Exploring Cognitive Flexibility and Response Inhibition in Individuals with Subclinical OC Tendencies

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Abstract

This study investigates the impact of subclinical obsessive-compulsive tendencies (sOCT) on cognitive flexibility and response inhibition, exploring their relationship with behavioral inhibition and activation systems (BIS/BAS). Obsessive-compulsive disorder (OCD) and its subclinical forms significantly impair cognitive functions such as response inhibition and cognitive flexibility. This research aims to bridge the gap between clinical OCD and sOCT by examining cognitive processes in a subclinical sample.

The study involved 30 participants, assessed using the Obsessive-Compulsive Inventory-Revised (OCI-R) and BIS/BAS scales. Participants performed a Go/NoGo task to measure response inhibition and a reversal learning task to assess cognitive flexibility. Multiple regression analyses examined the relationships between sOCT scores, BIS/BAS scores, and task performance, including post-error slowing (PES) to measure the ability to adjust responses after errors.

Results indicated no significant relationship between sOCT scores and commission errors or PES in the Go/NoGo task. Similarly, no significant relationship was found between sOCT scores and cognitive flexibility as measured by the reversal learning task. BIS/BAS scores did not show significant correlations with task performance. These findings suggest that while trends in the anticipated direction were observed, the cognitive impairments associated with sOCT might be subtler than those in clinical OCD populations.

Future research could benefit from incorporating control groups and using neuroimaging techniques to explore the neural mechanisms underlying cognitive inflexibility and response inhibition in sOCT. Understanding these mechanisms could contribute to early identification and intervention strategies in individuals with sOCT.

Introduction

Obsessive-compulsive disorder (OCD) is a psychiatric disorder with a prevalence of approximately 2-3% worldwide (Carmi et al., 2022). Common symptoms are persistent, unwelcome thoughts or visions, leading to compulsive actions that are repetitive, time-consuming, and adhere to rigid patterns (Benzina et al., 2016). Predominant obsessions include fears of contamination, persistent doubt, a need for orderliness or symmetry, violent thoughts, and sexual content. The compulsive acts, which are executed to counteract the distress linked with these obsessions or the anxiety, frequently involve behaviors such as excessive washing or cleaning, repeated checking, arranging objects in a precise manner, or counting (Benzina et al., 2016). Besides these, individuals suffering from OCD also tend to show cognitive deficiencies, such as reduced performance on response inhibition, cognitive flexibility, and reinforcement learning (Benzina et al., 2016; Gruner & Pittenger, 2016; Rosa-Alcázar et al., 2021).

More common than clinical OCD are subclinical obsessive-compulsive tendencies (sOCT), which can also significantly affect daily functioning and quality of life (de Bruijn et al., 2010; Francazio & Flessner, 2015; Hamo et al., 2018; Mataix-Cols et al., 1999; Sternheim et al., 2014). Investigating cognitive processes in subclinical samples can provide valuable insights into OCD's underlying mechanisms. For example, research by de Bruijn et al. (2010) provides evidence of the significant impact of sOCT. They conducted a comprehensive study comparing subjects with sOCT to those with clinical OCD and healthy controls. The findings revealed that subthreshold subjects exhibited similar levels of distress and impairment as those with clinical OCD. Specifically, subthreshold and OCD subjects scored similarly on measures of psychological vulnerability, health, and functional status, highlighting the significant impact of subclinical symptoms. This shows the importance of recognizing and addressing sOCT, as it can lead to substantial suffering and disability. The study suggests that individuals with subthreshold symptoms should be given particular consideration when developing diagnostic criteria and treatment strategies, to increase cases of early intervention for individuals with sOCT (de Bruijn et al., 2010).

Along this line, research involving first-degree relatives of OCD patients who are not afflicted suggests that there may also be a hereditary or family component to these cognitive impairments (Tezcan et al., 2017). On cognitive tests, unaffected relatives of OCD patients perform worse compared to healthy controls and OCD patients. This suggests that these cognitive deficiencies may be innate in people at genetic risk rather than solely the result of the disorder itself. According to Tezcan et al. (2017), first-degree relatives of OCD patients who were not affected also exhibited deficiencies in reversal learning tasks, although not as much as OCD patients. These results suggest the possibility that cognitive flexibility impairments are innate characteristics that contribute to the etiology of OCD, rather than just being symptoms of the condition itself. Valerius et al. (2008) also supported the concept of a continuum of cognitive impairments associated with OCD by observing cognitive deficits in OCD even in non-clinical groups.

One crucial aspect of cognitive functioning that is often impaired in OCD and sOCT is cognitive flexibility, which can be assessed using reversal learning paradigms (Gruner & Pittenger, 2016; Valerius et al., 2008). Reversal learning is a cognitive process that involves the ability to adapt behavior when the reinforcement contingencies of a stimulus change (Izquierdo et al., 2016). Tasks frequently measure cognitive flexibility by having subjects initially learn to respond according to reinforced stimulus-response (S-R) associations, and then adapt when reinforcement is associated with a previously irrelevant S-R pairing. Reduced activity in the orbitofrontal cortex (OFC) and striatum, which are linked to reward processing and behavioral adaptability, has been linked to these deficiencies (Remijnse et al., 2006; Tezcan et al., 2017).

Along this line, Sternheim et al. (2014) found that individuals with sOCT also exhibit poorer cognitive flexibility. Their study demonstrated that female students with sOCT showed more total and perseverative errors on cognitive flexibility tasks compared to those without OCD symptoms. Moreover, Francazio and Flessner (2015) examined cognitive flexibility in young adults showing obsessive-compulsive behaviors. They found that participants in the obsessive-compulsive group performed significantly worse on cognitive flexibility tasks compared to controls. These results suggest that cognitive flexibility deficits are prevalent in both clinical and subclinical OCD populations. This highlights the importance of understanding these impairments across the full spectrum of OC severity.

Reinforcement learning, as tested by a reversal learning task, correlates positively with reward sensitivity (Monni et al., 2023). Reward sensitivity is an aspect of an individual's drive to action and motivation, also known as the behavioral activating system (BAS). It drives goal-directed behavior and is associated with positive affective states, such as hope. This contrasts with the behavioral inhibition system (BIS), which reflects how individuals process punishment and novel or aversive stimuli. This system is linked to feelings of anxiety and fear in response to these cues. Individual differences in these systems can be measured using the BIS/BAS scale (Carver & White, 1994). By assessing individual differences in BIS/BAS sensitivities, we can increase our understanding of the motivational systems underlying behavior and their potential relationships with psychiatric conditions such as OCD (Carver & White, 1994). For example, Berger and Anaki (2014) have demonstrated that the BIS plays a significant role in OCD symptomatology, particularly in how individuals with OCD process punishment and aversive stimuli. Their study indicated that the BIS is strongly correlated with various OCD symptoms. This suggests that BIS-related mechanisms could support the cognitive and behavioral patterns observed in OCD, showing the relevance of investigating both BIS and BAS in relation to sOCT (Berger & Anaki, 2014).

In addition to cognitive flexibility, response inhibition is another critical aspect of executive function that is often impaired in individuals with OCD (Kertzman et al., 2018; Masharipov et al., 2023). Response inhibition is the ability to suppress inappropriate or unwanted actions (Chamberlain et al., 2005). It involves the intentional and voluntary control of motor responses to prevent interference from non-relevant information (Rosa-Alcázar et al., 2021). Impaired response inhibition in OCD patients has been investigated using tasks such as the Go/NoGo task, which assesses behavioral and cognitive inhibition (Bannon et al., 2002). The Go/NoGo task tests inhibition by presenting participants with two types of stimuli: "Go" stimuli, to which they must respond quickly by pressing a designated key, and "NoGo" stimuli, to which they must withhold their response. The task measures the participants' ability to suppress their impulse to respond when a NoGo stimulus is presented, thus providing an assessment of inhibitory control.

Research into response inhibition in OCD has produced mixed results. Abramovitch et al. (2014) describe that while some research has shown that individuals with OCD perform worse on tasks measuring response inhibition (e.g., Abramovitch et al., 2012; Martinot et al., 1990; Menzies et al., 2007; Penades et al., 2007), other studies have found no notable differences in response inhibition among those with OCD (e.g., Bohne et al., 2008; Boone et al., 1991; Krishna et al., 2011). These mixed findings suggest that the relationship between OCD and response inhibition may be influenced by various factors, such as differences in sample characteristics, task paradigms, or the severity of OCD symptoms.

sOCT has also been linked to impairments in response inhibition (Abramovitch et al., 2015). In a study using a subclinical OC sample, they found that participants with higher OC symptoms made significantly more commission errors on the Go/NoGo task compared to those with lower OC symptoms. Despite these differences, the performance of the high OC group was still within the normative range when adjusted for age and education, suggesting that while subclinical individuals may show response inhibition deficits, these may not be as severe as those observed in clinical populations.

Another observation in both reversal learning and response inhibition tasks is that participants tend to show increased reaction times after mistakes, known as post-error slowing (PES) (Rueppel et al. 2021). This behavioral adjustment, in which reaction times increase following errors, reflects heightened response caution and strategic adaptation to improve future performance. Rueppel et al. (2021) investigated the relationship between PES and OCD, finding that OCD patients do not consistently differ from healthy individuals in PES. This suggests unique patterns of cognitive control abnormalities in OCD. In contrast, Masharipov et al. (2023) explored non-selective response inhibition in OCD using a Go/NoGo task under conditions of uncertainty. They found that OCD patients exhibited pathological slowness. This suggests that, under certain conditions, OCD patients may show impaired response inhibition and increased reaction times. This shows potential inconsistencies in the findings related to PES in OCD. In this study, we will focus on whether these patterns are also observed in individuals with sOCT to explore the association.

In the current study, we investigated the influence of sOCT on cognitive flexibility and response inhibition. Given the complexity and variety of cognitive impairments associated with OCD, this study aimed to explore several key research questions. The primary research questions of this study were: (1) What is the relationship between sOCT and response inhibition capabilities, as assessed by performance on a Go/NoGo task? (2) What is the relationship between sOCT and cognitive flexibility capabilities, as assessed by performance on a reversal learning task? (3) How do BIS/BAS scores relate to cognitive performance on the Go/NoGo and reversal learning tasks?

To address these questions, the following hypotheses were formulated for this study: (1) Higher sOCT is associated with lower response inhibition capabilities. Specifically, individuals with higher sOCT exhibit more commission errors (i.e., pressing the designated button when they should not press) in the Go/NoGo task. Additionally, (2) based on the findings by Rueppel et al. (2021), sOCT scores are not significantly correlated with greater PES in the Go/NoGo task, indicating no increased difficulty in adjusting responses after making an error. Furthermore, (3) higher sOCT scores correlate with decreased cognitive flexibility. Participants with higher sOCT show lower reversal learning ratio scores, indicating poorer performance in adapting to changing reinforcement contingencies in the reversal learning task. (4) Higher BIS scores correlate with more commission errors in the Go/NoGo task and (5) a lower reversal learning ratio. (6) Individuals with higher BAS scores exhibit worse cognitive flexibility on the reversal learning task compared to those with lower BAS scores. (7) Higher BAS scores also correlate negatively with the number of commission errors in the Go/NoGo task.

This research can provide insights into how sOCT impacts cognitive processes such as flexibility and inhibition, which are important for adaptive behavior and decision-making. While there is already extensive research on clinical OCD, this is less the case in sOCT. By examining subclinical samples, we can identify early markers that may predispose individuals to OCD. This knowledge is not only academically relevant, but also has practical implications. It can inform the development of targeted interventions and strategies aimed at enhancing cognitive function in individuals with sOCT. This might improve their quality of life and daily functioning. Furthermore, by bridging the gap between clinical and subclinical cases of OCD, this study contributes to a better understanding of the disorder.

Method

Participants

For this study, a convenience sampling strategy was used. Sixteen adult participants were recruited from the researcher's social circle. Additionally, fourteen first-year psychology students were recruited through the University of Groningen's SONA system. The age distribution of the participants was as follows: eight participants (26.7%) were aged 25-30 years, and twenty-two participants (73.3%) were aged 18-24 years. The total sample consists of thirteen males and seventeen females.

sOCT

To measure sOCT, participants filled out the OCI-R questionnaire (Foa, 2002). This scale consists of 18 items, which are rated on a 5-point Likert scale, ranging from 0 ("not at all") to 4 ("extremely"). This measure includes items about multiple dimensions of OCD, such as washing, checking, and obsessing. We instructed participants to express the extent to which specific symptoms have bothered them in the past month. The total OCI-R score is the sum of all item scores. Prior to completing the computer tasks, this questionnaire was administered. The validity of the OCI-R has been confirmed by multiple studies (Huppert et al., 2007; Wootton et al., 2015).

BIS/BAS Scales

We used the BIS and BAS scales (Carver & White, 1994) to assess behavioral inhibition and activation. The questionnaire consists of 20 items, measured on a 4-point Likert scale, ranging from 1 ("strongly disagree") to 4 ("strongly agree"). The BIS scale measures participants' sensitivity to punishment, which inhibits behavior that may lead to negative or painful outcomes. People with a high BIS sensitivity are more likely to experience negative feelings in response to these cues. Three subscales, drive, fun seeking, and reward responsiveness, make up the BAS scale, which measures participants' behavioral activation systems. Example items include "I go out of my way to get things I want" and "When I get something I want I feel excited and energized.”. Validation studies, such as those by Genaro et al. (2021), have confirmed the reliability and validity of these scales

Reversal Learning Task

We performed a reversal learning task to measure participants' ability to adapt their decision-making strategies in response to changing conditions. On a screen, two vertically aligned numerical options were shown. These numbers represented points that participants could gain (reward) or lose (punishment). There were eight outcome combinations, all consisting of a high and a low number (e.g. 5-25; 25-5; 10-30; 30-10, etc.). Choosing the higher number is a high-risk decision since it could result in a large reward if correct and a large punishment if incorrect. The lower number is a lower risk, since participants can lose or gain fewer points. Figure 1 illustrates the task's setup.

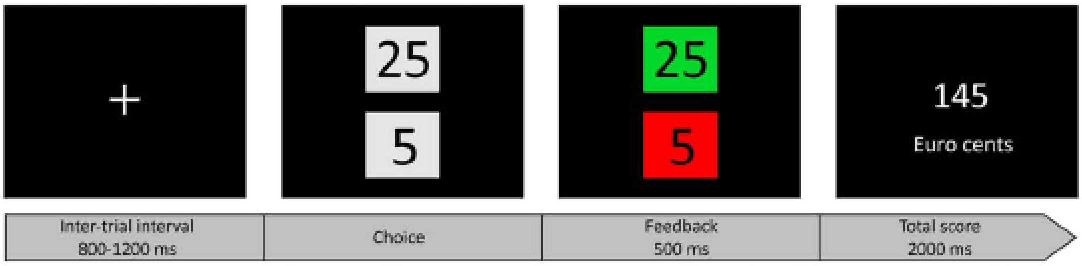

Figure 1. Reversal Learning Task Adapted from Wischnewski et al., 2016 (with permission). Participants choose between two numerical options representing potential points. Participants initially learn which number is more likely to be rewarded and must adjust their choices when the contingencies change.

The task consisted of 120 trials. In the first third of the experiment, options with a higher risk are favored (high risk: 80%, low risk: 20%). Participants had to switch to a low-risk approach in the second third of the experiment (20% high risk, 80% low risk). In the last third of the task, participants had to reverse their strategy again to high-risk options (high risk: 80%, low risk: 20%). However, to introduce an element of unpredictability and to better assess cognitive flexibility, the first reversal happened at a random trial between trials 32 and 48. Similarly, the second reversal occurred at a random trial between trials 72 and 88. This randomization ensured that participants could not anticipate the reversals, requiring them to adapt their strategies based solely on changing reinforcement contingencies. Prior to performing the task, participants were told they could use any technique to score as many points as possible, but they did not know about the reversals. The task took around ten minutes to complete.

Participants chose by clicking the ‘H’ key for the high-risk option and the ‘L’ key for the low-risk option. They were encouraged to respond fast, but there were no strict time constraints. Feedback was provided after each choice. A green square is for a correct decision, and a red square is for an incorrect one. The feedback appeared 500 milliseconds after a decision is made, and points were either added to or deducted from the participant's total score. After every 10 trials, this score appears on screen for 2000 milliseconds.

We measured the effectiveness of participants in adapting to these changing contingencies using the reversal learning ratio, where a score of -1 indicates consistent incorrect choices and a score of 1 indicates consistent correct choices. This ratio is calculated by comparing the number of correct choices (those that align with the current reinforcement contingencies) to the total number of choices. Specifically, the ratio is calculated for two transitions: from phase 1 to phase 2 and from phase 2 to phase 3. This measure quantifies the extent to which participants can adapt their behavior in response to changing reward structures. Importantly, this does not mean always getting the points, as the reward probability is 80/20. Instead, it means choosing the high-risk option when it is the best choice according to the task's reward structure. The RL ratio provides a quantitative measure of how well participants adapted their decision-making strategies in response to changing reinforcement contingencies.

Go/NoGo Task

The Go/NoGo task was employed to assess response inhibition. This task consisted of 480 trials, where participants were presented with visual stimuli on a computer screen. On 87.5% of trials, the “Go” stimulus (square or circle) was presented where participants had to respond by a button press as fast as possible. In the remaining trials a “NoGo” stimulus (triangle) where a response had to be withheld.

The primary measure of interest in this task was the participant's ability to correctly inhibit their response to the NoGo stimuli, which serves as an indicator of their inhibitory control. Reaction times and accuracy rates for both Go and NoGo trials were recorded to evaluate the participants' impulse control and response inhibition capabilities.

Measures of response inhibition in the Go/NoGo task include commission errors and post-error slowing. When participants fail to inhibit their response to the NoGo stimuli, commission errors occur, with a higher number of these errors indicating poorer response inhibition. Post-error slowing refers to the change in reaction time following a commission error; it is measured by comparing the reaction times on Go trials that follow an error with those that follow a correct response. Greater post-error slowing indicates increased difficulty in adjusting responses after making an error.

To ensure that actual response inhibition is measured, trials in which the response time was 2.5 times greater than the standard deviation of the participant's response times were removed from the analysis. This step was taken to exclude outlier trials that might not accurately reflect the participant's inhibitory control capabilities.

Procedure & Design

Participants first received an information form explaining the study's purpose, procedures, and their rights as research subjects. After reading this form, participants signed a consent form to formally agree to participate. Following this, they completed a short demographic questionnaire, gathering their age and gender.

Participants then proceeded to complete the OCI-R and the BIS/BAS questionnaires. Following this, they performed the Reversal Learning Task and the Go/NoGo Task. The order of the tasks was randomized to control for potential order effects. The entire session lasted approximately 40 minutes. The session was conducted in a quiet, controlled environment within the University of Groningen’s psychology department. All procedures received approval from the local ethics committee at the University of Groningen.

Statistical Analysis

The primary goal of the statistical analysis in this study was to examine the relationships between participants' scores on the OCI-R, the BIS/BAS scales, and their performance on the cognitive tasks (Reversal Learning Task and Go/NoGo Task). The analysis was conducted using IBM SPSS Statistics (Version 27).

Descriptive Statistics

To provide a comprehensive overview of the data distribution and central tendencies, descriptive statistics were calculated for all key variables, including mean scores, standard deviations, and ranges for the OCI-R, BIS/BAS scales, and performance metrics from the Reversal Learning Task and Go/NoGo Task.

Regression Analysis

To examine the relationships between obsessive-compulsive tendencies and cognitive performance, multiple regression analyses were conducted. These analyses assessed the unique contributions of OCI-R scores and BIS scores to cognitive flexibility and response inhibition. Specifically, the regression models included OCI-R scores and BIS scores as predictors to evaluate their combined and individual effects on the number of commission errors and post-error slowing in the Go/NoGo task, as well as the reversal learning ratio in the reversal learning task.

Post-Hoc Correlation Analysis

Following the multiple regression analyses, post-hoc Pearson correlation coefficients were computed to explore the trends in more detail. This correlation analysis aimed to identify whether higher levels of obsessive-compulsive tendencies and different motivational system sensitivities are associated with variations in cognitive flexibility and response inhibition, providing additional insights into the relationships between the questionnaire scores (OCI-R and BIS/BAS) and the task performance measures.

Results

Descriptive Statistics

We calculated descriptive statistics for the primary variables of interest: OCI-R, BIS, BAS, GNG commission errors, PES, and RL ratio. Table 1 presents the mean and standard deviation for each variable.

Table 1

Descriptive Statistics for the variables measured in the study, including means, standard deviations, and sample size.

	Mean	Std. Deviation	N
OCIR	17,6000	11,79304	30
BIS	19,3333	2,08993	30
BAS	37,9667	3,12370	30
Commission Errors	26,6667	10,41330	30
GNG_PES	3,1472	45,54047	30
RL_ratio	,21231	,178663	30

Multiple Regression

We conducted multiple regression analyses to evaluate the unique contributions of OCI-R, BIS, and BAS scores to cognitive performance.

Model 1: Commission Errors

The first multiple regression model examined the relationship between OCI-R scores, BIS, BAS, and commission errors on the Go/NoGo task. The model accounted for 9.2% of the variance in commission errors ($R^2 = 0.092$, Adjusted $R^2 = -0.012$), which was not statistically significant ($F(3, 26) = 0.882$, $p = 0.461$). OCI-R scores showed a positive relationship with commission errors ($\beta = 0.287$, $p = 0.138$), indicating that higher obsessive-compulsive tendencies might be associated with more commission errors, although this was not statistically significant. BIS scores ($\beta = -0.125$, $p = 0.512$) and BAS scores ($\beta = -0.033$, $p = 0.861$) did not show significant relationships with commission errors. Post-hoc correlation analysis supported these findings, with OCI-R showing a positive but non-significant correlation with commission errors (*r* = 0.276, *p* = 0.139), and BIS (*r* = -0.096, *p* = 0.613) and BAS (*r* = -0.029, *p* = 0.879) also not significantly correlated. An overview of the statistics is presented in Table 1 and Figure 1.

Table 1

Coefficients Model 1. Regression coefficients for the relationship between the number of commission errors and scores on the OCIR, BIS, and BAS scales.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	38,431	30,824		1,247	,224
	OCIR	,254	,166	,287	1,531	,138
	BIS	-,622	,937	-,125	-,664	,512
	BAS	-,111	,624	-,033	-,177	,861

a. Dependent Variable: Commission Errors

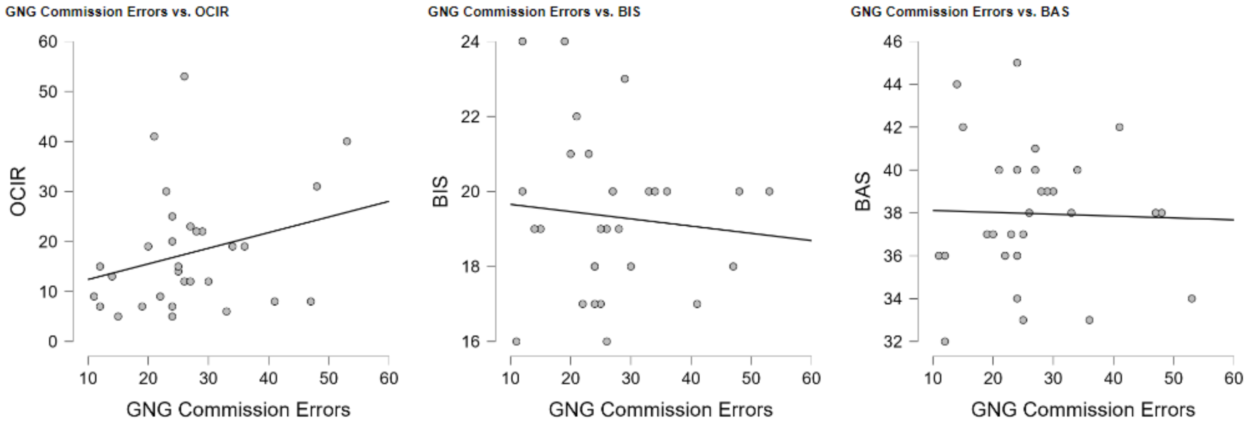

Figure 1

Correlations Model 1. Scatter plots showing the relationships between commission errors and scores on the OCIR, BIS, and BAS.

Model 2: Post-Error Slowing (PES)

The second regression model assessed the impact of OCI-R, BIS, and BAS scores on post-error slowing (PES) in the Go/NoGo task. This model explained 4.1% of the variance in PES ($R^2 = 0.041$, Adjusted $R^2 = -0.069$), and was not statistically significant ($F(3, 26) = 0.373$, $p = 0.774$). The OCI-R scores were not significantly related to PES ($\beta = -0.024$, $p = 0.900$), suggesting no significant impact of obsessive-compulsive tendencies on post-error slowing. Similarly, BIS ($\beta = 0.149$, $p = 0.448$) and BAS scores ($\beta = 0.149$, $p = 0.445$) did not show significant relationships with PES. Post-hoc correlation analysis further confirmed these results, as OCI-R ($r = -0.013$, $p = 0.946$), BIS ($r = 0.137$, $p = 0.462$), and BAS ($r = 0.139$, $p = 0.454$) were not significantly correlated with PES. An overview of the statistics is presented in Table 2 and Figure 2.

Table 2

Coefficients Model 2. Regression coefficients for the relationship between PES and scores on the OCIR, BIS, and BAS scales.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-140,469	138,530		-1,014	,320
	OCIR	-,094	,745	-,024	-,127	,900
	BIS	3,246	4,211	,149	,771	,448
	BAS	2,174	2,806	,149	,775	,445

a. Dependent Variable: GNG PES

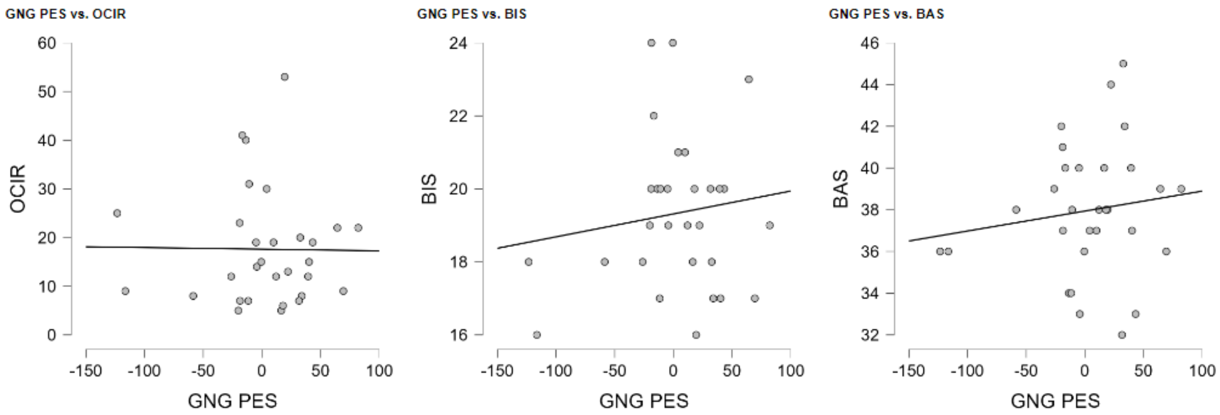

Figure 2

Correlations Model 2. Scatter plots showing the relationships between PES and scores on the OCIR, BIS, and BAS.

Model 3: Reversal Learning Ratio

The third regression model investigated the relationship between OCI-R, BIS, and BAS scores, as well as the reversal learning ratio in the Reversal Learning Task. This model accounted for 5.2% of the variance in the reversal learning ratio ($R^2 = 0.052$, Adjusted $R^2 = -0.057$), and was not statistically significant ($F(3, 26) = 0.475$, $p = 0.703$). The OCI-R scores showed a negative relationship with the reversal learning ratio ($\beta = -0.124$, $p = 0.523$), indicating that higher obsessive-compulsive tendencies might be associated with lower cognitive flexibility, but this was not statistically significant. BIS scores ($\beta = 0.129$, $p = 0.509$) and BAS scores ($\beta = -0.145$, $p = 0.454$) were also not significantly related to the reversal learning ratio. Post-hoc correlation analysis was consistent with these findings, showing no significant correlations between OCI-R ($r = -0.110$, $p = 0.563$), BIS ($r = 0.127$, $p = 0.504$), and BAS ($r = -0.152$, $p = 0.422$) and the reversal learning ratio. An overview of the statistics is presented in Table 3 and Figure 3.

Table 3

Coefficients Model 3. Regression coefficients for the relationship between RL Ratio and scores on the OCIR, BIS, and BAS scales.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	,348	,540		,645	,525
	OCIR	-,002	,003	-,124	-,647	,523
	BIS	,011	,016	,129	,670	,509
	BAS	-,008	,011	-,145	-,760	,454

a. Dependent Variable: RL_ratio

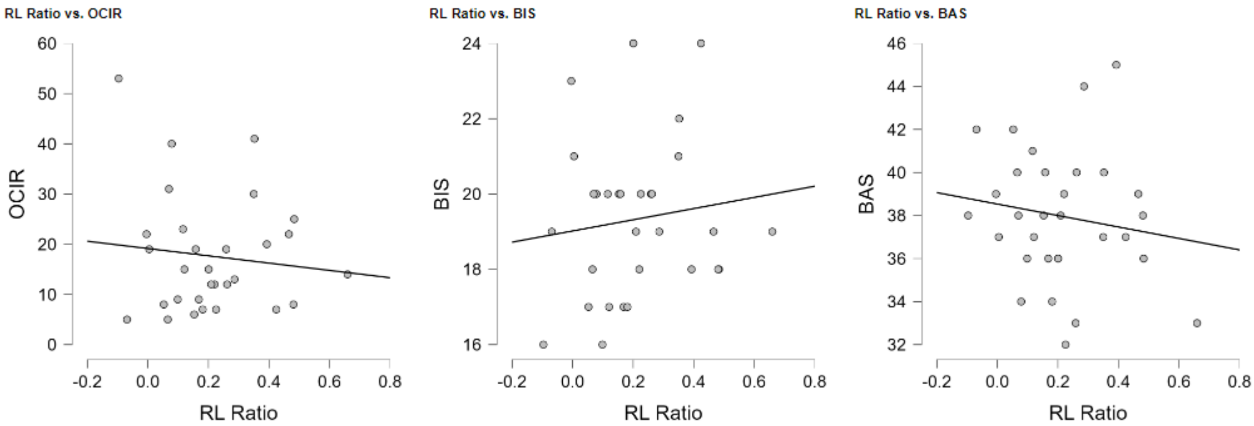

Figure 3

Correlations Model 3. Scatter plots showing the relationships between RL Ratio and scores on the OCIR, BIS, and BAS.

Discussion

The current study investigated the influence of subclinical sOCT on cognitive flexibility and response inhibition. In contrast to our hypothesis, we did not find a significant relationship between sOCT scores and commission errors in the Go/NoGo task. While not significant, a weak trend was observed in the anticipated direction, showing that higher sOCT scores were related to more errors. Additionally, no significant relationship was found between sOCT scores and PES on the Go/NoGo task, providing no evidence that sOCT could affect the ability to adjust responses after errors. For cognitive flexibility, we also found no significant relationship with sOCT scores. On face value, lower reversal learning ratios trended with higher sOCT scores, as was hypothesized. Furthermore, scores on the BIS/BAS scales did not show significant relationships with cognitive performance on either task.

This study's observed trends partially align with existing literature on cognitive impairments associated with OCD and sOCT. As was seen here, previous studies found increased commission errors in the Go/NoGo task, indicating impaired response inhibition in OCD patients (Bannon et al., 2002; Rosa-Alcázar et al., 2021). However, the lack of statistical significance suggests that the effect of sOCT on response inhibition may be less pronounced than in clinical OCD. Similarly, the trend towards lower reversal learning ratios with higher sOCT scores is consistent with studies highlighting executive dysfunction in OCD (Remijnse et al., 2006; Tezcan et al., 2017). Again, the absence of significant results might reflect the subtler nature of cognitive impairments in subclinical populations compared to clinically diagnosed individuals. Together, the evidence is not strong enough to show a clear relationship between sOCT and response inhibition or reversal learning. This could imply that 1) there simply is no relationship, or 2) an effect is present, but that the effect size is too small to be detected with the current sample size (N = 30).

In the broader context, various studies have reported mixed findings regarding cognitive functioning in subclinical obsessive-compulsive populations. For instance, Kim et al. (2009) identified significant executive functioning deficits in sOCT individuals, particularly in set-shifting and response inhibition tasks. In contrast, Johansen and Dittrich (2013) found no significant cognitive impairments in sOCT individuals across most neuropsychological tasks they used. Mataix-Cols et al. (2003) found specific deficits in spatial problem-solving abilities but no significant impairments in declarative or motor procedural learning. Adding to the mixed results, Hamo et al. (2018) evaluated neuropsychological performance in a subclinical obsessive-compulsive sample and found no significant differences in major cognitive domains between high OC (HOC) and low OC (LOC) groups after controlling for anxiety and depression symptoms. Their study shows that while the HOC group underperformed on various outcome measures, both groups performed within the normative range. These findings suggest that sOCT may not necessarily translate to measurable cognitive deficits when assessed using neuropsychological tools. This is consistent with the findings in this study, where the relationship between sOCT and cognitive performance on tasks like Go/NoGo and reversal learning was not statistically significant, although trends indicating poorer performance were observed.

While this study provides valuable insights into the cognitive impacts of sOCT, several limitations must be acknowledged to contextualize the findings appropriately. This study primarily used a sample of young adults aged 18–30, with the majority being first-year psychology students. This homogeneity limits the generalizability of the findings to broader, more diverse populations. Additionally, the reliance on a convenience sampling strategy introduces potential biases related to the educational background, age, and socioeconomic status of participants. These factors could influence the cognitive performance measures and the extent to which these results apply to other age groups or individuals outside of academic environments.

Moreover, the study's sample size of thirty participants is relatively small, which can affect the statistical power of the analyses and the ability to detect significant effects. Small sample sizes can decrease the possibility to find effects that have small effect sizes. Therefore, the findings should be interpreted with caution, as they may not capture the full range of variability present in larger, more diverse samples. Another limitation is the lack of a control group. While the study included participants with sOCT, it did not include a clinical OCD group for comparison. This limits the ability to contextualize the cognitive performance of the sOCT group relative to clinically diagnosed individuals. Including such groups would have provided more specific insights into the severity of cognitive impairments associated with different levels of obsessive-compulsive symptoms.

Furthermore, although well-validated, the neuropsychological tasks employed, namely the Reversal Learning Task and the Go/NoGo Task, have inherent limitations. These tasks may not fully capture the complexity of cognitive flexibility and response inhibition as they occur in real-world settings. Additionally, a variety of other factors, including participant motivation, task engagement, and fatigue, can impact performance on these tasks and are challenging to fully control.

The scope of neuropsychological assessments was also limited. The study focused on specific cognitive domains—cognitive flexibility and response inhibition—using particular tasks. However, OCD and sOCT are associated with a broader array of cognitive impairments. By not assessing these additional domains, the study provides a limited view of the cognitive deficits potentially associated with sOCT. A more comprehensive neuropsychological assessment could have offered a broader understanding of the cognitive profile of individuals with sOCT.

Future research could consider using neuroimaging techniques, such as EEG and fMRI, to replicate and extend the findings of this study. Investigating the neural mechanisms of cognitive inflexibility and response inhibition in sOCT could provide a better understanding of the cognitive deficits observed in this population. Some research has already explored the neural mechanisms of cognitive inflexibility in OCD, revealing significant abnormalities in brain function and structure. Gu et al. (2007) found in an fMRI study that OCD patients make significantly more errors in task-switching trials compared to healthy controls, which indicates impaired cognitive flexibility. Their study also showed differences in activation of the dorsal frontal-striatal areas, with healthy controls exhibiting significantly more activation than OCD patients. Specifically, patients with OCD showed reduced activity in the dorsal frontal-striatal regions and the ventromedial prefrontal and right orbitofrontal cortices (Gu et al. 2007). These neural abnormalities may underlie the cognitive inflexibility observed in OCD and potentially in individuals with sOCT.

Similarly, neural mechanisms of response inhibition have been investigated, revealing impaired inhibitory control in OCD. Chamberlain et al. (2005) conducted a study using fMRI to investigate the neural correlates of response inhibition in OCD. Utilizing a stop-signal task, a common paradigm to assess response inhibition, the results indicated that OCD patients showed impaired response inhibition, evidenced by longer stop-signal reaction times compared to healthy controls. Neuroimaging data revealed that this behavioral impairment was accompanied by reduced activation in the right inferior frontal gyrus, a region critically involved in inhibitory control. Additionally, OCD patients exhibited altered activation in the anterior cingulate cortex during the task, suggesting a broader network dysfunction underlying their impaired inhibitory control.

By using neuroimaging methods in future studies, researchers can gain deeper insights into the neural circuits involved in cognitive inflexibility and response inhibition in sOCT. This approach could help clarify the extent to which the neural mechanisms observed in clinical OCD are present in subclinical populations, potentially informing more targeted interventions and improving our understanding of the OCD spectrum.

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In writing this thesis, I used generative AI tools, specifically ChatGPT, to assist me with refining the language and structure of my work. The AI was used to brainstorm, suggest transitions between sections, and check for spelling, grammar or structuring mistakes. All AI-generated content was critically evaluated and modified to ensure alignment with academic standards. Their use was intended to enhance the clarity and coherence of my writing while maintaining the integrity and originality of my research.

Conclusion

This study investigated the influence of sOCT on cognitive flexibility and response inhibition. Contrary to our hypothesis, we did not find a significant relationship between sOCT scores and commission errors in the Go/NoGo task. While a weak trend was observed, this was not statistically significant. Additionally, no significant relationship was found between sOCT scores and post-error slowing (PES) on the Go/NoGo task, indicating that sOCT does not appear to affect the ability to adjust responses after errors. For cognitive flexibility, no significant relationship with sOCT scores was found. Although lower reversal learning ratios correlated with higher sOCT scores, these findings were not statistically significant. Furthermore, scores on the BIS/BAS scales did not show significant relationships with cognitive performance on either task.

These results show the need for future research with larger, more diverse samples to enhance the generalizability and robustness of the findings. Additionally, using control groups and further exploring the role of BIS/BAS in cognitive functioning could provide better insights into the motivational systems underlying OCD and sOCT. Understanding the cognitive profiles of individuals with subclinical symptoms can ultimately contribute to early identification and intervention, improving quality of life and functioning. Furthermore, incorporating neuroimaging methods, such as EEG and fMRI, could provide deeper insights into the neural circuits involved in cognitive inflexibility and response inhibition, increasing our understanding of the underlying mechanisms in sOCT and OCD.

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