

How Phone Notifications Impact Students' Typing Performance

An Experimental Study that Examines the Impact of Auditory Smartphone Notifications on Typing Performance and Cognitive Load in Adolescents

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Introduction & Significance

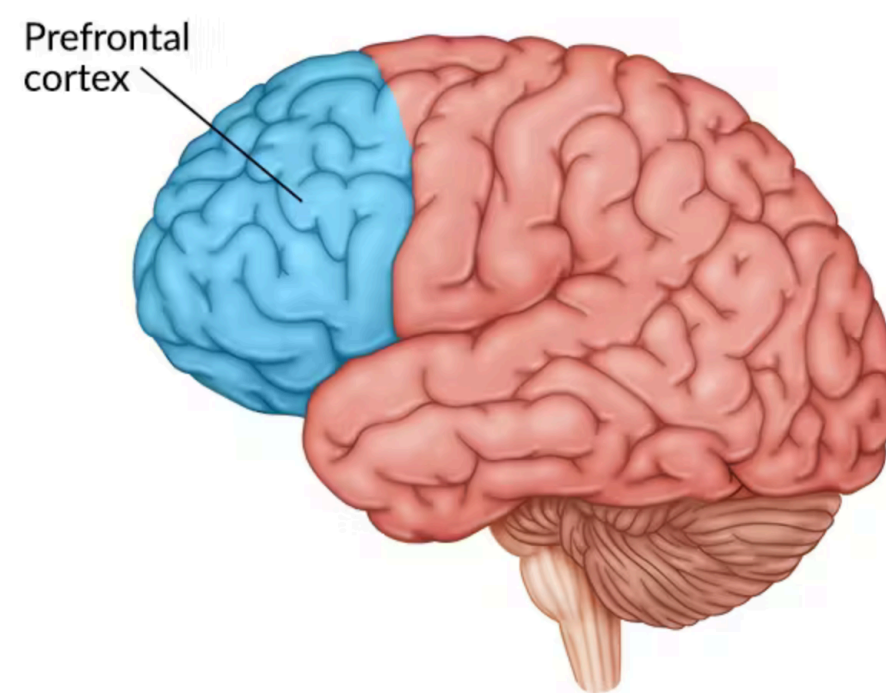
Smartphones are deeply integrated into modern life, and adolescents are exposed to frequent notification sounds throughout the day. These notifications are often perceived as harmless; however, cognitive science suggests that even brief interruptions can disrupt sustained attention during goal-directed tasks.

Human attention is limited and must prioritize relevant information while suppressing distractions. When an unexpected auditory stimulus occurs, it can compete for attentional resources and interrupt ongoing cognitive processing.

In academic environments, where sustained focus is essential, these interruptions may accumulate and reduce efficiency. Research shows that digital notifications can disrupt cognitive processing and slow performance, even when brief.

Typing is a cognitively demanding task requiring continuous attention, motor coordination, and real-time error monitoring, making it an effective model for measuring the impact of real-world distractions.

Cognitive Background & Prior Research



The prefrontal cortex is responsible for task regulation, working memory, and attention control.

Attention is a selective process that allows individuals to focus on relevant stimuli while filtering out irrelevant information. However, this system is vulnerable to attentional capture, in which sudden or salient stimuli automatically redirect focus.

When attention is diverted, individuals must re-engage with the original task using top-down control mechanisms, a process associated with the prefrontal cortex, which plays a key role in attention regulation, working memory, and goal-directed behavior.

This shift introduces a switching cost, meaning that performance may decrease due to the time and cognitive effort required to refocus. Research on cognitive load suggests that when mental resources are already engaged, additional stimuli can interfere with performance by competing for limited attentional capacity.

Furthermore, modern digital environments increase the frequency of these interruptions, raising concerns about their cumulative impact on cognitive efficiency and sustained attention over time.

Research Question

Do auditory notification sounds impair typing speed and accuracy during focused tasks?

Hypothesis

If participants are exposed to auditory smartphone notification sounds during typing tasks, then their typing speed and accuracy will decrease due to attentional capture, increased cognitive load, and switching costs associated with refocusing.

Variables

Independent Variable

- Presence of phone notification sounds during the typing task (silent condition vs. notification condition)

Dependent Variables

- Typing speed (words per minute, WPM), typing accuracy (percentage of correctly typed characters)

Controlled Variables

- Typing test platform (Monkeytype.com), duration of typing task (3 minutes 45 seconds), school-issued computers, testing environment (quiet conference room), notification sound, and volume level, instructions provided to all participants

Materials

- School-issued computers used by participants
- Monkeytype online typing test platform (Monkeytype.com)
- Pre-recorded phone notification sound file
- Quiet conference room used as the testing environment
- Google Sheets spreadsheet for recording and organizing data
- Signed parent consent forms

Methodology & Experimental Design

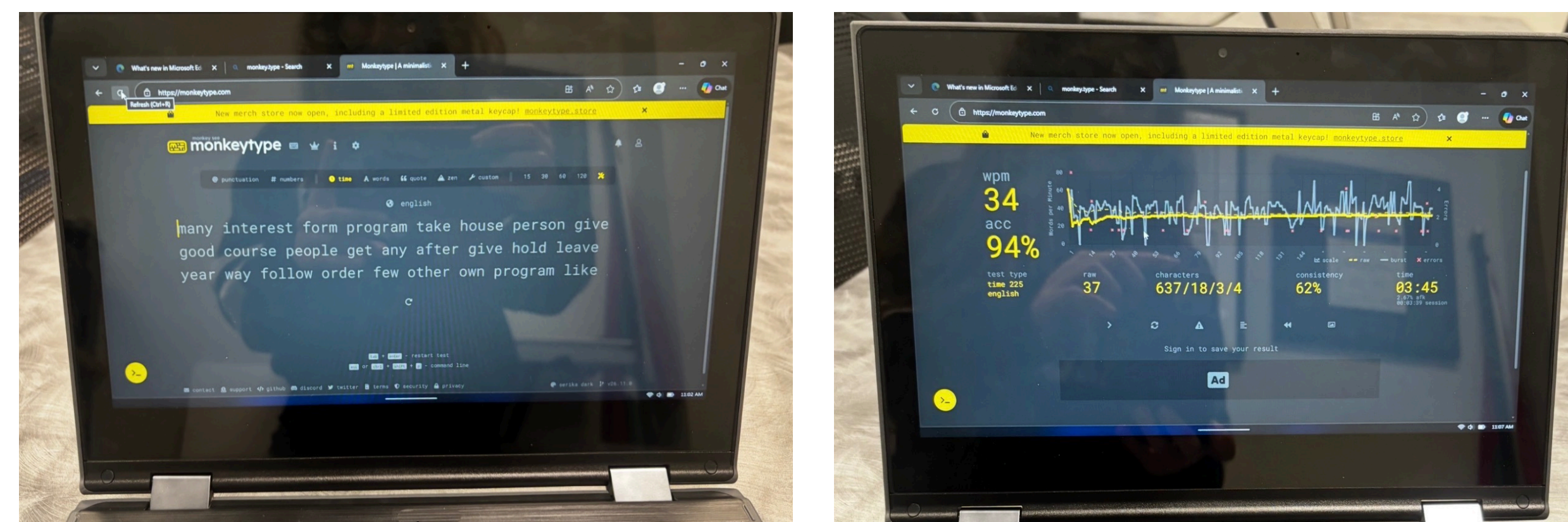
Participants aged 14–17 were recruited through in-class announcements at Signature School. The experiment was conducted in a quiet conference room using school-issued computers, with all participants completing the task on the same typing platform under **standardized conditions**.

Each participant completed two typing trials, each lasting 3 minutes and 45 seconds, using the Monkeytype platform to enable direct comparison between conditions.

In the control condition, participants completed the task in complete silence. In the experimental condition, **three realistic phone notification sounds** were delivered at 0:45, 1:45, and 2:45, each lasting approximately five seconds to simulate real-world interruptions.

A **counterbalanced within-subjects** design was implemented to control for order effects, with half of the participants completing the silent condition first and the other half completing the notification condition first.

Typing speed (words per minute) and accuracy (%) were recorded following each trial. Data were analyzed using a **paired-samples t-test** to assess statistical significance, and **Cohen's d effect size** was calculated to evaluate the magnitude of the observed differences.



Pre-task interface

Post-task results

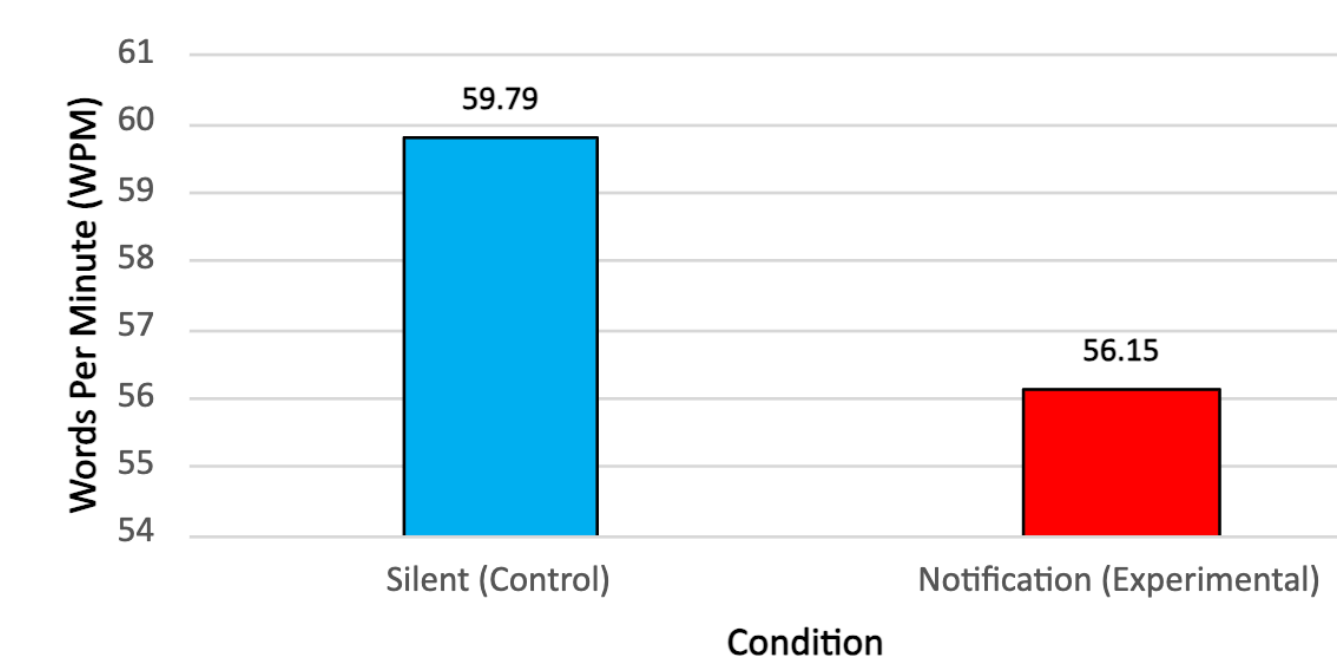
Design Strengths & Data Analysis Methods

- Within-subjects design reduces individual variability
- Counterbalancing minimizes order effects
- Controlled environment ensures consistency
- Standardized timing increases reliability
- A paired-samples t-test was used to compare typing performance between conditions
- Effect size was calculated using Cohen's d

- Participants (n = 34 high school students)
- Controlled Testing Environment (quiet room, standardized devices and conditions)
- Typing Task (3 minutes 45 seconds using a consistent platform)
- Within-Subjects Experimental Design (counterbalanced order of conditions)
- Experimental Conditions: Silent vs. Notification Condition
- Standardized Notification Intervention (3 timed notification sounds)
- Performance Measurement (Typing Speed [WPM] and Accuracy [%])
- Statistical Analysis (Paired t-test and Cohen's d effect size)

Results

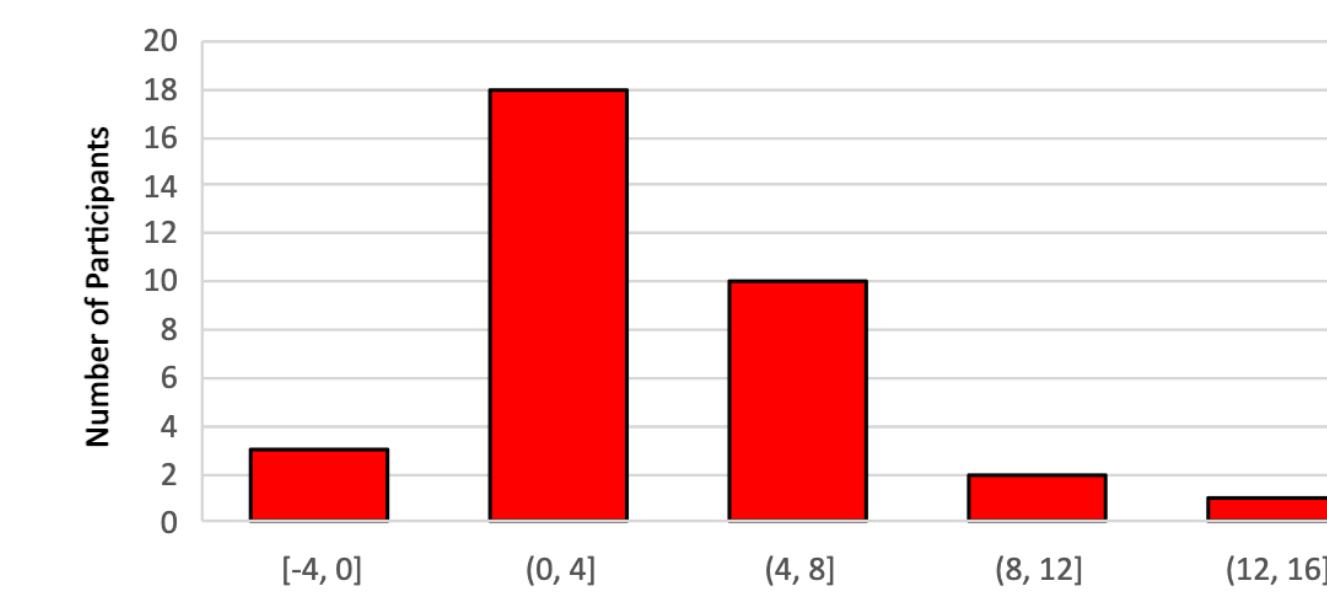
Average Typing Speed (WPM) Under Silent and Notification Conditions



Participants typed more slowly during the notification condition compared to silence.

Mean typing speed decreased from 59.79 WPM to 56.15 WPM, indicating that auditory interruptions reduced performance.

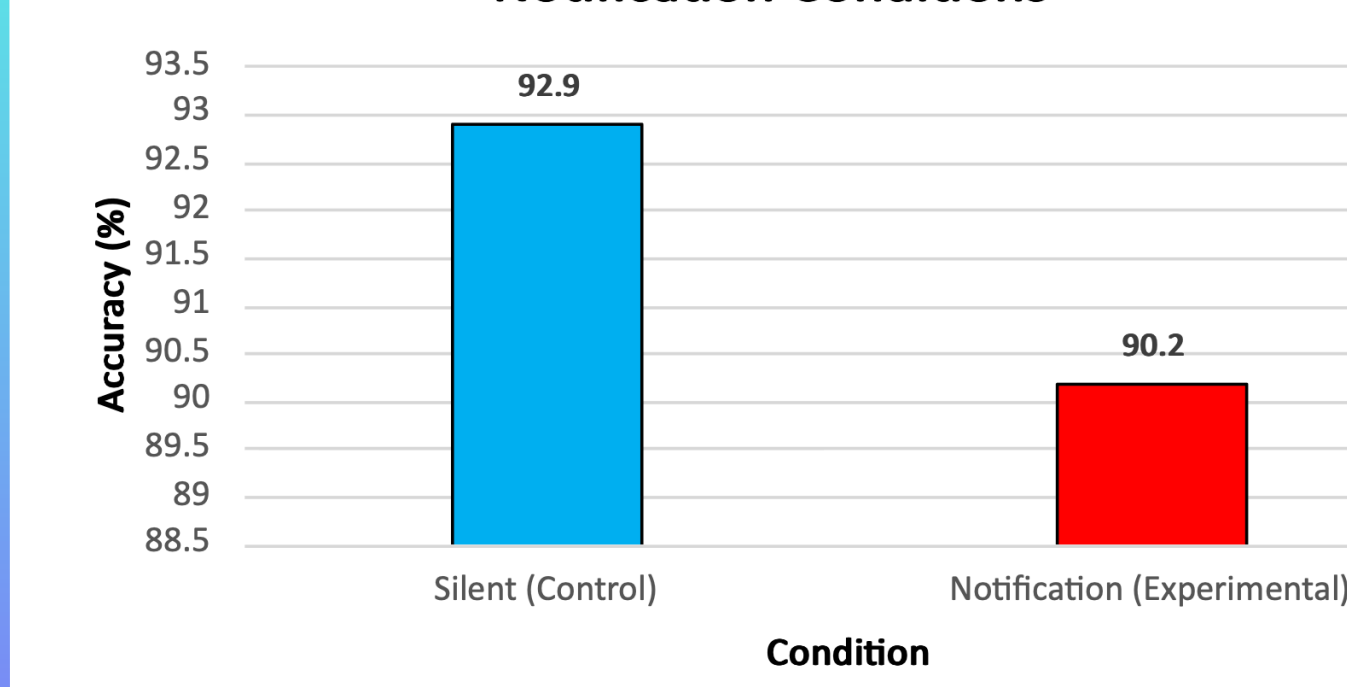
Distribution of Typing Speed (WPM) Change After Notification Sounds



Most participants showed a decrease in typing speed when exposed to notification sounds.

The distribution is skewed toward positive differences (control - notification), indicating that performance declined for the majority rather than only a few individuals.

Average Typing Accuracy (%) Under Silent and Notification Conditions



Participants typed less accurately during the notification condition compared to silence.

Typing accuracy declined by 2.7%, decreasing from 92.9% to 90.2%. This finding suggests that interruptions affected not only speed but also the precision and consistency of responses.

Analysis & Interpretation

Although the numerical differences appear small, a consistent decrease was observed across most participants, indicating a reliable effect of auditory notifications. The statistically significant results ($p < .001$) and large effect size (Cohen's $d \approx 0.95$) suggest that these differences are meaningful rather than due to chance. Notification sounds likely triggered bottom-up attentional capture, interrupting focus and requiring participants to re-engage using top-down control. This introduced a switching cost and increased cognitive load. As a result, even brief interruptions led to measurable declines in both speed and accuracy.

Key Findings

- Typing speed decreased by 3.64 WPM (~6.1%) under notification conditions, indicating reduced performance during auditory interruptions
- Typing accuracy also declined by 2.7%, suggesting that distractions affected speed and precision
- Results were statistically significant ($p < .001$), meaning the observed differences are unlikely to be due to chance
- A large effect size (Cohen's $d \approx 0.95$) was observed, indicating a strong and meaningful impact of notifications on performance

Conclusion

This study demonstrates that auditory smartphone notifications lead to a measurable decrease in typing performance, supporting the hypothesis that external digital stimuli interfere with sustained attention.

The consistent decline across participants suggests that this effect is driven by attentional capture, where unexpected sounds automatically redirect attention away from the task. This creates a switching cost, reducing both efficiency and accuracy.

From a cognitive perspective, this reflects a conflict between top-down control (regulated by the prefrontal cortex) and bottom-up attention triggered by notification sounds.

Overall, these findings indicate that even brief digital interruptions impose a real cognitive cost, potentially impacting students' ability to maintain focus during academic tasks.

These results highlight the importance of managing digital distractions in learning environments to support sustained attention and performance.

Limitations

This study was conducted with a relatively small sample size (n = 34) within a limited age range, which may affect generalizability to broader populations.

Additionally, typing passages were not identical across trials, which may have introduced minor variability in performance. Individual differences in baseline typing ability, attention span, and familiarity with typing tasks may have also influenced results.

Furthermore, the study measured short-term performance under controlled conditions and may not fully reflect long-term or real-world patterns of digital distraction.

However, the within-subject, counterbalanced design increases internal validity and supports the reliability of the observed effect.

Future Research: Attention Differences in ADHD

ADHD is associated with differences in the development of brain systems involved in attention, particularly the prefrontal cortex, which supports top-down control. Research suggests that these regions may develop more slowly, especially in childhood.

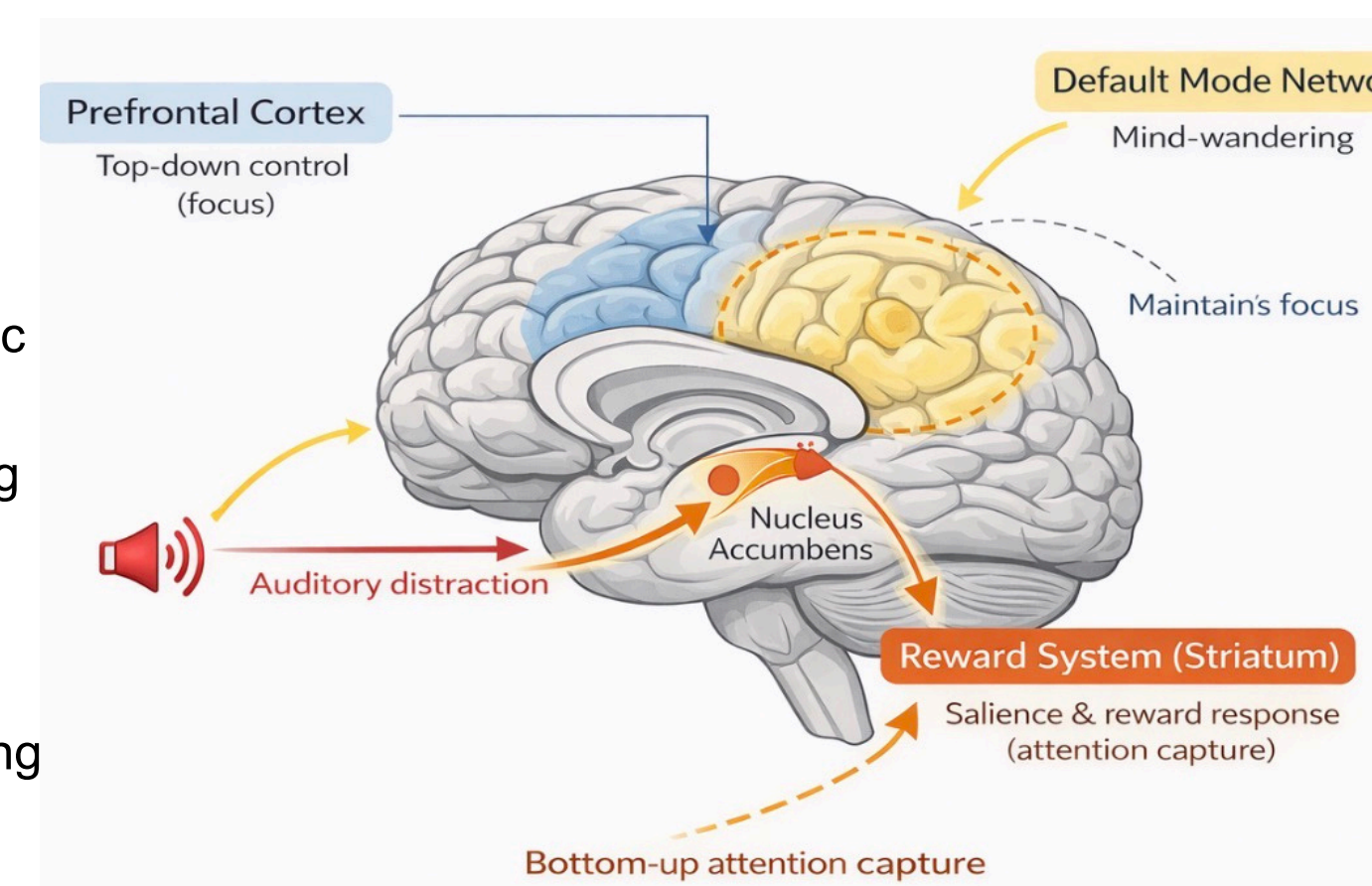
Based on this, future research could examine whether notification sounds produce larger performance declines in individuals with ADHD or higher ADHD symptom levels. Because notifications trigger automatic attentional capture, individuals with reduced top-down control may experience greater switching costs during tasks requiring sustained focus.

This could be tested by comparing changes in typing performance across different levels of attentional control.

Practical Implications

These findings suggest that reducing or managing notification interruptions during tasks may improve focus and performance. This has implications for academic settings, where minimizing digital distractions could support learning and productivity.

Strategies such as silencing non-essential notifications or structuring focused work periods may help mitigate attention disruptions.



Additional Future Directions

- Investigate how notification effects vary across task types (e.g., reading, problem-solving, studying)
- Examine the impact of notification frequency and timing on cognitive performance
- Explore whether long-term exposure to notifications affects attention and learning outcomes
- Study differences across age groups or academic levels

Key References

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