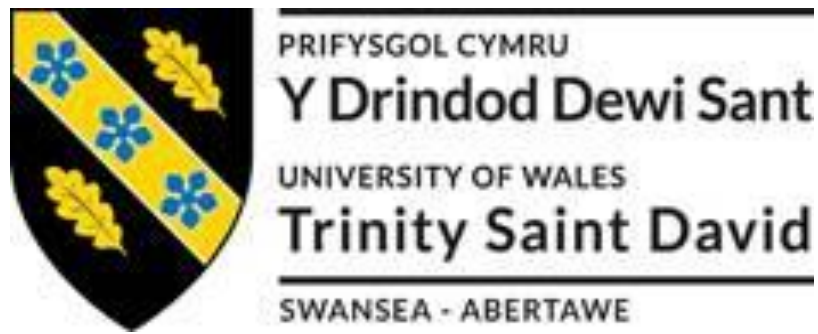




The Effect of Chronotype and Time of Testing on Attention Performance

2219657

Psychology Empirical Project March 2025

University of Wales Trinity Saint David

Dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor of Science (hons) in Psychology.

DECLARATION

This work has not previously been accepted in substance for any degrees and is not being concurrently submitted in candidature for any degrees.

Signed Harriet Adams..... (candidate)

Date 24/03/2025.....

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This dissertation is being submitted in partial fulfilment of the requirements for the degree of

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This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A reference list is appended.

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Abstract

This study examined the effects of chronotype and time of testing on attention performance. Participants completed the Stroop Colour and Word Test (SCWT; Stroop, 1935) to assess attention, followed by the Morningness/Eveningness Questionnaire (HEQ; Horne & Ostberg, 1976) to determine chronotype. Those scoring below 46 were classified as evening types, while scores of 46 and above indicated morning types. Participants were tested either in the morning or afternoon. It was hypothesised that individuals tested at a time aligning with their chronotype would perform better on the Stroop task than those at their non-optimal time. A 2x2 between-subjects ANOVA found no significant main or interaction effects of chronotype and time of testing on attention performance. However, potential methodological limitations may have influenced the findings, which will be discussed further in this thesis.

Chapter 1 - Literature review

In recent years, there has been a growing recognition of the influence of biological rhythms on cognitive performance, particularly in the context of academic or workplace performance and success (Zerbini & Merrow., 2017). Chronotypes, which refer to an individual's preferred timing for activities and functioning, are attributes that reflect the body's circadian rhythm, commonly known as the natural sleep-wake cycle (Martinez-Perez et al., 2020; Zerbini & Merrow., 2017). Adequate sleep is essential for sustaining optimal cognitive functioning during waking hours, whereas inconsistent or poor-quality sleep can lead to impairments in vigilant attention and alertness (Barcley & Myachykov., 2017; Belenky et al., 2003). Individual variations in chronotypes (morning or evening-oriented individuals) significantly influence differences in sleep patterns and neurobehavioral performance and functioning and have been shown to significantly impact cognitive performance, particularly in tasks involving attention and working memory (Barcley & Myachykov., 2017; Evansova et al., 2022).

The circadian rhythm is a biological mechanism that oversees various functions, such as core temperature regulation and the secretion of melatonin and is influenced by a person's time of day preferences or chronotype (Opstal et al., 2022). These individual differences in the circadian timing system have been shown to influence the daily organisation and functions of human behaviours (Schmidt et al. 2007). This insight has enabled professionals to classify individuals into different chronotype groups according to their daily preferences and sleeping habits (Schmidt et al., 2007; Taillard et al., 2003). A person's chronotype can be assessed through various methods, with the most common being a self-report questionnaire,

particularly Horne and Ostberg's (1976) Morningness-Eveningness Questionnaire (MEQ), where individuals are asked to track their alertness throughout the day and identify their preferred times for performing tasks or engaging in activities (Evansova et al., 2022; Matchock & Mordkoff., 2009). The process of determining chronotypes may also involve a series of objective, biological tests, including body temperature measurements, sleep monitoring, and melatonin secretion analysis (Evansova et al., 2022). The suprachiasmatic nucleus (SCN) of the hypothalamus serves as a central regulator of the internal circadian clock, orchestrating behavioural and hormone rhythms. It received light and dark signals directly from the retina of the eye, allowing it to synchronise sleep timing with environmental light conditions. Beyond the SCN, circadian oscillators are present in cells throughout the nervous system. These peripheral clocks, which are genetically programmed to maintain circadian rhythms, are kept in sync by the central SCN clock to create individual sleep-wake cycles (Montaruli et al., 2021).

Chronotypes can be categorised into three groups: morning, evening, and neither-types. Neither types, who are individuals who do not exhibit a specific circadian preference, generally make up the majority of the population. Approximately 60% of adults fall into this category, while the remaining 40% are classified as either morning types or evening types (Polanska et al., 2024). Morning types typically wake up and go to bed early, with their peak performance, both cognitive and physical, occurring earlier in the day. In contrast, evening types achieve their peak cognitive and physical performance later in the day (Polanska et al., 2024). Chronotypes influence more than just daily performance peak times and preferred sleep-wake schedules, they can also affect an individual's susceptibility to certain mental health disorders and physical issues. Research suggests that evening types are more likely to consume higher amounts of alcohol and tobacco compared to morning and neither types (Negri et al., 2011; Partonen., 2015). They also tend to engage in less physical activity,

maintain less healthy diets, and experience poor sleep quality. Furthermore, evening types often face challenges in academic performance, both in school and university and struggle to adapt to workplace environments, particularly during shift work (Partonen., 2015).

Chronotype differences have been found to play a substantial role in cognitive functioning. According to Lezak et al. (2012), the key mental activity variables that sustain the readiness of the cognitive system, including levels of consciousness, attention and activity rate, are closely linked to an individual's chronotype. For instance, morning types typically reach their peak cognitive activation approximately three hours earlier than evening types (Wiłkość-Dębczyńska & Liberacka-Dwojak., 2023). Research by Goldstein et al. (2007) suggests that evening-type individuals are better able to cope with increasing sleep pressure, enabling them to sustain cognitive performance into the evening, whereas morning-type individuals experience a decline in cognitive function as the day progresses. Their findings also indicate among adolescents, those tested at their non-optimal time along with evening types were at higher risk for behavioural adjustment issues. Additionally, individuals tested during their optimal time demonstrated a synchrony effect, demonstrating how aligning tasks with an individual's chronotype can optimise cognitive performance (Goldstein et al., 2007; Wiłkość-Dębczyńska & Liberacka-Dwojak., 2023). Goldstein et al.'s (2007) study utilised a large participant sample and incorporated input from the participant's parents or guardians. While this approach can be considered both a strength and a limitation, as parents or guardians are well-acquainted with their children's behaviours and routines, there is a risk of response bias. Specifically, parents may provide inaccurate responses on the Child Behaviour Checklist due to concerns about potential judgement of their parenting practices. Additionally, the study was conducted during the summer break when the adolescents were not attending school, which may limit the generalisability of the findings as it does not accurately represent their routines or behaviours that are present during the school year. This

is particularly relevant for the reliability of the results of the evening-type individuals, who are more likely to experience poor sleep and disturbed routines during the academic year.

Having established the role of chronotype in influencing and shaping cognitive processes, it is essential to examine attention as a key area of focus in this study. It has become one of the most widely researched areas of perception and cognition and is a vital cognitive process that is essential for human performance. Attention is comprised of three primary functions, alerting, orienting and executive control, that are each linked to distinct neural networks (Martinez-Perez et al., 2020; Matchock & Mordkoff., 2008; Valdez., 2019). The alerting network enables humans to interact effectively with their environment by detecting and processing upcoming stimuli, allowing for an appropriate response (Matchock & Mordkoff., 2008; Valdez., 2019). While the term ‘attention’ is often commonly associated with concentration, it encompasses a variety of processes (Morin., 2012). For instance, Ashcraft (2006) has identified six distinct meanings of attention, including biological alertness (a state of readiness for stimuli), visual search (shifting attention to one specific area) and selective attention (the capacity to focus on certain information while disregarding others; Morin., 2012). Several brain systems, particularly the prefrontal and parietal regions, play key roles in the components of attention (Valdez., 2019). When any aspect of the attention system becomes weakened, often due to brain damage, stress or sleep deprivation, performance on cognitive tasks is impaired (Valdez., 2019). Having strong attention skills and the ability to apply them is crucial in real-world situations, such as for achieving academic success, pursuing a career or excelling in a hobby or sport (Gallen et al., 2023).

Circadian variability plays a crucial role in shaping endogenous alertness throughout the day, influencing sustained attention and task performance (Martinez-Perez et al. 2020). These effects vary by chronotype, with attention levels fluctuating depending on the time of testing. As discovered in Martinez-Perez and colleagues' (2020) study, differences in executive control and alerting networks contribute to these variations, as individuals with different chronotypes exhibit distinct patterns of alertness and cognitive performance throughout the day. They further suggest that performance on tasks requiring sustained attention is likely to vary among individuals with different chronotypes, depending on the time at which testing occurs (Martinez-Perez et al., 2020). Their study examined both morning-type and evening-type individuals using two tasks: a Psychomotor Vigilance Task (PVT) to assess vigilant attention, and a flanker task to evaluate synchrony effects and attentional control. The findings revealed that participants who completed the PVT during their "non-optimal" time of day exhibited longer reaction times compared to those who completed it during their optimal time. Moreover, morning types displayed synchrony effects only when the task was performed during their optimal time, whereas evening types demonstrated synchrony effects regardless of the order of tasks or time of completion. Similarly, during the flanker task, evening-type participants consistently exhibited synchrony effects irrespective of the time of day, whereas morning-type showed no synchrony effects across the tasks (Martinez-Perez et al., 2020). It was suggested that one possible explanation for the observed differences between morning and evening-type individuals may be that morning-types are more sensitive to factors that can increase alertness at their non-optimal times of day. However, they were unable to fully explain why they were more attuned to certain aspects of attentional tasks compared to the evening types (Martinez-Perez et al., 2020). Furthermore, the study sample of 34 university students may limit the generalisability

and reliability of the findings, as the results are based on a small and specific population, raising questions about their applicability to a broader population.

Alongside the influence of chronotype on cognitive performance, the timing at which individuals are required to work, learn and engage in tasks can substantially affect their performance outcomes. Evans et al. (2017) conducted a study with university students to determine the optimal times for cognitive functioning that would enhance their performance and engagement in academic activities. Utilising a neuroscience-based theoretical model, they investigated the effects of sleep deprivation and circadian rhythms on cognition, along with self-report data. The neuroscience-based theoretical model incorporated both circadian rhythms and homeostatic sleep pressure to explain the variations in cognitive performance throughout the day, depending on an individual's chronotype (Evans et al., 2017). The study found that morning-type individuals reached their optimal cognitive performance around 9 am, with a gradual decline starting at 1 am and a steep plateau at 8 pm. In contrast, mild evening types peaked between 4:30 pm and 9 pm, while definite evening types had their highest performance occurring between 5 pm and 10:30 pm. This highlights how performance during an average working day can vary considerably depending on individual preferences and chronotypes. The researchers concluded that, for university students, the majority tend to prefer later working hours, and therefore, adopting a start time of mid-day to later afternoon would be beneficial for all students, as later start times are likely to enhance performance across chronotypes by aligning more closely with the optimal cognitive functioning periods of both morning-type and evening-type individuals (Evans et al., 2017).

In contrast, Arastoo et al.'s (2024) study on university students examined the impact of chronotype on quality of life and academic performance among students studying

medicine, technology and art. The study included 400 participants, each having completed the Quality of Life Questionnaire (WHOQOL-BREF; The WHOQOL Group., 1998), the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) and the Depression, Anxiety and Stress Scale (DASS-21; Henry & Crawford., 2005). While the findings did not indicate a significant relationship between chronotype and academic performance, contradicting previous research, they did reveal a significant association between chronotype and quality of life. Specifically, morning types demonstrated a higher quality of life compared to evening types, as measured by the WHOQOL-BREF scale. The researchers suggested that the lack of a significant relationship between chronotype and academic performance may be due to the majority of participants (60.5%) being classed as intermediate-type individuals (Arastoo et al., 2024). A key limitation of this study is its reliance on three self-report questionnaires, which may introduce response bias. Participants may feel inclined to exaggerate or conceal certain aspects of their lives, potentially compromising the accuracy of the findings. Lin Tel et al. (2023) highlighted in their study of social desirability bias that self-report surveys are particularly prone to biases, especially when dealing with sensitive or personal topics, as individuals may modify their responses due to fear of judgment or embarrassment.

The reviewed studies suggest an association between chronotype, time of testing, and attention, though some provide contradictory evidence. However, there is a limited number of studies and literature that focus exclusively on attention performance, as most examine cognitive and academic performance more broadly. While extensive research has been conducted on students, much of the literature centres on adolescents, students with ADHD, those enrolled in specific programmes such as medicine, or those in shift-working careers (Coogan & McGowan., 2017; Escribano & Diaz-Moralez., 2014; Selvi et al., 2015). Consequently, there is a gap in the literature regarding full-time university students in this context. Additionally, many studies rely heavily on self-report questionnaires, with some

incorporating up to three within a single study. Such questionnaires do not allow for the precise measurements of an individual's cognitive abilities or performance. In contrast, studies utilising psychometric tests, such as the Psychomotor Vigilance Task (PVT), the Flanker task and the Stroop test have consistently produced stronger evidence supporting the influence of chronotype on cognition. This task requires participants to focus on one aspect of a stimulus (the ink colour of a word) while ignoring the other (the word itself) (Parris et al., 2021). Identifying the colour in which a word is presented takes longer than when the word and colour are incongruent (e.g., identifying the colour "red" when the word says "yellow") compared to when they match (e.g., identifying the colour "red" when the word also says "red"), where the difference in colour-naming times is referred to as the Stroop interference effect. This task is a fundamental and widely utilised tool within cognitive psychology, as well as in clinical and neuropsychological practice to assess disorders and impairments while providing valuable insights into cognitive processes (Garcia-Marques & Fernandes, 2024). Furthermore, McMurray et al. (2016) effectively employed the Stroop task to detect variation in participants' attention performance when the test was conducted during their 'non-optimal' time of day, based on their chronotype, demonstrating the Stroop task's effectiveness in highlighting the differences in attention performance across individuals with varying chronotypes.

Building on previous literature, this study aims to further investigate the role of chronotype and time of testing on attention performance among full-time university students using the Stroop task. Given the significant effects that both chronotype and time of testing have been shown to exert on cognitive performance, it is hypothesised that these factors will also have a significant effect on attention performance. Furthermore, it is also predicted that individuals who complete the attention-based task at a time aligned with their chronotype will

perform significantly better than those who complete the task at a time misaligned with their chronotype

Chapter 2 - Methodology

2.1 Participants

The study was advertised through the University's Experiment Management System (EMS), which is accessible to all Psychology and Counselling students at UWTSD. Students were able to volunteer to participate via EMS and select a convenient time slot to attend in exchange for two course credits. A total of 39 university students participated in this experiment. Demographic data collected during the study revealed that the sample comprised of 7 male participants (18%), 31 female participants (79%), and 1 individual identifying as non-binary (3%). The age range spanned from 18 to 59 years of age ($M = 30.7$, $SD = 10.2$).

2.2 Design

This study employed a quantitative 2x2 between-subjects experimental design to examine the effects of time of testing and chronotype on attention performance. Each independent variable consisted of two conditions. The first independent variable was the time of testing (morning or afternoon), and the second independent variable was the participant's chronotype (morning or evening), which was determined by the Morningness/Eveningness Questionnaire (MEQ; Horne & Ostberg., 1976). The dependent variable measured was the participant's performance on an attention-based task, specifically the Stroop test (Stroop., 1935). This design resulted in four experimental conditions: (Morning testing + morning chronotype) (Morning testing + evening chronotype) (Afternoon testing + morning chronotype) (Afternoon testing + evening chronotype).

Participants were assigned to one of the four conditions based on their chosen time of participation and their overall score on the MEQ. The primary outcome variable, the scores on the Stroop task, were measured to assess the interaction and main effects of the

independent variables. To answer the research question “Does chronotype and time of testing affect attention performance” a two-way, between-subjects analysis of variance (ANOVA) 2 (Time of testing: morning or afternoon) x2 (chronotype: morning or evening) was calculated to examine the main effects of each independent variable and their interaction effect. A test for normality was conducted to ensure no outliers would confound the data, as well as a homogeneity of variance check via Levene’s test will be run through SPSS. The alpha level for significance will be .05, and effect sizes including partial eta squared and Cohen’s *f* will be reported. An additional 2x2 between-subjects ANOVA will be conducted on the Stroop task response time as a secondary outcome variable, including the same tests for normality and Levene’s test of homogeneity.

2.3 Materials

The study materials consisted of an information sheet (see Appendix A), a consent form (see Appendix B), an attention-based computer task, the Morningness/Eveningness Questionnaire (Horne & Ostberg.,1976; see Appendix C) which included a demographic form, and a debrief section (see appendix D).

The Morningness/Eveningness Questionnaire (MEQ; Horne & Ostberg., 1976) is a 19-item self-report tool designed to assess an individual’s chronotype by evaluating responses to a series of statements. It utilises a 5-point Likert scale, where lower total scores indicate an evening chronotype and higher overall scores indicate a morning chronotype. Scores on the MEQ range from 16 to 86, with questions such as “How alert do you feel within the first half hour after waking up in the morning?” and “If you went to bed at 11 pm at what level of tiredness would you be?”. Eight items within the questionnaire are reverse scored to ensure accurate measurements. The MEQ was chosen due to its strong test-retest reliability,

demonstrated by a correlation coefficient of approximately 0.80 and a Cronbach alpha of 0.70 (Horne & Ostberg, 1976). When analysed in SPSS, the reliability test found a Cronbach's Alpha of .77, indicating good internal consistency (See Appendix H).

A Stroop test (Stroop, 1935) was developed using the SuperLabs programming software. The test consisted of 60 trials, including 10 practice trials. Four colour names (red, blue, yellow and green) are displayed one at a time on the screen in a random order. The ink colour of each word can vary among the four colours, with 50% of the items being congruent (the ink colour matches the word) and the remaining 50% being incongruent (the ink colour differs from the word).

2.4 Procedure

2.4.1 Pilot study

Six pilot studies were conducted to ensure both programs (SuperLabs and Qualtrics) were functioning correctly and to verify that the study duration matched the advertised time on EMS. This also provided an opportunity to identify and resolve any errors before data collection began. During the pilot trials, adjustments were made to the study, including the randomisation of the order of words for each participant and reducing the time limit for each item from five seconds to three seconds, as pilot participants initially found the task too easy.

2.4.2 Ethical considerations

Before data collection could begin, the researcher completed a Dissertation Proposal form (see Appendix E) and an application of Ethical Approval (see Appendix F). This was to ensure the safety and well-being of both the participants and the researcher, as well as to guarantee that data collection and handling of confidential information followed proper

protocols within the university. This application was reviewed and approved by the School Research Ethics panel. This study posed minimal ethical concerns, as there was little to no risk of harm to either participants or the researcher. However, there was a potential risk that some participants might find the Stroop task challenging or frustrating due to its fast-paced nature. Additionally, while the questionnaire includes statements regarding preferred sleep and wake patterns, participants may have felt some discomfort in responding to personal questions or may have had concerns regarding the interpretation of their results. To address these concerns, the consent form explicitly stated that participants were under no obligation to continue with the study and could withdraw at any point if they wished (See Appendix B). Additionally, the researcher ensured that all participants were comfortable with their data being included in the study, and provided a final opportunity to withdraw, along with a debrief form that reiterated this information and offered additional details about the study (See appendix D)(British Psychological Society., 2021).

2.4.3 Study procedure

Following approval from the University ethics panel, the study underwent six pilot trials to ensure the functionality of both programs, to confirm that no modifications were required, and to verify the study's duration for advertisement on the EMS system and credit allocation. After these pilot checks, the study was advertised through the EMS system, allowing Psychology and Counselling students to register at a time that suited them. The study commenced with participants arriving at the laboratory, where they were provided with an information sheet and consent form. While participants reviewed the information sheet and provided consent on two forms, one for their records and one for the researcher to store securely in the laboratory, the researcher entered the unique participant ID into both

SuperLabs and Qualtrics. For instance, participant number 12 who completed the study in the morning was labelled as P12-MORNING. This system enabled the researcher to seamlessly merge data from Qualtrics and SuperLabs once transferred into Excel. Upon granting consent, participants were instructed to begin the Stroop task on the laboratory computer. Participants began by reading on-screen instructions that explained the task, which required them to identify the colour of the ink rather than the word itself. They responded using one of the four designated buttons, each labelled with a blue, yellow, red, or green sticker. This task included 10 practice trials, all lasting 3 seconds each, followed by the main trial of 60 words. Each word was displayed one at a time in the centre of the screen. If participants pressed the wrong key, for example, selecting blue instead of yellow, it was recorded as an incorrect answer. If they failed to respond within the three seconds, they were automatically moved on to the next word, with the absence of a response recorded as a “no response”. After completing the Stroop task, the researcher set up the Qualtrics questionnaire on the computer screen, instructing participants to complete the 19 questions from the Morningness/Eveningness Questionnaire, with each question displayed one at a time on a new page. Upon completing both tasks, participants were debriefed, provided with a debriefing form, and given the opportunity to ask any final questions or withdraw their data. They were then thanked for their participation and awarded two credits as compensation for their time.

Chapter Three: Results

Before data analysis could begin, the raw data from SuperLabs and Qualtrics were exported to Excel for data cleaning. After each participant completed the study, their data was downloaded from SuperLabs and Qualtrics into Excel, using their unique ID code, where it was organised into raw datasets. These datasets were then cleaned by removing unnecessary data and retaining only key information, such as overall scores, reaction times, participants' unique IDs (e.g. P12-MORNING), and demographic details. During this stage, total scores for the Stroop task and mean response times were calculated, with the highest possible Stroop score being 60. Once data collection was complete, the cleaned data was merged into a final combined Excel spreadsheet, where the MEQ and Stroop task data were combined. The refined dataset was then imported into SPSS for statistical analysis. Participants were placed into one of four groups based on their chronotype, as determined by their Morningness-Eveningness Questionnaire (MEQ) score (Horne & Ostberg., 1976), and their time of testing (morning or afternoon). The mean MEQ score was calculated ($M=46$, $SD=1.6$) to categorise participants as either morning chronotypes (those with scores of 46 and higher) or evening types (those scoring below 46). Twenty participants were assigned the morning chronotype, while 19 were assigned the evening chronotype.

During the data cleaning process in Excel, two participant datasets were removed. One was excluded due to an error causing the mean response time to be significantly outside the expected range, while the other was removed due to large amounts of missing data in their Stroop task data. Two outliers were identified in the Q-Q plots and histograms during the test for normality. Both outliers were within the response time scores, showing significantly faster mean response times compared to other participants. The one significant

outlier also had a much lower score on the MEQ than other participants, suggesting that the participant may not have accurately completed the study or may have rushed through the process. Consequently, this significant outlier was removed from the dataset, and the normality test was repeated. The second, less significant outlier remained in the response time data, however, as it did not substantially impact the results, it was not removed from the dataset.

Descriptive statistics

The means and standard deviations were calculated for each of the conditions (morning x evening chronotype; morning x afternoon participation) in the 2x2 factor design. Tables 1 and 2 present the descriptive statistics for the dependent variable (Stroop score and response time respectively) across the four conditions (See Appendix G)

3.1 Table 1

Descriptive statistics for scores on Stroop task per condition.

Group	Mean	Std. Deviation (SD)
Morning Chronotype x Morning testing	52.60	5.97
Morning Chronotype x Afternoon testing	45.70	10.42
Evening Chronotype x Morning testing	51.20	5.23
Evening Chronotype x Afternoon testing	51.78	6.94

3.2 Table 2

Descriptive statistics for mean scores on Stroop task.

	Mean	Std. Deviation (<i>SD</i>)
Total morning chronotype	49.15	8.99
Total evening chronotype	51.47	5.93
Total morning testing	51.90	5.05
Total evening testing	48.58	9.24

Overall, morning chronotypes scored higher than evening chronotypes and were also more influenced by time of testing, as morning chronotypes scored lower overall during their non-aligned time of day. The mean scores indicate consistently high performance across all conditions, as the maximum possible score on the Stroop task is 60. The relatively large variation in standard deviations across the groups indicates that one group ($SD=9.24$) exhibited a significantly wider range of scores compared to the other groups. These differences may also be attributed to variations in cognitive abilities and other external factors.

3.3 Table 3

Descriptive statistics for response time on the Stroop task per condition.

Variable	Mean	Std. Deviation (<i>SD</i>)
Morning Chronotype x Morning trial	839.22	84.06
Morning Chronotype x Afternoon trial	812.60	53.27
Evening Chronotype x Morning trial	832.05	73.35
Evening Chronotype x Afternoon trial	870.89	54.87

3.4 Table 4

Descriptive statistics of reaction times on Stroop task.

	Mean	Std. Deviation (<i>SD</i>)
Total morning chronotype	825.91	69.84
Total evening chronotype	850.45	66.52
Total morning testing	835.63	76.87
Total evening testing	840.21	60.42

Through inspecting the mean response times, it is clear that response times differ depending on the time of testing. Both chronotype groups displayed longer response times during their optimal time of day, with a decline in response times as they enter their non-optimal time.

Assumption checks

In order to test for normality, the Kolmogorov-Smirnov test was conducted which found a significance of .024, indicating that normality was not violated for any group and data was normally distributed across all conditions. See Appendix G for the Histogram and Q-Q Plot that display normal distributions across all conditions for both Stroop score and response times.

Outliers were checked using boxplots and Z-scores which detected two outstanding outliers, both influencing the response time data and one also influencing the Stroop score. Participant 35-afternoon was removed from the analysis due to its extreme outlier in the response time dataset. Following this, participant 7-mornings data remained in the dataset as it did not have a significant effect on the remaining data.

Inferential statistics

A two-way between-subjects analysis of variance (ANOVA) was conducted to assess the effect of chronotype (morning-type/evening-type) and time of testing (morning/afternoon) on attention performance on a Stroop task.

Results indicated that there was no interaction effect between chronotype and time of testing; $F(1,35) = 2.26, p > .05$. The main effect of chronotype did not reach statistical significance [$F(1, 35) = 1.38, p > .05$] and neither did the main effect of time of testing [$F(1, 35) = .08, p > .05$]

An additional 2x2 between-subjects ANOVA was conducted to explore the effects of chronotype and time of testing on the response times during the Stroop task. The results of the analysis found no interaction effect between chronotype and time of testing on response time, $F(1, 35) = 2.26, p > .05$. The main effect of chronotype did not reach statistical significance [$F(1, 35) = 1.38, p > .05$] and neither did the time of testing [$F(1, 35) = .08, p = .78$] (See Appendix G).

Levene's test of homogeneity of variance was conducted for both scores and response time. Based on the mean Stroop score, Levene's test was non-significant, $F(3,35) = 2.40, p = .08$, indicating a homogeneity of variance. Levene's test for response time was also non-significant, $F(3,35) = .62, p = .61$. This indicates that the assumption of homogeneity of variance was met.

Although no statistical significance was detected, there is still a noticeable difference in results between morning and evening chronotypes. Morning chronotypes did see a notable drop in scores during the afternoon trials in comparison to the morning trials, whereas the evening chronotypes had little to no change in scores during the different times of testing (see below chart).

Figure 1: Mean scores of MEQ across both chronotypes

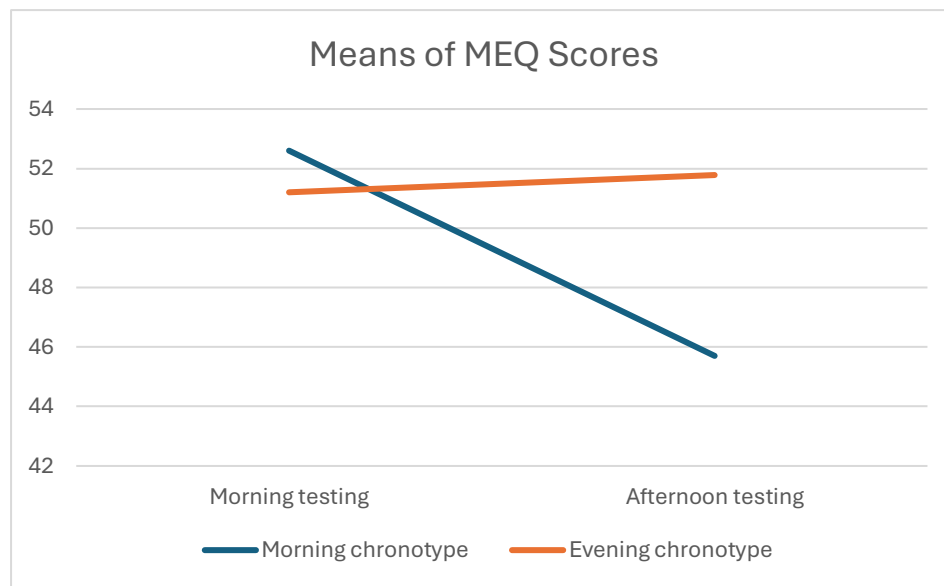
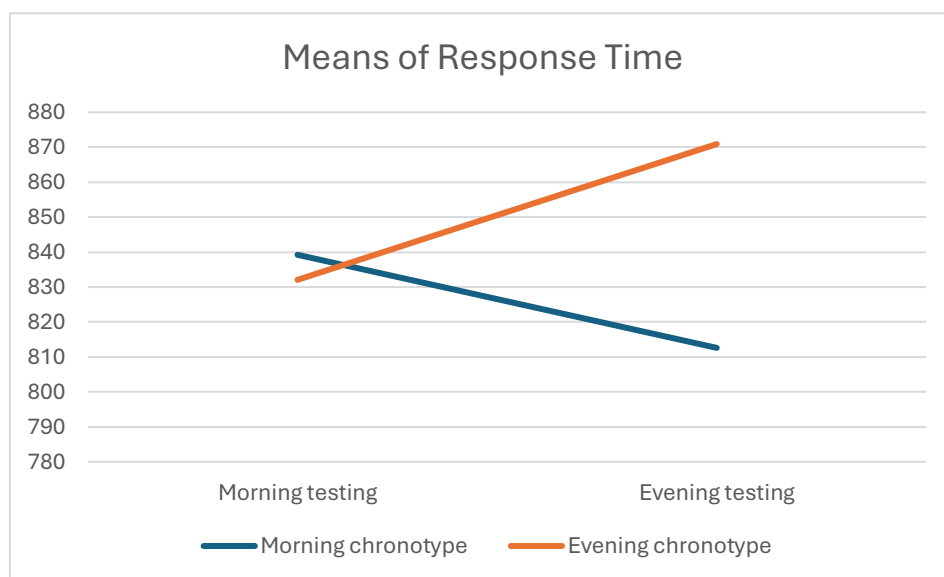


Figure 2: Mean response time across both chronotypes



Another difference worth noting is the difference in response time for both morning and evening chronotypes. The results indicate that morning-chronotypes displayed better scores during the morning, but with slower response times. In contrast, evening-chronotypes showed higher scores in the afternoon, but also with increased response times. Both chronotypes showed quicker response times but lower scores at their non-optimal time of day (see above graph).

Overall, the results indicate that there is no significant effect of chronotype or time-of-testing on attention performance when examining overall scores and response time.

Chapter Four: Discussion

The objective of this study was to investigate the influence of chronotype and time of testing on attentional performance, using the Horne and Ostberg (1976) Morningness-Eveningness Questionnaire (MEQ) and the Stroop task (Stroop., 1935). It aimed to address the following research questions: (1) Does chronotype and time of testing influence attentional performance? And (2) Do individuals perform better on an attention task when tested at a time of day that aligns with their chronotype? However, the results revealed no significant differences between chronotype or time of testing on the overall Stroop task scores. It was hypothesised that participants who completed the Stroop task at a time that aligned with their chronotype would perform better than those who completed it during a non-aligned time, although this expectation was not supported by the results. Although no statistically significant differences were observed, these findings provide useful insights that may contribute to further research. For instance, a trend was observed where morning chronotypes performed better during the morning, and evening chronotypes performed slightly better during the evening. Another notable finding was related to response time. Morning chronotypes had higher performance scores in the morning, along with higher response times, which decreased as their scores declined in the afternoon. Conversely, evening chronotypes exhibited better performance in the afternoon but had longer response times than in the morning. This suggests that participants may have been more focused during their peak times, potentially engaging more thoroughly with the task, which resulted in longer response times, indicating higher concentration and better performance. In contrast, increased response times during off-peak periods may reflect reduced alertness, possibly causing participants to rush through the task, particularly if they struggled to maintain focus. This contrasts with the findings of Martinez-Perez et al. (2020), who investigated vigilant

attention and executive control, and observed that evening-types exhibited slower response times in the morning compared to the evening. They suggested that this may be due to evening types not being fully alert for cognitive tasks that early in the day. This contradicts the findings of the present study, which indicate that slower response times were associated with greater accuracy.

Continuing with contrasts found in prior research, such as those of Martinez-Perez et al. (2020) and Goldstein et al. (2007), the present study did not identify a significant relationship between chronotype, time of testing, and performance. While these findings deviate from the existing literature supporting the hypothesis that chronotype and testing time affect performance, particularly attention, they still contribute to the understanding of this topic. Several factors may explain the differences between the present study's findings and prior research. For instance, Martinez-Perez et al. (2020) employed two distinct tasks to assess attention and executive control, in addition to using the MEQ (Horne & Ostberg, 1975) to determine chronotypes. The use of the Psychomotor Vigilance Task (PVT) and a Flanker task may have led to more precise results while minimising the influence of chance and other factors, as opposed to relying solely on one task such as the Stroop (Stroop, 1935) in this present study, therefore potentially accounting for the difference in results. The psychomotor vigilance task is a reaction time task that is widely used to assess changes in alertness resulting from sleep deprivation, specifically measuring sustained attention levels (Abad & Guileminault, 2012; Nasiri et al., 2023). PVT lapses indicate perceptual, processing, or executive failures within the central nervous system in the brain. The primary objective of the task is to measure sustained attention and vigilance while minimising the influence of extraneous cognitive processes (Usworth et al., 2020; Nasiri et al., 2023). In contrast, the Flanker Task is a target-based inhibition paradigm designed to assess the extent of the attentional focus within a target identification task. It serves as a measure of selective

attention and inhibitory control, requiring participants to suppress interfering information and disregard surrounding distractors (Servant & Logan, 2019). The results of a Stroop task, however, can be influenced by cognitive factors beyond attention, such as impulse control, response inhibition, information processing, and decision-making (Servant & Logan, 2019). As a result, the Stroop task places less emphasis on attentional factors compared to the Flanker task and PVT, which makes these tasks potentially more suitable for exploring topics such as chronotype and time of testing on attention performance specifically. Furthermore, the PVT accounts for the role of sleep deprivation, a consideration that may be relevant for certain chronotypes when completing the study outside of their optimal time.

Furthermore, Goldstein et al.'s (2007) study on adolescents found that those tested at a time aligned with their chronotype performed better on fluid intelligence tasks compared to those tested at non-optimal times. However, their methodology involved randomly assigning participants to either morning or evening testing groups. In contrast, in this present study, participants self-selected their testing time based on personal preference. This may have influenced the results, as participants could have chosen a time when they felt their best, although they were unaware of the study's true aims. On the other hand, given that all participants were university students, many may have selected their testing time based on convenience, such as scheduling before or after a lecture, rather than deliberately choosing a time when they expected to perform optimally. This factor should be taken into account for future research as it may have the ability to impact or potentially benefit study outcomes.

The present study contradicts several previous studies, such as that of Evansova et al. (2022) who found that both time of testing and chronotype differences significantly influenced cognitive processes; Matchock and Mordkoff (2009), who observed differences in

alerting scores between chronotype groups; and Clarisse et al. (2010), who discovered that time of day affects attention performance in a way that varies across chronotype groups. However, its findings align with those of Arastoo et al. (2024), who conducted a recent study examining students' quality of life and academic performance in relation to chronotype. Their large-scale study involving 400 students across three subjects, including medicine, technology and art, found no significant differences in chronotype distribution. Additionally, they observed no significant associations between chronotype and academic performance, reflection results similar to those of the present study. However, they did find a correlation indicating that morning types had a higher quality of life compared to evening types. This study by Arastoo et al. (2024) possesses several strong aspects that, upon further reflection, may highlight the limitations of the present study. For example, their study included 400 students across three disciplines, whereas the present study involved only 39 students from the Psychology and Counselling course. Both of these factors may represent limitations for this study, as the relatively small sample size may not have been sufficient for the 2x2 ANOVA design, potentially reducing the statistical power and increasing the likelihood of Type II errors (Cohen, 1988). According to Cohen's (1988) guidelines for required sample sizes, an ideal sample for the present study would have been 88 participants, with around 22 participants per variable group. Additionally, using only Psychology and Counselling students may be a limitation, as they are likely familiar with the Stroop task and could potentially guess the purpose of the study, thereby undermining the validity of the results. Furthermore, the small sample size, predominantly consisting of female participants from the same academic discipline limits the generalisability of these findings. Research by Cain et al. (2010) on sex differences in the timing of human circadian rhythms found that women had significantly higher melatonin fluctuations and lower internal temperature fluctuations than men. Additionally, women's sleep occurred later in their biological cycles compared to men,

even when both sexes were aligned with the same clock time (Cain et al., 2010). Building on this Santhi et al. (2016) discovered that women, especially those with evening chronotypes, displayed more variability in cognitive performance, performing worse in the morning compared to the males in the study. In contrast, the male participants showed a more consistent cognitive performance pattern throughout the day, regardless of their chronotype, suggesting that women's cognitive performance may be more susceptible to time-of-day effects, particularly when it occurs at a time that is not aligned with their chronotype (Santhi et al., 2016). This suggests that biological sex may influence research on chronotype and time of testing and should be considered when working with samples that include both males and females.

Another potential limitation of this study lies in the methodology. As previously mentioned, the attentional performance aspect of the study relied solely on the Stroop Word and Colour Task, which consisted of 60 colourful words being displayed one by one with a time limit of 1500ms per word. A practice run of 10 words was also included. Given the similarity in results and response times between all four participant groups, the Stroop task alone may not have been challenging enough to effectively assess attentional performance. To address this limitation, alternative tasks such as the Flanker Task (Eriksen & Eriksen, 1974) or the Psychomotor Vigilance Task (PVT; Dinges & Powell, 1985) could be used, or the Stroop task could be paired with a task such as the Dichotic Listening Test (Cherry, 1953) to also measure auditory attention. For instance, Facer-Childs et al. (2018) incorporated both the Psychomotor Vigilance Task (PVT) and the Memory and Attention Test to assess participants cognitive function, noting that the PVT is the most commonly used cognitive performance test in circadian and sleep research. Additionally, they included a physical task, measuring participants' maximum voluntary contractions through a six-second isometric grip strength test to evaluate physical alertness and function in relation to their circadian rhythms (Facer-

Childs et al. 2018). This led them to discover that ‘night owls’ or evening chronotypes, exhibited poorer performance earlier in the day, showing significant impairments across all tasks compared to the morning chronotypes (Facer-Childs et al. 2018). Furthermore, the method used to measure chronotypes may not have been the most effective. While the Morningness/Eveningness Questionnaire by Horne and Ostberg (1975) is a highly reliable scale that is widely used in research, relying solely on self-report measures may be less effective than combining them with objective biological measures. (Reid 2020).

Incorporating core body temperature measurements or melatonin levels would provide a more precise evaluation of circadian system timings, while also reducing the potential influence of desirability bias and other self-report limitations (Reid 2020). Unfortunately, due to the present study being conducted within a university setting, there are limited resources available for conducting biological testing, which would also require approval from the ethics panel to ensure it is safe to conduct testing on students within the university. The recommendation to incorporate biological measures for determining chronotypes may therefore be more feasible for larger research institutes or laboratories with the necessary equipment to provide such assessments. Another limitation of the study is the restricted testing timeframe, as it was conducted within university hours. This resulted in a narrow testing window, with the morning group being assessed between 9:00 am and 1:00 pm, and the evening group being assessed between 1:00 pm and 5:00 pm, which represents more of an afternoon period rather than the evening. In contrast, Hill and Chtourou’s (2020) study employed a broader timeframe of 8:00 am to 8:00 pm, allowing for a more comprehensive examination of the effects of time of testing, particularly for evening chronotypes who may reach peak performance after the typical work hours.

Although no statistically significant effect was observed, the trend in results suggests that a significance may emerge with further testing and a larger sample size. Moreover,

examining this potential trend has important practical implications that could positively impact performance in various aspects of life, including workplaces, sports and education. One example is the expectation for children to attend school and take tests or exams early in the day, which might not align with their chronotype (Escribano & Diaz-Moralez, 2014). Children and adolescents who are required to attend school early in the morning, particularly those with a natural evening chronotype, often experience poor sleep schedules. As a result, they are more likely to exhibit performance fluctuations, slower response times, and attentional difficulties (Escribano & Diaz-Moralez, 2014). Recognising that not all children are cognitively prepared to begin learning early in the morning and implementing solutions to accommodate this can significantly enhance their performance. For example, avoiding the scheduling of important exams or assignments at 9 am, or introducing a slower start to the day, such as an hour of free or study time during morning registration, would allow students to gradually wake up and transition into a learning mindset in a way that aligns with their individual needs (Escribano & Diaz-Moralez, 2014; Weir, 2024).

Furthermore, approximately 20% of workers in Europe and North America are involved in shift work, with many working night shifts that span from around 7 pm to 7 am (Reiter et al. 2021). Nurses, in particular, can work up to five-night shifts a week, or alternate between two-day shifts followed by two-night shifts. This constant variation in sleep-wake times can lead to circadian misalignment, which negatively impacts alertness, attention, and overall performance (Reiter et al, 2021; Czeisler & Gooley, 2007). Although night shift work may be problematic for morning chronotypes, as working during their non-optimal times can impair both alertness and cognitive performance, expecting only evening chronotypes to work night shifts while morning chronotypes take on day shifts is unrealistic and unfair. Furthermore, research has suggested several strategies to help workers adjust to shift work and prepare for changes in their sleep schedules. However, these strategies are not universally

applicable due to individual differences and varying living circumstances. As such, further research is needed to explore solutions for shift workers, as the high demands and lack of sleep can take a toll on their health and personal lives. One potential solution could be the implementation of safer shift schedules that allow for more rest time before and after night shifts, prioritising adequate sleep to avoid circadian misalignment (Reiter et al. 2021).

Moreover, approximately 20% of workers in Europe and North America engage in shift work, with many working night shifts from 7 pm to 7 am (Reiter et al., 2021). Nurses, in particular, may work up to five night shifts per week or alternate between day and night shifts, causing significant variation in their sleep-wake times. This disruption can lead to circadian misalignment, negatively affecting their alertness, attention and performance (Reiter et al., 2021; Czeisler & Gooley, 2007). While night shift work may be challenging for morning types, it is unrealistic and unfair to expect only evening chronotypes to work nights. Although various strategies exist to help workers adjust to shift work, these are not universally applicable due to individual differences and varying circumstances. Further research is needed to develop solutions for shift workers, as the high demands and inadequate sleep can harm their health and personal lives. Implementing safer shift schedules with adequate rest time before and after night shifts may help prevent circadian misalignment (Reiter et al., 2021). Understanding the roles of chronotype and the effects of optimal and non-optimal times of day on cognitive processes such as alertness, decision-making, and attention is vital to shaping the future of shiftwork, and even other workplace hours, ensuring workers' health, safety and performance. Developing strategies that consider chronotype and optimal performance times can help mitigate the negative effects of circadian misalignment and optimise working conditions in the future.

Future studies should aim to further investigate this particular area, as understanding how chronotype and the time of testing influence attentional performance could positively impact various aspects of life, including educational settings, workplaces and sports. As highlighted in the limitations, employing a variety of cognitive tasks, like Facer-Childs et al. (2018) would be more effective. This approach would capture a broader range of responses and offer a more comprehensive representation of cognitive functioning, which is especially in contexts like educational settings or professional environments, where individuals are required to engage in multiple cognitive processes. Including a variety of tasks would allow for a better understanding of how factors such as chronotypes and time of testing influence performance across various cognitive domains, offering insights that apply to real-world settings. Additionally, ensuring an adequate sample size is crucial, as this remains one of the primary limitations of the current study. These limitations should be carefully considered when replicating or conducting similar research. Although there is a substantial body of research on this topic, obtaining up-to-date, relevant, and statistically significant data will be invaluable for translating these findings into broader applications.

In conclusion, this study has established a strong foundation for future research, emphasising the significance of understanding and considering the effects of chronotype and time of testing on attentional performance. Although the hypothesis was not supported, the results still point in the direction of an effect, which was the primary aim of the research. This study is valuable for informing changes that accommodate the variation of chronotypes in real-world applications. However, future research is needed to strengthen and confirm these findings, especially through employing larger sample sizes, a broader range of cognitive tasks, and more precise experimental designs. Additionally, exploring individual differences and external factors that might mediate these effects could provide more comprehensive

insights. Understanding these influences could lead to more effective interventions, ultimately improving performance and well-being across different settings.

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Appendices

A -Information sheet



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Centre for Psychology and Counselling
SA1 Campus
Swansea

Participant Information Sheet

Title of Study: Exploring the effect of chronotype and time of testing on attention performance.

Research Team: Student Researcher: Harriet Adams (2219657@student.uwtsd.ac.uk) and Supervisor: Dr Kate Williams (kate.williams@uwtsd.ac.uk)

Date:

Invitation Paragraph:

You are being invited to take part in a research project being conducted by a third-year student within the Psychology and Counselling department at The University of Wales Trinity Saint David (UWTSd) for their Psychology Empirical Project. Before you decide to take part, it is important for you to understand why the research is being conducted and what participation will involve.

Please take time to read the following information carefully and discuss it with the researcher if you wish. Ask if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part. Thank you for reading this.

Purpose of Research:

The purpose of this study is to explore whether attention performance on a Stroop task varies depending on a person's wake/sleep cycle and the time they are tested.

What does taking part involve:

This study will involve an in-person experimental lab-based task. During this study you will be required to do the following:

- Provide demographic information of age and gender.
 - Take part in a computer-based task involving the Stroop test (Stroop, 1935), where you will be required to respond to a series of 60 words (colour names) by pressing a button corresponding to the ink colour in which the word is written (i.e., the word 'red' appearing in red ink or blue ink). Each word will have a 5 second time limit. You will also have 10 practice trials to begin.
 - You will then be asked to complete a 19-item questionnaire on your levels of activeness throughout the day and night.
-

B- Consent form



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Centre for Psychology and Counselling
SA1 Campus
Swansea

Participant Consent Form

Title of Study: Exploring the effect of chronotype and time of testing on attention performance.

Research Team: Student Researcher: Harriet Adams (2219657@student.uwtsd.ac.uk) and Supervisor: Dr Kate Williams (kate.williams@uwtsd.ac.uk).

Date:

1. I confirm that I have read and understand the Information Sheet for the above study.	Yes	No
2. I had an opportunity to ask questions and have them answered satisfactorily.	Yes	No
3. I understand that I may ask further questions at any time.	Yes	No
4. I understand that my participation is voluntary, and I am free to withdraw from the study at any time during the study without penalty or giving any reason.	Yes	No
5. I understand that my fully anonymised data will be utilised for only this research study, which is being conducted by a third-year Psychology student for the purpose of their undergraduate Psychology Empirical project and will be deleted once external examiner approval for the project has been obtained.	Yes	No
6. I have been informed that if I feel I would be uncomfortable answering personal questions about my wake and sleep patterns, or completing the attention-based Stroop computer task, that I should not take part in this study.	Yes	No
7. I understand that I may decline to answer any questions.	Yes	No
8. I understand that any data collected will be anonymised and stored in an anonymous format and once I leave the lab it will not be possible to trace the data back to me to withdraw.	Yes	No
9. I understand that the anonymised data provided will be securely stored and accessible only to the members of the research team directly involved in the study, and that confidentiality will be maintained.	Yes	No
10. I confirm that I am over 18 years old	Yes	No
11. I confirm I have normal or corrected-to-normal vision and colour vision.	Yes	No
12. I agree to take part in the above study.	Yes	No

Participant Name	Date	Participant Signature
_____	_____	_____
Researcher Name	Date	Researcher Signature
_____	_____	_____

There should be two signed copies, one for the participant, one retained by researcher for records.

C – Morningness-Eveningness Questionnaire

232

54 Morningness-Eveningness Questionnaire

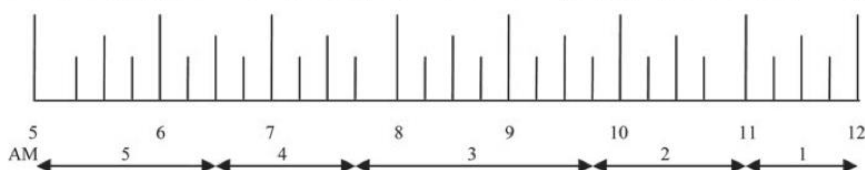
Morningness-Eveningness Questionnaire

Instructions:

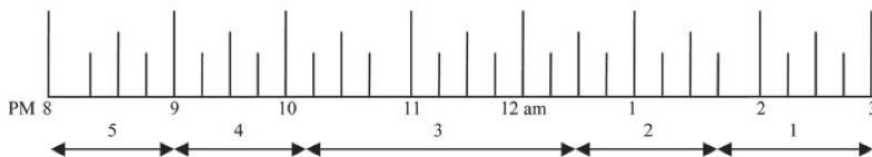
1. Please read each question very carefully before answering.
2. Answer ALL questions
3. Answer questions in numerical order.
4. Each question should be answered independently of others. Do NOT go back and check your answers.
5. All questions have a selection of answers. For each question place a cross alongside ONE answer only. Some questions have a scale instead of a selection of answers. Place a cross at the appropriate point along the scale.
6. Please answer each question as honestly as possible. Both your answers and the results will be kept, in strict confidence.
7. Please feel free to make any comments in the section provided below each question.

The Questionnaire with scores for each choice

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?



2. Considering only your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?



3. If there is a specific time at which you have to get up in the morning, to what extent are you dependent on being woken up by an alarm clock?

- Not at all dependent ☐ 4
 Slightly dependent ☐ 3
 Fairly dependent ☐ 2
 Very dependent ☐ 1

4. Assuming adequate environmental conditions, how easy do you find getting up in the mornings?

- Not at all easy ☐ 1
 Not very easy ☐ 2
 Fairly easy ☐ 3
 Very easy ☐ 4

5. How alert do you feel during the first half hour after having woken in the mornings?

- Not at all alert ☐ 1
 Slightly alert ☐ 2
 Fairly alert ☐ 3
 Very alert ☐ 4

6. How is your appetite during the first half-hour after having woken in the mornings?

- Very poor ☐ 1
 Fairly poor ☐ 2
 Fairly good ☐ 3
 Very good ☐ 4

7. During the first half-hour after having woken in the morning, how tired do you feel?

- Very tired ☐ 1
 Fairly tired ☐ 2
 Fairly refreshed ☐ 3
 Very refreshed ☐ 4

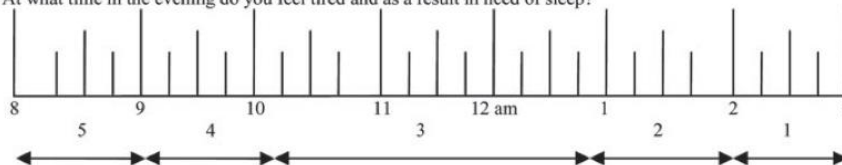
8. When you have no commitments the next day, at what time do you go to bed compared to your usual bedtime?

- Seldom or never later ☐ 4
 Less than one hour later ☐ 3
 1-2 hours later ☐ 2
 More than two hours later ☐ 1

9. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is between 7:00-8:00 a.m. Bearing in mind nothing else but your own "feeling best" rhythm, how do you think you would perform?

- Would be on good form ☐ 4
 Would be on reasonable form ☐ 3
 Would find it difficult ☐ 2
 Would find it very difficult ☐ 1

10. At what time in the evening do you feel tired and as a result in need of sleep?



11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day and considering only your own "feeling best" rhythm which ONE of the four testing times would you choose?

- 8:00-10:00 a.m. ☐ 6
 11:00 a.m.-1:00 p.m. ☐ 4
 3:00-5:00 p.m. ☐ 2
 7:00-9:00 p.m. ☐ 0

12. If you went to bed at 11 p.m. at what level of tiredness would you be?

- Not at all tired ☐ 0
 A little tired ☐ 2
 Fairly tired ☐ 3
 Very tired ☐ 5

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?

- Will wake up at usual time and will NOT fall asleep ☐ 4
 Will wake up at usual time and will doze thereafter ☐ 3
 Will wake up at usual time but will fall asleep again ☐ 2
 Will NOT wake up until later than usual ☐ 1

14. One night you have to remain awake between 4-6 a.m. in order to carry out a night watch. You have no commitments the next day. Which ONE of the following alternatives will suit you best?

- Would NOT go to bed until watch was over ☐ 1
 Would take a nap before and sleep after ☐ 2
 Would take a good sleep before and nap after ☐ 3
 Would take ALL sleep before watch ☐ 4

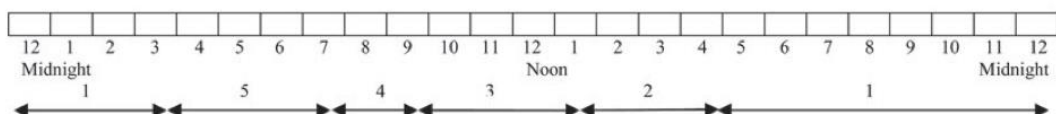
15. You have to do two hours of hard physical work. You are entirely free to plan your day and considering only your own "feeling best" rhythm which ONE of the following times would you choose?

- 8:00-10:00 a.m. ☐ 4
 11:00 a.m.-1:00 p.m. ☐ 3
 3:00-5:00 p.m. ☐ 2
 7:00-9:00 p.m. ☐ 1

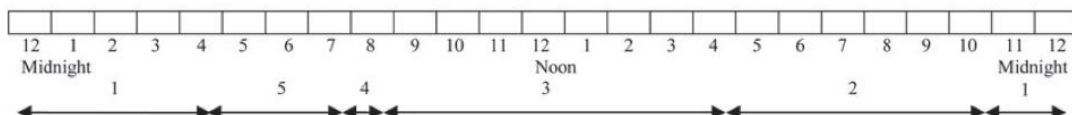
16. You have decide to engage in hard physical exercise. A friend suggests that you do this for one hour twice a week and the best time for him is between 10-11 p.m. Bearing in mind nothing else but your own "feeling best" rhythm how well do you think you would perform?

- Would be on good form ☐ 1
 Would be on reasonable form ☐ 2
 Would find it difficult ☐ 3
 Would find it very difficult ☐ 4

17. Suppose that you can choose your own work hours. Assume that you worked a FIVE hour day (including breaks) and that your job was interesting and paid by results. Which FIVE CONSECUTIVE HOURS would you select?



18. At what time of the day do you think that you reach your "feeling best" peak?



19. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?

- Definitely a "morning" type ☐ 6
 Rather more a "morning" than an evening type ☐ 4
 Rather more an "evening" than a "morning" type ☐ 2
 Definitely an "evening" type ☐ 0

D – Debrief form



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University of Wales
Trinity Saint David

Centre for Psychology and Counselling
SA1 Campus
Swansea

Participant Debrief Sheet

Title of Study: Exploring the effect of chronotype and time of testing on attention performance.

Research Team: Student Researcher: Harriet Adams (2219657@student.uwtsd.ac.uk) and Supervisor: Dr Kate Williams (kate.williams@uwtsd.ac.uk)

Thank you for taking part in this study.

The aim of this study was to explore whether individual chronotypes (natural body clock related to wake and sleep cycles), which will be calculated from your responses on the Morningness/Eveningness Questionnaire (MEQ; Horne & Ostberg, 1975) and time of testing (morning or afternoon) influences attention performance as measured through the Stroop task (Stroop).

Through conducting a controlled laboratory study, we aimed to isolate specific variables to effectively explore the research questions:

1. Do chronotypes and time of testing influence attention performance.
2. Do those who complete the attention-based task during the time that aligns with their chronotype (e.g., morning person tested during a morning session) perform better than those who are completing the task at a time that does not align with their chronotype (e.g., morning person tested during the afternoon).

There was a slight element of concealment in this study concerning the purpose of the MEQ and Stroop task, which was necessary to prevent participants from guessing the true aims of the study and potentially altering their behaviour or responses during the tasks.

If you wish to withdraw your data from the study, you must tell the researcher before leaving the lab. After leaving the lab, all your data will be anonymous, and we will not be able to trace it back to you.

If taking part in this study has raised any questions or concerns, please contact the researcher: Harriet Adams on 2219657@student.uwtsd.ac.uk or contact the research supervisor: Dr Kate Williams on kate.williams@uwtsd.ac.uk

E – Research proposal



Research Proposal

Research proposal (1,000 words overall)

Student Name and University ID number:	Harriet Adams (2219657)
Proposed Supervisor's name:	Kate Williams

Psychology Research Area (tick all that apply)

Social Psychology	Developmental Psychology	Biological Psychology ✓	Forensic Psychology
Health Psychology	Individual Differences	Educational Psychology	Political Psychology
Cognitive Psychology ✓	Clinical Psychology	Counselling Psychology	Occupational Psychology
Other: indicate briefly (not included in word count)			

Proposed Study Design (tick all that apply)

Quantitative ✓	Experimental ✓	Applied (with UWTSD students)	Online Questionnaire Survey
Qualitative	Quasi Experimental	Focus Groups	Online
Mixed Methods	Applied (with external organisation)	Interviews	Lab-based study ✓
If <u>Applied</u> , and involving an external organisation, please indicate your plans for gaining appropriate approvals from the organisation: (not included in the word count)		Other study design: indicate briefly (not included in word count)	

Suggested Research Title/Area: (between 10-15 words and must reflect the essence of your proposed research question, study design and study population and should be more specific than a broad topic area).

Exploring the effect of chronotypes and time of testing on attention performance during an attention-based task.


Background: 250 words

Why is your study important? What theory and empirical research evidence supports your research question? (Please provide a rationale for your study including a brief review of relevant psychological literature and theory and a minimum of five references).

Researchers over the past decade have increasingly focused on chronotypes and their impact on productivity and cognitive performance in both educational and workplace settings (Correa et al., 2014; Escribano & Diaz-Morales, 2014; Evansova et al., 2022; Jankowski et al., 2023; Matchock & Mordkoff, 2008). Chronotype refers to an individual's preferred time for daily activities, aligning with their circadian rhythm, or the body's natural sleep/wake cycle (Martinez-Perez et al., 2020). Studies have shown that cognitive performance varies based on chronotype, with superior performance occurring at one's optimal time of day (Schmidt et al. 2007; Opstal et al., 2022). For example, morning chronotypes tend to perform better at tasks in the morning, while evening chronotypes perform better in the evening (Facer-Childs et al., 2018; Opstal et al., 2022; Schmidt et al., 2007). Recent studies have delved into the influence of both chronotype and the time of day on cognitive functioning, particularly attention. Facer-Childs et al., (2018) noted that this could have significant negative effects on individuals who work, compete or learn during periods that do not align with their circadian rhythm or chronotype. A significant portion of current research on chronotypes and the potential impact on attention has concentrated on young children, older adults and shift workers, leaving a gap in the literature regarding the effect on students, particularly in higher education (Sabaoui et al., 2023). Therefore, further research is necessary to address this significant gap in the current literature. Recognising this phenomenon can be advantageous within educational, professional, sports and entertainment contexts to optimise performance and productivity.

Reference list

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- Martinez-Perez, V., Palmero, L.B., Campoy, G., & Fuentes, L.J. (2020). The role of chronotype in the interaction between the alerting and the executive control networks. *Scientific Reports*, 10,
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<https://doi.org/10.1525/collabra.57536>
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<https://doi.org/10.33069/cim.2023.0018>
- Schmidt, C., Colette, F., Cajochen, C., & Peigneux, P. (2007). A time to think: Circadian rhythms in human cognition. *Cognitive Neuropsychology*, 4(7), 755-789. <https://doi.org/10.1080/02643290701754158>

Please state the main research question(s) or hypotheses(s): (100 words max)

Does chronotype and time of testing affect attentional performance?

Chronotype and time of testing will have a significant effect on scores on an attention-based task.

Individuals with the morning chronotype will perform significantly better on the attention task than individuals with the evening chronotype when they complete the task in the morning compared to the afternoon.

Individuals with the evening chronotype will perform significantly better on the attention task than individuals with the morning chronotype when they complete the task during the afternoon compared to the morning.

Methodological Details (500 words)

Please summarise the key methodological approach: (you can include copies of proposed study materials as appendices if you wish). You must include details of the following:

- **Participants:** Who will your participants be, how will you access and recruit them, and how many are needed?
- **Design:** Using appropriate terminology clearly define key elements of your design (IVs, DVs, Qual approach, expt. manipulations etc). How do you plan to analyse your main data?
- **Materials:** What are the main measures, scales, experimental tools or other materials required for your study?
- **Procedure:** How will you carry out the study – define briefly what will happen to a participant in your study from the point of consent to the study debrief.

PARTICIPANTS

Students on a Psychology related course at UWTSD over the age of 18. They will voluntarily sign up via EMS and will receive two course credit for their participation. Participants must have normal to corrected vision to complete the psychomotor task. This study will categorise participants into morning and evening chronotype groups.

Based on the study design, around 60 participants will be required. This contrasts with larger sample sizes in similar studies, such as by Opstal et al., (2022) with 150 participants, and Matchock and Mordkoff (2008) with 80.

DESIGN

The study will use a 2x2 between-subjects experimental design. The first independent variable of chronotype will categorise participants as morning or evening chronotypes based on the Morningness/Eveningness questionnaire (MEQ; Horne & Ostberg, 1975).

The second independent variable of time testing will group participants by the time of day that they complete the study, morning group (9-11am) or afternoon (3-5pm).

The dependent variable will be the participant score on the Stroop Colour and Word Test (SCWT; Stroop, 1935).

MATERIALS

The Horne and Ostberg (1975) Morningness/Eveningness Questionnaire (MEQ) is a 19-item questionnaire designed to assess participant's alertness throughout the day, using Likert-style and time-scale questions. Questions include, "How is your appetite during the first half-hour after having woken in the morning?" and "Considering your own 'feeling best' rhythm, at what time would you get up if you were entirely free to plan your day?". This will determine participants specific chronotypes and place them into one of two groups, morning or evening chronotype. Score cut offs (low, medium, high) will categorise participants into their respective chronotype.

The Stroop Colour and Word Test (SCWT; Stroop, 1935) is used to evaluate cognitive interference control and measure attention span, particularly selective attention. The test consists of a series of colour names printed in various colours, and participants must correctly identify the colour of the ink of each word by pressing the corresponding key. A timer will be displayed for each word on the screen. Exceeding the time will result in an incorrect or unanswered score. The test will include 50 words and will take approximately 2-3 minutes to complete.

STUDY PROCEDURE

Participants will be recruited online through the EMS system and will complete the study at UWTSD Psychology Labs. After reviewing the information sheet and giving consent, they will be asked to complete the Stroop Colour and Word Test (SCWT) by pressing the colour key matching the text colour on the screen within the 3 second response time. They will then be directed to complete the Morningness/Eveningness (MEQ) questionnaire where they will be required to answer a series of questions and statements from with 'strongly agree' to 'strongly disagree'. The study will conclude with a debriefing session.

DATA AND ANALYSIS

The numerical data of the SCWT will be the number of correct colours identified. The overall scores will then be transferred into mean totals for each group in order to make comparisons. Numerical data will also be obtained and used to categorise participants into morning or evening people through calculating the sample mean scores of the MEQ.

WHAT STAT TEST

A 2x2 between-subjects ANOVA will be conducted. This will examine the main effect of each independent variable (morningness/eveningness and time of day) and their interaction on the dependent variable (performance on the attention task).

Key Ethical considerations (150 words)

In this section you are required to briefly outline any specific ethical considerations for your project. All projects will be expected to adhere to the BPS code of human research ethics, and you will need to submit a full ethics form which will document your specific processes for informed consent, debriefing, and data protection. Here you need to briefly note additional or specific key ethical considerations for your particular project e.g. potential for distress or discomfort, any deception, research with vulnerable populations or sensitive topic areas, and briefly outline how you expect to manage these risks within your project.

This study will involve a degree of deception, as participants will not be informed of the purpose of the questionnaire (morningness/eveningness), which they will complete after the SCWT. After the study has concluded, they will be debriefed and provided with information regarding the true objectives of the research project.

There is also a risk of potential stress or frustration for participants, particularly during the fast-paced and potentially challenging Stroop Test (SCWT). However, participants will be informed that they can notify the researcher throughout the study if they are struggling or wish to withdraw.

F – Approved Ethics Form



PG2 / E1 FORM

APPLICATION FOR ETHICAL APPROVAL

RESEARCH STUDENTS

This form is to be completed by the student within **SIX** months for full-time students and **TWELVE** months for part time students, after the commencement of the research degree or following progression to Part Two of your course.

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

This document is also available in Welsh.

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk, with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

In order for research to result in benefit and minimise risk of harm, it must be conducted ethically. A researcher may not be covered by the University's insurance if ethical approval has not been obtained prior to commencement.

The University follows the OECD Frascati manual definition of **research activity**: "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". As such this covers activities undertaken by members of staff, postgraduate research students, and both taught postgraduate and undergraduate students working on dissertations/projects.

The individual undertaking the research activity is known as the "principal researcher".

Ethical approval is not required for routine audits, performance reviews, quality assurance studies, testing within normal educational requirements, and literary or artistic criticism.

Please read the notes for guidance before completing ALL sections of the form.

This form must be completed and approved prior to undertaking any research activity. Please see Checklist for details of process for different categories of application.

SECTION A: About You (Principal Researcher)

1	Full Name:	Harriet Adams			
2	Tick all boxes that apply:	Member of staff:	☐	Honorary research fellow:	☐
	Undergraduate Student	☒	Taught Postgraduate Student	☐	Postgraduate Research Student
3	Institute/Academic Discipline/Centre:	Yr Athrofa: Psychology and Counselling			
4	Campus:	IQ, SA1 Campus, Swansea.			
5	E-mail address:	2219657@student.uwtsd.ac.uk			
6	Contact Telephone Number:				
For students:					

7	Student Number:	2219657
8	Programme of Study:	BSc Psychology
9	Director of Studies/Supervisor:	Dr Kate Williams

SECTION B: Approval for Research Activity

1	Has the research activity received approval in principle? (please check the Guidance Notes as to the appropriate approval process for different levels of research by different categories of individual)	YES	☒	NO	☐
					Date
2	If Yes, please indicate source of approval (and date where known): <i>Approval in principle must be obtained from the relevant source prior to seeking ethical approval</i>	Research Degrees Committee	☐		
Institute Research Committee		☐			
Other (write in) Dr Kate Williams (Dissertation supervisor)		☒	07/08/24		

SECTION C: Internal and External Ethical Guidance Materials

	Please list the core ethical guidance documents that have been referred to during the completion of this form (including any discipline-specific codes of research ethics, location-specific codes of research ethics, and also any specific ethical guidance relating to the proposed methodology). Please tick to confirm that your research proposal adheres to these codes and guidelines. You may add rows to this table if needed.				
1	UWTSD Research Ethics & Integrity Code of Practice				☒
2	UWTSD Research Data Management Policy				☒
3	UWTSD Student Code of Conduct				☒
4	BPS Code of Human Research Ethics (2021)				☒
5	BPS Code of Ethics and Conduct (2021)				☒

SECTION D: External Collaborative Research Activity

If there are external collaborators then you should gain consent from the contact persons to share their personal data with the university. If there are no external collaborators then leave this section blank and continue to section E.

1	Institution				
2	Contact person name				
3	Contact person e-mail address				
4	Is your research externally funded?	YES	☐	NO	☐
5	Are you in receipt of a KESS scholarship?	YES	☐	NO	☐
6	Are you specifically employed to undertake this research in either a paid or voluntary capacity?	Voluntary	YES	☐	NO
7		Employed	YES	☐	NO

8	Is the research being undertaken within an existing UWTSD Athrofa Professional Learning Partnership (APLP)?	If YES then the permission question below does not need to be answered.	YES	☐	NO	☐
9	Has permission to undertake the research has been provided by the partner organisation?	(If YES attach copy) If NO the application cannot continue	YES	☐	NO	☐

Where research activity is carried out in collaboration with an external organisation

10	Does this organisation have its own ethics approval system?	YES	☐	NO	☒
If Yes, please attach a copy of any final approval (or interim approval) from the organisation (this may be a copy of an email if appropriate).					

SECTION E: Details of Research Activity

1	Indicative title:	Exploring the effect of chronotypes and time of testing on attention performance.		
2	Proposed start date:	Oct/Nov 2024	Proposed end date:	20/05/2025
	Introduction to the Research (maximum 300 words per section) Ensure that you write for a <u>Non-Specialist Audience</u> when outlining your response to the points below: <i>Purpose of Research Activity</i> <i>Proposed Research Question</i> <i>Aims of Research Activity</i> <i>Objectives of Research Activity</i> Demonstrate, briefly, how Existing Research has informed the proposed activity and explain <i>What the research activity will add to the body of knowledge</i> <i>How it addresses an area of importance.</i>			
3	Purpose of Research Activity The purpose of this research activity is to explore whether chronotypes (natural body cycles) and the time of testing can influence performance on an attention-based task. Chronotypes, also referred to as an individual's preferred timing for daily activities (i.e., morning or afternoon/evening), and is a physiological process that aligns with the circadian rhythm, the body's natural sleep-wake cycle (Martinez-Perez et al., 2020). Many researchers, including Akram et al. (2018), Sabaoui et al. (2023) and Facer-Childs et al. (2018) have investigated the role of chronotypes within education. Facer-Childs et al. (2018) found that athletes with evening chronotypes were at a disadvantage when tested or undergoing learning activities during the morning. Based on this finding, they suggested that individuals who work, train or learn at times that do not align with their chronotype may experience a significant negative impact on their performance (Facer-Childs et al., 2018). However, a significant portion of the literature available on this subject overlooks its impact on individuals within higher education. Most studies have focused on young children, athletes, or professionals already in their careers (Sabaoui et al., 2023). Randler et al. (2017) observed that an individual's chronotype can change significantly over the course of their life, particularly during the transition from adolescence to adulthood, after which it remains relatively stable. Therefore, the studies conducted with primary and comprehensive school children are likely to show significant differences compared to the individuals within higher education who are in their early adulthood (Randler et al., 2017). Understanding the optimal times for young adults and students in higher education to perform is crucial for their learning and could lead to significant benefits in their university experience and academic performance.			

	Reference list Akram, N., Khan, N., Ameen, M., Mahmood, S., Shamim, K., Amin, M., & Rana, Q. (2018). Morningness-eveningness preferences, learning approach and academic achievement of undergraduate medical students. <i>Chronobiology International</i>, 35(9), 1262-1268. https://doi.org/10.1080/07420528.2018.1474473 Facer-Childs, E.R., Boiling, S., & Balanos, G.M. (2018). Effects of time of day and chronotype on cognitive and physical performance in healthy volunteers. <i>Sports Medicine</i>, 4(1), 47. https://doi.org/10.1186%2Fs40798-018-0162-z Randler, C., Faßl, C., & Kalb, N. (2017). From Lark to Owl: Developmental changes in morningness-eveningness from new-borns to early adulthood. <i>Scientific Reports</i>, 7. https://doi.org/10.1038/srep45874 Sabaoui, I., Lotfi, S., & Talbi, M. (2023). Circadian Fluctuations of Cognitive Psychomotor Performance in Medical Students: The Role of Daytime and Chronotype Patterns. <i>Chronobiology in Medicine</i>, 5, 127-137. https://doi.org/10.33069/cim.2023.0018. (this box should expand as you type)
4	Research Question 1. Does chronotype and time of testing affect attentional performance? 2. Do individuals perform better when completing an attention task during the time of day that matches their chronotype. (this box should expand as you type)
5	Aims of Research Activity The aims of this research project are to investigate the following: • Participants performance on an attention-based task depending on the time of day at which they complete the study. • Participants performance on an attention-based task depending on their individual chronotype. • Whether there is an interaction between chronotype and time of testing on attention performance. (this box should expand as you type)
6	Objectives of Research Activity The objective of this study is to examine in further detail whether chronotypes have the ability to influence a person's performance on attention-based tasks depending on the time of day in which they complete the study. (this box should expand as you type)
	Proposed methods (maximum 600 words) Provide a brief summary of all the methods that may be used in the research activity, making it clear what specific techniques may be used. If methods other than those listed in this section are deemed appropriate later, additional ethical approval for those methods will be needed. You do not need to justify the methods here, but should instead describe how you intend to collect the data necessary for you to complete your project.
7	Participant recruitment The research will take place in the 2nd floor Psychology Labs at UWTSD SA1 IQ campus. Participants will be recruited through the University's online Experiment Management System (EMS). Eligible psychology and counselling students can volunteer to participate in the study in exchange for two course credits.

	Data collection and Materials Participants will be provided with an information sheet (see appendix 1) and asked to complete a consent form (see appendix 2) before beginning the study. Participants will use the lab computer to complete the study through Qualtrics and SuperLab. To begin, participants will be directed to the computer where they will begin the Stroop test (Stroop, 1935), where they will be asked to respond to a series of 60 words (colour names) by pressing a button corresponding to the ink colour in which the word is written (i.e., the word 'red' appearing in red ink or blue ink). Each word will have a 5 second time limit. The total accurate ink colour responses will determine their attention performance. The total response time will also be used to analyse the accuracy of their results. Once completed, participants will be asked to complete the Morningness/Eveningness Questionnaire (MEQ; Horne & Ostberg, 1975; See appendix 3) along with a short demographic form. The MEQ contains 19 items designed to assess participants alertness throughout the day, categorising them as either morning or evening chronotypes. At the end of the questionnaire, participants will be debriefed by the researcher and given a paper copy of the questionnaire (See appendix 4). Design, Data, and Analysis: The numerical data from the Stroop Test will include the number of correct colours identified and the total time taken to complete the task. The overall scores will be converted into mean totals for each group for comparison. Additionally, numerical data will be gathered to categorise participants into morning or evening chronotypes by calculating the sample mean scores of the MEQ. A 2x2 between-subjects ANOVA will be conducted to analyse the collected data. This will examine the main effects of each independent variable (morningness/eveningness and time of testing) and their interactions with the dependent variable (performance on the attention task). <i>(this box should expand as you type)</i>		
	Location of research activity Identify all locations where research activity will take place.		
8	2nd floor Psychology Labs, IQ building. SA1 Campus, Swansea. <i>(this box should expand as you type)</i>		
	Research activity outside of the UK If research activity will take place overseas, you are responsible for ensuring that local ethical considerations are complied with and that the relevant permissions are sought. Specify any local guidelines (e.g. from local professional associations/learned societies/universities) that exist and whether these involve any ethical stipulations beyond those usual in the UK (provide details of any licenses or permissions required). Also specify whether there are any specific ethical issues raised by the local context in which the research activity is taking place, for example, particular cultural and/or legal sensitivities or vulnerabilities of participants. If you live in the country where you will do the research then please state this.		
9	N/A <i>(this box should expand as you type)</i>		
10	Use of documentation not in the public domain: Are any documents NOT publicly available?	NO YES	☒ ☐
11	If Yes, please provide details here of how you will gain access to specific documentation that is not in the public domain and that this is in accordance with the current data protection law of the country in question and that of England and Wales.		

	(this box should expand as you type)
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Does your research relate to one or more of the seven aims of the Well-being of Future Generations (Wales) Act 2015?		YES	NO
12	A prosperous Wales	☐	☒
13	A resilient Wales	☐	☒
14	A healthier Wales	☒	☐
15	A more equal Wales	☐	☒
16	A Wales of cohesive communities	☐	☒
17	A Wales of vibrant culture and thriving Welsh language	☐	☒
18	A globally responsible Wales	☐	☒
19	If YES to any of the above, please give details:		
Gaining insight into individual sleep patterns and their effects on daily activities, performance and learning abilities could play a significant role in promoting a healthier Wales. (this box should expand as you type)			

SECTION F: Scope of Research Activity

Will the research activity include:		YES	NO
1	Use of a questionnaire or similar research instrument?	☒	☐
2	Use of interviews?	☐	☒
3	Use of focus groups?	☐	☒
4	Use of participant diaries?	☐	☒
5	Use of video or audio recording?	☐	☒
6	Use of computer-generated log files?	☒	☐
7	Participant observation with their knowledge?	☐	☒
8	Participant observation without their knowledge?	☐	☒
9	Access to personal or confidential information without the participants' specific consent?	☐	☒
10	Administration of any questions, test stimuli, presentation that may be experienced as physically, mentally or emotionally harmful / offensive?	☐	☒
11	Performance of any acts which may cause embarrassment or affect self-esteem?	☐	☒
12	Investigation of participants involved in illegal activities?	☐	☒
13	Use of procedures that involve deception?	☐	☒
14	Administration of any substance, agent or placebo?	☐	☒
15	Working with live vertebrate animals?	☐	☒
16	Procedures that may have a negative impact on the environment?	☐	☒

17	Other primary data collection methods. Please indicate the type of data collection method(s) below.		
	Details of any other primary data collection method: This study will include the Stroop Test, adapted from Stroop (1935). This test will be conducted using SuperLab and will consist of two phases; a short practice trial followed by the main test of 60 words. SuperLab will be programmed to track correctly matched responses to the ink colours displayed on the screen, while also recording the response time to respond to each word and the overall completion time. (this box should expand as you type)	☒	☐

If NO to every question, then the research activity is (ethically) low risk and **may** be exempt from **some** of the following sections (please refer to Guidance Notes).

If YES to any question, then no research activity should be undertaken until full ethical approval has been obtained.

SECTION G: Intended Participants

If there are no participants then do not complete this section, but go directly to section H.

Who are the intended participants:		YES	NO
1	Students or staff at the University?	☒	☐
2	Adults (over the age of 18 and competent to give consent)?	☒	☐
3	Vulnerable adults?	☐	☒
4	Children and Young People under the age of 18? (Consent from Parent, Carer or Guardian will be required)	☐	☒
5	Prisoners?	☐	☒
6	Young offenders?	☐	☒
7	Those who could be considered to have a particularly dependent relationship with the investigator or a gatekeeper?	☐	☒
8	People engaged in illegal activities?	☐	☒
9	Others. Please indicate the participants below, and specifically any group who may be unable to give consent.		
	Details of any other participant groups: (this box should expand as you type)	☐	☒

Participant numbers and source		
Provide an estimate of the expected number of participants. How will you identify participants and how will they be recruited?		
10	How many participants are expected?	Approximately 60 participants will be required for this study. This is due to there being two between-subjects IVs within this study, each with two levels (morning/evening chronotype and morning/afternoon testing time), resulting in 4 possible groups. (this box should expand as you type)
11	Who will the participants be?	Participants will be students over the age of 18 within the Psychology and counselling department at UWTSD.

		(this box should expand as you type)
12	How will you identify the participants?	Participants will be recruited through the Experiment Management System (EMS) in exchange for 2 EMS credits. Participants will sign up through the online system and be identified when they attend the labs using their unique EMS ID code. A different unique ID code will then be assigned to their data. (this box should expand as you type)

	Information for participants:	YES	NO	N/A
13	Will you describe the main research procedures to participants in advance, so that they are informed about what to expect?	☒	☐	☐
14	Will you tell participants that their participation is voluntary?	☒	☐	☐
15	Will you obtain written consent for participation?	☒	☐	☐
16	Will you explain to participants that refusal to participate in the research will not affect their treatment or education (if relevant)?	☒	☐	☐
17	If the research is observational, will you ask participants for their consent to being observed?	☐	☐	☒
18	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
19	With questionnaires, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
20	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
21	Will you debrief participants at the end of their participation, in a way appropriate to the type of research undertaken?	☒	☐	☐
22	If NO to any of above questions, please give an explanation			
	(this box should expand as you type)			

	Information for participants:	YES	NO	N/A
24	Will participants be paid?	☐	☒	☐
25	Is specialist electrical or other equipment to be used with participants?	☐	☒	☐
26	Are there any financial or other interests to the investigator or University arising from this study?	☐	☒	☐
27	Will the research activity involve deliberately misleading participants in any way, or the partial or full concealment of the specific study aims?	☒	☐	☐
28	If YES to any question, please provide full details			
	Participants will not be informed that they are being divided into morning or evening groups based on their MEQ responses. They will also be unaware that the time of testing could affect their attention performance. However, this information will be disclosed to them during the debrief. (this box should expand as you type)			

SECTION H: Anticipated Risks

Outline any anticipated risks that may adversely affect any of the participants, the researchers and/or the University, and the steps that will be taken to address them. If you have completed a full risk assessment (for example as required by a laboratory, or external research collaborator) you may append that to this form.					
1	Full risk assessment completed and appended? <table border="1"> <tr> <td>Yes</td> <td>☐</td> </tr> <tr> <td>No</td> <td>☒</td> </tr> </table>	Yes	☐	No	☒
Yes	☐				
No	☒				
2	Risks to participants For example: sector-specific health & safety, emotional distress, financial disclosure, physical harm, transfer of personal data, sensitive organisational information <table border="1"> <tr> <td> Risk to participants: 1. Potential risk of distress. Participants may find the Stroop test to be challenging or frustrating, leading to feelings of frustration or anxiety. 2. Concerns may arise from the MEQ The MEQ may raise concerns for participants regarding their sleeping habits or inquiries about their mood. 3. Data protection. Participants may have concerns regarding the use and storage of their data during this study. <i>(this box should expand as you type)</i> </td> <td> How you will mitigate the risk to participants: 1. This study will comply with both BPS Code of Human Research Ethics (2021) and UWTSD Research Ethics & Integrity Code of Practice Guidelines. They will be informed prior to starting the experiment that they are able to withdraw from the study at any point during the study should they no longer wish to continue or if they become distressed. They will be reminded that there will be no penalty for withdrawing from the study. Also, they will be informed of the nature of the attention task and the focus of the sleep questionnaire prior to participating. 2. If participants start to feel uncomfortable during the MEQ task, they may notify the researcher and request to withdraw from the study at any point without penalty. If they have any concerns regarding the MEQ results or their responses to certain questions, they can contact the researcher who will signpost to the supervisor to provide further guidance. 3. The researcher will inform the participant that any data will be kept confidential, and all participant data will remain anonymous. Personal details, such as participants age, gender, and signatures will be stored securely in accordance with UWTSD Research Data Management. Electronic data from both Qualtrics and SuperLabs will be stored within a password-protected OneDrive file on the researcher's university account, and paper consent forms will be kept in a locked cabinet within the labs. All data will be destroyed after it has been approved by the module external examiner at the end of the course. <i>(this box should expand as you type)</i> </td> </tr> </table>	Risk to participants: 1. Potential risk of distress. Participants may find the Stroop test to be challenging or frustrating, leading to feelings of frustration or anxiety. 2. Concerns may arise from the MEQ The MEQ may raise concerns for participants regarding their sleeping habits or inquiries about their mood. 3. Data protection. Participants may have concerns regarding the use and storage of their data during this study. <i>(this box should expand as you type)</i>	How you will mitigate the risk to participants: 1. This study will comply with both BPS Code of Human Research Ethics (2021) and UWTSD Research Ethics & Integrity Code of Practice Guidelines. They will be informed prior to starting the experiment that they are able to withdraw from the study at any point during the study should they no longer wish to continue or if they become distressed. They will be reminded that there will be no penalty for withdrawing from the study. Also, they will be informed of the nature of the attention task and the focus of the sleep questionnaire prior to participating. 2. If participants start to feel uncomfortable during the MEQ task, they may notify the researcher and request to withdraw from the study at any point without penalty. If they have any concerns regarding the MEQ results or their responses to certain questions, they can contact the researcher who will signpost to the supervisor to provide further guidance. 3. The researcher will inform the participant that any data will be kept confidential, and all participant data will remain anonymous. Personal details, such as participants age, gender, and signatures will be stored securely in accordance with UWTSD Research Data Management. Electronic data from both Qualtrics and SuperLabs will be stored within a password-protected OneDrive file on the researcher's university account, and paper consent forms will be kept in a locked cabinet within the labs. All data will be destroyed after it has been approved by the module external examiner at the end of the course. <i>(this box should expand as you type)</i>		
Risk to participants: 1. Potential risk of distress. Participants may find the Stroop test to be challenging or frustrating, leading to feelings of frustration or anxiety. 2. Concerns may arise from the MEQ The MEQ may raise concerns for participants regarding their sleeping habits or inquiries about their mood. 3. Data protection. Participants may have concerns regarding the use and storage of their data during this study. <i>(this box should expand as you type)</i>	How you will mitigate the risk to participants: 1. This study will comply with both BPS Code of Human Research Ethics (2021) and UWTSD Research Ethics & Integrity Code of Practice Guidelines. They will be informed prior to starting the experiment that they are able to withdraw from the study at any point during the study should they no longer wish to continue or if they become distressed. They will be reminded that there will be no penalty for withdrawing from the study. Also, they will be informed of the nature of the attention task and the focus of the sleep questionnaire prior to participating. 2. If participants start to feel uncomfortable during the MEQ task, they may notify the researcher and request to withdraw from the study at any point without penalty. If they have any concerns regarding the MEQ results or their responses to certain questions, they can contact the researcher who will signpost to the supervisor to provide further guidance. 3. The researcher will inform the participant that any data will be kept confidential, and all participant data will remain anonymous. Personal details, such as participants age, gender, and signatures will be stored securely in accordance with UWTSD Research Data Management. Electronic data from both Qualtrics and SuperLabs will be stored within a password-protected OneDrive file on the researcher's university account, and paper consent forms will be kept in a locked cabinet within the labs. All data will be destroyed after it has been approved by the module external examiner at the end of the course. <i>(this box should expand as you type)</i>				

3	If research activity may include sensitive, embarrassing or upsetting topics (e.g. sexual activity, drug use) or issues likely to disclose information requiring further action (e.g. criminal activity), give details of the procedures to deal with these issues, including any support/advice (e.g. helpline numbers) to be offered to participants. Note that where applicable, consent procedures should make it clear that if something potentially or actually illegal is discovered in the course of a project, it may need to be disclosed to the proper authorities	
	N/A <i>(this box should expand as you type)</i>	
4	Risks to the investigator For example: personal health & safety, physical harm, emotional distress, risk of accusation of harm/impropriety, conflict of interest	
	Risk to the investigator: 1. Researcher email There is a possibility that inappropriate or unprofessional communication could be directed at the researcher, including via email. 2. Accusation of harm/impropriety Possible allegations of inappropriate, harmful or unprofessional behaviour could be made about the from the participant. 3. Physical safety within the lab There is a risk of physical harm within the labs, which may involve dangerous behaviour from other students or accidents involving equipment or computers. 4. Risk of data protection violations. There is the risk that participant data may become public or used for other non-research purposes. <i>(this box should expand as you type)</i>	<i>How you will mitigate the risk to the investigator:</i> 1. The researcher will ensure that their university email is used as the only point of contact between them and the participants. They will follow all UWTSD and BPS Ethics guidelines when working with the participants. Any concerning or inappropriate correspondence will be documented and reported to the lab manager/ project supervisor. 2. The researcher will ensure to follow all relevant UWTSD and BPS procedures regarding professional behaviour and the study will not commence until all approvals have been received. If the researcher becomes aware of any issues, these will be reported to the supervisor immediately. 3. If issues arise to either the participant or researcher, the study will be immediately suspended, and the academic supervisor will be informed immediately. If a participant becomes agitated, the researcher will terminate the study, remove themselves if they feel their personal safety is at risk and inform the lab manager. Also, research will only take place in the labs during open university hours from Monday-Friday 9am – 5pm. All lab sessions will be scheduled in advance to ensure that no unauthorised individuals are present. The lab manager will be informed of any incidents that occur. 4. All electronic data collected from Qualtrics and SuperLab will be stored securely on password protected computer files, only accessible by the researcher. Paper documents (consent forms) will be stored in locked files within the Labs. The storage of research data

		and participant information will be in accordance with UWTSD Research Data Management rules. Data will only be used and shared for intended purposes. <i>(this box should expand as you type)</i>		
5	University/institutional risks For example: adverse publicity, financial loss, data protection			
	Risk to the University: 1. Adverse publicity. Researchers not adhering to codes of research ethics. 2. Data protection. Data leaks and exposures or data could be used for alternative purposes <i>(this box should expand as you type)</i>	How you will mitigate the risk to the University: 1. The researcher will conduct themselves with professionalism and respect towards all participants, fellow students and staff within the labs. They will comply with the UWTSD Research Ethics and Integrity Code of Practice, the Student Code of Conduct, and the BPS Code of Human Research Ethics (2021). 2. The researcher will adhere to the UWTSD Research Data Management Policy and UWTSD Data Protection and Storage Protocol. Data and study information will be kept confidential at all times, with proper management and secure storage of data in both the lab and online files. Data will only be shared with project supervisors and examiners when requested. Upon completion of the research project, data will be deleted from the researcher's computer, and physical copies will be disposed of properly. <i>(this box should expand as you type)</i>		
6	Environmental risks For example: accidental spillage of pollutants, damage to local ecosystems			
	Risk to the environment: N/A <i>(this box should expand as you type)</i>	How you will mitigate the risk to environment: <i>(this box should expand as you type)</i>		
Disclosure and Barring Service				
	If the research activity involves children or vulnerable adults, a Disclosure and Barring Service (DBS) certificate must be obtained before any contact with such participants.	YES	NO	N/A
7	Does your research require you to hold a current DBS Certificate?	☐	☒	☐

8	If YES, please give the certificate number. If the certificate number is not available please write "Pending"; in this case any ethical approval will be subject to providing the appropriate certificate number.	
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SECTION I: Feedback, Consent and Confidentiality

1	Feedback What de-briefing and feedback will be provided to participants, how will this be done and when? At the end of the study, the researcher will debrief the participant, explaining the true objectives and purpose of the research and offering an opportunity to address any final questions. The researcher will also emphasise that once the participant leaves the lab, their data cannot be withdrawn as it will be anonymous. Finally, participants will receive a physical debrief from (See appendix 3) to take home, outlining the key research aims and providing contact details of both the researcher and the research supervisor. (this box should expand as you type)
2	Informed consent Describe the arrangements to inform potential participants, before providing consent, of what is involved in participating. Describe the arrangements for participants to provide full consent before data collection begins. If gaining consent in this way is inappropriate, explain how consent will be obtained and recorded in accordance with prevailing data protection legislation. Participants will be aware that the study includes a sleep pattern questionnaire and a short attention-based computer task when signing up via EMS. They will receive an information sheet (See appendix 1) on arrival, outlining the study's research title and providing basic details about the questionnaire and attention task. Participants will be given a consent form (See appendix 2), and they must check every box and sign the consent form to provide full consent, otherwise they will not be permitted to proceed with the study. (this box should expand as you type)
3	Confidentiality / Anonymity Set out how anonymity of participants and confidentiality will be ensured in any outputs. If anonymity is not being offered, explain why this is the case. Participants will be identifiable to the researcher solely through their unique EMS identification code used during sign-up. All research data will be anonymised, with EMS numbers being replaced by a unique participant ID. Only anonymised data will be used for analysis and the reporting of the final results. This data will be securely stored in a password-protected file on the researcher's profile on the lab computer, within their password protected Qualtrics account, and in their password protected University OneDrive account, in compliance with UWTSU Data Protection and Storage Protocol. The researcher will ensure that all participant data remains confidential and is used exclusively for its intended purposes. (this box should expand as you type)

SECTION J: Data Protection and Storage

	Does the research activity involve personal data (as defined by the General Data Protection Regulation 2016 "GDPR" and the Data Protection Act 2018 "DPA")?	YES	NO
1	<i>"Personal data" means any information relating to an identified or identifiable natural person ('data subject'). An identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Any video or audio recordings of participants is considered to be personal data.</i>	☒	☐
	If YES, provide a description of the data and explain why this data needs to be collected:		

2	This study will gather participants' age and gender in order to provide demographic information and will NOT be linked to participant names or EMS ID. Names will be collected on the consent form, but these will be stored separately to all other study data in a locked cabinet in the Psych Labs. <i>(this box should expand as you type)</i>		
	Does it involve special category data (as defined by the GDPR)?	YES	NO
3	"Special category data" means sensitive personal data consisting of information as to the data subjects' – (a) racial or ethnic origin, (b) political opinions, (c) religious beliefs or other beliefs of a similar nature, (d) membership of a trade union (within the meaning of the Trade Union and Labour Relations (Consolidation) Act 1992), (e) physical or mental health or condition, (f) sexual life, (g) genetics, (h) biometric data (as used for ID purposes).	☐	☒
	If YES, provide a description of the special category data and explain why this data needs to be collected:		
4	<i>(this box should expand as you type)</i>		

	Will data from the research activity (collected data, drafts of the thesis, or materials for publication) be stored in any of the following ways?	YES	NO
5	Manual files (i.e. in paper form)?	☒	☐
6	University computers?	☒	☐
7	Private company computers?	☐	☒
8	Home or other personal computers?	☐	☒
9	Laptop computers/ CDs/ Portable disk-drives/ memory sticks?	☒	☐
10	"Cloud" storage or websites?	☒	☐
11	Other – specify:	☐	☒
12	For all stored data, explain the measures in place to ensure the security of the data collected, data confidentiality, including details of backup procedures, password protection, encryption, anonymisation and pseudonymisation: All manual files, including paper consent forms, will be securely stored in a locked cabinet within the Psychology labs. Once they are no longer needed following module completion confirmation from the external examiners, they will be disposed of appropriately. All research data will be stored electronically, with Qualtrics and SuperLab data being stored in the researcher's University accounts under password protection. The Qualtrics data will be downloaded in an anonymised format into SPSS and stored in a password-protected file on the researcher's University OneDrive account. Any SuperLab data will be transferred from the lab computers to the researcher's secure University OneDrive file and a secure memory stick. All collected data will only be linked through unique participant ID codes. <i>(this box should expand as you type)</i>		

Data Protection		
Will the research activity involve any of the following activities:	YES	NO

13	Electronic transfer of data in any form?	☒	☐
14	Sharing of data with others at the University outside of the immediate research team?	☐	☒
15	Sharing of data with other organisations?	☐	☒
16	Export of data outside the UK or importing of data from outside the UK?	☐	☒
17	Use of personal addresses, postcodes, faxes, emails or telephone numbers?	☐	☒
18	Publication of data that might allow identification of individuals?	☐	☒
19	Use of data management system?	☒	☐
20	Data archiving?	☐	☒
21	If YES to any question, please provide full details, explaining how this will be conducted in accordance with the GDPR and Data Protection Act (2018) (and any international equivalents, where appropriate):		
	Data from SuperLab will be downloaded and transferred from the lab computers onto a secure encrypted memory stick, which will be used to transfer the data onto the researcher's password-protected University OneDrive file. Qualtrics data will be downloaded in an anonymised format into SPSS and stored in a password-protected file on the researcher's University OneDrive file. The final dissertation materials will be shared with UWTSD academic staff in the form of a written report and presentation. <i>(this box should expand as you type)</i>		
22	List all who will have access to the data generated by the research activity:		
	Harriet Adams (researcher), Dr Kate Williams (Dissertation supervisor), External Examiners on request. <i>(this box should expand as you type)</i>		
23	List who will have control of, and act as custodian(s) for, data generated by the research activity:		
	Harriet Adams (researcher) <i>(this box should expand as you type)</i>		
24	Give details of data storage arrangements, including security measures in place to protect the data, where data will be stored, how long for, and in what form. Will data be archived – if so how and if not why not.		
	The study will collect data using both Qualtrics and SuperLab. Data from Qualtrics will be stored in its anonymous format within the researcher's password protected Qualtrics account. It will be downloaded to excel and SPSS, where it will be transferred onto the researcher's password-protected University OneDrive account. Data collected from SuperLab will be anonymous and will be transferred from the lab computer via a secure memory stick to the researcher's University OneDrive account. Any data on the memory stick will be deleted after transferring. Paper consent forms will be securely stored in a locked cabinet within the Psychology Labs. After the completion of the Psychology Empirical Project, and external examiner confirmation, all data and consent forms will be deleted/destroyed. All data storage will adhere to the UWTSD Research Data Management Policy. <i>(this box should expand as you type)</i>		
25	Please indicate if your data will be stored in the UWTSD Research Data Repository (see https://researchdata.uwtsd.ac.uk/). If so please explain. <i>(Most relevant to academic staff)</i>		
	Any data gathered during this study will not be stored in the UWTSD Research Data Repository at this point and will not be held after the conclusion of the empirical project.		

	(this box should expand as you type)		
26	Confirm that you have read the UWTSD guidance on data management (see https://www.uwtsd.ac.uk/library/research-data-management/)	YES	☒
27	Confirm that you are aware that you need to keep all data until after your research has completed or the end of your funding	YES	☒

SECTION K: Declaration

	The information which I have provided is correct and complete to the best of my knowledge. I have attempted to identify any risks and issues related to the research activity and acknowledge my obligations and the rights of the participants. In submitting this application I hereby confirm that I undertake to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice which is published on the website: https://www.uwtsd.ac.uk/research/research-ethics/		
1	Signature of applicant:	H.Adams	Date: 25/09/24

For STUDENT Submissions:

2	Director of Studies/Supervisor:	Dr Kate Williams	Date: 04.10.24
3	Signature:	<i>K. E. Williams</i>	

For STAFF Submissions:

4	Academic Director/ Assistant Dean:		Date:
5	Signature:		

Checklist: Please complete the checklist below to ensure that you have completed the form according to the guidelines and attached any required documentation:

☒	I have read the guidance notes supplied before completing the form.
☒	I have completed ALL RELEVANT sections of the form in full.
☒	I confirm that the research activity has received approval in principle
☐	I have attached a copy of final/interim approval from external organisation (where appropriate)
☐	I have attached a full risk assessment (where appropriate) ONLY TICK IF YOU HAVE ATTACHED A FULL RISK ASSESSMENT
☒	I understand that it is my responsibility to ensure that the above named research activity will meet the University's Research Ethics and Integrity Code of Practice.
☒	I understand that before commencing data collection all documents aimed at respondents (including information sheets, consent forms, questionnaires, interview schedules etc.) must be confirmed by the DoS/Supervisor, module tutor or Academic Director.

RESEARCH STUDENTS ONLY

Once complete, submit this form via the **MyTSD Doctoral College Portal** at (<https://mytsd.uwtsd.ac.uk>).

RESEARCH STAFF ONLY

All communications relating to this application during its processing must be in writing and emailed to pgresearch@uwtsd.ac.uk, with the title 'Ethical Approval' followed by your name.

STUDENTS ON UNDERGRADUATE OR TAUGHT MASTERS PROGRAMMES should submit this form (and receive the outcome) via systems explained to you by the supervisor/module leader.

Appendix

1. Information sheet

Participant Information Sheet

Title of Study: Exploring the effect of chronotype and time of testing on attention performance.

Research Team: Student Researcher: Harriet Adams (2219657@student.uwtsd.ac.uk) and Supervisor: Dr Kate Williams (kate.williams@uwtsd.ac.uk)

Date:

Invitation Paragraph:

You are being invited to take part in a research project being conducted by a third-year student within the Psychology and Counselling department at The University of Wales Trinity Saint David (UWTSd) for their Psychology Empirical Project. Before you decide to take part, it is important for you to understand why the research is being conducted and what participation will involve.

Please take time to read the following information carefully and discuss it with the researcher if you wish. Ask if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part. Thank you for reading this.

Purpose of Research:

The purpose of this study is to explore whether attention performance on a Stroop task varies depending on a person's wake/sleep cycle and the time they are tested.

What does taking part involve:

This study will involve an in-person experimental lab-based task. During this study you will be required to do the following:

- Provide demographic information of age and gender.
- Take part in a computer-based task involving the Stroop test (Stroop, 1935), where you will be required to respond to a series of 60 words (colour names) by pressing a button corresponding to the ink colour in which the word is written (i.e., the word 'red' appearing in red ink or blue ink). Each word will have a 5 second time limit. You will also 10 practice trials to begin.
- You will then be asked to complete a 19-item questionnaire on your levels of activeness throughout the day and night.

At the end of the study, you will be debriefed by the researcher, and you will be provided with the study debrief sheet.

How long will the study take:

This study is expected to take around 20 minutes to complete. If you have signed-up via the Experiment Management System (EMS), you can expect to receive 2 credits.

Benefits of participating:

Whilst there are no immediate benefits for those people participating in the study, it is hoped that this work will contribute to the existing body of knowledge on the role of sleep and attention within learning and higher education settings.

Risks of participating:

There are no immediate risks to participation in this study. However, there is a possibility of potential stress due to the fast-paced and potentially challenging nature of the Stroop computer-based task. If you feel you would be uncomfortable engaging in this computer task, you are advised not to take part in this study or if you do commence with this task but feel it becomes too overwhelming, again you can withdraw from the task without reason and without penalty. Some people may also be concerned with completing questions about their waking/sleeping habits and activity levels. Again, if you feel this would be the case, you are advised not to take part in this study, or if you start answering these questions and feel it is too overwhelming you can withdraw from the task without reason and without penalty and consult with the research supervisor for further signposting. You can also choose not to answer any questions on this questionnaire if you are not comfortable answering them.

Participation and withdrawal:

Participation in this study is completely voluntary and you also have the option of not answering any questions throughout any part of the study if you do not feel comfortable answering them. You can withdraw at any point during the study without penalty. If you wish to withdraw during the study, please inform the researcher. You do not need to give a reason for withdrawing. **However, please note, once you leave the lab environment, it will not be possible to withdraw your data, as it will be anonymous.**

How will your data be used and processed:

Your data will only be used for the purpose of the research activity. Your name will only be collected on the consent form and consent forms will not be related to study data. This study will also collect demographic data of age and gender. This is for the purpose of descriptive statistics, which form the standard reporting measures in psychology. Once the data is collected, it will be aggregated for presentation purposes by calculating the mean age and total gender numbers. This data will also not be linked to your name. The researcher will not disclose data information or use it for any other purposes.

How will your data be collected and stored:

All collected raw data will be kept in a raw format and then aggregated for analysis purposes. Computer data will be collected via SuperLab, and this data will be stored on the SuperLab computer within the Psychology labs. It will only be accessed by the researcher through a password protected



PG2 / E1 FORM

university account. All SuperLab data will be anonymous and copied from the lab computer to the researcher's university OneDrive account, which will also be protected with password. If there would be a need to transfer data by a memory stick, the memory stick will be encrypted, and the data will be deleted once transfer is completed. Qualtrics data also be anonymous and stored in the researcher's password protected Qualtrics account. Qualtrics data will be downloaded in an anonymised format into excel and SPSS and stored in a password-protected file on the researcher's University OneDrive account. Physical consent forms will be preserved in a securely locked filing cabinet located in the Psychology Labs and separate from the anonymised electronic data. This data will be subsequently deleted after the module assessment undergoes evaluation by the end of year examination board.

How can you contact the researchers if you have any questions:

You can contact the research student via email: Harriet Adams – 2219657@student.uwtsd.ac.uk

You can also contact the research supervisor via email: Dr Kate Williams – kate.williams@uwtsd.ac.uk

If you have any immediate questions, please ask the researcher now. If you are happy to continue, please read, complete, and sign the corresponding consent form.

H – SPSS Output

Cronbach's Alpha for reliability of the MEQ

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.773	.816	19

Item Statistics

	Mean	Std. Deviation	N
MEQ_1*	2.49	1.048	39
MEQ_2*	2.67	1.060	39
MEQ_3	1.56	.912	39
MEQ_4	2.23	.842	39
MEQ_5	2.08	.900	39
MEQ_6	1.72	.944	39
MEQ_7	1.74	.637	39
MEQ_8*	1.97	.811	39
MEQ_9*	2.15	.875	39
MEQ_10*	3.00	1.214	39
MEQ_11	3.00	1.573	39
MEQ_12	2.54	1.144	39
MEQ_13	2.08	1.109	39
MEQ_14	2.46	1.072	39
MEQ_15	2.69	.893	39
MEQ_16	2.36	1.063	39
MEQ_17*	3.97	2.978	39
MEQ_18*	4.18	3.831	39
MEQ_19	1.95	2.051	39

Descriptive Statistics

Between-Subjects Factors

	Value	Label	N
Time of testing	1	Morning	20
	2	Afternoon	19
Chronotype	1.00	Morning	20
	2.00	Evening	19

Descriptive Statistics

Dependent Variable: Response Time

Time of testing	Chronotype	Mean	Std. Deviation	N
Morning	Morning	839.22300	84.061392	10
	Evening	832.05100	73.353418	10
	Total	835.63700	76.873294	20
Afternoon	Morning	812.60200	53.271892	10
	Evening	870.89489	54.865464	9
	Total	840.21442	60.423911	19
Total	Morning	825.91250	69.842416	20
	Evening	850.45074	66.522946	19
	Total	837.86703	68.480424	39

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	39	18	59	30.67	10.212
Gender	39	1	3	1.85	.432
Valid N (listwise)	39				

Statistics

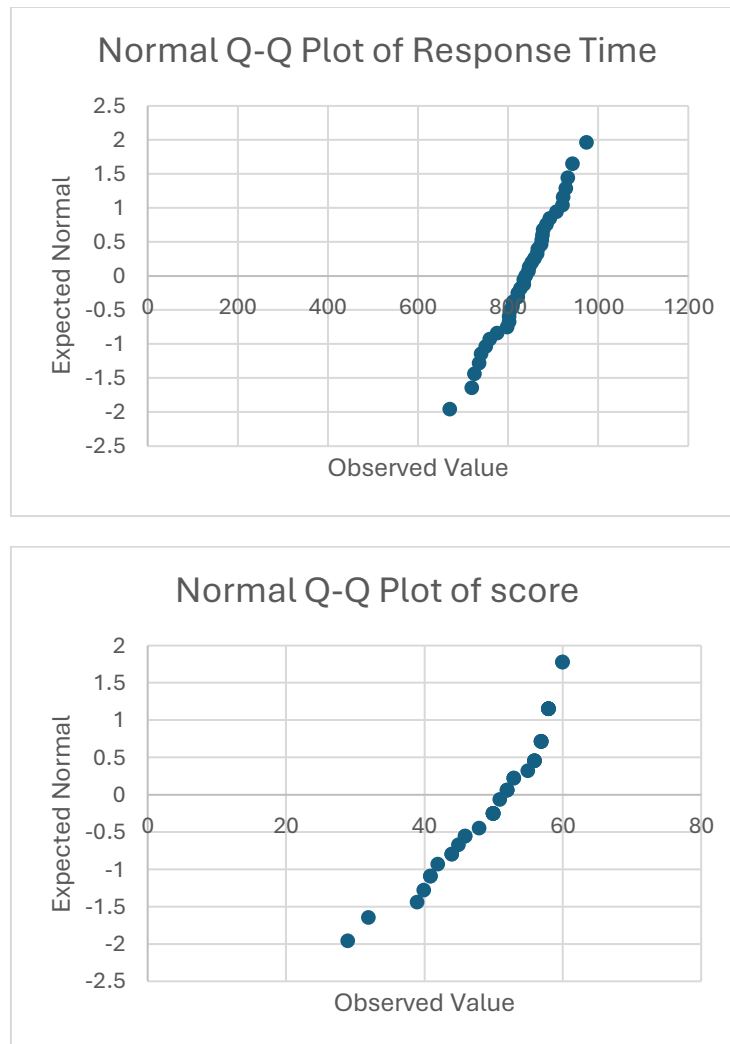
Gender

N	Valid	39
	Missing	0

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	7	17.9	17.9	17.9
	Female	31	79.5	79.5	97.4
	Non-binary	1	2.6	2.6	100.0
	Total	39	100.0	100.0	

G – Q-Q Plot of Response time and Stroop Score



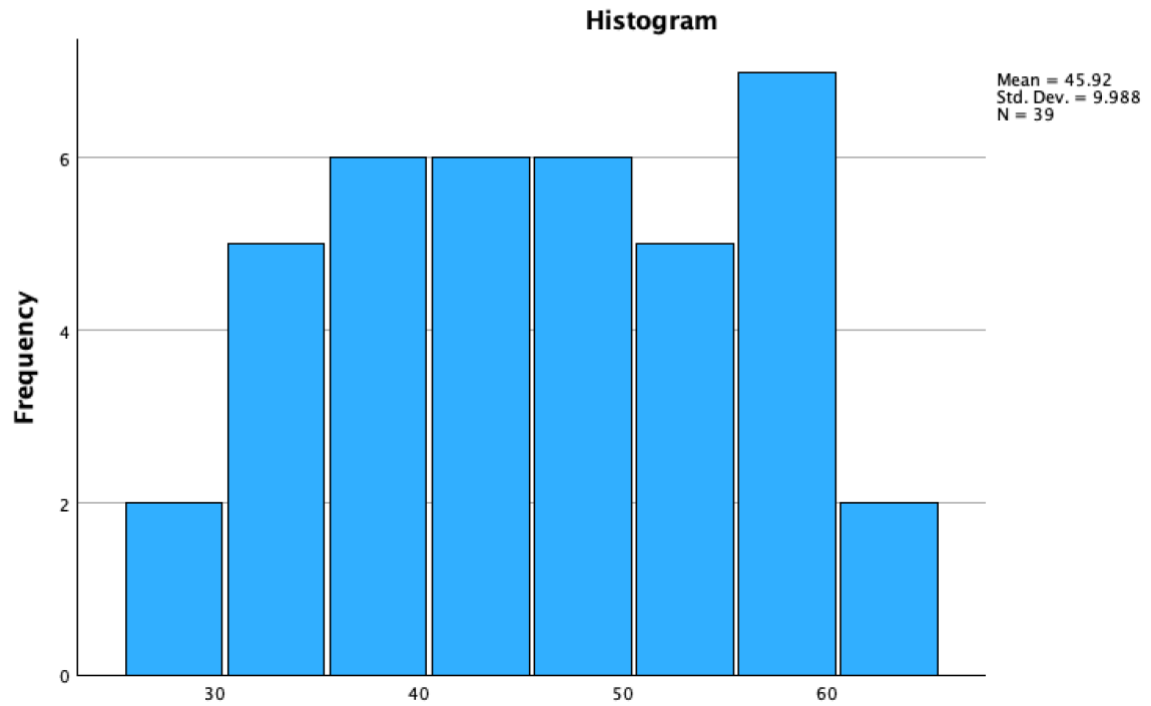
Test of Normality for MEQ Score and Response Time

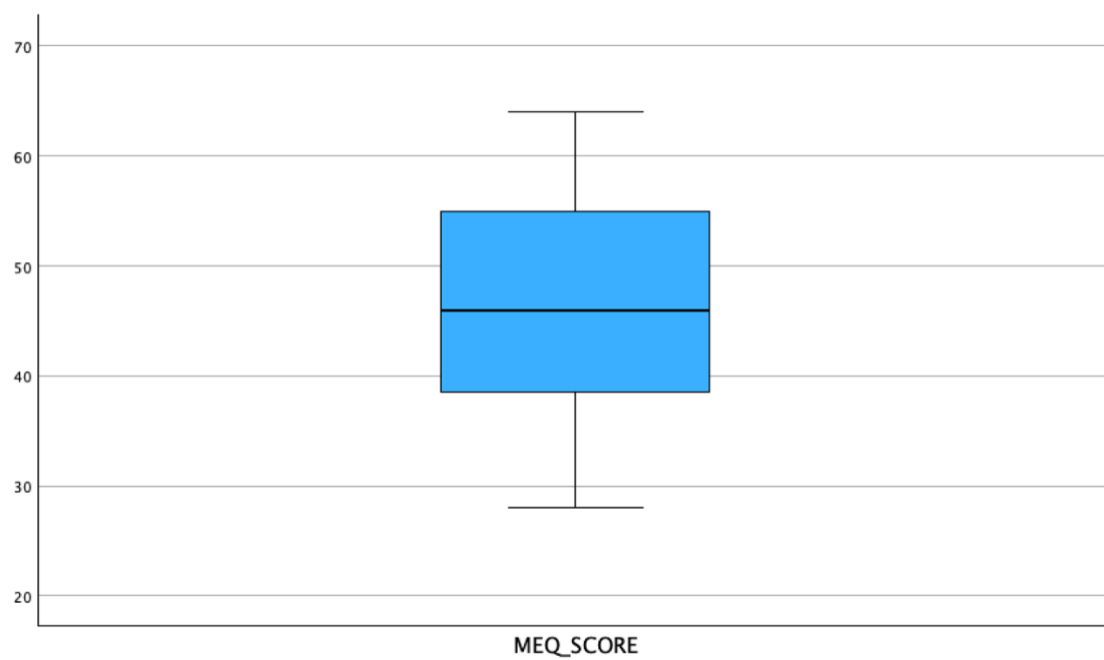
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
MEQ_SCORE	.100	39	.200*	.961	39	.198
score	.152	39	.024	.914	39	.006
Response Time	.079	39	.200*	.986	39	.896

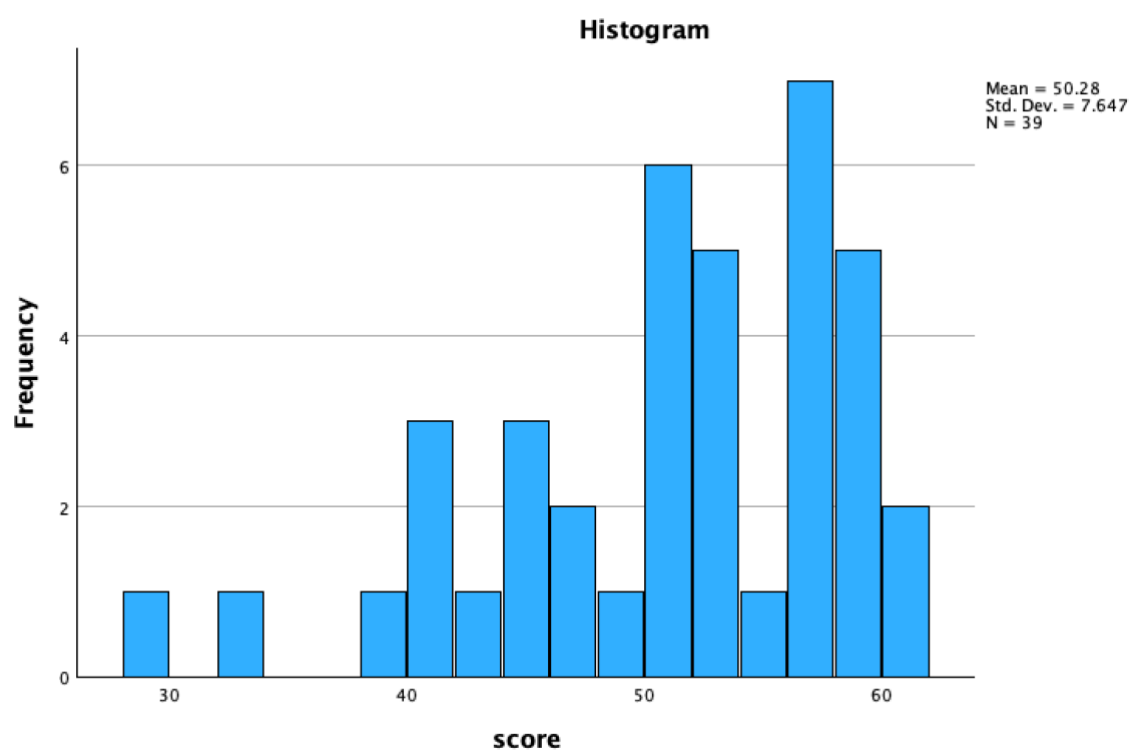
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

MEQ_SCORE



score



2x2 ANOVA of Stroop score

Tests of Between-Subjects Effects

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	292.242 ^a	3	97.414	1.767	.171	.132
Intercept	98544.512	1	98544.512	1787.396	<.001	.981
Timeoftesting	97.226	1	97.226	1.763	.193	.048
Chronotype	53.226	1	53.226	.965	.333	.027
Timeoftesting * Chronotype	136.015	1	136.015	2.467	.125	.066
Error	1929.656	35	55.133			
Total	100825.000	39				
Corrected Total	2221.897	38				

a. R Squared = .132 (Adjusted R Squared = .057)

Descriptive Statistics

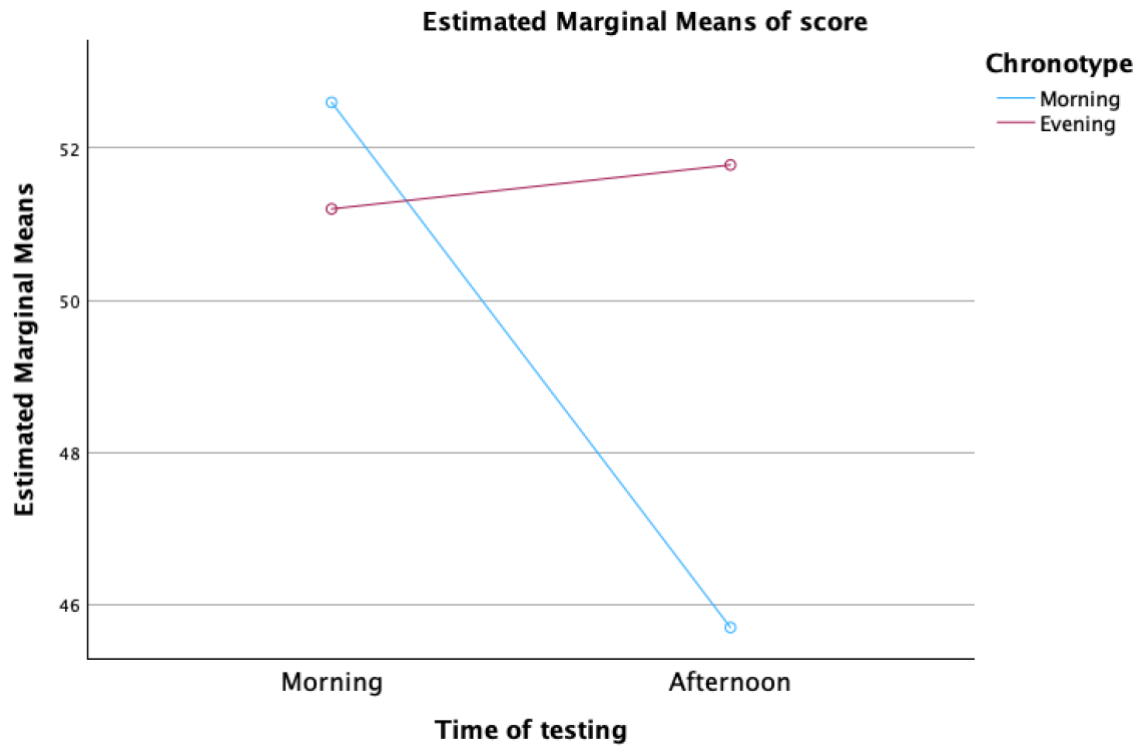
Dependent Variable: score

Time of testing	Chronotype	Mean	Std. Deviation	N
Morning	Morning	52.60	5.967	10
	Evening	51.20	5.224	10
	Total	51.90	5.505	20
Afternoon	Morning	45.70	10.425	10
	Evening	51.78	6.942	9
	Total	48.58	9.246	19
Total	Morning	49.15	8.993	20
	Evening	51.47	5.929	19
	Total	50.28	7.647	39

Levene's Test of Equality of Error Variances^{a,b}

		Levene Statistic	df1	df2	Sig.
score	Based on Mean	2.401	3	35	.084
	Based on Median	1.635	3	35	.199
	Based on Median and with adjusted df	1.635	3	29.664	.202
	Based on trimmed mean	2.384	3	35	.086

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.



2x2 ANOVA of Stroop Response Time

Tests of Between-Subjects Effects

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	292.242 ^a	3	97.414	1.767	.171	.132
Intercept	98544.512	1	98544.512	1787.396	<.001	.981
Timeoftesting	97.226	1	97.226	1.763	.193	.048
Chronotype	53.226	1	53.226	.965	.333	.027
Timeoftesting * Chronotype	136.015	1	136.015	2.467	.125	.066
Error	1929.656	35	55.133			
Total	100825.000	39				
Corrected Total	2221.897	38				

a. R Squared = .132 (Adjusted R Squared = .057)

Estimated Marginal Means

1. Grand Mean

Dependent Variable: score

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
50.319	1.190	47.903	52.736

2. Time of testing

Estimates

Dependent Variable: score

Time of testing	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Morning	51.900	1.660	48.529	55.271
Afternoon	48.739	1.706	45.276	52.202

Pairwise Comparisons

Dependent Variable: score

(I) Time of testing	(J) Time of testing	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
Morning	Afternoon	3.161	2.380	.193	-1.671	7.994
Afternoon	Morning	-3.161	2.380	.193	-7.994	1.671

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

