Neuropsychological Characteristics of Nonclinical Obsessive-Compulsives

Michael R. Moland ©

Lakehead University

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Running Head: Nonclinical Obsessive-Compulsives

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Abstract

Neuropsychological functioning was examined in 118 introductory psychology students (males=43, females=75) who reported varying levels of nonclinical obsessive-compulsive behaviours. Using the four subscales of the Padua Inventory, five groups of students were identified: (1) High Obsessive-Compulsives (N=22); (2) Low Obsessive-Compulsives (N=23); (3) High Compulsives (N=24); (4) High Obsessives (N=25); and (5) Normal Scorers (N=24). It was assumed that students reporting nonclinical obsessive-compulsive behaviour would demonstrate visual spatial deficits that were similar to what has been reported in recent research on obsessive-compulsive patients. A visual spatial memory deficit involving the organization and recall of sequences was identified in the high compulsive group compared to the normal and high obsessive scorers. This finding could not be explained by group differences in depression, anxiety, or intelligence. Failure to find any group differences in verbal memory indicative of left-hemisphere functioning implies that the deficit seen in compulsives may reflect right-hemisphere impairment. Gender differences in verbal and visual spatial tasks was observed. The findings are congruent with recent neuropsychological research on clinical obsessive-compulsives and nonclinical compulsive 'checkers'.

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Neuropsychological Characteristics of Nonclinical Obsessive-Compulsives

The purpose of the present research was to investigate the neuropsychological characteristics of obsessive-compulsive (OC) behaviour in a nonclinical student sample. Previous work has been limited to the study of cognitive functioning in OC patients and memory deficits in nonclinical compulsive 'checkers'. This study attempted a more thorough neuropsychological examination of nonclinical obsessive, compulsive, and obsessive-compulsive students using tests that measure verbal and visual spatial memory, set-shifting ability, and cerebral laterality.

Theoretical and Experimental Background

Recent evidence suggests that many clinically normal individuals report obsessive thoughts and behaviours which are similar to those experienced by obsessive-compulsive (OC) patients (Rachman & de Silva, 1978; Salkovskis & Harrison, 1984; Frost, Sher, & Geen, 1986; Sanavio, 1988). This finding may prove important in obtaining a clearer understanding of the pathophysiology and aetiology of Obsessive-Compulsive Disorder (OCD).

In studying the phenomenology of OCD in apparently 'normal' people, researchers have been able to gain access to large populations. Of particular interest has been the study of OC behaviours among college students. Research indicates that the obsessive thoughts and impulses commonly experienced by students show a similar pattern of form and content, (Rachman & de Silva, 1978) incidence, frequency, and dismissability (Salkovskis & Harrison, 1984) to that which has been reported in OCD patients. Likewise, among students, nonclinical compulsive 'checkers' who must repeatedly check to ensure that an activity has been carried out, are more apt to meet clinical criteria for Obsessive-Compulsive Disorder as compared to nonclinical non-checkers (Sher, Martin, Raskin, & Perrigo, 1991). Research on nonclinical compulsives has also revealed that these individuals possess poorer memory for prior actions compared to noncompulsive controls, (Sher, Frost, & Otto, 1983; Sher, Mann, & Frost, 1984) a finding that has been replicated in a clinical setting (Sher, Frost, Kushner, Crews, & Alexander, 1989).

Neurobiology of Obsessive-Compulsive Disorder

There is a growing body of evidence supporting a biological basis for

OCD. Studies have demonstrated high concordance rates in monozygotic twins (Inyoue, 1965), an increased rate of left-handedness (Flor-Henry, Yeudall, Koles, & Howarth, 1979), co-morbidity with neurological disorders such as Sydenham's Chorea (Swedo et al., 1989) and Tourette's Syndrome (Bornstein, 1991), success of pharmacotherapy (Murphy et al., 1989), and overall deficits on neuropsychological tests (Boone, Ananth, Philpott, Kaur, & Duenderedjian, 1991; Christensen, Kim, Dysken, & Hoover, 1992; Zeilinski, Taylor, & Juzwin, 1991).

The use of noninvasive radiographic techniques provides further evidence of a neurological disorder underlying OCD. Studies using Positron Emission Tomography (PET) imaging have revealed consistent abnormalities within the orbital frontal cortex of OCD patients, marked by increased glucose metabolism, particularly in the left hemisphere (Baxter, 1987; Baxter, 1989; Swedo, Schapiro, Grady, Cheslow, & Goldberger, 1989). However, research using magnetic resonance imaging (MRI) remains less clear, with most studies failing to identify such abnormalities (Garber, Ananth, Chiu, Griswold, Oldendorf, 1989; Kellner et al.1991). Quantitative electroencephalographic studies consistently indicate frontal lobe anomalies (Pricep et al., 1993; Kuskowski et al., 1993) suggestive of right-hemisphere impairment (Kuskowski et al., 1993).

Neuropsychology of Obsessive-Compulsive Disorder

Recently, there have been a number of systematic attempts to examine the neuropsychological correlates of OCD. Moreover, much of this work has been plagued by diverse methodological problems such as insufficient sample sizes, inappropriate diagnostic criteria, and a lack of control measures. Many OCD patients for example, exhibit high levels of depression, making it unclear in uncontrolled studies whether observed deficits are attributable to OCD or to depression (Christensen, et al., 1992).

Despite a lack of consensus regarding the neuropsychological contributions to OCD, carefully controlled studies indicate an association between OCD and right hemisphere deficits (Hollander et. al.,1990). These neuropsychological deficits include impairment in visual spatial memory (Zielinski et al., 1991; Boone et al., 1991) visual memory (Sher et al., 1989; Boone et al., 1991, Hollander et al., 1990) and nonverbal recent memory deficits (Boone et al., 1991; Christensen et al., 1992). Furthermore, some studies have also revealed deficits in memory for prior actions in compulsive checkers as compared to noncheckers in nonclinical samples (Sher et al., 1983; Sher et al., 1984). The former may be important in explaining why checkers must repeatedly verify that a prior action was properly carried out (Sher et al., 1983). Furthermore, neuropsychological testing of subjects with trichotillomania (compulsive hair pulling) suggests that similar spatial processing deficits can be found in individuals with a disorder resembling OCD (Rettew, Cheslow, Rapoport, Leonard, & Lenane, 1991). Likewise, Behar et al. (1984), reported significant deficits in the number of errors made by OCD adolescents over 10 trials on the Stylus Maze task and significant increases in the number of errors for both 'away' and 'toward' scales of Money's Road Map Test of Directional Sense (Money, Alexander, & Walker, 1965). They concluded that OCD individuals compared to controls show decrements in skills requiring the mental rotation of oneself in space, and in understanding and developing a sense of the implicit rules and patterns associated with maze learning.

Recent studies have also examined cognitive set-shifting ability in OCD subjects, a task thought to be sensitive to frontal lobe functioning. Both clinical patients (Head, Bolton, & Hymas, 1989) and nonclinical compulsive checkers (Goodwin & Sher, 1992) have been shown to produce significantly more total errors and perseverative errors on the Wisconsin Card Sorting Test

(WCST) as compared to nonobsessive-compulsive controls.

Measurement of Obsessive-Compulsive Disorder

Several assessment tools are available for measuring obsessive-compulsive disorder. Self-report type questionnaires are commonly used and include such instruments as The Leyton Obsessional Inventory (LOI)(Cooper, 1970), Maudsley Obsessional-Compulsive Inventory (MOCI)(Hodgson, & Rachman, 1977), Padua Inventory (PI)(Sanavio, 1988), and Compulsive Activity Checklist (CAC)(Freund, Steketee, & Foa, 1987). Of these, the MOCI and CAC have been most often used (Sternberger & Burns, 1990). The MOCI measures the severity of obsessive-compulsive behaviours, while the CAC assesses the extent to which compulsive behaviours interfere with daily activities (Sternberger et al., 1990).

Two obsessional factors as well as two compulsive factors consistently emerge from the factorial analysis of the PI, which distinguish it from other inventories that produce only two compulsive factors, such as the MOCI and CAC (Sternberger et al., 1990). The two obsessive factors outlined by Sanavio (1988) from the PI consists of 'impaired control over mental activities', which measures doubts and ruminations, and 'urges and worries of losing control over motor behaviours' which measures urges involving harm to oneself or others and fears associated with loss of control. Of the compulsive factors, 'checking behaviours' measures repetitive checking behaviours and 'becoming contaminated', includes items involving a preoccupation with dirt and improbable contaminations.

Sanavio (1988) reported very good test-retest reliability, as well as convergent and divergent validity among other well established measures of obsessional complaints, namely the MOCI, and LOI, in the original clinical and nonclinical Italian samples. Furthermore, the factor structure, convergent and divergent validity, and reliability have produced very similar results among American (Sternberger et al., 1990), Dutch (Van Oppen, 1992) and Italian nonclinical samples (Sanavio, 1988), indicating the stability of the PI as a measure of OC behaviour across cultures.

In light of the evidence that has been provided for the reliability and validity of The Padua Inventory in measuring both obsessions and compulsions, researchers have recommended the PI as a suitable instrument in furthering studies of obsessions and compulsions in nonclinical subjects (Sanavio, 1988; Sternberger et al., 1990).

Rationale of the Present Study

Previous studies investigating neuropsychological functioning in OCD patients have been criticized for design inconsistencies and methodological short-comings. The use of highly depressed subjects, as well as inadequate attempts to control for group differences in IQ have led to difficulties in interpreting results across studies. Likewise, many functional issues in OCD continue to remain unresolved. Most studies addressing laterality in OCD for example have done so indirectly, relying solely upon test scores from visual spatial and verbal performance measures to infer lateralized deficits in OCD rather than a direct measure of laterality. Recent evidence from carefully controlled studies suggests that clinical obsessive-compulsive patients show right-hemisphere performance decrements on tasks measuring visual spatial and visual memory. Replication and extension in a nonclinical sample might add more clarity to this relationship. Furthermore, the small sample sizes common to OCD patient research have prevented researchers from examining the influence of gender on OC behaviour and cognitive functioning.

In this study an attempt was made to identify the neuropsychological characteristics of nonclinical students who report obsessive-compulsive behaviours. To ensure that this phenomenon was adequately explored, several neuropsychological tests were selected from previous OC research to form a battery encompassing a broad range of cognitive functioning. In light of recent evidence indicating a visual spatial deficit in OCD, it was necessary to examine this finding in depth by selecting an array of tests that measured a broad spectrum of visual spatial ability. The Hooper Visual Organization Test was used to measure visual spatial integration; the Visual Memory Span was used to assess memory for visual spatial sequences; and the Visual Reproduction Test was used to examine visual spatial memory. However, because the tests of visual spatial organization and visual spatial memory used in this study involve primarily nonverbal right hemisphere processing, it was necessary to include the Logical Memory Test, a measure of left hemisphere verbal memory, to control for a possible global memory deficit. The Dichotic Listening Test was used to determine whether a hemispheric advantage existed for the simultaneous presentation of verbal (words) and nonverbal (music) stimuli. Because hemispheric advantages can be linked to hemispheric activation, information from the Dichotic Listening Test could prove useful in conjunction with other measures in developing a clearer understanding of the nature of lateralized deficits. The Wisconsin Card Sorting Test (WCST) was selected as a measure of perseveration, which appears to be a fundamental characteristic of most types of OC behaviour. If these behaviours are indeed perseverative in nature, one might expect to see an increase in perseverative responses on the WCST, a finding which would lead one to suspect deficits in frontal lobe functioning.

Different subgroups of OC behaviour as well as gender were examined in order to determine if any connection might exist between a person's gender, their type of OC behaviour, and their neuropsychological performance. In light of the similarity between the obsessions and compulsions reported in clinical and nonclinical samples, it was thought that nonclinical OC subjects would experience functional deficits that were similar to that which has been reported in research on OCD patients.

Method

Participants

One hundred and sixty-two males and females attending Lakehead University were screened from a pool of 715 introductory psychology students completing the Padua Inventory (PI) an obsessive-compulsive questionnaire. On the basis of PI scores, students were classified into 5 groups: High obsessive-compulsives (High OC), low obsessive-compulsives (Low OC), high compulsives (High C), high obsessives (High O) and normal scorers. The criteria for the entry into each group was as follows: High OC (scoring equal to or greater than 1 S.D above the sample mean on all four PI factors); Low OC (scoring equal to or less than 1 S.D below the sample mean on all four PI factors); High C (scoring equal to or greater than 1 S.D above the sample mean on both PI compulsive factors, and less than the sample mean on the other 2 obsessive factors); High O (scoring equal to or greater than 1 S.D above the sample mean on both PI obsessive factors, and equal to or less than the sample mean on the remaining two compulsive factors); and normal scorers (selected at random from within 1 S.D of the sample mean on all four PI factors). One hundred and twenty-six students agreed to participate in the full study. Data from one student were excluded from the analysis due to complete deafness in one ear, while data from another student were not included after brain impairment screening revealed that he had experienced a seizure one year prior to testing. Three mature students were excluded because they were older than the pre-determined cutoff of 30 yrs of age (ie. 38 yrs, 43 yrs, 52 yrs), which was selected to prevent factors associated with age from unduly influencing the analysis. Three other students were excluded from the analysis because they were on anti-depressant medication at the time of testing. The final sample included 118 students (43 males and 75 females) ranging from 18-30 yrs of age (mean = 20.20, S.D. = 2.24). Students who completed the full study had 2 bonus marks added on to their final mark in their Introductory Psychology course.

Test Materials

The following tests were used to examine group and sex differences within the following cognitive domains: Dichotic Listening (laterality); Hooper Visual Organization Test (visual spatial integration); WMS-R Visual Memory Span Forward and Backward (memory for visual spatial sequences); Wisconsin Card

Sorting Test (cognitive set shifting ability); and WMS-R Visual Reproduction (visual spatial memory) and Logical Memory (verbal memory).

Padua Inventory. The Padua Inventory (PI) (Sanavio, 1988), a self-report inventory designed to measure obsessive-compulsive behaviours was used to screen subjects. The PI has demonstrated good validity and reliability across cultures in both clinical and nonclinical subjects (Sanavio, 1988; Sternberger et al., 1990). It contains 60 items which measure the degree of distress elicited by specific thoughts and behaviours. Each item is rated on a five point scale (0-4) according to the degree of disturbance: A '0' indicates no disturbance, while '4' indicates that the item is very disturbing. The questionnaire produces a four-factor structure consisting of two obsessive factors: 1) 'impaired control over mental activities' 2) 'urges and worries of losing control over motor behaviours', and two compulsive factors: 3) 'becoming contaminated' 4) 'checking behaviours'. The PI is the only self-report instrument which provides a strong measure of obsessional dimensions distinct from compulsive dimensions of OCD, allowing a more comprehensive study of this phenomena (Sternberger, et al., 1990).

Beck Depression Inventory. The Beck Depression Inventory (BDI) (Beck, Steer, & Garbin, 1988) was used to investigate the relationship between depression and OC behaviour. The BDI contains 21 items that describe themes that are related to depression, including mood, sense of failure, and loss of appetite. Within each item are four statements of increasing severity that are arranged on a four point scale (eg. '0' indicating no problem, to '3' which implies a severe problem with the item). Higher scores indicate an increase in severity of depression. Depression has long been associated with the experience of OCD in patients. For this reason, it was important to control for the influence that depression might have on the neuropsychological performance of subjects, and to see to it that only factors specific to OCD contributed to any observed differences.

State-Trait Anxiety Inventory. The State-Trait Anxiety Inventory (STAI) (Spielberger, 1983) was used to obtain a measure of anxiety among subjects. State anxiety (A-State) measures transitory, subjective feelings of apprehension and tension that change over time. The inventory comprises 20 statements describing specific feeling states (eg., "I feel calm"; "I am jittery"). Subjects are required to indicate how they feel toward these statements 'at the moment' (not at all, somewhat, moderately so, very much so). Scores are graded according to the intensity of responses.

Trait anxiety (A-Trait) measures more stable, lasting feelings of anxiety. Individuals are instructed to indicate how they feel 'generally' toward 20 similar statements (eg., "I am inclined to take things hard," "I am a steady person.") according to the frequency with which each statement applies to them (almost never, sometimes, often, almost always). Individuals with high A-trait are particularly sensitive to interpersonal situations presenting some threat to their self-esteem, such as performance evaluation or anticipated failure (Anastasi, 1988). Anxiety is a prominent feature of OCD, and because anxiety might adversely affect performance, it was necessary to examine the effects of this factor in the study.

Vocabulary. The Vocabulary subtest of the Weschler Adult Intelligence Scale (WAIS-R) (Weschsler, 1981) was administered in order to obtain an IQ measure across all subjects. The Vocabulary Subtest contains 35 words listed in order of difficulty. The examiner simply asks the subject what each word means. Testing is complete when five consecutive errors have been made or when all items have been administered. Items are scored either '0', '1', or '2' according to how accurately each item is defined. Vocabulary is recognized as the single best indicator of both verbal, and general mental ability (Lezak, 1983). Likewise, Vocabulary subtest scores are strongly correlated with Full Scale IQ scores from the WAIS-R (Wechsler, 1981). Furthermore, because verbal tasks tend to reflect left-hemisphere functioning, it was thought that vocabulary test scores would be less sensitive to samples with suspected right-hemisphere impairments like that reported in OCD.

Brain Impairment Screening Questionnaire. A brief 9 item questionnaire was developed by the researcher and administered prior to testing to determine whether any subject had encountered an illness or head injury which could possibly influence their neuropsychological test performance. Sample items on the questionnaire included " Have you ever suffered any head injury?", Have you ever had a seizure?", and "Do you have any disease or any familial history of disease?".

The Edinburgh Handedness Inventory. The Edinburgh Handedness Inventory (EHI) (Oldfield, 1971) was used to determined hand preference among subjects. The EHI lists ten activities involving the use of one's hands, such as writing, throwing, and using a toothbrush. Beside each item are two columns labled left and right. The person indicates their hand preference by putting a '+' in the appropriate column. A strong hand preference for an activity is indicated by '++'. If there is no clear hand preference for an activity, the subject then puts '+' in both the left and right columns. The number of '+' within each column is calculated, and a handedness score is obtained by subtracting the left hand score from the right hand score, dividing this by the sum of the right and left hand scores and multiplying the result by 100. The result is a number between +100 (indicating an absolute right hand preference) and -100 (indicating an absolute left hand preference). Understandably, categorizing individuals as either left handed, right handed or mixed, is rather arbitrary. For this reason, criteria similar to that used by Briggs and Nebes (1975) for a student sample were selected for this study. Students scoring greater than or equal to +38 were called right-handed, those with scores falling between +38 and -38 were considered mixed, and those scoring equal to or lower than -38 were deemed left handed.

<u>Hooper Visual Organization Test.</u> The Hooper Visual Organization Test (HVOT) (Hooper, 1983) was used to measure visual spatial functioning in OC

subjects. The HVOT consists of 30 pictures of disassembled objects. Subjects are asked to verbally identify each cut-up picture. The HVOT assesses visuoconceptual functions and may be useful to isolate the perceptual component of subjects' scores on constructional visuoperceptual tests (Lezak, 1983). Items in this test tend to invoke perceptual fragmentation in subjects most likely attributable to right-hemisphere deficits (Lezak, 1983). A well controlled study by Boone et al. (1991) suggests that OCD patients score significantly poorer than controls on the HVOT.

Dichotic Listening. Dichotic Listening was used to determine lateralization of language and music in OC subjects. In this task, subjects wearing stereo headphones are asked to attend to two recorded stimuli presented simultaneously to each ear. Superior recall from the left ear generally suggests an advantage for the right hemisphere and vise versa, due to the stronger influence of contralateral auditory pathways. Wexler and Goodman (1991); and Rapoport et al.(1981) have found significantly lower right-ear advantages in OCD patients compared to controls on language related dichotic listening tasks.

Words. In the 'words' portion of the dichotic listening test, subjects are presented three sets of two word pairs. One word within each pair is sent to the left ear while the other is sent simultaneously to the right ear. Immediately following presentation of each three set sequence, the tape is stopped and the subject is asked to recall verbally as many words as they can remember. Responses are recorded and the remaining trials are administered (22 in total, reversing headphones following the tenth trial). One mark is given only to each correctly recalled word; no mark is given to words which resemble the target words. A cerebral laterality index is calculated by subtracting the number of correct left-ear responses from the number of correct right-ear responses and dividing this by the sum of the correct right and left ear responses.

Subjects typically demonstrate a right ear advantage for the 'words' portion of the dichotic listening test, as the left hemisphere in most people is adapted for language specialization.

Music. The 'music' segment of the dichotic listening test determines ear advantage for musical stimuli. For this task, subjects attend to two brief musical excerpts presented simultaneously, one to each ear. After a short pause, the subject is presented one melody to both ears and then must recognize whether that melody is the same or different than either of the two they heard previously. The 'music' subtest contains 48 trials. Headphones are reversed after trial 24. Following administration, the number of correct right and left ear responses are calculated. Similar to the words subtest, a cerebral laterality index is obtained by subtracting the number of correct right ear responses from the number of correct left ear responses and dividing by the sum of the correct right and left responses.

Wisconsin Card Sorting Test. The Wisconsin Card Sorting Test (WCST)(Berg, 1948) was used to measure cognitive set shifting ability and perseveration in OC subjects. The WCST (Computer Version-2)(Heaton, Chelune, Talley, Kay, & Curtiss, 1993) is a computerized version of the Wisconsin Card Sorting Test (WCST). As in the original WCST, the computerized version uses stimulus cards and response cards that fall into various categories: colour (red, blue, yellow, or green), form (crosses, circles, triangles, and stars), and number (one, two, three, or four). When the test begins, subjects are presented on the computer screen with an array of four stimulus cards arranged from left to right in this order: one red triangle, two green stars, three yellow crosses, and four blue circles. Positioned immediately below the stimulus cards on the screen is a response card. The subject is asked to match each consecutive response card that appears, to one of the four stimulus cards above. After each response, the computer displays only a 'right' or 'wrong' prompt on the screen. The correct sorting principle is never revealed to the subject. When the subject makes 10 consecutive sorts according to the correct principle ('colour' being first), the correct sorting principle suddenly changes to 'form'. Administration of the WCST is complete when all three principles (ie. colour, form, number) are sorted through twice, or when all the cards (128 in total) have been sorted.

The WCST measures a subject's ability to form, maintain, and shift cognitive set (Heaton et al., 1993), abilities believed to be associated with frontal lobe functioning. Recent studies have revealed that nonclinical subjects who demonstrate high 'checking' scores on the Maudsley Obsessional-Compulsive Inventory produce more total errors and perseverative errors (ie. response repetition despite negative feedback cues) on the WCST compared to controls (Goodwin & Sher, 1992). Similarly, the ability to shift cognitive set in patients with OCD appears to be impaired as well (Harvey, 1986; Head, Bolton, & Hymas, 1989).

Visual Memory Span. The Visual Memory Span (VMS) subtest of the Wechsler Memory Scale-Revised (WMS-R)(Wechsler, 1987) was used in this study to provide a measure of visual-spatial memory in subjects. The VMS test is sub-divided into Tapping Forward and Tapping Backward sections.

Tapping Forward. In this task, a card containing an arrangement of eight red coloured squares is placed in front of the examinee. The examiner taps the blocks in a predetermined sequence and the subject is required to copy this tapping pattern from memory. Each successfully completed trial is followed by consecutive trials of increasing length (ie. one tap added to each sequence) and complexity, until the subject's span of immediate recall is established. The test is complete when the subject fails both trials on any item.

Tapping Backward. The Tapping Backward subtest is similar to the Tapping Forward subtest except that the test card contains green coloured squares, and the examinee must copy the examiner's tapping sequence in reverse order.

Visual Memory Span measures immediate recall of sequences and spatial memory sensitive to right temporal lobe dysfunction involving hippocampal areas (Zielinski et al., 1991). The nature of the VMS test makes it a useful measure of right hemisphere function because the ambiguity of the blocks suppresses verbal mediation (ie. minimal left hemisphere involvement) during memorization of each sequence. Research by Zielinski et al.(1991) suggests that patients with OCD show significant performance decrements on block tapping compared to controls.

Logical Memory. The Logical Memory subtest of the Wechsler Memory Scale Revised (WMS-R) was used as a measure of immediate and delayed (20 min) verbal memory. The examiner reads two paragraphs to the subject, stopping between each presentation at which time the subject begins immediate free recall of the paragraph. Paragraph A contains 24 memory units or "ideas" while paragraph B consists of 22. One point is awarded to the subject for every "idea" that is recalled with the highest attainable score being 23 (ie. A+B /2). Following testing for immediate recall, other different tests are administered for a predetermined length of time, then the subject is asked to provide a delayed recall of the contents of each paragraph. The Logical Memory subtest is sensitive to left-hemisphere memory involving verbal mediation. Research comparing OCD patients with controls has failed to show any differences on the Logical Memory subtest (Christensen et al., 1992; Boone et al., 1991).

Visual Reproduction. The Visual Reproduction subtest of the Wechsler Memory Scale -Revised, was used as a test of nonverbal, figural memory. Similar to the Logical memory subtest, it involves an immediate as well as delayed recall trial (20 minutes). In this test, four cards with printed designs are each displayed for ten seconds then removed, at which point the subject must then draw the design from memory. Research by Christensen et al. (1992) has demonstrated that OCD patients compared to controls perform more poorly on the delayed recall portion of the Visual Reproduction subtest.

Procedure

Screening

During the third week of September, 1993 students from three separate introductory psychology classes were asked to participate in a study examining intrusive thoughts and impulses in students. They were told that the study involved completing an initial questionnaire concerning intrusive thoughts and impulses, and that some of them would be contacted later and asked to participate in a second phase of the study which involved filling out additional questionnaires and performing a variety of motor tasks. Students were asked to write their first name and phone number on the back of their inventory to enable the experimenter to contact them at a later time should they meet the criteria for the second phase of the study. Students were told that their participation in this study was voluntary, involved no risk to them, and that their results would be kept confidential. They were also encouraged to contact the researcher at any time if they had any questions or concerns related to the study. Immediately prior to administration of the PI, students were read the following introduction to the inventory adapted from Salkovskis and Harrison (1984). "This is a questionnaire regarding the occurrence of unpleasant, unwanted thoughts and impulses. Thoughts and impulses of this kind are experienced by many people and is quite normal. The information gained from this questionnaire will likely be considerably useful in increasing our knowledge of intrusive thoughts and impulses."

Data from the PI were scored, and students meeting the criteria for selection into one of the five obsessive-compulsive behaviour groups were called by the researcher and asked to participate in the second phase of the study.

Neuropsychological testing

Testing took place in a quiet research room at the university and was free of distractions. All tests were administered by the researcher and presented in the same order to all subjects. Following every neuropsychological testing session, each student was re-administered the PI. It took approximately 2 hrs for each participant to complete testing. Neuropsychological testing took place over a five month period. All scoring was done by the researcher under blind conditions (ie. the group assignment of the participants was not known to the researcher at the time of neuropsychological testing).

Results

Statistical Procedures

To determine the stability of the PI's four OC factors over time, the pre-test and post-test means for each of the four factors were compared. A considerable degree of regression to the mean was noted in the students scores across the two administrations of the PI. Paired t-tests (using Bonferroni correction for multiple comparisons) revealed significant differences in the scores for obsessive factor I ('Impaired Control Over Mental Activities'), ($t(117) = 5.44$, $p < .0001$) from the first PI administration (M = 25.2, SD = 15.6) to the second PI administration (M = 20.5, SD = 14.1). Significant differences were also shown in the scores for obsessive factor II ('Losing Control Over Motor Behaviours'), ($t(117) = 3.81$, $p < .0001$) from the first testing period (M = 6.5, SD = 6.0) to the second testing period (M = 5.0, SD = 5.3). No significant differences were found for compulsive factor I ('Fear of Becoming Contaminated'), ($t(117) = 2.34$, $p > .05$) from time one (M = 13.0, SD = 9.2) to time two (M = 11.7, SD = 9.6), or for compulsive factor II ('Checking Behaviours'), ($t(117) = 1.65$, $p > .10$) from the first administration (M = 12.2, SD = 8.6) to the second administration

(M = 11.3, SD = 8.2). Because of uncertainty regarding the stability of the means for the four PI factors over time, a Pearson product-moment correlation was calculated among the four pre-test and post-test factors for all five OC groups combined to determine if pre-test and post-test scores for each factor were still strongly related to each other despite the presence of lower post-test scores due to regression to the mean. Analysis revealed that the pre-test and post-test measures of the same factor correlated highly with each other, while moderate correlations were found between the remaining combinations of the four factors (see Table 1).

Separate multivariate analyses of covariance (MANCOVA) were used to examine group and sex differences in neuropsychological performance within the following cognitive areas: Dichotic Listening (laterality); Hooper Visual Organization Test (visual spatial integration); WMS-R Visual Memory Span Forward and Backward (memory for visual spatial sequences); Wisconsin Card Sorting Test (cognitive set shifting ability); and WMS-R Visual Reproduction (visual spatial memory) and Logical memory (verbal memory). Depression, IQ, state-anxiety, and trait-anxiety were used as covariates. Univariate follow-up tests were conducted using the Student Newman Keuls statistic only in instances where the MANCOVA was significant. Statistical analyses

Table 1

Correlations Between Pre-Test and Post-Test Measures of the Padua Inventory (PI) Four Factors

	Post-test Measure of PI Factors[a]			
	Post-test FI	Post-test FII	Post-test FIII	Post-test FIV
Pre-test Measure of PI Factors[a]				
Pre-test FI	.81**	.43**	.59**	.59**
Pre-test FII	.44**	.80**	.69**	.32**
Pre-test FIII	.55**	.62**	.79**	.39**
Pre-test FIV	.59**	.23*	.43**	.72**

:Note. Total sample N = 118.

*$p < .01$, one-tailed. **$p < .001$, one-tailed.

[a]FI (Obsessive Factor FI : Impaired control over mental activities),

FII (Compulsive Factor FII : Becoming contaminated),

FIII (Compulsive Factor FIII : Checking behaviour),

FIV (Obsessive Factor FIV : Urges and worries of loss of control of motor behaviour).

were conducted using SPSS-PC+ statistical software. To determine the effect of outlying values in the study, MANCOVA was conducted with and without outliers. Table 2 presents data on gender and handedness for all OC groups.

A one-way ANOVA did not show any significant age differences between groups F (4, 113) = 1.13, $p > .35$. However, significant group differences were found using a one-way ANOVA on the WAIS-R vocabulary measure F (4, 113) = 3.46, $p < .05$. Follow-up analysis revealed that the low OC group performed higher than the high OC scorers, high C scorers, and the normal OC scorers on WAIS-R vocabulary (see Table 3.) SPSS MANOVA revealed a significant gender by group interaction on affect, Wilks' criterion F (12, 281) = 1.86, $p < .05$. Univariate follow-up analysis revealed that females belonging to the high OC group scored significantly higher than all but the male and female high O groups on depression, (univariate F (4, 108) = 2.67, $p < .05$), and the high O females scored significantly higher on depression than all groups except the male high OC, high C, and high O scorers and the female high OC scorers (see Figure 1). No gender by group differences were found for state-anxiety, (univariate F (4, 108) = .81, $p > .52$) or trait-anxiety, (univariate F (4, 108) = 1.84, $p > .12$). A significant main effect for group was shown on depression, state-anxiety, and

Table 2

Characteristics of Student Sample

	Obsessive-Compulsive (OC) Groups [a]				
	Group 1 (n = 22)	Group 2 (n = 23)	Group 3 (n = 24)	Group 4 (n = 25)	Group 5 (n = 24)
Gender					
Male	9	10	7	7	10
Female	13	13	17	18	14
Handedness					
Right	18	21	18	20	19
Left	1	0	3	2	2
Mixed	3	2	3	3	3

Note. Total sample N = 118.

[a]Group 1 (High OC scorers), Group 2 (Low OC scorers), Group 3 (High Compulsive scorers), Group 4 (High Obsessive Scorers), Group 5 (Normal OC scorers).

trait-anxiety, Wilks' criterion F (12, 281)= 4.23, $p < .001$. The high OC and high O groups scored significantly higher than the low OC, high C, and normal scorers on these measures (See Table 3.) Table 4. presents the means and standard deviations for OC groups on all neuropsychological tests.

A 2 X 5 between-subjects multivariate analysis of covariance (MANCOVA) was performed on all of the dependent variables presented in Table 4. Depression, state-anxiety, trait-anxiety, and vocabulary test scores were used as covariates. Independent variables included sex (males and females) and group (high OC scorers, low OC scorers, high C scorers, high O scorers, and normal OC scorers). MANCOVA yielded a significant difference between groups, Wilks' criterion F (64, 351) = 1.50, $p < .05$. Univariate analysis revealed significant differences in music recalled from the left ear, F (4, 113) = 2.81, $p < .05$, between high OC scorers and low OC scorers on the Dichotic Listening task. Univariate analysis also indicated a reliable difference between groups on the WMS-R Forward Visual Memory Span test, with the normal OC group scoring higher than the high C group, (univariate F (4,113) = 2.54, $p < .05$). No significant group differences were found on any of the remaining neuropsychological measures.

Significant main effects for sex, Wilk's criterion F (16, 89) = 2.49,

Table 3

Means, Standard Deviations, and Standard Error of Pre-test Measures

	Obsessive-Compulsive (OC) Groups [a]															
	Group 1 (n = 22)			Group 2 (n = 23)			Group 3 (n = 24)			Group 4 (n = 25)			Group 5 (n = 24)			
	M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE	Significance
Age	19.5	.7	.16	20.7	2.8	.60	20.1	2.5	.51	20.0	2.3	.47	20.6	2.2	.44	NS
WAIS-R Vocabulary	42.7	10.4	2.1	49.4	7.9	1.6	42.8	8.3	1.7	45.7	8.5	1.7	41.7	7.8	1.6	<.05
Beck Depression Inventory	15.7	10.6	2.2	4.3	2.4	.51	7.5	4.2	.85	14.2	6.8	1.4	8.8	5.8	1.2	<.001
State-Anxiety	42.7	12.9	2.6	32.9	9.3	1.9	34.1	7.0	1.4	38.9	9.1	1.8	35.9	10.6	2.1	<.001
Trait-Anxiety	50.0	14.3	2.9	31.0	5.9	1.2	39.6	7.9	1.6	49.5	11.5	2.3	39.9	10.1	2.0	<.001

Note. Total sample N = 118.

[a]Group 1 (High OC scorers), Group 2 (Low OC scorers),
Group 3 (High Compulsive scorers), Group 4 (High Obsessive Scorers), Group 5 (Normal OC scorers).

Figure 1. Mean Beck Depression Inventory (BDI) scores as a function of gender, and obsessive-compulsive group.

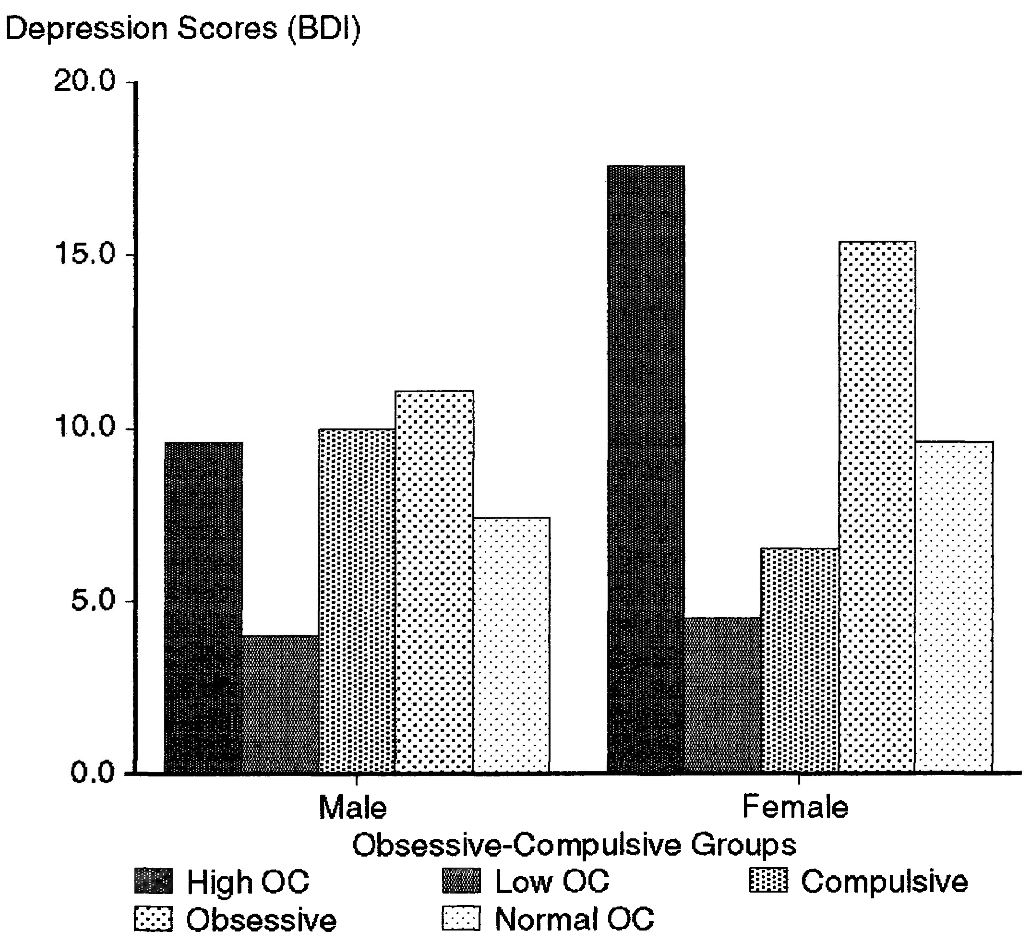

Table 4

Means, Standard Deviations, and Standard Error of Neuropsychological Measures

	Obsessive-Compulsive (OC) Groups [a]															
	Group 1 (n = 22)			Group 2 (n = 23)			Group 3 (n = 24)			Group 4 (n = 25)			Group 5 (n = 24)			
	M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE	M	SD	SE	Significance
Dichotic Listening																
Words																
Right Ear	25.3	6.8	1.4	26.0	6.3	1.3	22.5	4.8	1.0	25.4	4.4	.9	26.0	4.1	.8	NS
Left Ear	18.9	7.4	1.6	20.2	7.3	1.5	21.0	4.6	.9	19.9	7.4	1.5	21.1	6.8	1.4	NS
Asymmetry	15.1	29.2	6.2	13.4	26.5	5.5	3.4	17.1	3.5	14.0	23.1	4.6	12.0	21.1	4.3	NS
Music																
Right Ear	10.2	2.0	.4	9.3	2.5	.5	9.3	2.1	.4	9.7	1.7	.3	9.0	2.5	.5	NS
Left Ear	10.7	1.2	.2	8.9	2.5	.5	9.7	1.8	.4	10.0	1.4	.3	9.6	2.3	.5	<0.05
Asymmetry	3.4	14.4	3.1	-2.2	25.5	5.3	2.3	14.4	2.9	1.7	10.2	2.0	3.8	18.1	3.7	NS
Hooper Visual Organization Test	26.7	1.8	.4	27.1	1.4	.3	26.0	2.0	.4	26.7	2.1	.4	26.5	1.6	.3	NS
WMS-R Visual Memory Span																
Forward	8.9	1.8	.4	9.2	1.2	.3	8.9	0.9	.2	9.5	1.5	.3	10.2	2.2	.4	<0.05
Backward (Outliers included)	9.0	1.9	.4	9.2	1.4	.3	8.0	1.3	.3	9.0	1.8	.4	8.5	1.3	.3	NS
Backward (Outliers removed)	9.1	1.8	.4	9.1	1.3	.3	8.0	1.4	.3	9.2	1.8	.4	8.4	1.3	.3	<0.05[b]
Wisconsin Card Sorting Test																
Trials	86.1	15.8	3.4	87.4	15.4	3.2	99.3	20.0	4.1	92.8	18.3	3.7	91.1	17.7	3.6	NS
Perseverative Responses	11.0	10.8	2.3	9.9	8.0	1.7	14.3	12.7	2.6	11.0	10.0	2.0	10.3	8.2	1.7	NS
Perseverative Errors	9.7	8.5	1.8	9.3	7.3	1.5	12.9	10.7	2.2	9.9	7.6	1.5	9.7	7.2	1.5	NS
WMS-R Visual Reproduction	9.2	0.8	.2	9.3	0.5	.1	9.2	0.5	.1	9.2	0.6	.1	9.2	0.6	.1	NS
20-min Recall	8.9	0.9	.2	8.8	1.2	.2	8.9	1.2	.2	8.7	1.0	.2	8.6	1.4	.3	NS
WMS-R Logical Memory	12.8	2.8	.6	13.8	3.6	.7	11.8	3.8	.8	12.7	3.6	.7	12.5	3.6	.7	NS
20-min Recall	11.7	2.8	.6	12.3	3.2	.7	11.0	3.9	.8	11.4	3.9	.8	11.0	3.4	.7	NS

Note. Total sample N = 118.

[a] Group 1 (High OC scorers), Group 2 (Low OC scorers), Group 3 (High Compulsive scorers), Group 4 (High Obsessive Scorers), Group 5 (Normal OC scorers).

[b] Total sample N = 106

$p < .01$, were found on the Hooper Visual Organization Test, (univariate F (1, 104) = 9.03, $p < .01$) with males scoring higher than females, and on the left ear scores on the words segment of the Dichotic Listening Test, (univariate F (1, 104) = 5.75, $p < .05$) with females demonstrating better performance than males. Performance on the WMS-R Logical Memory, univariate F (1, 104) = 4.64, $p < .05$, and WMS-R Logical Memory (20-min delayed recall), (univariate F (1, 104) = 4.84, $p < .05$) showed that females scored consistently higher than males on these measures (see Table 5).

Univariate outliers were identified within groups on the following measures: WCST Perseverative Responses, Group 1 (1), Group 2 (2), Group 3 (2), Group 4 (2), Group 5 (3); WMS-R Visual Reproduction, Group 4 (1); WMS-R Visual Reproduction (Delayed Recall), Group 3 (1). No multivariate outliers were found using Mahalanobis distance.

Repeating the MANCOVA procedure with outliers removed from the analysis revealed an additional effect among groups Wilks' criterion F (64, 304) = 1.64, $p < .01$, on the WMS-R Backward Visual Memory Span test, (univariate F (4, 92) = 2.80, $p < .05$) with the high obsessive scorers performing better than the high compulsive scorers (see Table 4).

Table 5

Means, Standard Deviations, and Standard Error of Neuropsychological Measures by Gender

	Gender						
	Males (n = 43)			Females (n = 75)			
	M	SD	SE	M	SD	SE	Significance
Dichotic Listening							
Words							
Right Ear	25.8	5.6	.9	24.6	5.3	.6	NS
Left Ear	18.9	6.4	1.0	21.1	6.7	.8	$p<0.05$
Asymmetry	16.3	23.3	3.6	8.8	23.5	2.7	NS
Music							
Right Ear	9.6	2.2	.3	9.4	2.2	.2	NS
Left Ear	9.5	2.1	.3	9.9	1.8	.2	NS
Asymmetry	-0.7	16.6	2.5	3.2	17.2	2.0	NS
Hooper Visual Organization Test	27.3	1.5	.2	26.2	1.8	.2	$p<0.01$
WMS-R Visual Memory Span							
Forward	9.3	1.7	.3	9.4	1.6	.2	NS
Backward	9.2	1.5	.2	8.5	1.6	.2	NS
Wisconsin Card Sorting Test							
Trials	90.4	17.1	2.6	92.1	18.4	2.1	NS
Perseverative Responses	10.6	7.5	1.1	11.7	11.3	1.3	NS
Perseverative Errors	9.8	6.5	1.0	10.6	9.2	1.1	NS
MS-R Visual Reproduction	9.3	0.5	.1	9.2	0.6	.1	NS
30-min Recall	8.8	1.2	.2	8.8	1.1	.1	NS
WMS-R Logical Memory	12.3	3.5	.5	12.9	3.6	.4	$p<0.05$
30-min Recall	10.9	3.5	.5	11.7	3.4	.4	$p<0.05$

Note. Total sample N = 118.

Discussion

The results of the present study suggest that nonclinical compulsive students demonstrate deficits in visual spatial memory compared to other obsessive-compulsive scorers. This effect was seen on the WMS-R visual memory span (forward recall) with and without outliers, where compulsives scored significantly lower than normal OC scorers, and on the backward sections of the WMS-R visual memory span (outliers removed), with compulsives scoring poorer than the obsessive group. Differences between groups in WMS-R visual memory span performance could not be accounted for by variations in depression, state or trait-anxiety, or intelligence.

Although regression to the mean was seen to occur in the post-test scores upon second administration of the PI, evidence of the stability of the PI factors over time was demonstrated by a strong Pearson Product Moment Correlation between the PI's pre-test and post-test scores.

The present study suggests that individuals who score high on compulsive behaviour represent a distinct subgroup of obsessive-compulsive disorder characterized by distinct behavioural and quite possibly neuroanatomical differences. A lack of homogeneity in the obsessive-compulsive population might explain why inconsistencies have been found across other studies, including the work done by Zeilinski et al. (1991) and Boone et al. (1991), that have examined cognitive processes in obsessive-compulsive disorder. A recent study by Arts, Hoognuin, and Haan (1993) for instance suggests that obsessive patients form a subgroup of obsessive-compulsive patients, characterized by greater depression, and less intelligence compared to obsessive-compulsives patients as a whole. Furthermore, Prichep et al. (1993) identified two subtypes of OCD patients from electroencephalographic recordings. Patients showing excess theta activity were virtually unresponsive to treatment with serotonin reuptake inhibitors, while those showing increased alpha activity responded well to treatment.

Nevertheless, the findings of the present study appear congruent with research conducted by Zeilinski et al. (1991) who reported significant deficits in visual spatial sequencing found on Block Tapping between a group of obsessive-compulsive patients and normal controls. The results of this study also provide support for the work of Sher et al. (1983) where in a sample of nonclinical compulsive 'checkers' they not only found deficits in memory for prior actions compared to nonclinical 'noncheckers', but also the inability of checkers to distinguish real from imagined events compared to noncheckers.

These findings have been used to explain why repeated checking to make sure that an action has been carried out occurs in nonclinical compulsive checkers (Sher et al.,1984). The visual spatial memory deficit found in the present sample of compulsives (comprised of checkers and washers) somewhat parallels the findings of Sher et al. (1983) which also involved mediation of a nonverbal task requiring the organization and recall of sequences. Interestingly, a recent study by Rubenstein, Peynircioglu, Chambless, and Pigott (1993) extends the findings of Sher et. al (1983, 1984), demonstrating that compared to normals, checkers recalled fewer actions in general, and were more likely to be unsure whether they performed, observed, or wrote these actions. The study however, failed to find any differences in checkers' recall of verbal material and cartoon actions, of which the latter according to the authors was arranged in a meaningful sequence of events compared to the human actions which were isolated and distinct from each other (Rubenstein et al., 1993). The authors suggested that the memory deficits seen in checkers might be attenuated through better temporal organization when remembering actions (Rubenstein et al., 1993). This might also explain why the compulsive group in the present study did not demonstrate any impairment on the WMS-R Logical Memory test which involved recalling verbal information contained in sequentially organized, meaningful stories.

The deficit observed in the compulsive group on the visual spatial memory task does not appear to reflect a global memory deficit in this subgroup. If the compulsives had a more general memory impairment, one would expect poorer performance on the logical memory portion of the WMS-R (a measure of left hemisphere verbal memory) which did not occur. It appears that the visual spatial memory deficit seen in the compulsive group was more likely of right hemisphere origin.

The finding in this study that high obsessive-compulsive scorers were more capable of identifying musical stimuli from the left ear than the low obsessive-compulsive scorers on the dichotic listening task is intriguing. Studies investigating laterality in obsessive-compulsive disorder have shown lower right ear advantages (REA) among OCD patients compared to controls on language related dichotic tasks, suggestive of decreased left hemisphere functioning (Wexler and Goodman, 1991; Rapoport et al., 1981). A decrease in REA between groups on the words subtest however, was not supported in the present study. The superior left ear recognition of musical stimuli by high obsessive-compulsives seen in this study may be indicative of increased right hemisphere functioning (ie. an 'active' right hemisphere).

Although no significant group differences were found on any remaining neuropsychological tests, it should be noted that the compulsive group had the lowest means on 9 of the 16 measures. Such findings suggest the possibility that other underlying brain pathologies might exist among this particular group, which could be looked at in future investigations.

The traditional gender differences in visual spatial performance on the Hooper Visual Organization Test confirm that this test can be sensitive to gender differences (Boyd, 1981). Being the only visual spatial measure in this study to show gender differences suggests that the HVOT measures a construct that is independent of the other visual spatial tests.

The finding that females correctly recalled more words from the left ear on the dichotic listening task than males may be related to the greater lateralization of verbal functions in the left hemisphere of males compared to females (Lezak, 1983). Since the pattern of verbal functions in the left hemisphere and visual spatial functions in the right hemisphere are thought to be more pronounced in males as compared to females, this would explain why males in this study were less capable of recalling words sent first to the right hemisphere.

Research has demonstrated gender differences on measures of verbal memory with females performing better than males (Youngjohn, Larrabee, & Crook, 1991). This finding was supported in our study, with females showing consistently higher scores than males on the WMS-R Logical Memory subtest, a measure of verbal memory.

The present findings suggests that nonclinical compulsives who comprise a subgroup of nonclinical obsessive-compulsives, show visual spatial memory deficits involving the organization and recall of sequences. There is modest evidence indicating that compulsives might be impaired on other cognitive tasks as well, possibly related to memory. Supplementary research would be necessary to verify this notion. In light of recent findings revealing the presence of subgroups within OCD that share the same clinical expression but show different patterns of pathophysiology (Pricep et al., 1993) it is imperative that future investigations of cognitive functioning in OCD verify the existence of different subgroups which could otherwise lead to equivocal or contradictory research findings.

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Appendix A

Dear Participant:

I am a psychology graduate student conducting a study involving the nature of unwanted thoughts and impulses in students. Thoughts and impulses of this kind are experienced by many people and are quite normal. Still, because little is known about these phenomena, the information gained from this research will likely be considerably useful in increasing our knowledge of intrusive thoughts and impulses.

At the beginning of the term you completed a questionnaire involving intrusive thoughts and impulses. Presently, you have been selected to participate in a second phase of the study where you will be asked to complete additional questionnaires as well as perform some simple motor tasks requiring about two hours of your time. In this second phase of the study, we will gain a great deal of information on how your brain processes information. Once the study has been completed you can inquire about the results of the study as well as obtain some feedback regarding your unique style of information processing and how it relates to brain functioning. Furthermore, in appreciation of your contribution to this study, you will receive 2 extra marks added on to your

Introductory Psychology final grade.

All information you provide will remain confidential between myself and my supervisor, Dr. K. P. Satinder. No individual will be identified in any report of the results. Further, this project stresses voluntary participation, and you may withdraw from the study at any time. Nevertheless, we expect that most people will find this study personally interesting.

Thank you for your cooperation.

Yours respectfully,

Michael Moland

Appendix B

Consent Form

My signature below indicates that my participation in this study was voluntary and I was assured at the outset that I was free to withdraw at any time. The purpose of the study ("Intrusive Thoughts and Impulses and Patterns of Cognitive and Motor Abilities in Students," conducted by Michael Moland of Lakehead University) was explained to me to my satisfaction. I understand that the study is concerned with the factors associated with intrusive thoughts and impulses and cognitive/motor abilities in students. I have been assured that there are no risks to me involved in this study; that my contributions will remain completely confidential; and that I may inquire about the results of the study once it has been completed.

Name:____________________

Signature:____________________

Date:____________________

Appendix C

Clinical Background

Before we can proceed with this study, it is important to first gain some background information regarding any past or present illness or incident which may possibly influence the way in which you process information. Once again, the information you provide will be kept strictly confidential.

1) Have you ever suffered any head injuries in a automobile accident?

____

2) Have you ever suffered any head injury under any other circumstance?

____

3) Do you often experience headaches? Migraines? How often?

____

4) Have you ever had a seizure?

____

5) Have you ever lost consciousness?

____

6) Do you use drugs? Are you currently on any medication?

____

7) Have you ever had a stroke or any type of heart problem?

____

8) Do you have any disease, or any familial history of disease?

____