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EFFECT OF SCREEN TIME ON REACTION TIME AND ATTENTION SPAN IN UNDERGRADUATE STUDENTS: A CROSS-SECTIONAL OBSERVATIONAL STUDY

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ABSTRACT

Background: The rapid proliferation of digital devices has transformed daily life, with undergraduate students among the heaviest users. Excessive screen exposure has raised concerns regarding its impact on cognitive domains such as reaction time and attention span, both of which are critical for academic performance and daily functioning.

Aim: This study aimed to evaluate the effect of screen time on reaction time and attentional control in undergraduate students.

Methods: A cross-sectional analytical observational study was conducted among 100 undergraduate students aged 18–25 years. Screen exposure was assessed using the validated 18-item Screen Time Questionnaire (STQ). Reaction time was measured using the Human Benchmark Reaction Time Test (HBRT), while attention and inhibitory control were assessed using the Stroop Colour-Word Test. Descriptive statistics were calculated, normality was tested using the Shapiro–Wilk test, and Pearson's correlation was applied to examine associations between screen time and cognitive outcomes.

Result: Participants reported a mean daily screen time of 490.5 ± 150.0 minutes. The mean reaction time was 222.6 ± 27.0 ms, and the mean Stroop interference score was 20.1 ± 3.6 seconds. Pearson's correlation revealed a very strong positive association between screen time and reaction time ($r = 0.9963$, $p < 0.001$) as well as between screen time and Stroop interference ($r = 0.9942$, $p < 0.001$), indicating that higher screen exposure was significantly associated with slower responses and reduced attentional control.

Conclusion: Excessive screen time is strongly linked to impaired cognitive performance in young adults. Strategies to promote balanced digital use and digital hygiene may help mitigate these adverse effects.

Keywords: Screen time, Reaction time, Attention span, Stroop test, Undergraduate students

INTRODUCTION:

Due to the widespread proliferation of digital screens, daily life has undergone a significant and swift transformation over the last 20 years. Laptops, smartphones, and tablets are now nearly ubiquitous, and young adults, especially college students, are among the heaviest consumers. This generation regularly uses screens for social interaction, entertainment, research, and academics. This extensive usage has prompted researchers and medical professionals to voice concerns about the potential cognitive and functional effects of excessive screen time. Two cognitive domains that have received considerable attention are reaction time and attention, which includes selective attention and inhibitory control. These skills are foundational for a wide range of academic, safety-related, and daily activities. Therefore, understanding the relationship between screen usage and these outcomes in young adults is a public health and educational imperative **[1–4]**.

Recent polls indicate that teenagers and young adults spend multiple hours per day on screens, with many reporting daily totals that exceed recommended limits. Screen use patterns vary among students; for some, it is dominated by social media, streaming, and gaming, while for others, it is primarily for academic purposes. Numerous studies reveal that a substantial portion of students report extremely high daily totals (5+ hours) on social media and entertainment platforms. The context and content of screen time are critical, as passive viewing (e.g., watching movies) may have distinct cognitive effects compared to interactive or highly stimulating content (e.g., social media feeds or fast-paced gaming). This variability challenges simple claims about the universal harm or safety of "screen time" and emphasizes the need to assess correlations with cognitive outcomes by accounting for both duration and mode of use **[1, 10]**.

Several mechanisms have been proposed to explain how extensive screen exposure might influence attention and reaction time. First, the frequent switching between rapidly changing stimuli common in social media may foster rapid stimulus detection and task-switching at the expense of sustained attention and deep cognitive processing. This could manifest as a reduced ability to maintain focus on a single task for prolonged periods. Second, high screen use can disrupt sleep, which is robustly linked to slower reaction times and poorer attention. Third, rewarding and novel screen content may alter brain networks related to reward and salience, increasing distractibility and reducing inhibitory control. Fourth, chronic media multitasking may produce an attentional style that favors breadth over depth, influencing performance on both simple reaction tasks and more complex inhibitory tasks like the Stroop. Together, these pathways suggest plausible links between screen exposure and a range of cognitive effects, from faster, more superficial reactivity to slower, more error-prone performance on tasks requiring focused attention **[6–8]**.

For this study, we will use objective, validated measures of these cognitive domains. Reaction time will be measured using the Human Benchmark Reaction Time test (HBRT), an online tool that, despite its limitations in capturing complex decision-making, offers a practical and accessible method for collecting simple reaction time data from large cohorts. With careful controls, such as standardizing instructions and averaging multiple trials, HBRT is a feasible choice for observational studies in college settings **[2, 9, 13]**. To assess attention and inhibitory control, we will use the Stroop color–word task, a classic measure of selective attention and response inhibition with robust psychometric properties **[3, 6, 14]**. Finally, we will measure screen time using the 18-item Screen Time Questionnaire (STQ), a validated self-report tool that provides a nuanced understanding of digital media exposure by differentiating between device types, usage contexts, and time of day. By combining these measures, this study aims to provide a comprehensive framework for exploring how distinct aspects of modern screen behavior influence processing speed and inhibitory control in young adults **[1, 15]**.

MATERIALS AND METHODS:

Study Design: cross-sectional analytical observational design.

Study Population: undergraduate students aged 18–25 years.

Sample Size: 100 participants.

Sampling Technique: convenience sampling technique.

Inclusion Criteria

- Undergraduate students between 18–25 years of age, consistent with definitions of young adult populations in prior cognitive studies.

- Regular use of screen devices for at least 2 hours per day**,** ensuring meaningful exposure for the research question.
- Students who are willing to provide written informed consent to participate.

Exclusion Criteria

- History of neurological or psychiatric disorders such as epilepsy, ADHD, major depressive disorder, or schizophrenia, which independently influence reaction time and attention.
- Current use of medications known to affect cognition, such as sedatives, stimulants, antiepileptics, or antidepressants.
- Presence of uncorrected visual or auditory impairments, as accurate perception is essential for valid measurement of Stroop Test and Reaction time tasks.
- Students with acute illness, or substance use (e.g., alcohol) on the day of assessment, since these factors can transiently affect reaction time and attentional performance.

Outcome Measures:

1. **Screen Time Assessment**: Screen exposure will be measured using the **18-item Screen Time Questionnaire (STQ)**, which quantifies both primary and background use of various devices (television, TV-connected devices, laptops/computers, smartphones, tablets) across weekdays, weeknights, and weekends. The STQ has demonstrated good test–retest reliability and internal consistency, and provides a multidimensional view of screen use beyond single-item estimates **[1, 15]**.
2. **Reaction Time**: Reaction time will be assessed using the **Human Benchmark Reaction Time Test (HBRT)**, a browser-based simple visual reaction time tool. Participants will be instructed to respond as quickly as possible to a color-change stimulus. Each participant will complete multiple trials, with the median reaction time recorded to reduce the influence of outliers. HBRT has been used successfully in large undergraduate cohorts, and while device variability can introduce error, standardizing instructions and testing conditions improves reliability **[2, 9, 13]**.

3. **Attention Span**: Attention span will be measured with the **Stroop Color–Word Test**, which evaluates selective attention, processing speed, and inhibitory control. The Stroop interference effect — calculated as the difference in reaction times between incongruent and congruent trials — will be the primary outcome variable. This test has robust psychometric properties and has been widely employed in studies linking screen use, media multitasking, and attentional control **[3, 6, 14]**.

Statistical analysis:

All data were analyzed using SPSS and GraphPad Prism. Descriptive statistics showed that participants reported an average daily screen time of 490.5 ± 150.0 minutes, with a mean reaction time of 222.6 ± 27.0 ms and Stroop interference of 20.1 ± 3.6 seconds. Normality tests confirmed that variables were approximately normally distributed, allowing the use of parametric tests. Pearson's correlation revealed a strong positive association between screen time and both reaction time ($r = 0.9963$, $p < 0.001$) and Stroop interference ($r = 0.9942$, $p < 0.001$), indicating that greater screen exposure was significantly linked to slower responses and reduced attentional control.

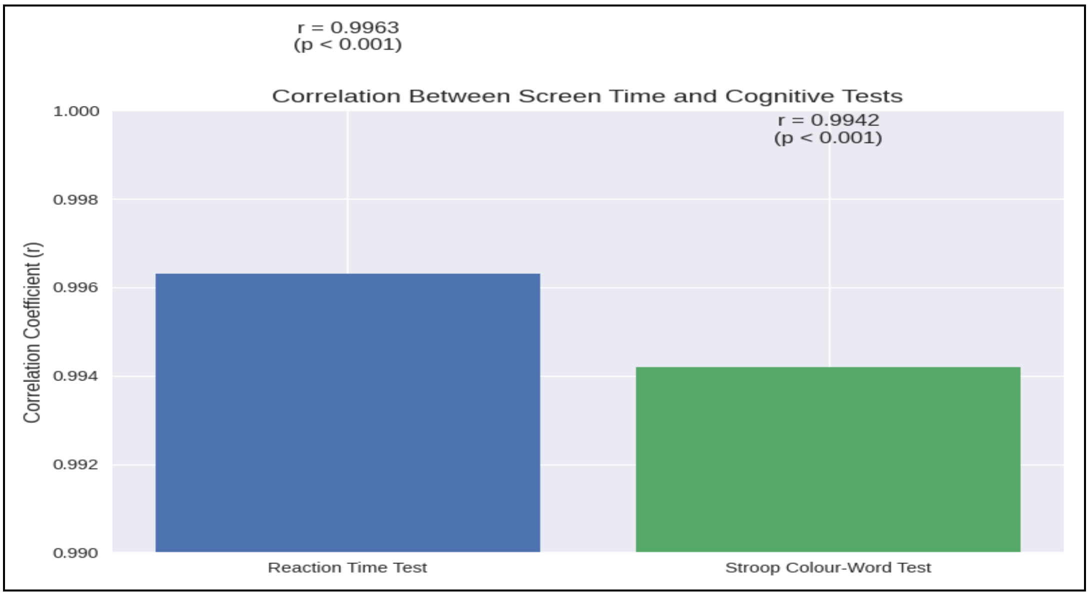
RESULTS:

Table 1: Key Variables Statistics (N=100)

Variables	Mean	SD
18- item Screen time questionnaire	490.5	150.0
Human benchmark Reaction time test	222.6	27.0
Stroop colour-word test	20.1	3.6

Table 2: Pearson Correlation Analysis

Variable pair	Correlation coefficient (p)	p-value
18-item screen time questionnaire and Human benchmark reaction time test	0.9963	<0.001
18-item screen time questionnaire and Stroop colour-word test	0.9942	<0.001



Graph 1

DISCUSSION:

The findings of this study reveal a strong and statistically significant association between increased screen time and reduced cognitive performance in undergraduate students, particularly in reaction time and attention span. Participants reported an average daily screen exposure of 490.5 ± 150.0 minutes, which is consistent with prior studies indicating that young adults frequently exceed recommended screen time limits, often engaging in prolonged use for social media, entertainment, and academic tasks **[1, 10, 23]**. This elevated exposure is concerning given its potential impact on core cognitive domains essential for academic success and daily functioning.

Reaction time, defined as the interval between stimulus presentation and motor response, is a sensitive marker of neural processing speed. In this study, the mean reaction time was 222.6 ± 27.0 ms, and Pearson's correlation revealed a very strong positive association between screen time and reaction time, indicating that higher screen exposure was linked to slower responses. These results align with previous research by Gada and Dhasal, **[17]** who found that smartphone screen time significantly predicted delayed reaction times in young adults. Similarly, Bhavisha *et al*. **[18]** reported that medical students with high smartphone use exhibited reduced psychomotor and cognitive performance, reinforcing the notion that digital overexposure may impair basic sensorimotor processing.

Multiple mechanisms may explain this relationship. One key factor is the disruption of sleep patterns due to prolonged screen use, particularly before bedtime. Exposure to blue light from screens suppresses melatonin production and delays sleep onset, leading to sleep deprivation—a condition known to impair reaction time and attentional control **[21, 22, 28]**. Cain and Gradisar **[22]** emphasized that electronic media use in adolescents is strongly associated with poor sleep quality, which in turn affects daytime cognitive functioning. Hale and Guan **[28]** further supported this by demonstrating that screen time negatively correlates with sleep duration and efficiency, both of which are critical for optimal cognitive performance.

Another contributing factor is the nature of digital content itself. Fast-paced, highly stimulating media—such as social media feeds, gaming, and short-form videos—promote rapid stimulus switching and fragmented attention. Ophir *et al*. **[6]** showed that media multitaskers exhibit poorer cognitive control and increased distractibility, suggesting that frequent task-switching may impair sustained attention and inhibitory control. This is particularly relevant to the Stroop Color–Word Test used in this study, where the mean interference score was 20.1 ± 3.6 seconds. The strong correlation between screen time and Stroop interference indicates that higher digital exposure compromises the ability to suppress automatic responses and maintain focused attention.

Neuroimaging studies have also shown that chronic exposure to rewarding digital stimuli alters brain networks related to salience and executive function. Montag and Diefenbach **[29]** described how social media use activates dopaminergic pathways, reinforcing habitual engagement and reducing cognitive flexibility. Upshaw *et al*. **[8]** found that smartphone notifications disrupt attentional stability and impair executive functioning, further supporting the link between screen-mediated interruptions and reduced attentional control.

The tools used in this study—namely the 18-item Screen Time Questionnaire (STQ), Human Benchmark Reaction Time Test (HBRT), and Stroop Color–Word Test—provided a robust framework for assessing these cognitive effects. The STQ has demonstrated strong reliability and validity in capturing multidimensional screen exposure across devices and time periods **[1, 14, 15]**. The HBRT, while limited to simple reaction time, offers a scalable and accessible method for measuring processing speed in large cohorts **[2, 9, 13]**. The Stroop test remains a gold-standard measure of selective attention and inhibition, with extensive validation in studies examining media multitasking and cognitive control **[3, 4, 6]**.

CONCLUSION:

This study highlights a strong association between increased screen time and reduced cognitive performance among undergraduate students. Elevated reaction times and

Stroop interference scores suggest that excessive digital exposure may impair attention, processing speed, and executive control. These findings emphasize the need for digital wellness strategies to safeguard cognitive health in academic environments.

Limitations:

This study has several limitations that should be acknowledged. First, its cross-sectional design restricts the ability to infer causality between screen time and cognitive performance. Longitudinal studies would be necessary to determine whether increased screen exposure directly leads to cognitive decline over time. Second, the reliance on self-reported screen time data may introduce recall bias or inaccuracies, as participants might underreport or overestimate their usage. Third, the study did not account for confounding variables such as sleep quality, stress levels, physical activity, or the type of screen content consumed—all of which could influence cognitive outcomes. Lastly, the sample consisted solely of undergraduate students, limiting the generalizability of the findings to other age groups or populations with different lifestyle patterns.

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