studies showing substantial improvements and others suggesting small short-term impacts (Ahmad et al., 2019).

The current pilot study accordingly investigated the effects of the lavender scent stimulation on perceived stress, concentration, and academic performance among adolescents during academic tasks. By bridging this gap, the study will be able to develop some initial evidence on the plausibility and possible worth of scent-based interventions in educational settings.

Methods

2.1 Participants

In this pilot study, ten adolescent subjects were identified in a secondary school setting. Each of the participants was within the adolescent age range and was actively pursuing formal academic programs. The participants prepared themselves to complete academic tasks in both experimental conditions: the exposure to the scent of lavender and the no-scent control condition. A within-subject design was used to downplay the effects of individual differences in cognitive ability, baseline stress levels, and scent sensitivity.

The small sample size represents the preliminary nature of the research. Aromatherapy studies often use pilot studies to determine the viability of the research and to approximate the size of effect before subsequent large-scale research (Rahmawati et al., 2022).

2.2 Scent Selection

The choice of lavender essential oil was based on its properly established calmative and cognitive-stimulating effects. Past studies have also indicated that lavender inhalation is linked to anxiety reduction, enhanced emotional regulation, and attentional performance in diverse groups (Ahmad et al., 2019; Malloggi et al., 2021). Beyond this, neurophysiological evidence of EEG research indicates that lavender also affects neural changes in reaction accuracy and attention to diverse relocation (Afghan et al., 2024).

Moreover, both systematic reviews indicate the significance of the quality of essential oils and inhalation techniques in assessing the effectiveness of aromatherapy (Malloggi et al., 2021). It is on this basis that the use of lavender was deemed fitting and theoretically sound as a scent in the study of academic task performance.

2.3 Experimental Design

Within-subject experimental design was chosen. Participants were also told to compete on the same problem-solving challenges in two conditions: the presence of the lavender scent and the no-scent condition. The sequence of conditions was counterbalanced in order to minimize the possible order and fatigue effects. The application of lavender aroma was performed by passive sniffing in the testing space, where similar exposure was maintained among participants.

Both conditions underwent standardization with regard to the difficulty of the task, time taken, as well as the instruction method in order to facilitate internal validity. The methodological strategy is congruent with recent research on the impact of ambient aromas on cognitive functioning and stress recovery (Zhang et al., 2025).

2.4 Measurement Instruments

The use of brief self-reporting questionnaires was applied to measure perceived stress and concentration, and these were administered at the end of every task session. The participants assessed their levels of stress and concentration on three-point ordinal scales (low, moderate, high). Aromatherapy studies use subjective measures extensively because they are sensitive to short-term psychological shifts (Rahmawati et al., 2022).

Task scores were used to assess academic performance, which was calculated as the total number of correct responses to the problem-solving tasks.

2.5 Data Analysis

Non-parametric statistical tests were used due to the small sample size and ordinal data type. The results of the scent and no-scent conditions were compared and analyzed using Wilcoxon signed-rank tests. Control of multiple comparisons was effected by the Holm correction. Rank-biserial correlation was used to determine the extent of observed effects (Luan et al., 2023).

Results

This pilot study established a number of interesting patterns regarding the impacts of lavender scent stimulation on perceived stress, concentration, and academic performance among adolescent study participants. Although statistical significance was not achieved, most preponderantly due to the small sample size, both descriptive statistics and effect size estimates indicated patterns worth additional investigation.

3.1 Effects of Lavender Scent on Concentration

When it comes to concentration, subjects indicated higher levels of concentration in the lavender scent condition compared to the no-scent condition. As was demonstrated in Table 1, the mean concentration scores moved up to 2.30 in the lavender software, as compared to 1.90 in the no-scent condition. The perceived disparity is associated with a medium-to-large effect size, which suggests that the influence of the scent of lavender on the attentional focus during academic activities may have a meaningful impact. The results support previous studies that suggest that lavender inhalation can have beneficial effects on cognitive processes in terms of attention, accuracy, and cognitive flexibility (Afghan et al., 2024). The improvement in concentration observed could be due to the existence of direct neural pathways between the olfactory system and brain activity regions that are related to attention and executive functioning.

3.2 Effects of Lavender Scent on Academic Performance

A similar promising trend was noted in academic performance. The average task scores increased from 7.50 out of 10 correct during the no-scent condition to 8.50 out of 10 correct during lavender. This effect is a medium effect size, which suggests that there may be a significant enhancement in task performance. Correspondent literature has consistently reported parallel improvements in aromatherapy studies relating to academic performance and stress examinations of students. As an example, it was found in study findings by Enwright et al. (2022) that chiropractic students tended to show less test anxiety and better perceived academic readiness when exposed to lavender and rosemary scents. Also, a meta-analysis by Luan et al. (2023) showed that inhalation-based aromatherapy was effective in reducing test anxiety and indirectly enhancing academic performance in college students. Though the current study used adolescents instead of university students, the recorded performance improvement indicates that the cognitive advantages of lavender have the potential to be extended to levels of education.

3.3 Effects of Lavender Scent on Perceived Stress

Conversely, perceived stress levels also exhibited very little difference between the two experimental conditions. The results indicated that the mean stress scores were slightly lower in the no-scent condition than those found in the lavender exposure, as shown in Table 1, 2.10 as compared to 2.00. This small effect indicates that a short period of smelling lavender could be inadequate to produce detectable or immediate decreases in subjective stress between adolescents. This finding is consistent with previous studies showing that aromatherapy's effect against stress could require increased exposure duration, repetitive sessions, or a higher baseline of stress (Ahmad et al., 2019). Though Ahmad et al. (2019) found that academic stress was significantly lowered after lavender aromatherapy, in their research, participants were repeatedly exposed in a long-term intervention, which could explain the results.

3.4 Summary of Results

Figure 1 shows the variation in mean concentration scores between the two experimental conditions. According to the bar chart, it is evident that the concentration was higher in the lavender scent condition when compared to the no-scent condition, which affirms the descriptive trends in Table 1. Its agreement with tabular and graphical data indicates that one can have confidence in the observed pattern, despite the small sample size.

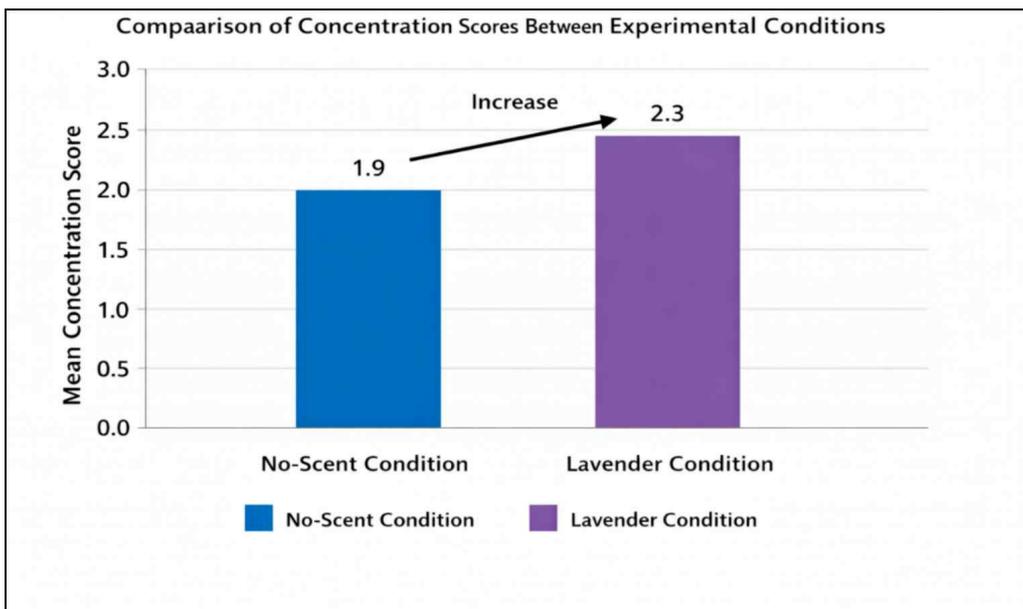


Figure 1: Comparison of Concentration Scores Between Experimental Conditions

Table 1: Mean Scores for Stress, Concentration, and Academic Performance (N = 10)

Variable	No-Scent Condition	Lavender Condition
Perceived Stress	2.10	2.00
Concentration	1.90	2.30
Academic Performance	7.50	8.50

In general, the results indicate that stimulating lavender scent could have stronger short-term implications on cognitive (i.e., concentration and task performance) and affective (i.e., perceived stress) outcomes. These outcomes indicate the significance of identifying the body of cognitive and emotional variables in assessing scent-based amenities in learning environments. Even though cocaine-induced stress reduction might need longer or repeated exposure to the scent, concentration and academic performance may already show signs of improvement after short exposure to the scent during academic activities.

Discussion

This pilot study measured the effect of lavender scent stimulation on reportedly perceived stress, concentration, and academic performance in adolescents. The findings show that exposure to lavender could improve concentration and academic performance in the course of scholastic activities, even when they are not accompanied by immediate decreases in perceived stress. Concentration scores increased between 1.90 in the no-scent condition and 2.30 with exposure to lavender, and the academic performance increased between 7.50 and 8.50 correct responses, showing that olfactory stimulation can be associated with some actionable effects on cognitive functioning. These results are harmonious with the literature available that highlights the cognitive-boosting properties of aromatherapy (Afghan et al., 2024; Luan et al., 2023).

The recorded enhancement of concentration coincides with neuroscientific data that lavender can have a certain impact on the activity of the brain linked to attentional processes and cognitive adaptation. EEG research additionally proved a strong impact of lavender inhalation on shifting between attentional capacities and response accuracy in the brain (Afghan et al., 2024). Such effects are especially relevant in adolescence, a period of development when the prefrontal cortex and executive functioning systems have not yet reached maturity, and thus they are susceptible to environmental and sensory stimuli. In addition, the study of environmental perfumes shows that environmental exposure to vegetable-compounded scents,

e.g., lavender and gardenia, can boost brain functionality and aid stress relief, which supports the extended generally nationwide generalizability of smell-based interventions (Zhang et al., 2025; Cai et al., 2025). All of these findings support the practicality of straightforward, non-invasive treatments, including aromatherapy, to promote cognitive engagement in educational settings.

Despite increases in concentration and academic achievement, there were only marginal differences in the levels of perceived stress in the experimental conditions. This minimal change can probably be explained by the short-term scent exposure provided in the given research. Previous studies have found that the potential stress-reduction effects of aromatherapy become more evident after extended or repeated exposure, and long-lasting inhalation produces more significant psychological and physiological coping benefits (Malloggi et al., 2021; Ahmad et al., 2019). Besides, personal variation in olfactory sensitivity and baseline stress are also possible sources of variation in outcomes, as not every adolescent will react to scent-induced stimuli. These deliberations indicate that the humble stress-related results do not subordinate the potential value of lavender aromatherapy; in fact, these findings underline the importance of exposure time and personal sensitivity.

New information also indicates that aromatherapy can be most effective when used together with other sensory-based modalities. The existing evidence in comparative research shows that when scent stimulation is combined with other modalities like music therapy, it may have synergistic effects that result in a larger reduction in measures of physiological stress and increased emotional control (Borzoo et al., 2025). It seems that multimodal methods are especially useful in the context of education, where students are constantly subjected to multifaceted stressors and competing cognitive tasks. This means that an olfactory, auditory, or visual approach to intervention can offer a more rigorous method of focus enhancement, anxiety reduction, and general well-being during school.

The use of aromatherapy in academic settings is also supported by meta-analytic results. As recent reviews suggest, inhalation-based aromatherapy is effective in reducing the levels of test anxiety and improving the academic performance of high school and university students (Enwright et al., 2022; Luan et al., 2023). These findings resonate with the current results and indicate that the cognitive benefits of olfactory interventions can be extended across the education process and conditions of study. Additionally, multiple studies emphasizing the significance of the quality of essential oils, their concentration, and the method of delivery emphasize the need to have standardized and carefully controlled aromatherapy regimens to ensure predictable results (Malloggi et al., 2021).

Overall, the findings of this pilot study support the hypothesis that lavender aromatherapy will be effective as a viable, low-cost intervention approach to enhance cognitive function in adolescents. The improvements in focus and academic achievement, though low in immediate stress reduction terms, proved to be significant, showing that the changes could be applied in

educational institutions. Further research must focus on longer detail intervention, personalized volumization of smell, and multisensory format of contribution to maximize cognitive and emotional positive effects. Further studies increasing sample sizes and adding objective physiological indicators of stress (heart rate variability or cortisol levels) would contribute to the evidence base of using aromatherapy in academic areas further.

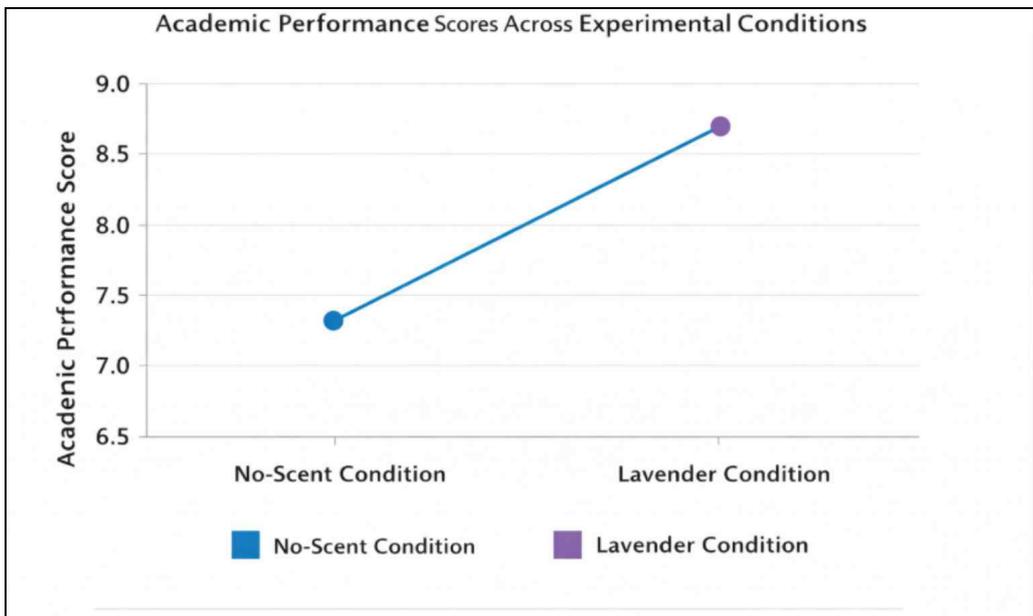


Figure 2: Academic Performance Scores Across Experimental Conditions

This pilot study provides initial results that lavender smell stimulation can help improve concentration and academic performance in academics among teenagers. The subjects showed that attentional control and accuracy in the tasks were better in the lavender tests than in the non-scent condition, implying that aromatherapy could have a positive effect on cognitive performance in the educational environment. The stress-reduction effects in this short-term study were not significant, but the indicated cognitive benefits illustrate the potential of scent stimulation as a low-cost, non-invasive, and simple intervention to promote learning settings.

The results are to be viewed cautiously since the sample size was small ($N = 10$) and the exposure was limited. Future studies would employ a more diversified population sample of adolescents (towards larger samples), longer or repeated scent exposure tasks, and objective measures of stress, like heart-rate fluctuation or cortisol level. Future investigations may benefit from longitudinal research throughout academic semesters on the effectiveness of aromatherapy treatments in improving concentration, academic performance, and general student well-being.

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