



Digital Zeigarnik Stress: Exploring the relationship between Digital Clutter, Attention Residue, and Perceived Academic Stress among College Students

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Abstract: The increasing use of digital technologies has become an integral part of students' academic lives while also introducing new cognitive challenges. Digital clutter, characterized by multiple open browser tabs, unread notifications, and unfinished digital tasks, may ultimately interfere with attention and subsequently contribute to academic stress. Grounded in the Zeigarnik Effect, Attention Residue Theory, and the Transactional Model of Stress and Coping, this study examined the relationship between digital clutter, attention residue, and perceived academic stress among college students while also investigating the mediating role of attention residue. A quantitative, cross-sectional, correlational research design was employed. A sample of 161 college students aged 18–27 years was selected through convenience sampling. Data were collected using a researcher-adapted Digital Clutter Questionnaire, a four-item attention residue questionnaire based on Leroy's (2009) conceptualization, and the Perceived Stress Scale-10 (PSS-10). Pearson's product-moment correlation and mediation analysis using Hayes' PROCESS Macro (Model 4) were employed to test the hypotheses. The findings revealed significant positive relationships among digital clutter, attention residue, and perceived academic stress. Furthermore, attention residue significantly mediated the relationship between digital clutter and perceived academic stress, indicating that digital clutter contributes to academic stress primarily by increasing attention residue. The study highlights the importance of promoting healthier digital habits, effective

digital task management, and strategies to reduce attention residue in order to support students' psychological well-being.

Keywords: *Zeigarnik Effect, Digital Clutter, Attention Residue, Perceived Academic Stress.*

1. Introduction

The rapid advancement of digital technology has transformed students' educational experiences across the globe. Gadgets like laptops, smartphones, tablets, and Internet-based learning platforms have become a major part of students' lives. They are used for accessing educational resources, attending virtual classes, and completing academic tasks which leads to digital engagement. While this technological advancement has made life easier and faster, it has also come with a set of cognitive challenges. Students today often multitask across multiple digital platforms, switching between academic work, social media, messaging applications, and numerous browser tabs within a single study session. Often considered harmless, this digital engagement in various tasks at once can impact students' attention, productivity, and psychological well-being.

Although this digital transformation has made information easily accessible, it has also given rise to an often-overlooked phenomenon known as digital clutter. Unlike traditional distractions, digital distractions are often self-initiated, persistent, and easily accessible. Digital clutter often includes a large number of persistently open browser tabs and unread notification badges that consistently hover over one's attention and reduce their ability to maintain a cognitive focus on a single task. Although students commonly perceive multitasking as an efficient strategy for managing academic demands, it is slowly contributing to increasing levels of academic stress and mental fatigue among them.

One theoretical perspective that integrates these cognitive processes related to digital clutter is the Zeigarnik Effect. The theory was first introduced by Bluma Zeigarnik in 1927, and later translated into English (Zeigarnik, 1927/1938). It is considered a psychological phenomenon in which a person tends to remember uncompleted or interrupted tasks better than completed ones. The theory states that uncompleted tasks create a state of cognitive tension that persists until the task is completed. With an increase in the number of digital academic tasks, it raises an important question of whether the digital working environment also leads to cognitive tension (Wendsche et al., 2026). Multiple open browser tabs, unread notifications, and unfinished assignments may function as reminders of uncompleted tasks, potentially

extending the Zeigarnik Effect into students' everyday digital experiences. Open browser tabs may function as digital open loops, continually reminding individuals of unfinished tasks and maintaining cognitive engagement (Allen, 2015)

Furthermore, Sophie Leroy's theory of attention residue explains how unfinished tasks continue to influence cognitive functioning. When individuals switch from an unfinished task to another before completing it or when unfinished digital tasks remain open in the background, a portion of their working memory remains anchored to it, thus disturbing their ability to pay attention to the task at hand. In addition, this residual attention limits the cognitive resources available for the new task, reducing concentration, increasing mental fatigue, and impairing overall task performance, which often leads to frustration and elevated academic stress (Leroy, 2009)

College students frequently manage multiple academic responsibilities simultaneously, including assignments, examinations, online coursework, project deadlines, and extracurricular commitments. In doing so, sometimes the workload becomes too much, enough to make the student feel overwhelmed despite investing substantial time in academic work. The Transactional Model of Stress and Coping proposed by Lazarus and Folkman (1984) explains that stress is not merely an environmental stimulus but a two-way interaction between the person and their environment. Stress increases when environmental demands exceed cognitive and personal resources. In a digital learning environment, open browser tabs and unread notifications act as constant reminders of unfinished tasks and reduced control over academic responsibilities.

Although previous studies have independently examined digital distractions, multitasking, attention residue, and perceived stress, these constructs have largely been studied in isolation. While studies have examined physical clutter and digital distraction, limited research has investigated whether attention residue mediates the relationship between digital clutter and perceived academic stress among college students. Thus, integrating these constructs in one study will help us understand how digital study environments influence students' cognitive and psychological well-being.

The present study aims to examine the relationship between digital clutter (specifically open browser tabs and unread notifications), attention residue, and perceived academic stress among college students. Grounded in the Zeigarnik Effect, Attention Residue Theory, and the Transactional Model of Stress and Coping, this study aims to explore whether attention residue explains the relationship between digital clutter and perceived academic stress.

Understanding these relationships may provide valuable insights for developing interventions to promote healthier digital study habits and improve psychological well-being in higher-education settings.

2. Review of Literature

2.1 *Digital Clutter and Its Psychological Consequences*

Osmany et al. (2025) examined the impact of physical clutter and found that it significantly contributes to stress, emotional exhaustion, drained attention, and impaired psychosocial functioning in workplace and household settings. However, in the modern paperless world, a student's clutter is largely digital. Preceding this physical framework, Ma et al. (2023) investigated browsing clutter, digital behaviours and user coping strategies through a mixed-methods approach consisting of two parts: an interview study (N = 16) and an online survey study (N = 400). The findings suggested that maintaining approximately 5-10 open tabs per window often represented a tipping point that leads to stress. This was considered the point at which an individual showed physical and cognitive frustration. Furthermore, the study noted that users actively reported feelings of guilt, stress, and shame when confronting their open tabs. When evaluating coping mechanisms, Ma et al. differentiated between action and attitude-oriented changes. They found that a change in attitude towards messy tabs (emotion-focused coping) does not reduce stress; instead, what is important is actively changing behavior, which includes forcing oneself to take action and closing the tab after a task is finished and setting digital boundaries. Collectively, these findings suggest that digital clutter is not emotionally neutral but instead carries an emotional burden.

2.2 *The Zeigarnik Effect and Unfinished Cognitive Loops*

Zeigarnik Effect, according to the APA Dictionary of Psychology can be defined as the tendency for interrupted, uncompleted tasks to be better remembered than completed tasks. Syrek et al. (2014) emphasized the importance of unfinished tasks as stressors that delay recovery. They also found a positive relationship between unfinished tasks and impaired sleep among 118 knowledge workers who filled out online diary surveys both before and after the weekend over a period of five weeks. Subsequent research in this field has discovered that humans have an inherent need for completion, which increases their chances of receiving positive reinforcement from supervisors (Claessens et al., 2010). Because the human brain naturally craves closure, unfinished tasks remain active in the working memory, creating background cognitive tension. A study by Masicampo and Baumeister (2011) proved that

unfulfilled goals do not just sit idle; rather, they actively interfere with the cognitive functioning of an individual. Specifically, these unfulfilled goals drain the working memory resources until a concrete action plan is made to close the loop. However, the plan can only reduce thoughts of unfinished goals and does not necessarily alter goal-directed emotions. Consequently, every open tab may serve as a visual reminder of an incomplete task such as a half-read research paper or a pending assignment portal. Mark et al. (2008) conducted a study on 48 participants, and the data suggested that people often try to compensate for unfinished tasks by working faster, a strategy that is often accompanied by elevated levels of stress, frustration, and mental pressure.

2.3 Attention Residue and Cognitive Resource Depletion

Individuals often tend to switch from one task to another before completing the previous one, leaving behind a portion of their attention and cognitive resources anchored to the initial task. Hence, there is a division of attention, which decreases their ability to focus on new tasks. This phenomenon occurs because an individual has a finite cognitive capacity that gets divided between unrelated tasks. This concept of attention residue was formally introduced by Sophie Leroy (2009) in her article, *'Why Is It So Hard to Do My Work?'*. Two experiments were conducted with a sample of 78 undergraduate students who worked on two tasks, A and B. The experiments revealed that to shift their complete attention to the subsequent task B, the initial task must be completed, allowing the individual to disengage from the prior task. However, the results indicated that individuals frequently struggle to fully disengage their attention from an incomplete task, which affects their performance on upcoming tasks.

Another study conducted by Leroy and Glomb (2018) emphasized how the frequency of interruptions alters the ability to finish tasks on time, leading to attention residue, frustration, and diminished performance. In a student's academic life, they continuously shift between various browser tabs and applications. Each open tab or unread notification acts as an interruption that constantly triggers the cumulative layers of attention residue throughout a single study session. When focusing on multiple tasks simultaneously, working memory is split, thereby hindering the ability to process information, increasing errors, and imposing time constraints. Thus, students may become increasingly overwhelmed by the accumulation of unfinished tasks. Because the brain is operating at a reduced capacity, students experience intense mental fatigue and frustration, directly feeding into elevated levels of perceived academic stress.

2.4 The Transactional Model of Stress and Coping

To understand how the cognitive drain leads to psychological distress in an individual, research must focus on Lazarus and Folkman's (1984) Transactional Model of Stress and Coping. A study conducted by Goh et al. (2010) tried to explain transactional processes of appraisal, stress and coping among a sample of 129 Australian participants, validating the complex relationship between primary appraisal, secondary appraisal, stress and coping mechanisms. Primary appraisal in the life of a student is when the student looks at their digital environment and evaluates the threat level. The secondary appraisal occurs when the student evaluates their coping resources. The core idea of transactional theory dictates that psychological stress occurs when environmental demands are appraised by the individual as exceeding their available resources and endangering well-being. Because attention residue may have already depleted cognitive resources, the individual's remaining mental capacity may be appraised as insufficient to meet the demands of unfinished work visible on the screen. Ultimately, open browser tabs are not just digital tools but instead act as environmental stressors. They demand high cognitive resources by generating continuous Zeigarnik loops while simultaneously draining the mental capacity needed to deal with them via attention residue. This imbalance may result in an appraisal of overload, ultimately contributing to elevated academic stress.

3. Methodology**3.1 Aim**

The present study aims to examine the relationship between digital clutter, attention residue, and perceived academic stress among college students.

3.2 Research Objectives

- a) To assess the level of digital clutter, attention residue, and perceived academic stress among college students.
- b) To investigate the relationship between digital clutter and attention residue among college students.
- c) To determine whether digital clutter is associated with perceived academic stress among college students.
- d) To evaluate the mediating role of attention residue in the relationship between digital clutter and perceived academic stress among college students.

3.3 Hypothesis

H1: There will be a significant relationship between digital clutter and attention residue among college students.

H2: There will be a significant relationship between digital clutter and perceived academic stress among college students.

H3: There will be a significant relationship between attention residue and perceived academic stress among college students.

H4: Attention residue will significantly mediate the relationship between digital clutter and perceived academic stress among college students.

3.4 Research design

This study adopted a quantitative, cross-sectional, correlational research design to examine the relationships among digital clutter, attention residue, and perceived academic stress among college students. A quantitative approach was adopted because the study involves the collection and statistical analysis of numerical data obtained through self-report questionnaires. A cross-sectional design was deemed suitable as it allows to collect data from the participants at a single point in time, allowing for the examination of the variables as they naturally occur without any experimental manipulation. A correlational design was used to investigate the associations among digital clutter, attention residue, and perceived academic stress. Additionally, mediation analysis was conducted to examine whether attention residue explains the relationship between digital clutter and perceived academic stress.

Since no variables were manipulated or controlled by the researcher, the study is non-experimental in nature.

3.5 Sample

1. **Sample size:** A total of 161 (34 males and 127 females) college going students aged between 18-27 years were recruited. The sample included students from a wide range of academic disciplines, including Medicine, Law, Psychology, Pharmacy, Biotechnology, Computer Science, and other undergraduate and postgraduate programs.
2. **Sampling method:** Participants were recruited using convenience sampling through an online Google Form circulated among students from different colleges and universities. Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

3.6 Variables

- a) *Independent Variable*: Digital Clutter
- b) *Mediating Variable*: Attention Residue
- c) *Dependent Variable*: Perceived Academic Stress

3.7 Measures

3.7.1 Digital Clutter Questionnaire (DCQ)

Digital clutter was assessed using a researcher-adapted questionnaire based on the conceptualization of digital clutter proposed by Uğur and Çalışkan (2022). The original instrument was developed for workplace settings; therefore, the items were modified to reflect the digital academic environment of college students. It was used to assess the level of digital clutter experienced by individuals. The questionnaire consists of 10 items rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). One item is reverse scored before calculating the total score. Total scores range from 10 to 50, with higher scores indicating greater levels of digital clutter. In the present study, the Digital Clutter Questionnaire demonstrated good internal consistency (Cronbach's $\alpha = 0.822$). Permission to adapt the instrument was obtained from the original authors.

3.7.2 Attention Residue Scale (ARS)

Attention residue was assessed using a four-item questionnaire developed for the present study based on the theoretical framework proposed by Leroy (2009). It was used to assess the extent to which an individual's attention remains occupied by a previous task while performing a new task. The concept of attention residue was first introduced by Dr. Sophie Leroy (2009). The scale consists of four items rated on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Total scores range from 4 to 20, with higher scores indicating greater attention residue, reflecting increased difficulty in disengaging from previous tasks. In the present study, the Attention Residue Scale demonstrated acceptable internal consistency (Cronbach's $\alpha = .793$).

3.7.3 Perceived Stress Scale-10 (PSS-10)

The Perceived Stress Scale-10 (PSS-10), developed by Cohen, Kamarck, and Mermelstein (1983), was used to assess the degree to which individuals perceive situations in their lives as stressful during the previous month. Permission to use the PSS-10 was obtained through the ePROVIDE platform in accordance with the instrument's licensing requirements. The scale consists of 10 items rated on a 5-point Likert scale ranging from 0 = Never to 4 = Very Often. Four items (Items 4, 5, 7, and 8) are reverse scored before calculating the total

score. Total scores range from 0 to 40, with higher scores indicating higher levels of perceived stress. The PSS-10 has demonstrated good psychometric properties, with Cronbach's alpha values ranging from 0.78 to 0.91, indicating good reliability and validity. In the present study, the Perceived Stress Scale demonstrated good internal consistency (Cronbach's $\alpha = 0.826$).

3.8 Procedure

Data for the present study was collected via Google Form, which was distributed to college and university students through convenience sampling. Before participating, respondents were provided with an informed consent form explaining the purpose of the study. Participants were assured of anonymity, confidentiality, and voluntary participation and that the data collected would be used solely for academic research purposes only. The selected participants were asked to complete a structured questionnaire. Clear instructions were provided for completing the questionnaires, and participants were encouraged to respond honestly and independently. Upon completion of data collection, the responses were screened for completeness and accuracy prior to statistical analysis.

3.9 Statistical Analysis

The collected data was analyzed using IBM Statistical Package for the Social Sciences (SPSS) Version 32.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed to summarize the data. The internal consistency of the study instruments was assessed using Cronbach's alpha. Pearson's product-moment correlation was performed to examine the relationships among the study variables. Mediation analysis was conducted using Hayes' PROCESS Macro (Model 4) with 5,000 bootstrap samples.

4. Result

Table 4.1: Descriptive statistics of digital clutter, attention residue, and perceived academic stress ($N = 161$)

Variable	M	SD	Min	Max	Skewness	Kurtosis
Digital Clutter	30.39	6.970	16	48	0.175	-0.592
Attention Residue	13.86	3.062	4	20	-0.341	-0.144
Perceived Academic Stress	20.79	6.170	1	37	0.124	0.251

Note. M = Mean; SD = Standard Deviation; Min = Minimum; Max = Maximum.

Descriptive statistics were calculated for digital clutter, attention residue and perceived academic stress among college students based on a sample of 161 participants. As shown in Table 4.1, the mean digital clutter score was 30.39 (SD = 6.970), with scores ranging from 16 to 48. The mean attention residue score was 13.86 (SD = 3.062), with a range from 4 to 20. The mean perceived academic stress score was 20.79 (SD = 6.170), with the scores ranging from 1 to 37.

The skewness values ranged from -0.341 to 0.175, while the kurtosis values ranged from -0.592 to 0.251. All values fell within the acceptable range, indicating that the assumption of normality was met.

Table 4.2: Pearson's correlation matrix for digital clutter, attention residue, and perceived academic stress ($N = 161$)

Variables	DC	AR	PAS
DC (Digital Clutter)	—		
AR (Attention Residue)	0.374***	—	
PAS (Perceived Academic Stress)	0.256**	0.331***	—

Note. **Correlation is significant at the 0.01 level (2-tailed). ***Correlation is significant at the 0.001 level (2-tailed).

Pearson's product-moment correlation analysis was conducted to examine the relationships among digital clutter, attention residue, and perceived academic stress. As shown in Table 4.2, digital clutter was positively and significantly correlated with attention residue ($r = .374, p < .001$) and perceived academic stress ($r = .256, p = .001$). Attention residue was also positively and significantly correlated with perceived academic stress ($r = .331, p < .001$). These findings indicate significant positive associations among all three study variables.

Table 4.3: Regression Coefficients for the Mediation Analysis ($N = 161$)

Outcome Variable	Predictor	B	SE	t	p
Attention Residue	Digital Clutter	0.164	0.032	5.086	< .001
Perceived Academic Stress	Digital Clutter	0.136	0.071	1.926	.056
Perceived Academic Stress	Attention Residue	0.551	0.161	3.420	< .001

Note. B = unstandardized regression coefficient; SE = standard error.

A simple mediation analysis was conducted using Hayes' PROCESS Macro (Model 4) with 5,000 bootstrap samples to examine whether attention residue mediated the relationship between digital clutter and perceived academic stress. As shown in Table 4.3, digital clutter significantly predicted attention residue ($B = 0.164$, $SE = 0.032$, $t = 5.086$, $p < .001$). When both digital clutter and attention residue were entered as predictors of perceived academic stress, attention residue significantly predicted perceived academic stress ($B = 0.551$, $SE = 0.161$, $t = 3.420$, $p < .001$), whereas the direct effect of digital clutter on perceived academic stress was not statistically significant ($B = 0.136$, $SE = 0.071$, $t = 1.926$, $p = .056$).

Table 4.4: Total, Direct, and Indirect Effects of Digital Clutter on Perceived Academic Stress through Attention Residue ($N = 161$)

Effect	B	SE	95% CI	p
Total Effect	0.227	0.068	[0.093, 0.361]	.001
Direct Effect	0.136	0.071	[-0.004, 0.276]	.056
Indirect Effect	0.091	0.037 [†]	[0.025, 0.168]	—

Note. B = unstandardized regression coefficient; SE = standard error. For the indirect effect, SE represents the bootstrap standard error (BootSE). The indirect effect was estimated using 5,000 bootstrap samples.

As presented in Table 4.4, the total effect of digital clutter on perceived academic stress was statistically significant ($B = 0.227$, $SE = 0.068$, $p = .001$). However, after attention residue was included as the mediator, the direct effect of digital clutter on perceived academic stress was not statistically significant ($B = 0.136$, $SE = 0.071$, $p = .056$). The indirect effect of digital clutter on perceived academic stress through attention residue was significant ($B = 0.091$, $BootSE = 0.037$, 95% CI [0.025, 0.168]), as the bootstrap confidence interval did not include zero. These findings provide evidence that attention residue significantly mediated the relationship between digital clutter and perceived academic stress.

5. Discussion

The present study, titled Digital Zeigarnik Stress: Exploring the relationship between Digital Clutter, Attention Residue, and Perceived Academic Stress among College Students, aimed to examine the relationship between digital clutter and perceived academic stress while also investigating whether attention residue mediates this relationship. Perceived academic stress refers to the psychological pressure and emotional strain experienced by students when

they perceive that academic demands, such as coursework, examinations, assignments, time management, and academic expectations, exceed their available coping resources. Accordingly, the study sought to determine whether attention residue serves as the underlying mechanism through which digital clutter contributes to perceived academic stress.

A total of 161 college students (34 males and 127 females) participated in the study through convenience sampling. The findings supported all of the proposed hypotheses. Digital clutter was found to be positively associated with attention residue and perceived academic stress. Additionally, attention residue demonstrated a significant positive relationship with perceived academic stress. Furthermore, the mediation analysis revealed that attention residue significantly mediated the relationship between digital clutter and perceived academic stress. Specifically, higher levels of digital clutter were associated with greater attention residue, which, in turn, was associated with higher levels of perceived academic stress.

5.1 Digital Clutter and Attention Residue

The first hypothesis proposed that there would be a significant relationship between digital clutter and attention residue among college students. The findings supported this hypothesis, revealing a significant positive relationship between digital clutter and attention residue ($r = .374$, $p < .001$). Furthermore, regression results from the mediation model confirmed that digital clutter significantly predicted attention residue ($B = 0.164$, $SE = 0.032$, $p < .001$). These findings suggest that students who experienced higher levels of digital clutter were also more likely to experience greater attention residue.

These findings can be explained through the Zeigarnik Effect (Zeigarnik, 1927) which states that open browser tabs, unread notifications, and unfinished digital tasks may function as persistent reminders of incomplete work, making it difficult for students to mentally disengage from previous tasks. This explanation is further supported by Leroy's (2009) Attention Residue Theory, which proposes that switching from an unfinished task to a new one leaves a portion of an individual's attention focused on the previous task, thereby limiting the cognitive resources available for the current task at hand. This finding is consistent with previous studies by Ma et al. (2023), who reported that excessive browser tabs were a source of cognitive and emotional burden, and by Mark et al. (2008), who found that unfinished tasks and frequent interruptions increased mental workload.

5.2 Digital Clutter and Perceived Academic Stress

The findings supported the second hypothesis by demonstrating a significant positive relationship between digital clutter and perceived academic stress ($r = .256$, $p = .001$). In

addition, regression results indicated that digital clutter significantly predicted perceived academic stress ($B = 0.227$, $SE = 0.068$, $p = .001$). These findings suggest that students who experienced higher levels of digital clutter were also more likely to report greater levels of perceived academic stress.

These findings can be explained through the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984), which proposes that stress arises when environmental demands exceed an individual's available coping resources. In the present study, digital clutter, in the form of open browser tabs, unread notifications, and unfinished digital tasks, may have acted as environmental stressors that contributed to academic overload. The present findings are consistent with those of Osmany et al. (2025), who found that clutter contributed to stress and emotional exhaustion.

5.3 Attention Residue and Perceived Academic Stress

Consistent with the third hypothesis, attention residue was found to be positively associated with perceived academic stress ($r = .331$, $p < .001$). Regression results from the mediation analysis further indicated that attention residue significantly predicted perceived academic stress ($B = 0.551$, $SE = 0.161$, $p < .001$). These findings suggest that students who experienced higher levels of attention residue were also more likely to report greater levels of perceived academic stress.

These findings can be explained through Attention Residue Theory (Leroy, 2009), which proposes that when individuals switch from one unfinished task to another, a portion of their attention remains focused on the previous task, thereby reducing the cognitive resources available for the current task. Consequently, students may experience difficulty concentrating, increased mental fatigue, and reduced academic efficiency, all of which can contribute to higher levels of perceived academic stress. The present findings are consistent with those of Leroy and Glomb (2018), who reported that incomplete task transitions reduce concentration and increase cognitive strain, thereby increasing the likelihood of experiencing academic stress.

5.4 The Mediating Role of Attention Residue

The fourth and central hypothesis of the study, that attention residue would significantly mediate the relationship between digital clutter and perceived academic stress, was supported by the findings, which revealed a significant indirect effect of digital clutter on perceived academic stress through attention residue ($B = 0.091$, $BootSE = 0.037$, 95% CI [0.025, 0.168]). The total effect of digital clutter on perceived academic stress was significant ($B = 0.227$, $SE = 0.068$, $p = .001$); however, after attention residue was included in the model, the direct effect

of digital clutter on perceived academic stress became non-significant ($B = 0.136$, $SE = 0.071$, $p = .056$). These findings indicate that attention residue mediated the relationship between digital clutter and perceived academic stress, suggesting that digital clutter increases perceived academic stress indirectly by increasing students' attention residue. Although a significant positive relationship was observed between digital clutter and perceived academic stress, mediation analysis revealed that this relationship was largely explained through attention residue. In other words, digital clutter did not appear to influence academic stress directly after accounting for attention residue; rather, it contributed to stress by increasing students' attention residue.

These findings can be understood by integrating the Zeigarnik Effect (Zeigarnik, 1927), Attention Residue Theory (Leroy, 2009), and the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984). Open browser tabs, unread notifications, and unfinished digital tasks may function as reminders of incomplete work, thus creating a sense of urgency and cognitive tension that makes it difficult for students to disengage from previous tasks while focusing on their current academic work. According to Attention Residue Theory, this incomplete disengagement from the previous task often leads to a division of attention, leaving a portion of attention focused on earlier tasks, reducing the cognitive resources available for the current task. Consequently, when students perceive these persistent cognitive demands as exceeding their available coping resources, they are more likely to experience higher levels of perceived academic stress.

Overall, the findings suggest that attention residue serves as the primary psychological mechanism through which digital clutter exerts its effects on perceived academic stress. Rather than influencing stress solely through the cluttered digital environment of the students, digital clutter appears to increase stress by leaving students cognitively preoccupied with multiple unfinished digital tasks, thereby reducing their ability to concentrate effectively on their current academic work. These findings highlight the importance of managing digitally cluttered environments in ways that minimize unnecessary distractions and support effective task completion among college students. Interventions aimed at reducing digital clutter and promoting better digital task management may help reduce attention residue and, consequently, reduce perceived academic stress among college students. However, simply minimizing digital clutter may not be sufficient to reduce academic stress. Addressing the psychological sense of incompleteness associated with unfinished digital tasks may be equally important in promoting students' well-being.

6. Conclusion

This study explored the relationship between digital clutter, attention residue and perceived academic stress among college students, with a particular focus on their implications for students' mental health and overall well-being. The study also investigated the mediating role of attention residue. The findings supported all four hypotheses, demonstrating that digital clutter was positively associated with attention residue and perceived academic stress, while attention residue was also positively related to perceived academic stress. Furthermore, mediation analysis revealed that attention residue significantly mediated the relationship between digital clutter and perceived academic stress.

The findings suggest that digital clutter increases academic stress among students primarily by increasing attention residue. By integrating the Zeigarnik Effect, Attention Residue Theory, and the Transactional Model of Stress and Coping, the study provides a clear understanding of how digitally cluttered environments affect students' cognitive functioning and psychological well-being. The findings emphasize the importance of fostering healthier digital habits, effective digital task management, and greater awareness of the cognitive consequences of unfinished digital tasks. As academic activities continue to become increasingly digital, it is important to promote both self-awareness and awareness of one's digital environment.

6.1 Limitations

Cross-Sectional Research Design: The present study employed a cross-sectional research design, which limits the ability to establish causal relationships among digital clutter, attention residue, and perceived academic stress. Future studies using longitudinal or experimental designs would provide a better understanding of the directionality of the relationships among these variables.

Sampling and Generalizability: The study used convenience sampling and included only college students, which may limit the generalizability of the findings to other age groups and populations. Future studies should try to include more diverse samples, which would improve the external validity of the findings.

Self-Report Measures: The questionnaire used for sample collection included self-report questions. These questions often make the responses susceptible to biases such as social desirability and common method bias. Future studies may incorporate more objective measures to reduce the likelihood of response biases.

Limited Scope of Variables: The present study examined the relationship between digital clutter, attention residue, and perceived academic stress. However, other variables that may influence perceived academic stress, such as academic workload, sleep quality, personality characteristics, coping strategies, and time management skills, were not included in the present study.

6.2 Future Implications

Future Research: Future studies may employ longitudinal and experimental research designs to establish causal relationships among digital clutter, attention residue, and perceived academic stress. Examining these variables across diverse populations such as adolescents and working professionals can provide a better understanding of the topic and strengthen the generalizability of the findings.

Practical Applications: The findings of the present study highlight the importance of promoting digital well-being, effective task management, and strategies aimed at reducing attention residue. Educational institutions and organizations may incorporate digital well-being programs and awareness initiatives to help students manage digital distractions and reduce academic stress. Additionally, training programs that encourage organized digital workspaces, effective notification management, and healthy task-switching habits may help minimize attention residue and improve students' concentration and overall psychological well-being.

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