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Article

The effect of workspace tidiness on schoolwork performance of high school students

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SUMMARY

Adolescents tend not to prioritize organization. Previous research indicates that the degree to which a student's workspace is organized can impact their academic performance. Current literature shows that an organized desk produces better focus and efficiency. Prior studies focused on college students, the professional workplace, and home clutter. However, no literature explored these effects on high school students. The impact of tidy workspaces on adults cannot be assumed to hold for adolescents because of differences in development. Here, we investigated changes in the accuracy and efficiency of high school students when completing an academic task in organized and disorganized environments. We hypothesized that high school students would perform worse, in terms of accuracy and efficiency, in a disorganized environment. Twenty-three high school student volunteers were given a standardized math test in both organized and disorganized workspaces. While students answered more questions and more questions correctly on average in the organized environment, a repeated measures t-test indicated that statistical significance was not reached. Despite this study's lack of statistical significance, further research on this topic is warranted.

INTRODUCTION

Individuals are always looking for ways to improve their efficiency and accuracy to meet the demands of the current modern society. One factor that can impact efficiency is the optimization and organization of the workspace (1,2). Generally, people prefer and feel more comfortable in organized over disorganized environments (3). Further, working in disorganized environments tends to be stressful and distracting (1). Stress and distraction can have a negative impact on efficiency by causing fatigue and lack of focus (4). Interestingly, however, a recent study found that disorganized environments promoted more creativity, which plays a role in quality, accuracy, and efficiency (5).

There are many apparent disadvantages of working in a disorganized environment. The visual perception system in the brain can process a limited number of outside stimuli, which can compete for visual attention (6,7). The more stimuli present, the harder it is for the brain to focus on one object (6,8). The clutter in disorganized workspaces can impact focus on the task at hand. Distractions such as objects and perceptions can slow down a person's ability to process information, causing mistakes (4). For example, when asked to watch and answer questions about a video, college participants procrastinated and answered fewer questions correctly in a disorganized environment (9). In addition, when tasked with a baffling puzzle, college participants persisted with the task for a shorter amount of time in a disorganized environment (1). Current research regarding workspace organization has examined a variety of subjects, including college students, the professional workplace, and home clutter. Most studies that looked at the effects of disorganized workspaces on academics utilized college students. While college students are convenient subjects for college professors to study, they do not represent the traits and experiences of different age ranges (10,11). Research on this issue in high school settings is seldom, if ever, conducted.

A profound amount of cognitive and biological changes occurs in adolescent development (12). These changes contribute to behavioral differences between adults and adolescents (12). Due to the underlying changes in the brain, adolescents are more likely to lose concentration from distractions than adults (12). On the contrary, the developing brain enhances the ability to learn and memorize new information (13). When given various learning tasks, such as memorizing card numbers, adolescents displayed stronger memory than adults (14). Therefore, generalizing study results of adult-aged participants to adolescents can draw incorrect conclusions.

Workspaces play a crucial role in the academic lives of high school students. On average, high school students spend about 2.7 hours on homework per school night (15). Students can reduce that time or finish more tasks by finding ways to be more efficient. Because adolescents tend not to prioritize organization, there is a risk that the workspace they use to complete academic tasks will be disorganized (15).

The purpose of this study was to determine in what way clutter and distraction affect high school students when trying to complete assignments. To address this research gap, we sought to determine the impact of the workspace organization by assessing academic accuracy in mathematics. We gave students standardized math tests in two types of environments, one organized and one disorganized. Considering that each high school student varies in academic ability, we opted for a within-subject design where each participant performed the math test in an organized and disorganized environment in separate sessions. A one week gap separated each session. We hypothesized that student performance would decrease when completing an academic task in a disorganized workspace versus an organized one. We measured student performance by recording the number of test questions attempted in each environment (efficiency), and the number of questions answered correctly in each environment (accura-

cy).

RESULTS

In this study, we sought to determine in what way clutter and distraction affect the academic performance of high school students by assessing academic performance using a set of mathematics questions answered in either organized or disorganized environments. Our two primary dependent variables were student efficiency and accuracy. We defined efficiency as the number of attempted test questions in the given amount of time, while accuracy was defined as the number of test questions answered correctly. Examining both measures is important because attempting more questions correctly indicates increased focus and potentially increased test scores. We compared students' test results in both environments.

We designed two standardized math tests of equivalent difficulty. Students took a test in the organized environment first and in the disorganized environment one week later (**Figure 1**-**2**). To provide the most accurate results, we conducted a repeated measures t-test. This statistical analysis measures one group of participants in both conditions (11). Testing each participant in each workspace limited the effects of academic knowledge, level of math tested, and test-taking ability on the results.

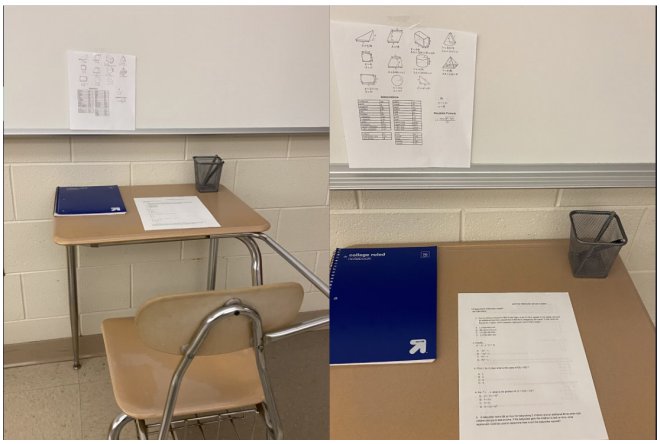

Figure 1: Organized workspace environment. The environment was designed to be minimal and neatly organized. Papers were placed neatly, and very few pens and pencils were in the cup holder. On the left is a zoomed-out image of the work environment, and on the right is a zoomed-in image of the desk.

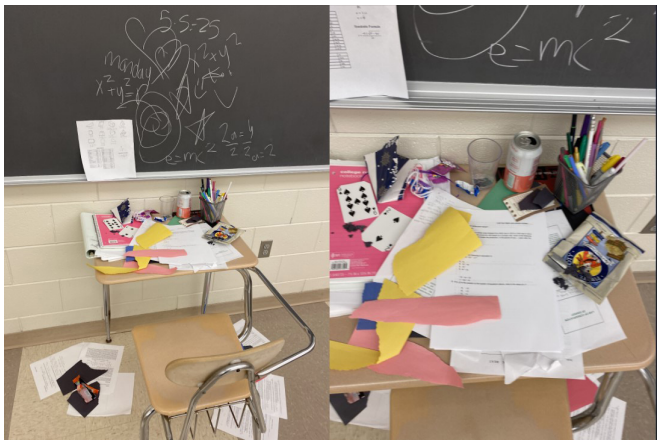

Figure 2: Disorganized workspace environment. The environment was designed to be cluttered and disorganized. Folders and pencil cup holders were overcrowded, and papers, food wrappers, cups, pencils, and pens were scattered all over each desk space. On the left is a zoomed-out image of the work environment, and on the right is a zoomed-in image of the desk.

We graded the 23 student participants' tests and tabulated the number of questions attempted and the number of questions correct. Once completed, we analyzed the results using a repeated measures t-test in a statistical software tool. Selecting a two-tailed t-test showed us whether test results skewed better or worse.

To use a repeated measures t-test, the distribution of results must be normal. A Shapiro-Wilk normality test was conducted on the data. The normality test indicated that the test results fit a normal distribution (p= 0.259 questions attempted and p = 0.359 questions correct). As the results were normally distributed, we conducted the repeated measures t-test.

There was a trend for students to attempt more questions on the test in the organized environment than on the test in the disorganized environment (**Figure 3**, mean = 22.52 for test 1 versus mean = 20.61 for test 2). The t-test analysis indicated that the change in student efficiency did not reach statistical significance in the disorganized environment at a 95% level of confidence (p = 0.051, t(22) = 2.061).

For the accuracy metric, students answered, on average, the same number of questions correctly in the two environments (**Figure 4**, mean = 17.78 for test 1 versus mean = 16.56 for test 2). Once again, the comparison of the number of correct questions between test 1 and test 2 indicates that student accuracy did not reach statistical significance in the disorganized environment at a 95% level of confidence (p = 0.175, t(22) = 1.40).

After the second test, participants were asked to fill out a short survey asking about their workspace preferences. The survey intended to compare if the test results aligned with the participant's personal preferences. Based on the survey, about 85% of the students found the disorganized environment stressful, and 89% felt more focused in the organized workspace.

DISCUSSION

We examined how workspace organization affects the academic performance of high school students when completing a standardized math test. The experimental hypothesis predicted high school students would perform worse in disorganized workspaces. Many current studies suggest that the organization of a work environment can be a source of distraction affecting performance (1,2,4,9). However, our study's results did not conclusively support the hypothesis. While the averages for both efficiency and accuracy indicated that students performed worse, the results were not statistically significant. In the post-test survey, 85% of the students reported that the disorganized environment was more stressful than the organized environment, and 89% reported feeling more focused in the organized workspace.

Interestingly, after reviewing the results, we found one student whose performance substantially improved in the disorganized test environment, with six more attempted questions and ten more correct questions. If the scores from this one student are discarded, the results become statistically significant for both student efficiency and accuracy. However, their

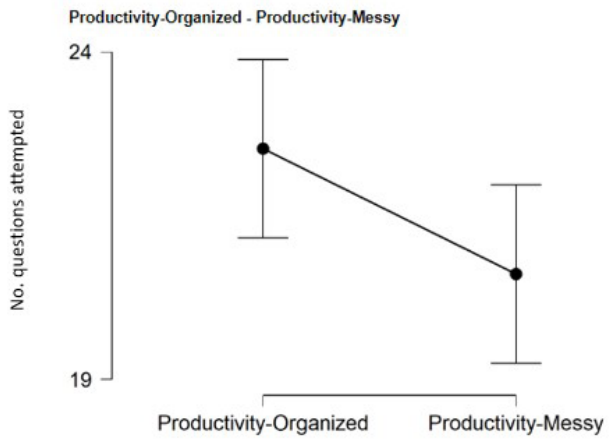

Figure 3: Efficiency statistics results. Effect of organization on efficiency. The circles represent the average number of questions completed for each test, while the bars represent the standard error of the mean (means were 22.52 for the organized condition versus 20.61 for the disorganized condition).

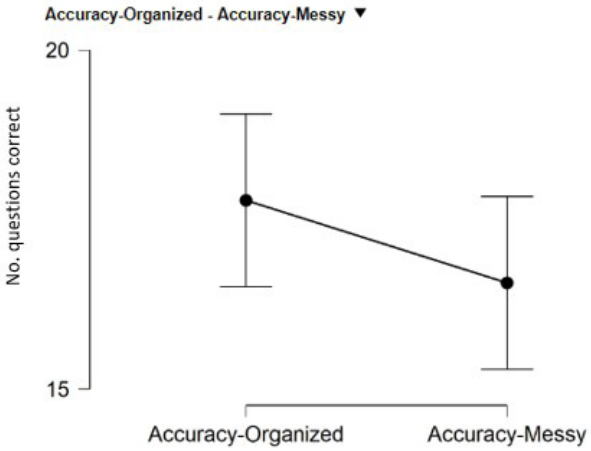

Figure 4: Accuracy statistics results. Effect of organization on accuracy. The circles represent the average number of questions completed for each test, while the bars represent the standard error of the mean (17.78 for the organized condition versus 16.56 for the disorganized condition).

performance did not constitute being a statistical outlier, so the data could not be discarded. It is possible that a factor we did not control, for instance, a poor night of sleep, may have influenced their results during the first test. Additional studies could minimize variation with more test subjects or counterbalancing the testing order.

Our findings examining high school students are not consistent with the decline in performance observed with college participants. When given challenging puzzles, college participants persisted for longer in the organized environment (1). In another study, the more distracting the environment, the more college participants answered questions on a presented video inaccurately (5). This study did not find a similar decline in efficiency in academic performance. Also, there was no significant difference in accuracy observed with high school participants. Using tests that assess different cognitive functions, such as memorization or creativity, instead of academic performance might yield different results.

One way to explain the results is that the clutter presented in the disorganized environment served as a distraction. The more clutter presented in the visual field, the harder it is for the brain to stay focused on the task at hand (6). Additionally, current studies suggest a relationship between disorganized workspace environments and stress (1,3,4). Students may have preferred the appearance of the organized workspace environment as they reported feeling more stressed in the disorganized environment. A sample of college participants expressed feeling more comfortable and relaxed when completing tasks in an organized environment (9). As opposed to the overall results, we found that a small portion of participants performed better in the disorganized environment than the organized one. Subsequently, 9.5% of participants reported that the disorganized environment did not affect their focus. Clutter may affect students differently based on personality and organizational preference (3). The lack of influence may also result from low conscientiousness when taking the test (2).

The results of this study are useful for three groups of people: students, teachers, and parents. Students looking to improve their grades could easily improve their academic accuracy by organizing their workspace before studying. Organizing can improve focus on assignments by limiting distractions in the workspace. Completing assignments more efficiently can also help students receive more sleep. If students feel they do not gain enough insight in an organized environment, they could implement creative ways of studying, such as using colorful markers or making flashcards. Teachers can improve the accuracy of their students by offering a neat and orderly classroom and test-taking environment in school, eliminating distractions from their walls. Schools can educate students and parents on the importance of workspace organization. This research is important as it adds a new sample population to the pre-existing research examining workspace organization with high school-aged students.

There are several limitations to consider with the results of this study. The most crucial restraint is the small participant sample size and low volume of data. Similar studies used an average participant sample size of 50–75 participants for more reliable and statistically significant results. Due to the limited time given, only 23 student participants were sampled. Additionally, the participants may not represent the general public as the high school students were sampled from one high school in Crown Point, Indiana. Secondly, a limitation was the validity of the math tests as accurate measures. A different standardized math test was required in each environment instead of the same test due to the repeated measure method. Despite efforts to reduce this hindrance by having the tests evaluated by experts for similar academic levels and question types, the differences in each test weaken the math tests as a reliable measure. Another impediment to consider is the Hawthorne effect which is the phenomenon of participants modifying their behavior in controlled environments based on what they think the purpose of the study is (16). Participants may have performed worse in the disorganized environment because they inferred the purpose of this study. Additionally, the order of student testing was not counterbalanced. Lastly, participant variances like coffee intake or the amount of sleep received the night before could not be controlled.

This study opens the possibility for a variety of further re-

search. The subject pool could be expanded to achieve more valid results. A future study improvement would be to randomize the test questions by using a computer-generated test or randomizer. This change would reduce the effects of differences between the two standardized math tests and make the test a more reliable measure. Research on this topic could also be expanded by investigating the effect of workspace organization on a high school student's memory and perception instead of academic accuracy. Memory or psychometric tests with challenging puzzles and patterns could be utilized to eliminate the need for a certain level of math proficiency. Finally, a possible extension to this research could examine high school students with mental disorders such as attention deficit/hyperactivity disorder and find ways to help them set up their environments to best accommodate their condition since these students greatly struggle with focus.

In sum, we did not find a difference in the efficiency of high school students completing an academic test in the two environments. The study results, however, indicate that further research should be conducted to see if an effect can be found.

MATERIALS AND METHODS

Subjects

The participants consisted of 23 high school students from Crown Point Public High School in Northwest Indiana who voluntarily participated. They were limited from grades 10 to 12 and were required to either have taken or be currently enrolled in Algebra to ensure that all participants were familiar with the math concepts on the standardized tests. Eleven students from grade 10, six from grade 11, and six from grade 12 participated. Students were ages 15–18. Subjects under the age of 18 were required to have parental consent from a legal guardian (minimum 18 years of age) to participate. The Institutional Review Board at Crown Point High School approved the study protocol. To acquire participants, a blind carbon copy email was sent out to a group of teachers asking if they wished to inform their students about the study to make the participant poll more randomized. Emails were sent to science teachers (Psychology and Chemistry) and teachers in charge of Crown Point High School community service clubs, such as the National Honor Society and Key Club. Participants volunteered for the study by filling out a Google Form. Students were offered either two community service hours or one National Honor Society point for their participation in the study. Participants were enrolled in math classes, including regular and honors Algebra II, Dual Credit and honors Trigonometry/Pre-Calculus, and AP Calculus.

Participants in the study were not made aware of the purpose or method of the study until after the study was completed. Also, student identity was kept hidden from the researcher. This design ensured that participant bias and reactivity were not influential to the results. After the study, participants were fully debriefed on the method and results.

Standardized Mathematics Tests

Two standardized math tests of equal difficulty were designed for the study. Each 15-minute test contained 30 questions with multiple-choice answers, ensuring that participants could not finish the tests in the time allotted. The questions were designed to be solved without the use of a calculator. Test questions were created using standardized test questions taken by high school students for college admissions as a model. The math tests covered standard high school math topics in Algebra I, Algebra II, and Geometry. Questions included a mix of word problems, solving and simplifying equations, shapes, and linear graphing questions. Participants took the tests on paper and were not permitted to use a calculator.

Ideally, the test given in each environment would be identical to eliminate any effects based on question skill level. However, because the same participants would be used, different math tests were used in each environment to minimize a practice effect. The test questions were evaluated by five math teachers from Crown Point High School who are familiar with standardized test formats to ensure their validity. The teachers evaluated if the tests were of an appropriate academic level and similar to each other in difficulty and filled out an open-ended survey asking for their suggestions. The tests were modified based on the feedback.

Experimental Equipment and Environment

A classroom at Crown Point High School was utilized for the workspace environments. This classroom was staged both as an organized workspace environment and a disorganized one. Three testing spaces were set up in the classroom. Each testing space was set up on different sides of the room and faced the wall to limit the distraction of others testing. Ordinary objects commonly found on a teenager's desk were used as props. The props included folders, papers, pencils and pens, pencil cup holders, food wrappers, cups, books, and posters. Each prop was completely sanitized before the test, including decontaminating the food wrappers. For the organized workspace environment, the papers were organized in the folders, the pencils and Eleven students from grade 10 pens were minimal and neatly organized in a cup holder, and the food wrappers and cups were not used on each desk workspace (**Figure 1**). In the disorganized workspace, the folders and pencil cup holders were overcrowded, and there were papers, food wrappers, cups, pencils, and pens scattered over each desk (**Figure 2**).

Experimental Procedure

Participants completed two standardized math tests on different days. Students were asked to come in either before or after school. Students took the test in the organized environment first and in the disorganized environment one week later. Surveys were used to plan testing days and accommodate student schedules. Participants had fifteen minutes to complete each test. The last four digits of the participants' phone numbers were used to track the tests.

Statistical Analysis

An open-source statistical software tool called JASP was utilized for the statistical analysis. Once the data was loaded, a repeated measures, or paired, t-test model was selected along with a Shapiro-Wilk normality test. The repeated measures t-test shows if the results are significant with a degree of confidence and how strong that significance is. P-values of 0.05 or below are significant with 95% confidence. The data from the study was recorded in a Google Spreadsheet.

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