

Investigating the Relationship between OCD Traits, Cognitive Rigidity and Working Memory
Capacity in Students

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Project Submission Sheet

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Firstly, I would like to thank you friends for getting me through this semester. The support during this final year has been greatly appreciated and I am beyond grateful for everyone who has encouraged me to keep going.

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Abstract

The study of “Cognitive Rigidity and Working Memory Capacity in Students with OCD traits” aims to assess cognitive rigidity and working memory capacity in students with high levels of Obsessive-Compulsive Disorder (OCD) traits. The objectives of this study are: 1) to measure OCD traits in a general student population; 2) to measure cognitive rigidity (specifically attentional control) using a Standard Stroop Task; 3) to measure working memory capacity using the Digit Span Task; 4) to examine whether there is a relationship between OCD traits in students and working memory capacity. This study hypothesises that cognitive load in students with high OCD traits may impair attentional control (an aspect of cognitive rigidity) and working memory capacity (WMC), resulting in poorer performance in the Stroop Task and the Digit Span Task in comparison to students with lower OCD trait scores.

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Introduction

Cognitive functions such as working memory (WMC) and attentional control are important for academic success and mental wellbeing. These functions are responsible for how we respond to our environment. Understanding the effects of WMC and attentional control in students can help us to understand how students process information and how they adjust to academic demands. Researchers have become increasingly interested in investigating whether there is a link between psychological traits and cognitive performance. Previous studies have looked at the effects of Obsessive-Compulsive Disorder (OCD) on cognition and WMC. However, there are a number of gaps in current research which have not been extensively addressed as of yet. Current research focuses primarily on clinical OCD populations while non-clinical populations such as students with OCD traits are understudied. It is important to include non-clinical groups in research as this may provide further insight and support individuals with OCD traits.

In academic settings, it may be beneficial to understand whether students with OCD traits exhibit cognitive interference and working memory disruption as this can improve awareness of personality effects on academic performance and improve support for those even without a diagnosis. Academic stress may also worsen OCD traits in students. Therefore, investigating whether there is a link between OCD traits and cognitive performance and working memory capacity in a non-clinical group of students may help us to improve mental wellbeing and cognitive performance through early intervention in the future.

OCD traits are considered to be a range of thinking and behaviour patterns which are similar to OCD, such as repeated checking, intrusive thoughts and perfectionism. An individual may have characteristics OCD traits but they may not be as severe as those with a diagnosed disorder.

Research has suggested that OCD traits may impact executive functioning, a range of mental processes which help an individual to plan, recall, task-switch and remain focused. Cognitive rigidity is a form of executive dysfunction which refers to difficulty in adapting and adjusting our thinking and can cause difficulty in switching tasks and changing usual thought patterns. Cognitive rigidity is linked closely to working memory capacity (WMC) – the brain's storage of information. These two functions often have a reciprocal influence on the other and may play an important role in cognitive performance in those with OCD traits. Understanding whether OCD traits impact students' WMC and cognitive performance may also provide insight as to why mental health issues such as anxiety and depression are becoming more prevalent today in students.

Understanding the interplay between cognitive rigidity and working memory capacity in students with OCD traits may contribute to a greater understanding of cognitive flexibility within a non-clinical educational context. This study may outline potential areas in which students with OCD traits face cognitive deficits impacting their performance in comparison to students with lower OCD traits. This study may also potentially promote mental health awareness and improve future interventions for those with OCD in an educational setting.

This literature review will provide an in depth explanation of the constructs of cognitive rigidity and working memory capacity and OCD traits in both a clinical and non-clinical context by utilising current research. This review will also evaluate experimental methodologies and identification of gaps within previous studies to highlight the importance of studying cognitive rigidity and working memory capacity using a non-clinical sample of students with OCD traits.

Theoretical Background

Cognitive Rigidity and OCD

Cognitive rigidity is a broad term which refers to difficulties in adapting to novel or changing environments and switching between modes of thinking (Zmigrod, 2019).

Cognitive tasks are often used to measure different components of cognitive rigidity and how these components differ from person to person. There are several components of cognitive rigidity such as task switching, stroop inhibition, updating working memory and post-conflict adaptation (Meiran et al., 2010). Meiran et al. (2010), found that a clinical group of OCD patients demonstrated difficulty in disengaging from cognitive tasks, particularly with switching mode, even when they were informed that they were no longer required to switch. This suggests that task-switching tests such as the Stroop Task may be useful in assessing whether students with higher OCD trait scores exhibit similar cognitive inflexibilities. The study also found that patients with OCD showed a lesser ability to translate advance task information into performance and this was negatively correlated with rumination scores. Muller and Roberts (2004), found that patients with diagnosed OCD demonstrated cognitive deficits in other components of cognitive rigidity such as attentional control. This was also suggested to be due to hypervigilance toward stimuli which align with their specific obsessions.

These studies highlight that certain OCD traits may predict poorer performance in tasks which require cognitive flexibility, the ability to adapt goal-directed behaviour in response to changing environmental demands (Ionescu, 2011). These studies highlight the importance of studying cognitive rigidity in a non-clinical student population as these effects may also be visible in students without a clinical diagnosis.

WMC Deficits and Role in OCD

Working memory is defined by Wilhelm et al. (2013) as a cognitive system which provides access to information required for ongoing cognitive processes. Working memory capacity (WMC) refers to individual differences reflecting the limited capacity of a person's working memory. Wilhelm et al. (2013) suggested that cognitive mechanisms of building, maintaining and updating bindings (associations between data) are important components of WMC effecting performance in cognitive tasks. This highlights the importance of investigating whether these binding mechanisms are impacted in students with OCD traits.

A study by Titz and Karbach (2014) reported that working memory and executive functions uniquely contribute to academic success beyond intelligence. The study reported that good working memory had positive correlation with academic abilities such as mathematic performance, reading and comprehension. This supports the importance of investigating WMC in a student population and whether cognitive difficulties in those with OCD traits impacts performance in tasks.

Another study by Kyndt et al. (2011) found that working memory is responsible for active maintenance of information during ongoing processing and/or distraction. This suggests the important of working memory for cognitive tasks involving problem-solving and comprehension as previously mentioned. The study also found that students with high working memory capacity maintained lower scores on the surface and deep approaches to learning than students with low working memory capacity. This suggests that students with high working memory capacity have a greater cognitive flexibility and are able to process new information more efficiently. This study also emphasises the importance of attentional control as high attention span was positively correlated with academic performance. This study mentions that students with higher WMC have better attentional control which is essential for academic performance as students are able to maintain focus. This also

strengthens our rationale for this study as investigating cognitive rigidity in students with OCD traits may help us to understand any differences in performance in cognitive tasks.

These studies outline the importance of WMC and its components such as building, maintaining and updating bindings through attentional control and working memory span in students. These studies highlight how these components of WMC correlate with greater cognitive flexibility and contribute to successful academic performance in students.

Interplay Between Cognitive Rigidity and WMC in OCD

Cognitive rigidity and WMC have been extensively studied in clinical OCD populations. Meiran et al. (2010) found that OCD patients exhibited slower adaptation to single-task conditions following task switching. This slower adaptation is referred to as a fadeout effect and was identified along with difficulty to disengage from the previous task. This supports our hypothesis that students with higher OCD trait scores may also find it difficult to adapt between trials in cognitively demanding tasks such as the Stroop Task.

Benzina et al. (2016) found that OCD patients exhibited impairments in tasks which required using working memory, especially organisational processes. The study highlights that previous research on working memory and OCD has demonstrated inconsistent results due to methodology differences. The also study found that working memory impairments in OCD patients were related to organisational processing issues. This highlights the value of using the Digit Span Task to investigate whether deficits in organisational processing are exhibited in non-clinical samples.

A study conducted later by Rosa-Alcázar et al. (2021) found that OCD patients showcased significant difficulty in the Reverse Digit Span Task in comparison to patients with Generalised Anxiety Disorder (GAD) and Social Anxiety Disorder (SAD) which suggests that WMC impairments may be more significant in those with OCD traits. This also

suggests that further use of the Reverse Digit Span task in non-clinical studies may allow us to examine closely the specific effects of WMC on students with higher OCD traits. Kashyap and Abramovitch (2021) noted that patients with OCD generally underperform in the Stroop Task which may indicate difficulty with tasks which required interference control which is a component of attentional control. This reinforces our hypothesis that using the Stroop Task to measure cognitive rigidity may show similar results in students with OCD traits.

The findings from these studies suggest that the fadeout effect and difficulty disengaging from previous tasks may be due to attentional control deficits which are characteristic of OCD. It was also highlighted that further study is needed to find consistent results when using cognitive tasks such as the Stroop Task to assess attentional control and the Digit Span Task to assess WMC. Furthermore, the findings suggest that cognitive rigidity in OCD patients may be exhibited as difficulties when shifting focus and adapting to new tasks, highlighting deficits in attentional control and WMC. As these studies also use a clinical population, examining these issues in a non-clinical setting may provide an additional perspective on how these constructs effect cognitive and academic performance in students with OCD traits.

Empirical Research Review

Cognitive Inflexibility in Non-Clinical OCD Population

An article by (Robbins, 2022) noted that individuals with OCD traits in a non-clinical population exhibited cognitive inflexibility in tasks which require ‘set shifting’ between dimensions such as the Extra-Dimensional Set-Shifting task. This suggests that even in non-clinical populations, those with high OCD characteristic traits may demonstrate difficulty with focus adjustment when required to switch attention between different dimensions of information. As this suggests OCD traits may impair executive functioning, it also validates the importance of exploring whether cognitive flexibility is disrupted in students without a

formal diagnosis. This suggests that Stroop Task may be an effective measure of cognitive flexibility as individuals are required to divert their attention from certain dimensions (meaning of a word) and focus on the colour. Furthermore, Meiran et al. (2010) found that a non-clinical group of individuals with high OCD traits exhibited difficulty in adapting their thinking between congruent and incongruent trials in the Stroop Task. They referred to this as post-conflict adaptation as these individuals found it difficult to adjust their focus after each trial in comparison to the control group. This suggests that Stroop Task performance may be able to detect post-conflict adaptation in students with high OCD traits.

WMC Impairments in Non-Clinical OCD Population

Harkin and Kessler (2011) reported that working memory impairments are observed in a non-clinical group of individuals with OCD traits. The study found that these impairments were dependent on the task and were often linked to executive dysfunction due to selective attention and binding issues. This finding suggests our study's hypothesis of WMC hindering performance in students with OCD traits even without a clinical diagnosis. The study also suggests that impairments in this domain are explicitly demonstrated when tasks require complex cognitive interference or bindings.

Rosa-Alcázar et al. (2021) mentions that individuals with OCD traits (without a diagnosis) also demonstrated poorer performance in tasks relating which require working memory in comparison to the control group and other disorders. They found that the non-clinical OCD trait group scored lower on the reverse version of the Digit Span Task. This suggests that verbal tasks requiring working memory manipulation such as the reversal of stored memories in this case are more difficult for those with OCD traits than without.

Parallels Between Cognitive Rigidity and WMC

Rosa-Alcázar et al. (2021) also drew a parallel between cognitive rigidity and working memory capacity for this group as cognitive inflexibility was also found to be

reduced in this group. They noted that cognitive inflexibility due to OCD traits may make it difficult to adjust during this task and reallocate information when the task requires manipulation of stored information. This overlap supports our study's focus on both cognitive rigidity and WMC as both of these functions may have a reciprocal influence on the other in those with OCD traits. As working memory involves storing and updating information, deficits with WMC may effect rigidity as an individual attempts to sort information. These parallels may be due to similarities in cognitive rigidity and WMC as they both require selective attention and binding different pieces of information.

Methodologies

Limitations of Stroop Task

A few limitations have been identified when using the Stroop Task to assess cognitive rigidity in OCD populations. A study by Straub et al. (2021)) outlined that this task measures attentional control and inhibition but may not assess broader implications of cognitive rigidity such as emotional distraction, a characteristic trait of OCD which often affects performance during tasks. However, this may be a strength of this thesis as controlling for the effects of emotional stimuli by using the standard version of the Stroop Task may provide a more concise result for the effects of cognitive rigidity on performance alone. Straub et al. (2021) also noted that the Stroop Task may not be suitable in measuring the effects of complex task switching adaption in those with OCD traits. The complexity of cognitive rigidity may manifest in multiple ways which is difficult to assess using one cognitive performance task. The findings from this study suggests that it may useful to use other tasks to provide a broader insight of the implications of OCD traits. Another limitation as noted by Straub et al. (2021) and several other studies is that the Stroop Task has shown inconsistent findings primarily in clinical populations.

Limitations of Digit Span Task

Limitations of using the Digit Span Task include inconsistent findings across studies to assess WMC due to differences in administration (Redick & Lindsey, 2013). However, it is noted that the reverse version of the Digit Span Task is a suitable measure for WMC in OCD populations due to its reliable assessment of manipulation of stored memory ability and validity of results as previous studies have shown common specific deficits.

Justifications and Comparisons

Cognitive rigidity is often measured in studies with tasks such as the Wisconsin Card Sorting Task, Einstellung Water Jar Task and the Stroop Task. The Stroop Task is a time-efficient and validated widely measure of cognitive interference. While set-shifting tasks which require adaptation give us a broad idea of the effects of cognitive interference, the Stroop Task is limitedly focused on the attentional control aspect of cognitive rigidity for this study.

The Forward Digit Span Task focuses on measuring short-term memory while the reverse version is focused on short-term memory recall plus reordering of information. This reverse version of the task aligns with the aims of this study as it is more effective in finding executive dysfunction. The reverse version creates greater variability in non-clinical samples which allows for individual differences to be

Gaps in Current Research

As previous studies highlight a need for additional congruous findings in line with other studies, this thesis implies to acknowledge this with further use of these measures within a non-clinical population. Many studies have assessed these variables without using a control group which makes interpretation of results complex without direct comparison. This thesis will use a post hoc group assignment to divide high from low scorers on the OCD Questionnaire. This will then be used to divide an OCD trait group (higher scorers) and a

control group (lower scorers) when assessing performance on Stroop Task and Digit Span Task.

In conclusion, this study investigates the relationship between cognitive rigidity and WMC in students with OCD traits. Current research suggests that individuals who have high OCD traits exhibit difficulties with attentional control and task-switching which reflects their cognitive rigidity. These difficulties are also linked with WMC impairments which affect their ability to store and update information. These effects would supposedly impact academic performance involving certain cognitive processes. Clinical research has shown significant cognitive inflexibility in OCD patients and a few studies have seen these effects in non-clinical populations. The Digit Span Task and Stroop Task are appropriate measures as studies suggest when combined to assess WMC, and cognitive rigidity, specifically in relation to attentional control. This study will use a non-clinical student population to address a gap in current literature, aiming to provide an understanding of effects of OCD traits on students' academic abilities and clarify previous inconsistent findings. Results from this study may benefit educational settings through mental health awareness and encourage improvement for educational supports. Further research may be essential to broaden our understanding of the complex nature of OCD traits on performance.

Method

Participants

This study included a sample of N=50. These participants were undergraduate students in Ireland. Convenience sampling was used by sharing the study link with students who were available to participate through social media platforms and by asking students on university group chats online. Snowball sampling was also used as a few participants shared the study link with other students. The inclusion criteria for this study were students aged between 18-30 years old, fluent in English, provided full consent and had no formal diagnosis

of OCD. Exclusion criteria included those with a clinical diagnosis of OCD and non-English speakers. Participation was voluntary, completely anonymous and participants had the right to withdraw at any time. This study was approved by the Ethics Committee at the National College of Ireland.

Design

This study has a quantitative, correlational and cross-sectional experimental design. An online software – The Gorilla Experiment Builder (Gorilla.sc) was used to design the study. Participants completed the full study on this platform and results were stored confidentially and anonymously using unique ID codes for each participant on the researchers account. The predictor variable in this study is OCD trait scores (OCI-R scores). The criterion variables were 1. Cognitive Rigidity – measured by Stroop Task performance scores and 2. WMC – measured by the Reverse Digit Span Task scores. A correlational design was used for this study to aid in identifying whether there is a relationship between these variables and help us to generate further hypotheses and predict future outcomes in research. The control variables in this study included age, gender and field of study. This study hypothesises that higher OCD traits scores will be associated with lower attentional control resulting in poorer performance in the Stroop Task. This study also hypothesises that higher OCD trait scores will be associated with reduced working memory capacity, resulting in poorer performance in the Digit Span Task. Students with higher OCI-R scores will perform worse in comparison to those with lower scores, indicating to higher cognitive rigidity and exhibit lower scores on working memory task.

Materials/Measures

Obsessive-Compulsive Inventory – Revised (OCI-R)

The first part of this study presented to the participants via Gorilla Experiment Builder is the OCI-R questionnaire. This is an 18-item self-report survey which includes 6

subscales of OCD: washing, checking, ordering, obsessing, hoarding and neutralising.

Participants score each item on a 0-4 Likert scale (0 = Not at all, 4 = Extremely). The scores can range between 0-72. Higher scores on the OCI-R indicate higher OCD traits. A 0-5 score indicates no OCD traits, 6-15 indicates mild OCD traits, 16-25 indicate moderate OCD traits, 26-40 indicate severe OCD traits and 41-72 indicates extreme OCD traits. A score above 21 is generally the cut-off, indicating a higher likelihood of clinically significant OCD symptoms.

Standard Stroop Task

The next part of this study presented involved a standard Stroop Task to assess cognitive rigidity. This task included a total of 36 trials with 9 congruent trials – the colour of the ink matched the word displayed and 27 incongruent trials – the colour of the ink did not match the word displayed. Trials were randomised when presented to prevent participants' predictability of the next trial and in order to control the effects of the trials on participants' responses. There were more incongruent trials included in this task to increase cognitive overload and to assess the effect of attentional demands more reliably. The Stroop Effect was measured more effectively using this design as incongruent trials often reflect the level of participants' cognitive interference. Higher reaction times and higher error rates on incongruent trials indicated lower attentional control and higher cognitive rigidity in participants. This task is a widely validated measure used commonly in psychological research due to its reliability as a measure of executive function/dysfunction.

Reverse Digit Span Task

The Reverse Digit Span task assesses working memory capacity. Participants are presented with a sequence of numbers in which they must then recall in reverse order. The sequence of numbers begins with 2 digits and continues up to 7 digits. Each sequence length has two trials. The task only ends if a participant fails two consecutive trials of the same sequence length (e.g., if a participant fails to accurately recall both trials of 5 digits length,

the task ends). The aim of this task is to capture recall accuracy, reaction times and error rates. Also, to assess how well those with varying OCD trait scores perform on a WMC task.

Procedure

Following recruitment of participants, they were provided a link via text message to this study hosted on Gorilla.sc. Upon clicking the link and “start”, participants were first presented with a participant information sheet, detailing what the study is about, what it involves, who can take part, possible risks for taking part, assurance of confidentiality/data management, what will happen with the results and who to contact for further information. This was then followed by a consent form in which participants could consent that they agree to the terms of the study in order to continue. Participants were then presented with a Demographic Questionnaire which requested their Age (input whole number), Gender (“Female, Male”, “Non-Binary”, “Prefer not to say” and “Other”) and Field of Study (“STEM”, “Business”, “Social Sciences”, “Humanities”, “Arts” and “Other”). The OCI-R questionnaire followed the demographic questionnaire. Participants then took part in the standardised digital Stroop task containing 36 trials. Upon completion of the Stroop Task, participants then took part in the Reverse Digit Span Task. The final part after completion of the tasks was a debriefing sheet which displayed immediately after the reverse digit span task. This debrief sheet included the purpose of the study, contact information, support resources, information on data handling, GDPR-compliance and ethical considerations. Participants were given the right to withdraw confidentially during the debrief or consent to allow the data to be collected in the debrief form at the end. The entire study was approximately 10-15 minutes to complete and anonymous unique ID’s were assigned to each participants data. The data was stored securely in the researcher’s university cloud, in compliance with GDPR.

Statistical Analysis Plan

Analyses of the study data will be conducted using SPSS v27. Preliminary screening of data will be conducted to check for any outliers. Descriptive statistics will be conducted on OCI-R scores, Stroop scores and Reverse Digit Span scores to check for the mean and SD (standard deviation) across participants for each variable. The data will be checked for normality to ensure it is normally distributed and ensure validity of results. If data is normally distributed, Pearson's correlation analysis will be conducted to check the relationships between variables before regression. A Multiple Regression analysis will then be conducted to test whether OCI-R scores predict accuracy scores and reaction times on the Stroop task and Reverse Digit span task while controlling for (Age, Gender and Field of study).

Results

Descriptive Statistics

Descriptive statistics were calculated for OCI-R total scores, Stroop total scores, Stroop reaction time (ms), Reverse Digit Span total correct scores, Reverse Digit Span reaction time (in ms), Age, Gender and Field of Study. The mean, standard deviation, ranges and sample size are displayed in Table 1 to summarheise the distribution of scores.

Table 1

Descriptive Statistics

	N	Mean	SD	Min	Max	Range
OCI-R total score	50	21.38	10.56	0	42	42
Stroop total correct	50	32.60	4.63	21	36	15
Stroop reaction mean (ms)	50	1446.80	456.47	647.33	2970.92	2323.58
RDS total correct	50	8.12	2.77	4	14	10
RDS reaction mean (ms)	50	8141.74	2298.56	3095.33	14198.20	11102.87
Age	50	23.60	2.93	18	30	12
Gender	50	1.48	0.54	1	3	2
Field of Study	50	3.02	1.80	1	6	5

Note. *N* = 50; OCI-R = Obsessive-Compulsive Inventory-Revised; RDS = Reverse Digit Span.

Assumption Checks

Assumption tests were conducted the data to check for normality of total score, total correct and reaction time variables, and whether the data meet the requirements for further analysis. Table 2 displays the Shapiro-Wilk Normality Test results for total scores on each test and reaction times. The Stroop Total Correct scores, Stroop Reaction Time and Reverse Digit

Span Total Correct show statistically significant deviations from normality ($p < .05$).

However, upon further inspection of the histograms and Q-Q plots for these variables, severe skew/kurtosis was not indicated except for Stroop Total Correct scores. This variable exhibited a negative skew due to most participants scoring well on the Stroop Task. Given this analysis and the study sample size ($N=50$), proceeding to conduct a robust parametric-testing using Pearson Correlation Analysis and Multiple Regression is justified.

Table 2

Shapiro-Wilk Normality Test

	W	P
OCI-R Total Score	.975	.377
Stroop Total Correct	.730	< .001
Stroop Reaction Time (ms)	.935	.008
RDS Total Correct	.951	.037
RDS Reaction Time (ms)	.968	.192

Correlation Analysis

Pearson correlation analysis was conducted to examine whether there was an association OCI-R scores, Stroop total scores, Stroop reaction times, Digit Span scores and Digit Span reaction times. There was a significant positive correlation between OCI-R scores and Digit Span reaction time, $r = .35$, $p = .013$ (see Table 3). This indicates higher OCD traits were associated with slower reaction times on the Reverse Digit Span Task. The correlations between OCI-R scores, Stroop accuracy, Stroop reaction times and Reverse Digit Span accuracy were insignificant (all $p > .05$).

Table 3*Pearson Correlations between Variables*

Variable	1	2	3	4	5
1. OCI-R Total Score	—				
2. Stroop Total Correct	-0.17	—			
3. Stroop Reaction Time (ms)	0.20	-0.62**	—		
4. Digit Span Total Correct	0.07	0.42**	-0.34*	—	
5. Digit Span Reaction Time (ms)	0.35*	-0.24	0.51**	0.50**	—

Note. $N = 50$; Pearson correlation coefficients are presented; $p < .05$; $p < .01$.

Multiple Regression Analyses

Four separate multiple regression analyses were conducted to investigate whether OCI-R scores predicted dependent variables: Stroop accuracy, Stroop reaction times, Reverse Digit Span accuracy and Reverse Digit Span reaction times. Age, gender and field of study were treated as independent covariates and controlled during each analysis and OCI-R was the main predictor during each analysis. B, SE B, β , t, p, R^2 , F(df) and Model p values are reported in Table 4.

Table 4*Multiple Regression Analyses Combined*

DV	IV	B	SE B	β	t	p	R^2	F(df)	Model p
Stroop Total Correct	OCI-R	-0.078	0.062	-0.177	-1.26	.214	.156	2.08(4,45)	.099
	Age	-0.314	0.228	-0.199	-1.38	.175			
	Gender	-2.363	1.307	-0.277	-1.81	.077			
	Field	-0.304	0.391	-0.118	-0.78	.440			
Stroop Reaction Time (ms)	OCI-R	12.486	6.001	0.289	2.08	.043	.180	2.47(4,45)	.058
	Age	55.934	22.155	0.359	2.53	.015			
	Gender	-165.737	127.093	-0.197	-1.30	.199			
	Field	-3.276	37.964	-0.013	-0.09	.932			
RDS Total Correct	OCI-R	0.028	0.039	0.109	0.72	.474	.035	0.41(4,45)	.798
	Age	0.149	0.146	0.158	1.02	.312			
	Gender	-0.593	0.836	-0.116	-0.71	.482			
	Field	-0.012	0.250	-0.008	-0.05	.963			
RDS Reaction Time (ms)	OCI-R	82.960	30.345	0.381	2.73	.009	.173	2.36(4,45)	.068
	Age	25.697	112.026	0.033	0.23	.820			
	Gender	-1038.306	642.638	-0.246	-1.62	.113			
	Field	-47.768	191.966	-0.037	-0.25	.805			

Note. $N = 50$; Field = Field of Study B = unstandardised regression coefficient; $SE\ B$ = standard error for B ; β = standardised beta coefficient. Gender coded as 1 = female, 2 = male, 3 = non-binary, 4 = prefer not to say, 5 = other; Field of study coded as 1 = STEM, 2 = Business, 3 = Social Sciences, 4 = Humanities, 5 = Arts, 6 = Other; $p < .05$ values indicated in bold; R^2 , F , and Model p reported for full regression model of each outcome.

Stroop Accuracy (Stroop Total Correct)

The regression model indicates that demographic factors and OCI-R scores were not significant predictors of Stroop Accuracy. $R^2 = 0.156$ indicates about 16% variance in Stroop accuracy across all independent variables (OCI-R, age, gender and field of study). This indicates a medium effect according to Cohen (1988). $F(4, 45) = 2.08$, $p = .099$ indicates the independent variables were not significant predictors of the dependent variables. $B = -0.078$, $SE\ B = 0.062$ indicates that Stroop accuracy decreased by 0.078 for every 1 point increase in OCI-R scores. This result is not significant. $\beta = -0.177$ indicates OCI-R scores have a low effect in predicting Stroop accuracy. The predictor's covariate's effect are also indicated as insignificant in $t = -1.26$ and $p = .214$ values ($t < 2$, $p > .05$). None of the covariates were significant predictors in any domain (all $p > .05$).

Stroop Reaction Time

The regression model indicates some significance in OCI-R scores predicting Stroop reaction time. $R^2 = .180$ indicates 18% variance in Stroop reaction times across all predictors. This indicates a medium effect size according to Cohn (1988). $F(4, 45) = 2.47$, $p = .058$ indicates the overall model was not marginally significant ($p > .05$). However, $B = 12.49$, $SE\ B = 6.00$, which indicates that Stroop reaction times increased by 12.49ms for every 1 point increase in OCI-R scores. This result shows a small-moderately significant, positive association between Stroop reaction time and OCI-r scores according to Cohen (1988). ($B > 5$). $\beta = .29$ indicating that with every 1 standard deviation increase in OCI-R scores, the

Stroop reaction time increased by .29 standard deviations. This indicates a small-moderate positive effect between OCI-R scores and Stroop reaction time. Values $t = 2.08$, $p = .043$ indicate OCI-R scores have a significant effect ($t > 2$, $p < .05$) predicting higher Stroop reaction times. Age was found to be a significant predictor of Stroop reaction time $p = .015$. $B = 55.93$ for Age which indicates that Stroop reaction times increased by 55.93 ms for every additional year of age. All other covariates were insignificant predictors (all $p > .05$).

Reverse Digit Span Accuracy (Reverse Digit Span Total Correct)

The regression model depicts Reverse Digit Span accuracy were not significantly predicted by OCI-R scores. $R^2 = .04$ shows 0.4% variance in Reverse Digit Span accuracy across all predictors. This low R^2 value indicates small effect of OCI-R scores and demographic factors on Digit Span accuracy according to Cohen (1988). $F(4, 45) = 0.41$, $p = .798$ indicates the overall model was insignificant ($p > .05$). This insignificant effect is also indicated by $B = 0.03$, $SE B = 0.04$ values. $\beta = .11$ indicating that Reverse Digit Span accuracy increased by .11 standard deviation for every 1 standard deviation increase in OCI-R scores. This indicates a weak effect ($\beta < 3$). Values $t = 0.72$, $p = .474$ also indicate OCI-R scores had an insignificant effect in predicting Reverse Digit Span Accuracy ($t < 2$, $p > .05$). None of the covariates were significant predictors of Reverse Digit Span Accuracy (all $p > .05$).

Reverse Digit Span Reaction Time

The regression model indicates that Reverse Digit Span reaction times were predicted by OCI-R scores with moderate significant. $R^2 = .17$ shows there was 17% variance in Reverse Digit Span reaction times across all predictors. This R^2 value indicates a medium effect size in the model's predictors on Digit Span reaction times, according to Cohen (1988). $F(4, 45) = 2.36$, $p = .068$ indicates the overall model was insignificant in predicting Reverse

Digit Span reaction times ($p > .05$). However, $B = 82.96$, $SE B = 30.35$ values indicating that OCI-R scores had a high effect on Reverse Digit Span reactions times. $\beta = .38$ value indicates that Reverse Digit Span reaction times increased by .38 standard deviations for every 1 standard deviation increase in OCI-R scores. This showcases a moderate effect in OCI-R predicting Reverse Digit Span reaction times ($\beta > .3$) according to Cohen (1988). Values $t = 2.73$, $p = .009$ indicate OCI-R scores had a significant effect in predicting Digit Span reaction time ($t > 2$, $p < .05$). None of the covariates were significant predictors of Reverse Digit Span reaction time (all $p > .05$).

Discussion

The aim of this study was to investigate whether there is a relationship between OCD traits and Cognitive Rigidity and Working Memory Capacity (WMC) in a non-clinical student population. This study used the Obsessive-Compulsive Inventory (OCI-R) – a non-clinical questionnaire to assess OCD traits, a standardised Stroop task to measure attentional control – a key dysfunction of cognitive rigidity, and the Reverse Digit Span (RDS) task to measure WMC. Demographic factors (Age, Gender, Field of Study) were treated as covariates during analysis to control for any confounding relationships.

A non-clinical sample was used for this study to provide a greater sub-clinical understanding of the effects of OCD traits on cognitive performance in students.

The hypotheses of this study were 1) Higher OCD trait scores will be associated with greater cognitive rigidity measured by Stroop task performance (lower accuracy and higher reaction times). 2) Higher OCD trait scores will be associated with reduced WMC measured by the RDS task (lower accuracy and higher reaction times).

The results indicated that higher OCD trait scores were associated with higher reaction times on the RDS task. Statistical results for Stroop reaction times, Stroop accuracy and Digit Span accuracy indicated these were not significantly predicted by OCI-R scores or any covariates.

Key Findings

SPSS analyses indicated there was a significant positive association between OCI-R scores and Digit Span reaction time ($r = .35$, $p = .013$; Table 3). This suggests that higher OCD traits are associated with slower working memory responses.

There were no significant associations found between OCI-R scores and Stroop accuracy ($r = -0.17, p > .05$; Table 3). There were also no significant associations found between OCI-R scores and Stroop reaction times ($r = .20, p > .05$; Table 3).

Multiple regression analyses indicated that OCI-R scores significantly predicted RDS reaction time ($\beta = .381, t = 2.73, p = .009$; Table 4). Demographic predictors were treated as covariates controls during these analyses. No significant associations were found for OCI-R scores predicting Stroop accuracy, Stroop reaction times and RDS accuracy.

These findings partially supported the second hypotheses of this study “Higher OCD trait scores will be associated with reduced WMC measured by the RDS task” as higher reaction times were observed in participants with higher OCD trait scores. The first hypothesis “Higher OCD trait scores will be associated with greater cognitive rigidity measured by Stroop task performance” was not supported by the study findings as the results showed insignificant associations between OCI-R scores, Stroop Total Correct (accuracy), Stroop Reaction Times and RDS Total Correct (accuracy) variables.

Interpretation of Findings

The association between higher OCI-R scores and higher RDS reaction times suggests that OCD traits in students may be associated with slower responses and less efficient working memory. These results suggests that this association is observed even in a non-clinical OCD population.

The findings of this study indicated non-significant associations between Stroop task performance (accuracy and reaction times) and OCI-R scores. This does not reflect previous research findings reported by Meiran et al. (2010) and Kashyap & Abramovitch (2021). Their findings suggested that individuals with OCD exhibited poorer performance in the Stroop task. This comparison suggests OCD traits may not cause severe cognitive rigidity effects in

non-clinical populations. Otherwise, the comparison suggests the effect size of this study may be too small to draw strong associations in this sample size ($N = 50$). It is also possible that students with OCD traits possess learned strategies which contribute to better cognitive performance.

The significant association between higher OCD traits and higher RDS reaction times in this study suggests that this relationship may be explained through theories of executive functioning. Cognitive Rigidity and WMC are often described to have a reciprocal influence on each other in executive processing. Cognitive rigidity which is often prevalent during task- or attention-switching, may inhibit working memory by increasing how much effort is required to adapt to conflicting information and task demands. The results of this our study indicate moderate executive dysfunction in individuals with high OCD traits. This may be due to difficulty to adapt attention and thinking (cognitive rigidity).

“Speed-accuracy-trade-off” is also suggested to be quite common in individuals with OCD. This is when individuals have a higher concern for being accurate than time spent on a task. This is often leads to slower task performance and may be due to OCD traits such as checking (going over responses in their head) and ordering (rearranging until it feels right) (Erhan & Balci, 2015).

The findings of this study contribute to existing research as it demonstrates that investigating executive functions in non-clinical OCD trait populations can yield measurable results. It also contributes through findings of measured differences in cognitive processing (slower reaction times) in those with higher OCD traits than those with lower OCD traits (Kim et al., 2009).

Strengths of Study

This study used validated measures: OCI-R questionnaire, Standardised Stroop Task and Reverse Digit Span Task. To increase reliability and accuracy of results, these measures were digitalised. Participants took part in the whole study online to ensure recording of data (reaction times and scores) were assessed consistently across all participants. Upon consenting to debrief, this design ensured there was no missing data as participants could not continue to any next section (questionnaires or tasks) without full completion of the present section. Demographic responses (age, gender and field of study) were recorded for each participant as covariates to control for any confounding effects during analysis. The use of a non-clinical student sample addresses a gap in current research by investigating executive functions in those with high OCD traits. Analyses of the results included normality checks and justification for parametric analysis. All data collected was GDPR-compliant and ethically-compliant in accordance with the National College of Ireland Ethics Committee.

Limitations

The sample size (N=50) may have limited statistical power to detect significant effects. The design of this study being cross-sectional means results cannot indicate causes, only the associations between variables. Self-reported measures were also used for OCD traits through the OCI-R which may have lacked accuracy by clinical measures of individual OCD traits. There was a negative skew of scores in Stroop accuracy. This may have reduced the study's ability to detect effects reliability. Only students were recruited for this study. This may limit the study's generalisability of findings to a wider population with OCD traits. There may have been other confounding variables that were not controlled for during the study such as IQ and stress. Online data collection allowed participants to take part in any environment. This may have had implications on results if participants were in distracting environments.

Implications

This study highlights that slower working memory processing is observed in individuals with high OCD traits, even without an clinical diagnosis. The results of this study suggest that there may be cognitive influences leading to differences in performance time in those with high OCD traits. Interventions aimed to support students with high OCD traits may help students to improve processing speed and cognitive task demands. The findings highlight the importance of assessments of disorder traits beyond clinical thresholds and understanding the implication of those assessments on cognitive performance. For future research, exploring larger sample sizes and other populations such as non-students, may help to determine whether slower working memory processing is observed similarly.

Conclusion

In summary, the findings of this study found that higher OCD trait scores in students were associated with longer reaction times in the Reverse Digit Span task which assessed working memory processing. The results did not find any associations between higher OCD trait scores and Reverse Digit Span accuracy, Stroop accuracy or Stroop reaction times. These findings suggest that OCD traits were not severely effected by attentional control deficits (or other aspects of cognitive rigidity) in a non-clinical student sample. However, the findings suggest moderate cognitive impacts on working memory processing in students with high OCD traits. Further research on OCD traits in non-clinical populations should explore whether other cognitive tasks investigating executive functions yield similar findings.

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