Overactive conflict-monitoring and separation-distress: Cognitive and affective components of obsessive-compulsive disorder?

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DECLARATION:

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this discussion from the work, or works, of other people has been attributed, and has been cited and referenced.

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Abstract

This study was designed to investigate the interrelation between cognition and affect in obsessive-compulsiveness/Obsessive-Compulsive Disorder (OCD). Based on established empirical evidence that hyperactive conflict-monitoring is highly correlated both with hyperactivity in the anterior cingulate cortex (ACC) and with symptom severity in OCD – and therefore that overactive conflict-monitoring can be conceptualized as a possible mechanism of the disorder – it was hypothesized that hyperactivity of the PANIC/separation-distress emotion system in the brain (which is largely localized in the ACC) would co-vary with conflict-monitoring levels in people with tendencies towards OCD and thus could be considered the correlate of OCD in the affective sphere. Two questionnaires (the Meta-Cognitions Questionnaire and the Padua Inventory) were used to position a non-clinical, college sample of 1119 participants in terms of their tendency towards obsessive-compulsiveness. The top 21 and bottom 20 scorers were then tested to gauge their levels of cognitive conflict-monitoring and separation-distress. Independent t-test analysis revealed that the two groups differed significantly on scores of separation-distress (as well as on the Affective Neuroscience Personality Scales subscales ANGER, FEAR and PLAY), whilst there was no significant difference in the group scores for conflict-monitoring. Correlational analyses revealed no significant relationships between any of the nine OCD questionnaire factors and conflict-monitoring; similar analyses emphasized differences found for separation-distress scores and provided further, detailed description of relationships between the OCD questionnaire factors and this affective aspect. Implications for neuropsychology are that separation-distress seems likely to be a pivotal emotion involved in OCD.

Keywords: Obsessive-compulsive disorder (OCD), sub-clinical/subsyndromic OCD, conflict, error-monitoring/conflict-monitoring, emotion, separation-distress

Chapter 1: Introduction

Passion is a positive obsession. Obsession is a negative passion.

- Paul Carvel, Belgian writer

Emotion and cognition are fundamental points of interest in the science of psychology. They have been continuous subjects of research since the beginnings of the discipline, and the subject of fascination and debate for centuries before. Whilst behavioural psychologists throughout the first half of the twentieth century dismissed both emotion and cognition as introspective and therefore immune to empirical investigation, the way these internal, intangible elements function and what they imply about the human mind remained at the fore of curiosity in psychology. Their integral role in the psychological life of humans could not be ignored. Human nature hungers for explanations regarding personality and behaviour, for the motivators behind our unique existences. Though the innate curiosity about emotion and cognition prevailed, science did not possess the requisite tools to study these reified concepts according to its own empirical rigours. It is only during the last few decades that science has begun to comprehend, clarify, and in many cases unveil startlingly counterintuitive discoveries about the complexities of the mind.

It is in this spirit of new scientific possibility in the realms of emotion and cognition that the current piece of research was undertaken. Its conception was inspired by the neurobiological theories of emotion that are emerging and by modern neuroimaging techniques that are enabling such theories to evolve. One of the main reasons it is relevant to utilize these developing techniques to investigate affect and cognition, is that it may lead to far greater understanding in the realm of psychological pathology. Owing to the convergence of several fascinating neuropsychological findings regarding emotion and cognition in the neuropsychiatric pathology of Obsessive-Compulsive Disorder (OCD), this condition will provide the focus for the current dissertation. OCD involves constant intrusion of highly unpleasant and negatively-charged emotional thoughts, ideas or images (obsessions) that bring about relentless repetition of stereotyped motor or

mental behaviours (compulsions). In the clutches of OCD, people are compelled to carry out specific acts to negate the emotional distress or dreaded outcome of their obsessions. Their compulsions persist, even though their behaviours are not realistically related to their fears, and – more intriguingly – even though they *know* this to be the case. Behaviours intended to ward off crippling anxiety, metamorphose into pathologically endless spirals of self-perpetuating stereotypies: the more someone with OCD gives in to his urge to check, for example, that his back door is locked before he goes to sleep, the more he will be compelled to repeat the action over and over again. The perpetual cycles of checking, doubting and cleaning that ensnare OCD sufferers is sharply counterintuitive: why should a repeated action not quell the urge to perform it, as it does in the non-OCD population? It is this fundamental dissonance between cause and effect – and the related chasm between the rational and obsessed self within every OCD sufferer – that has spurred decades of research into the disorder. The reality of OCD violates all intuitions regarding the nature of cognition, and leaves many unanswered questions in terms of the experience of emotion in the disorder.

Why should the cognitive process of logical reasoning break down in OCD, rendering the patient victim to a merciless spiral of repetitive thought? And why should such intense anxiety about the fear or obsession persist unabated in the face of this same unassailable logic? It certainly appears as though there is far more at work beneath the surface in obsessive-compulsiveness than some small oddity in the cognitive process. The brain is equipped to deal with cognitive dissonance and it would seem that the incongruity encountered in OCD should be no exception – the violation of cognitive fluidity that arises as a result of an inner and outer state of affairs that are not reconciled should easily be dealt with by the *gestalt* rationality of the human mind. Why the brains of those with OCD should fail to correct and maintain cognitive harmony in this way is the subject of a vast body of empirical research stemming from a broad spectrum of psychological frameworks. Through neuroimaging techniques and related clinico-anatomical investigations of brain structure and function, it is becoming clear that specific brain regions, as well as certain neurochemically-mediated brain circuits, are strongly

implicated in OCD. The motivation for this dissertation is based on these findings, and on related cognitive and affective neuroscience research.

Over the last few decades, neuropsychological research has suggested that obsessions and compulsions in OCD arise from the persistent sense that something is wrong in the immediate environment: chronic and maladaptive hyperactivation of the orbital frontal cortex (in which certain distributed pathways appear to be consistently implicated in error detection) seems largely involved in this intensely experienced, yet incorrect, perception (Schwartz & Begley, 2002). Such hyper-vigilance of environmental errors has been observed in other studies, in which brain areas that became activated during the resolution of cognitive conflict were investigated. Such studies pointed to what appeared to be the crucial involvement in cognitive conflict resolution of a brain region called the anterior cingulate cortex (ACC); this strengthened the hypothesis that hyperactive error-detection plays a central role in OCD, when it was discovered that those with the disorder reliably display heightened metabolic activity in the ACC (Baer, Wetter, Nichols, Greene & Berry, 1995; Breiter et al., 1996; Breiter & Rauch, 1996; Gehring, Himle & Nisenson, 2000; Schwartz, 1999; Schwartz & Begley, 2002; Schwartz, Stoessel, Baxter, Martin & Phelps, 1996; van Veen & Carter, 2002).

The ACC is part of a theoretically grouped network of structures known as the limbic system, a diffuse 'structure' broadly conceptualized as being responsible for affective reactivity (Solms & Turnbull, 2002). The amygdala is considered a key aspect of the limbic system, and is largely instrumental in mediating the conscious and unconscious generation, experience and perception of fear and dread (Damasio, 1999; Kandel, Schwartz, & Jessell, 1991; Solms & Turnbull, 2002) – two emotions that feature prominently in the subjective experience of OCD. The amygdala projects into the striatum, one of the four basal ganglia nuclei, which has also been found to be overactive in the brains of those with OCD (Schwartz & Begley, 2002). The ACC is therefore anatomically interrelated with structures that generate some of the most commonly perceived emotions in the disorder. However, neurobiological and neuroimaging research has also recently revealed that the ACC is an important part of one of the primary neural

basic-emotion command systems in the mammalian brain: the emotion known as PANIC or separation-distress (Panksepp, 1998).

Additional reason to pursue a study relating the above elements comes from the psychoanalytical conception of the separation-distress emotion in obsessional neurosis (Bowlby, 1960; Fairbairn, 1952). As discussed in Chapter 2, it is clear that Freud conceptualized true obsessional neuroses as fundamentally affective or *emotional* in nature, as opposed to cognitive (Freud, 1924). Psychoanalytic approaches to the disorder, in line with phenomenological evidence, suggest that obsessive-compulsiveness involves an inability to 'let go', and that it revolves essentially around the issue of *loss* (Bowlby, 1960; Fairbairn, 1952). Based on the convergence of these lines of evidence from disparate psychological standpoints, the rationale for this dissertation stems from the suggestion made by neuropsychological studies into hyperactivity of the ACC. Recent research suggests that the functioning of this brain structure in both normal and abnormal cognition might provide an invaluable lead to a better understanding of the workings of emotion in OCD, and also of how disturbances in basic, primitive emotion may develop into the cognitive malfunction characteristic of this mental illness.

1.1. The research problem and objectives

The overall aim of this study is to discover whether PANIC or separation-distress is heightened in participants who also show a heightened tendency towards obsessive-compulsiveness. This research question will be addressed by measuring obsessive-compulsiveness with two established questionnaires (The Meta-Cognitions Questionnaire; MCQ; Cartwright-Hatton & Wells, 1997 and the Padua Inventory; PI; Sanavio, 1988) and statistically examining the relationship of the overall combined score obtained to scores on a measure of separation-distress (the PANIC subscale of the Affective Neuroscience Personality Scales; ANPS; Davis, Panksepp, & Normansell, 2003).

A related issue of interest – but one that cannot be directly addressed by the design of this study – is whether separation-distress could be the primary emotion involved in OCD or,

more broadly, in obsessive-compulsive tendencies. The salience of fear-anxiety in the disorder is in no way refuted, but a consideration is that it may be a secondary emotion, closely related to separation-distress. In investigating the affective nature of OCD, the dissertation will attempt to address the hiatus between the cognitive and psychoanalytic literature on OCD; the former often neglects the role of emotion altogether, while the latter centres on emotion but neglects to delineate its involvement with techniques now available to neuropsychological science. When the various research findings discussed above are considered in the light of current knowledge regarding OCD as well as the modern understanding of emotion and cognition as deeply and hierarchically connected brain processes, it seems highly plausible that the disordering of cognition in OCD *does* in fact, as intimated by psychoanalysis, arise as a secondary manifestation of the disorder.

Owing to the lead provided by ACC hyperactivity in both OCD patients and in hyperactive cognitive conflict-monitoring, another necessary aim of the study is to investigate whether a significant increase in conflict- or error-monitoring (evaluated by a meta-cognitive Stroop task) is significantly related to heightened obsessive-compulsiveness, measured as described above. Establishing this would lead to the correlation of separation-distress and conflict-monitoring, in the context of OCD, providing the possibility that they could be conceptually positioned as emotional and cognitive manifestations of the disorder, respectively. It is hoped that the findings might contribute in a minor way towards a new, integrative approach to understanding mental experience, one in which cognition and emotion are properly considered as deeply entrenched processes arising dependently out of the evolution of the brain, a neuroscientific account which is finally able to fit with the nature of holistic subjective experience.

This dissertation aims to replicate evidence that supports conflict-monitoring as a possible mechanism of OCD, and to establish separation-distress as its covariant in the affective sphere. This will be done by investigating the association between performances on tests of conflict-monitoring and separation-distress and correlating these tendencies with subclinical obsessive-compulsiveness. In subsequent research, the cognitive and

affective tests used in this dissertation could be extended to a neuroimaging paradigm, for inclusion in a neuroimaging study. The specific aims of such a study would depend largely on the results of this dissertation.

1.2. Overview: Research design and methodology

This dissertation documents an empirical study of the cognitive and hypothesized affective manifestations of OCD. Two established questionnaires were used to position an undergraduate college sample along a spectrum of obsessive-compulsiveness. Once their overall scores (an average of their scores on the two questionnaires) had been finalized, participants at the extreme high and low end of the spectrum were asked to participate in the second part of the research. This involved evaluation of their affective profiles (also by means of a questionnaire) and assessment of the extent to which they monitor cognitive conflict. The extent to which hyperactivity of cognitive conflict-monitoring and the separation-distress emotion covaried with obsessive-compulsiveness (or specific elements of obsessive-compulsiveness) was analyzed in the hope of shedding new light on the affective processes underlying OCD. An empirical, positivist approach was therefore relied upon to investigate the research problem.

1.3. Overview: Development of dissertation

Chapter 2 of this dissertation will review the academic literature that informs the background to this research study. First, key concepts are defined and then a brief overview of the various approaches to OCD is given, to contextualize the disorder and document the theories that have contributed to its modern conceptualization. Thereafter, empirical research on the significant elements informing the research hypothesis is presented. This includes research identifying error-monitoring brain activity and the relation of its malfunction to obsessive-compulsive cognition; research on the ACC in terms of its role in cognitive conflict-monitoring, and its implication in OCD; neurobiological evidence for basic-emotion command systems in the mammalian brain, in particular, the PANIC or separation-distress emotion system and its relation to the ACC. The chapter will be concluded with an explanation of the convergence of this evidence in such a way that warrants the current empirical investigation.

Chapter 3 describes the research design and methodology, giving a full account of sampling procedures; issues of research design, measurement and ethics; and explanations regarding the chosen methods of data collection, capturing, editing and analysis. Chapter 4 presents the results obtained from the study. Finally, Chapter 5 entails a full discussion of the interpretation of the results; their theoretical and practical implications in terms of both previous research and the aims and hypotheses of this dissertation; and the limitations and recommendations for future research to be considered at the completion of this investigation.

Chapter 2: Literature review

Before reviewing the literature relevant to the research topic, it will be necessary to define the few key variables that will recur throughout this dissertation. In addition, at the beginning of the literature review, special attention will be given to a brief overview of the different approaches that have been taken towards OCD throughout its history as a psychological entity.

2.1. Operationalization of key variables

This section outlines the key concepts in the current research study, and defines them specifically for the purposes of this dissertation. *Obsessive-Compulsive Disorder (OCD)* has already been discussed. However, it will be defined again here, so that it may be related to the other critical terms. *OCD* is a neuropsychiatric disorder characterized by two classes of symptoms: obsessions and compulsions; the former are continually recurring, unwanted thoughts that usually concern a specific feared circumstance, while the latter are repetitive, ritualistic behaviours carried out to reduce anxiety associated with the obsessions (American Psychiatric Association, 1994 in Gehring et al., 2000). The obsessions are experienced as highly distressing (Maltby, Tolin, Worhunsky, O'Keefe & Kiehl, 2004) and pervasive, especially in light of the ego-dystonic nature of the disorder – regardless of the intensity of an OCD urge to, for example, wash one's hands again, the sufferer *knows* rationally that his hands are not dirty and is able to reflect insightfully on the utter senselessness of the obsession (Schwartz & Begley, 2002), though the urge and its associated fear persist unabated. OCD is the fourth most common mental disorder; it has a six month prevalence of one to two percent (Myers et al., 1984 in Maltby et al., 2004) and a lifetime prevalence of two to three percent (Robins et al., 1984 in Maltby et al., 2004).

Sub-clinical or *Subsyndromic obsessive-compulsive disorder* is the term given to a level of clinically significant symptoms, which do not cause enough distress or impairment to meet full diagnostic criteria for clinical OCD, as stipulated by the DSM-IV, which maintains that for an OCD diagnosis, symptoms must 1) cause marked distress, 2) consume more than an hour daily, or 3) significantly interfere with routine functioning or

relationships (Leckman & Cohen, 1999). This is an appropriate point to state the approach of the current dissertation to clinical diagnosis of OCD. It is clear from the empirical literature that there has been dissent over the classification of the disorder. Until quite recently, it was mostly maintained that the strict criteria outlined in the DSM-IV should remain the diagnostic standard for OCD, which resulted in its being seen as a relatively rare disorder (Esman, 1989; Stein, 1996, both in Stein et al., 1999). Based on evidence in the recent decades, however, that the disorder is mediated by specific neurochemical circuitry (Altemus et al., 1994; Goodman et al. 1990, both in Leckman & Cohen, 1999; Zohar & Insel, 1987a, 1987b) and that certain neuroanatomical systems play important roles in mediating its course (Baxter et al., 1992; Insel, 1992; Wise & Rapoport, 1989; both in Leckman & Cohen, 1999), there has been a contemporary shift in the conceptualization of OCD from a strictly defined, rare phenomenon to a spectrum of disorders that vary in their symptom constellations and in their intensity and which are far more prevalent in the population than previously estimated (Karno et al., 1988; Weissman et al., 1994, both in Leckman & Cohen, 1999).

The issue of precisely defining OCD should not be of critical concern in this dissertation, firstly because the research takes the contemporary approach of OCD existing as a spectrum of disordered thoughts, emotions and behaviours experienced at some level by everyone, secondly because a sub-clinical sample will be targeted, and thirdly because the topic is not *directly* a study into the disorder of OCD itself, but rather uses the disorder as a platform from which to investigate primitive, prototype emotions involved in obsessive-compulsive-*type* thought and behaviour (and the manner in which faulty cognition may arise from underlying emotional pathology). The research will focus on overactivity in two domains: error-monitoring and separation-distress. Error-monitoring has already been established as integral to the clinical picture of OCD, and any findings correlating it with separation-distress could strongly substantiate the argument that this particular emotion system is the one chiefly implicated in the clinical disorder of OCD.

However, even resisting an extension of the findings to the criteria-fulfilling disorder (based on the fact that this research will use a sub-clinical sample), will not detract from

any correlations discovered between obsessive-compulsiveness per se and both separation-distress and error-monitoring. And if the approach to the disorder suggested by modern neuroimaging is that OCD be viewed not so much as a *distinct* pathological process but more as a *tendency* towards certain neurochemical patterns (patterns that are observed prolifically and continuously in those diagnosed with OCD, but which also may be observed in the normal population in correspondence with certain cognitions and emotional experiences), the findings of this dissertation may be well positioned to draw at least limited and exploratory conclusions about the relationships amongst obsessive-compulsiveness, separation-distress and conflict-monitoring.

Conflict in this dissertation refers to the cognitive process in which the brain recognizes that the responses one is making are in some manner not synchronized with a desired state of affairs (Gehring et al., 2000). In cognitive terms, this may be referred to as the presence of two incompatible streams of information processing (van Veen & Carter, 2002). Recognition of cognitive conflict results in the generation of error-related negativity (ERN), which is a component of the event-related brain potential (ERBP) – a scalp-recorded measure that reflects through a series of voltage oscillations any neuronal activity associated with sensory, cognitive or motor events, with good temporal resolution but not as accurate spatial resolution (Hillyard & Anllo-Vento, 1998 in Langleben et al., 2002; van Veen & Carter, 2002). The ERN begins at 50 to 150 milliseconds after the moment of error in reaction time (RT) tasks (Gehring et al., 2000; van Veen & Carter, 2002) and seems the best current technique for locating the actual moment of experienced cognitive conflict.

The concept of conflict has often been confounded in the empirical literature with that of *control* (van Veen & Carter, 2002). However, recent studies have provided the means by which to distinguish clearly between them: by using fMRI scans to analyze ACC activity in relation to RTs on RT tasks, researchers have shown that a high degree of control is needed during consecutively incongruent trials, and that in this situation, conflict is low; conversely, when many consecutive congruent trials are suddenly followed by an incongruent trial, control is lower and conflict is highest (Botvinick, Nystrom, Fissell,

Carter, & Cohen, 1999 in van Veen & Carter, 2002). This demonstrably dissociates the two concepts; although interrelated, they are clearly different – and even complementary – in nature.

The terms *error-* and *conflict-monitoring* are used interchangeably in this dissertation. Most broadly, they are used to refer to the neurochemical and cognitive process of the recognition of conflict in the information-processing, cognitive sense. In other words, error- or conflict-monitoring is the process whereby *discrepancies* in cognitive input or in cognitive tasks are analyzed as a precursor to dealing with such conflict by making specific decisions in terms of perception, sensation, or cognition. The terms are easiest to illustrate by means of cognitive tasks that emanate from the interference paradigm, which have been used to separate the concepts of conflict and control: in one version of the Eriksen flanker task, for example, participants are instructed to respond to a target (usually an arrow) presented at the centre of their computer screen and to respond to the identity of the target by pressing one of two buttons (the left or the right arrow button, according to their perceived orientation of the arrow on screen), and they must identify the central target while attempting to ignore peripherally presented, distracter targets (van Veen & Carter, 2002). Since the trials are presented consecutively and fairly rapidly, errors will of course be expected to occur, owing to partial or incomplete stimulus analysis (van Veen & Carter, 2002).

Event-Related Potential (ERP) studies have revealed that awareness of these kinds of impulsive 'slips' follow the error commission almost immediately, as reflected by a large, negative deflection in the ERP that has been called Error-Related Negativity (ERN; van Veen & Carter, 2002). It is hypothesized that processing of the stimulus continues after error commission, and that the subsequent presence of *both* the correct and incorrect (executed) response in the person's mind generates the context of conflict, leading to the peak of ERN (van Veen & Carter, 2002), which therefore can be seen as a reflection of error-detection (Scheffers, Coles, Bernstein, Gehring & Donchin, 1996 in Gehring et al., 2000). Of course, this kind of conflict seems mechanistic and somewhat irrelevant when compared to the type of conflict faced in reality – for example, the conflict experienced

by an OCD patient when he knows he has turned off the stove and yet feels an excruciating mental urge to check it again. However, the foundational concept is the same: two competing streams of disparate information that cannot co-exist harmoniously and demand a decision regarding which will gain precedence. Various studies have demonstrated that neurons in the orbito-frontal cortex, striatum and anterior cingulate cortex increase exponentially in their firing rate when a cognitive error is detected (Thorpe, Rolls & Maddison, 1983; van Veen & Carter, 2002), suggesting their possible participation in a distributed network of error-detection. The neurons return to a base rate of firing activity when internal expectations are once again synchronized with external circumstances (Schwartz & Begley, 2002).

Emotion will be defined in its biological sense, and as distinct from 'feelings', according to a pioneer of the neurobiology of emotions, Antonio Damasio (1999). Emotions are complex, pattern-forming constellations of chemical and neural responses that serve their evolutionary purpose by fulfilling some regulatory function that is advantageous to the survival of the organism in which it manifests. At the most fundamental level, this means maintaining the vulnerable internal milieu of the organism within relatively narrow parameters – the process known as homeostasis. Emotions arise from biological templates in the mammalian brain, though they are open to modification by culture and the intervention of unique experiences in every organism's life. Set, subcortical brain regions are responsible for the generation of emotions, and are automatically activated without the need for consciousness; in this sense, emotions are largely stereotyped. Emotions are manifested in both the body (in terms of visceral, musculoskeletal and vestibular systems) and the brain: they create vast changes in brain circuitry that lead to the generation of consciously felt feelings.

Separation-distress is the feeling associated with the PANIC basic-emotion neural system ingrained in the mammalian brain (Panksepp, 1998). When removed from its social support system, an organism's PANIC emotion system is activated to increase its chances of survival, by generating the instinct to engage in *distress vocalizations (DVs)* – some form of crying – for the initial period of separation, in an attempt to locate the caregiver;

followed by a withdrawal that has been likened to depression, in which DVs are discontinued as a way to remain hidden from predators and to shift the responsibility for the search to the caregiver (Panksepp, 1998).

2.2. The empirical literature

Many theoretical frameworks, arising from all regions of the psychological landscape, have been put forward to account for OCD. Freud distinguished obsessions from phobias by the relationship between cognition and emotion in each of these neuroses: he certified 'true obsessions' as those in which the emotional state is the main feature of the neurosis (Freud, 1924). In an obsession, the emotional state persists unaltered, whereas the cognitions associated with it often vary (Freud, 1924). By contrast, the emotional state of "morbid anxiety" that dominates phobic neuroses (Freud, 1924, p. 129) may be present or absent according to the varying salience of the object or situation that provokes a phobia. In other words, it is the cognitive appraisal of the phobic object that evokes anxiety in phobias, whereas it is the constant emotional state that exists first in obsessive neuroses, and that leads to the development of cognitive rationalizations as attempts at neutralizing the distressing emotion. Freud provides as an example, people who have doubting obsessions. Such sufferers may have many doubts at the same time or constantly varying doubts that follow one another, but their central emotional state – doubt – remains the same (Freud, 1924).

It is evident that very early on Freud intimated the primacy of emotion in obsessive disorders. Contrary to the cognitive and behavioural approaches to OCD that dominated the second half of the twentieth century (discussed below), he recognized that the ideas or cognitions associated with obsessions rather represent a secondary problem in the disorder. He reasoned that the obsessive process, whereby "absurd or quite harmless ideas stand out in the foreground of consciousness and resist dislodgement by logic, even proving completely refractory to it" (Hitschmann, 1921, p. 165), results from the false nature of the mental obsessions: they are only covers for emotions which have been long disconnected from the obsessions in a chain of cognitive replacements. From this theoretical viewpoint, it is futile to council those with OCD to appraise their obsessions

rationally, because the real connection of the powerful affect and the substituted idea is lost, until perhaps uncovered through extensive psycho-analytical investigation. Here, Freud's conceptualization of obsessive disorders again coalesces with the converging evidence from contemporary research into OCD – as well as with subjective experiences reported by patients – in terms of the struggle to understand the circumlocutory nature of obsessions (and their related compulsions) and their frustrating, impenetrable resistance to logic.

Freud made sense of the startling incongruity between the specific cognitions and the apparently drastic and over-reactive emotional states they invoke in obsessive patients as follows: based on extensive clinical investigations, he claimed that the emotion exhibited by patients with obsessive disorder is always justified, and that its apparent incongruity stems from the fact that "the associated idea is no longer the appropriate original one, aetiologically related to the original obsession, but is one which replaces it, a substitute for it" (Freud, 1924, p. 129). Freud maintained that the replaced ideas are always related to past sexual experiences that the patient is desperate to forget and that the substitution is made possible by the patient possessing a certain kind of "mental disposition" (Freud, 1924, p. 129). However, in terms of a contemporary neuropsychological understanding of the relationship between emotion and cognition, the psychoanalytic description of obsession seems accurate and adequate in a self-contained manner: vast undercurrents of disturbed emotion lead to the development of strictly controlled cognitive rationalizations, in an effort to contain and repress an affective turmoil that would threaten the integrity of the self were it allowed to surface.

Behavioural schools of thought viewed OCD as a simple matter of operant conditioning. The fact that individuals are subjectively rewarded for their compulsions, by an immediate and intense drop in otherwise disabling anxiety, explains why they continue to execute such actions and why the behaviours are prone to increase exponentially. One of the most rigorous therapies to arise from the behaviourist school of psychological thought was Exposure and Response Prevention (ERP): patients were literally *forced* to confront the stimulus they dreaded most (such as a filthy public toilet) and were then prevented –

to the point of physical restraint, where necessary – from carrying out their coping, obsessive-compulsive response (Schwartz & Begley, 2002). Proponents of the therapy lauded its merit by claiming a success rate of 60 to 70 percent, but it was later discovered that this figure excluded the 20 to 30 percent of OCD patients who refused to take part when they learned what the procedure actually involved, as well as the 20 percent who dropped out, horrified by the experience to which they had been subjected (Schwartz & Begley, 2002).

The largely unsuccessful application of this treatment to OCD can be accounted for partly by Freud's theoretical approach discussed above, in that strict behavioural therapy neglects to recognize the underlying, uniquely human and individual conflicting emotions that manifest as the disorder (Schwartz & Begley, 2002). Cognitive-behavioural research and practice has focused on combining a milder behavioural approach with cognitive re-evaluation in order to eradicate obsessive-compulsive thinking and behaviour from patients' repertoires by encouraging them to reconstruct their reward-stimulus contingencies. Although the general principles of conditioning prevail, this technique relies rather on gentle, cognitive coaxing away from thought patterns in which performing the compulsive behaviour is considered a realistic cause for relief, towards systems of reward in which *resisting* the compulsion becomes cause for cognitive reward in terms of anxiety relief.

The overwhelming majority of the empirical literature available on OCD consists of research emanating from the cognitive theoretical framework, which focuses on faulty thought patterns and other errors in cognitive and sensory processing that lead to the trademark slavish repetition of stereotyped behaviours in the disorder. Conceptualizing OCD from within a cognitive framework can have good explanatory power. For example, research has shown that the more times people with OCD carry out a compulsive act, the more they multiply visual memories of the act in their minds and the less able they are to distinguish amongst its many, almost identical, visual representations (van den Hout & Kindt, 2003). In other words, patients keep checking (for example) because the grossly disinhibited manner in which they carry out the checking itself undermines their

confidence in their memories, by making the checking situation more and more familiar every time they go through it and thus decreasing how vivid and detailed their memories are, two factors crucial to memory confidence (van den Hout & Kindt, 2003). Thus – counter to intuition – they become less sure about the reality of having executed an act and it becomes increasingly impossible to be absolutely certain that they actually *have* just performed the behaviour. This logic rests upon considering OCD from a visuo-perceptual, memory function and cognitive confidence point of view, which although contributing significantly to the understanding of faulty thinking in the disorder, falls far short of uncovering anything of its origins.

Even with advances in neuroimaging, the cognitive approach has remained more or less unitary in terms of its insistence on cognition – often conceptualized as independent from emotion – as the underlying cause of OCD. Evidence of brain areas and circuitry involved in OCD can strengthen the cognitive account of the disorder in the absence of any reference to emotion, depriving emotion of its instrumental place in the development of the disorder. Neuroimaging research has consistently demonstrated basal ganglia dysfunction as important in the pathophysiology of OCD (Baxter et al., 1992, Breiter et al., 1996, Luxenberg et al., 1988, Rauch et al., 1994, Robinson et al., 1995). The basal ganglia consist of four principal nuclei: the striatum (which consists of various structures: caudate nucleus, putamen and ventral striatum, including nucleus accumbens), the globus pallidus/pallidum, the substantia nigra (including pars reticulata and pars compacta), and the subthalamic nucleus (Kandel, Schwartz, & Jessell, 1991).

Various neural circuits link the thalamus and the cerebral cortex, with the basal ganglia forming the major subcortical components thereof; through these connections, the basal ganglia contribute not only to voluntary movement (as was assumed early on in research of this area), but also to skeletomotor, oculomotor, cognitive and emotional functions (Kandel, Schwartz, & Jessell, 1991). It has become evident that these basal ganglia-thalamocortical circuits are segregated, with integration of functions occurring *within* as opposed to between the delineated circuits (Kandel, Schwartz, & Jessell, 1991). Frontal motor cortex regions mediate basal ganglia functions, by virtue of the circuits beginning

and ending in specific frontal lobe regions, dependent on the thalamic feedback generated by the specific circuit: the limbic basal ganglia-thalamocortical circuit appears to begin and end in the anterior cingulate area and the medial orbitofrontal cortex (Kandel, Schwartz, & Jessell, 1991). The medial-ventral parts of the head of the caudate nucleus, as well as the nucleus accumbens (both striatal structures of the basal ganglia) appear to receive the most input from orbitofrontal and cingulate cortex regions; these are the basal ganglia structures most highly activated in OCD (e.g., Maltby et al., 2004; Whiteside, Port, & Abramowitz, 2004).

Subsystems of the caudate nucleus receive input from motor areas of the frontal lobe (e.g., the frontal eye fields, lateral orbital, supplementary motor and premotor areas) and from visuoperceptual areas of the parietal lobe (Alexander et al., 1986; Gillman, Dauth, Frey & Penny, 1987). Thus various areas of the caudate control motor- and perceptual-processing that contributes to visuomotor integration, consistent with the findings that those with OCD display deficits in visuomotor integration (Behar et al., 1984; Boone, Ananth, Philpott, Kaur & Djenderedjian, 1991; Hollander et al., 1990; Hollander et al., 1993). Some research has also found mild dysexecutive deficits in OCD, such as difficulties with cognitive set-shifting and obsessional slowness (Hymas, Lees, Bolton, Epps & Head, 1991) and problems with occulomotor inhibition (Rosenberg, Dick, Ohearn & Sweeney, 1997).

It is important to consider properly the complex structure and function of the basal ganglia, as this has a significant bearing on the interpretation of brain activity resonant with obsessive-compulsive emotion and thought. The basal ganglia may be accurately conceptualized as a network that functions to recruit neural pathways in a habit-forming manner, as well as working to inhibit complex behavioural sequences – the work of researchers such as Cromwell and Berridge (1997) has shown how striatopallidal lesions can result in disinhibition of such habit-based behavioural sequences, for example, disinhibition of paw treading in rats, an animal model that bears closely on hyperkinetic movement in human diseases of the basal ganglia (such as chorea in Huntington's disease and verbal and motor tics in Tourette's syndrome). Such a consideration of the role of the

basal ganglia in consolidating behaviour sequences makes clear that a pathological consequence of these otherwise sophisticated adaptive mechanisms would be consistent with the presentation of OCD.

However, the complexities of basal ganglia function and connectivity, and its possible role in the co-dependent generation of the emotional and cognitive phenomenology of obsessive-compulsive symptoms, is notably absent from the literature. More often, a cognitive model of OCD will focus on the mechanics of how visual and motor perceptions are integrated or which psychometric tests demonstrate sub-normal set-shifting and processing speed performance in OCD patients, illustrating how the cognitive approach is typically devoid of reference to emotion. The fact that faulty cognitive set-shifting, processing speed and visuomotor integration, for example, could represent the adverse *effects* of a primary, underlying affective disturbance, is not even considered, and such elements are seen rather as straightforward contributors to OCD. This approach needs to be challenged. Freud's psychoanalytic theories not only incorporate, but are founded upon, human emotion. Neuropsychological techniques (such as neuroimaging) as well as theoretical development in neuropsychology, particularly regarding emotion (from neurobiology of emotion pioneers such as Damasio and Panksepp), could now allow a fusion of Freudian and contemporary neuroscience theories that would advance the neuropsychology of emotion, both in OCD and in general.

More comprehensive, holistic theories of OCD, ones that focus on the primacy of affect in the disorder, now need – and are finally able – to be explored. It is testament to the sheer complexity of the disorder that, although all the theories discussed above contribute to a keener understanding of OCD, none of them successfully encapsulates it in its entirety. It remains for all available evidence regarding the mental illness of OCD to be unified by a strong basic framework. The most contemporary research approach – neuroimaging – seems to offer a window into the disorder and a framework for its explanation that may elucidate the common and valid contributions of each of the theoretical frameworks that have gone before; or a method, at least, to point out useful

new research directions. It is hoped that this dissertation contributes to the beginnings of a unification of thought, practice and research regarding emotion and cognition on the topics of both OCD and (more broadly) on the neuropsychology of emotion.

As intimated, OCD is represented in the empirical literature by a vast body of research. Its focus was predominantly cognitive until recent decades, when technological advances meant that functional and structural imaging studies began to facilitate immense progress in the field. Originally, Positron Emission Tomography (PET) scans began to make it possible to study the structure of the brains of OCD patients and to compare them with those of matched controls without the disorder. One of the earliest of these studies, an analysis of the PET scans of 24 OCD patients, suggested that three main brain structures were consistently implicated in the disorder: the orbital frontal cortex, the caudate nucleus and the anterior cingulate gyrus all demonstrated "hypermetabolic activity" in the brains of those with OCD (Baxter et al., 1988 in Schwartz & Begley, 2002, p. 62). As scanning and imaging techniques became more refined, functional Magnetic Resonance Imaging (fMRI) combined with ERBP measures, and Single Positron Emission Computerized Tomography (SPECT), proved the most illuminating and thus widely used imaging procedures for the study of OCD.

Using these research tools, the particular patterns of discordant neural activity that appeared closely related to the disorder was further revealed. Convergence of findings regarding functional hyperactivity in OCD is evident in the recent literature, as demonstrated by the overlap in brain regions concluded by various researchers to be implicated in the disorder: the orbitofrontal-striatal circuit (Stein et al., 1999); cortical-striatal-thalamic-cortical circuit (Gehring et al., 2000); frontal-striatal circuits, especially including the orbitofrontal cortex, anterior cingulate cortex, thalamus and caudate (Maltby et al., 2004); the fronto-subcortical circuit, involving the orbitofrontal and cingulate cortex, the ventromedial striatum, the globus pallidus/substantia nigra pars reticulata complex, the thalamus and its connections with the cortex (Bucci et al., 2004); and significant, consistent hyperactivity in the orbital gyrus and the head of the caudate nucleus, even in a tightly controlled meta-analytical review of 13 PET and SPECT

scanning studies of OCD (Whiteside, Port & Abramowitz, 2004). Although inconsistencies in imaging study results exists, it has been empirically established through the brain imaging research paradigm that hypermetabolic activity in the orbitofrontal cortex – with particular involvement of the anterior cingulate cortical region and the caudate nucleus – is strongly implicated in OCD.

2.3. Heterogeneity of OCD

As with all clinical syndromes, OCD is vastly heterogeneous in its clinical presentation. This has led some researchers to view its variants as a *spectrum* of disorders rather than one single category of mental illness (Stein, 2000). It is argued that it may even be necessary to delineate various types of OCD spectrums, so varied and often irreconcilable are the data on the illness from the fields of neurochemistry, neuroanatomy, genetics, neuroimmunology and animal models (Stein et al., 1999). The established heterogeneity of OCD is important in its implications for the present dissertation, in that it must alert the researcher to the fact that tendencies towards obsessive-compulsiveness on the part of participants may correlate most strongly with one or more sub-categories within OCD, which are investigated as a group of similar (but not standard) indicative factors in the various OCD questionnaires. In the two questionnaires that will be used for data collection in this dissertation, the sub-categories considered indicators of OCD are as follows. First, in the Meta-Cognitions Questionnaire, there are five factors on which obsessive-compulsive tendency converges: positive beliefs about worry, negative beliefs about the uncontrollability of thoughts and corresponding danger, lack of cognitive confidence, negative beliefs about thoughts in general (including themes of superstition, punishment and responsibility), and cognitive self-consciousness (Cartwright-Hatton & Wells, 1998). Second, in the Padua Inventory, there are four factors: impaired control of mental activities, becoming contaminated, checking behaviours, and urges and worries of losing control over motor behaviours (Sanavio, 1988).

2.4. The anterior cingulate cortex and conflict-monitoring

The rationale for this dissertation stems from a specific focus on one of the brain regions shown to be hyperactive during obsessive compulsive affect and cognition: the anterior

cingulate cortex (ACC). The ACC has attracted a good deal of research attention, beginning with the finding that it appeared to control the selection of actions and the focusing of attention (Bush et al., 1998; Posner & Dehaene, 1994). fMRI studies of the ACC, however, have since revealed its crucial involvement in emotional tasks with cognitive demand (Phan, Wager, Taylor & Liberzon, 2002), and it is this function of the ACC that is of core relevance in this study. It has been found that the ACC is particularly involved in the cognitive task of conflict detection: van Veen and Carter (2002) distinguished control from conflict by pairing congruent and incongruent interference task trials (e.g., Stroop test and Eriksen flanker interference paradigm). The ACC was most strongly activated when an incongruent trial followed congruent trials, that is, when control was lowest (resulting in longer reaction times) and conflict was highest.

In line with this research, ERP studies (Reason, 1990 in van Veen & Carter, 2002) reveal that people often make fast, impulsive errors when subjected to conflict (as in the interference paradigms) and that their error is followed 50-150 milliseconds later with a large, negative deflection. This has been termed error-related negativity (ERN), and has been demonstrated to coincide with heightened ACC activity (Carter, Braver, Barch, Botvinick & Noll, 1998; Kiehl, Liddle & Hopfinger, 2000, both in van Veen & Carter, 2002). The ACC is thus implicated in error-related activity (Menon, Adleman, White, Glover & Reiss, 2001). Furthermore, research shows that the more certain subjects are that they have made a mistake, the more ERN is enhanced; this suggests that motivational factors are largely implicated in the monitoring of responses in the context of conflict, reflected in heightened ACC activity (Gehring et al., 1993 Falkenstein et al., 2000, both in Hajcak, McDonald & Simons, 2004; Johannes et al., 2001).

OCD patients reliably show increased activity in the ACC: during rest, during symptom provocation and after making errors on cognitive tasks (Gehring et al., 2000; Ursu, Jones, Shear, Stenger & Carter, 2003). The following evidence suggests that the ACC is specifically involved in OCD: first, patients show increased ACC activity on *both* correct and incorrect high-conflict trials, though they have similar reaction times and make a similar amount of errors on interference tasks, compared with normal controls (Gehring

et al., 2000; Fitzgerald et al., 2005); therefore people with OCD are unusually sensitive to conflicts, and researchers have suggested that such hyperactive error-detection may cause continuous preoccupation with correcting perceived – though more often than not, non-existent – mistakes (Pitman, 1987; Schwartz et al., 1996). Gehring et al. (2000) found that: 1) ERN was enhanced in OCD individuals (confirming previous research), and also that 2) the magnitude of this enhancement correlated with symptom severity, a second strong line of evidence in favour of the implication of an overactivated ACC in OCD. This study also found, however, that although people with OCD showed "heightened and prolonged electrophysiological response to errors" (Gehring et al., 2000, p. 5) they did not show a significant group difference to healthy controls in ERN activity on correct, high-conflict trials.

Other studies (e.g., van Veen & Carter, 2002) *have* shown such significant differences. These conflicting results are perhaps inevitable as a result of small sample sizes and the heterogeneity of OCD as a syndrome, but Gehring et al. suggest another reason for the result. They note that the simple yes/no response paradigm that operates in something as straightforward as the Stroop task (used in this study) or similar laboratory interference tasks will not necessarily induce the effect of 'comparator dysfunction', that is, dissonance between internal reference points and a desired state of affairs, that is crucial to OCD. They note that, realistically, OCD involves a focus on symptom-relevant events (e.g., related to checking, cleaning one's hands, counting objects), and therefore that future research should study symptom-relevant events in relation to ACC hyperactivity. Maltby et al. (2004) found that only correctly-rejected, high-conflict trials produced unusually high ACC activation, and suggest therefore that correctly-rejected, high-conflict trials that involve response inhibition could provide a better conceptualization of compulsions in OCD. Although there is some inconsistency of results, recent literature suggests that the ACC is gaining credence as a key structure in conflict detection.

Further evidence for the role of an overactivated ACC in OCD comes from the comparison to the quality of ACC dysfunction in other neuropsychiatric and cognitive disorders: reduced ACC activity has been demonstrated in both schizophrenia (Carter,

Mintun, Nichols & Cohen, 1997; Carter, MacDonald, Ross & Stenger, 2001, both in van Veen & Carter, 2002) and in Attention Deficit/Hyperactivity Disorder (ADHD; Bush et al., 1999). The major implication of an underactive error-monitoring network for schizophrenia is that post-error adjustments are made less effectively (van Veen & Carter, 2002); for ADHD, it could mean that underactive error-monitoring is the result or the cause of defective attentional control. Again, it is established in the literature that an overactive ACC is indicative of hyperactive conflict-monitoring: cognitive tests done during neuroimaging have established that OCD patients have heightened activity in the anterior cingulate cortex (ACC), which correlates with hyperactive conflict-monitoring. However, it is unreasonable to conceptualize OCD as a purely cognitive disorder. It is equally – if not primarily – an affective disorder. The affective aspect of OCD has been explored in the psychoanalytic literature, in which 'obsessional neurosis' is conceptualized as a pathological distortion of separation and loss mechanisms: patients deal with relentless, ambiguous feelings of fear that they might lose or harm their love object.

2.5. The anterior cingulate cortex and separation-distress in OCD

The cognitive evidence discussed above neglects the role of emotion in OCD. As stated before, it is unreasonable to consider that OCD has cognitive but not affective aspects – it is, by its very nature, an affective disorder. Four of the main "basic command systems for emotionality" (Panksepp, 1998) in the mammalian brain are as follows: SEEKING, which controls appetitive, goal-directed behaviours; RAGE, which mediates anger; FEAR, which controls responses that reduce an organism's risk to bodily harm; and PANIC, which mediates social emotional attachment processes and arouses a sense of loss and sorrow when an organism is separated from its social support system (Panksepp, 1998). It is hypothesized in this study that PANIC is the underlying emotion in OCD, for the following reasons. First, PANIC is the only basic-emotion system in which the ACC is implicated, suggesting crucial involvement of this system in OCD because of the evidence relating heightened ACC activity, hyperactive conflict-monitoring and OCD. Second, both panic disorders and OCD respond to Selective Serotonin Reuptake Inhibitors (SSRIs; panic medication) but not to benzodiazepines (antianxiety drugs),

which target the FEAR/ANXIETY system (Panksepp, 1998; Solms & Turnbull, 2002). Third, psychoanalytic and phenomenological evidence suggest that the separation-distress/PANIC system is crucially implicated in OCD.

2.5.1. The ACC in the PANIC emotion system

Anatomically, the capacity to experience separation-distress seems to have emerged from the evolution of the more basic pain systems in the brain; specifically, the PANIC system arises largely from a variety of associated networks, which include the midbrain periaqueductal grey (PAG); the medial diencephalon (especially the dorsomedial thalamus); the ventral septal area, the preoptic area and numerous areas in the bed nucleus of the stria terminalis; and the ACC in some higher species (Panksepp, 1998). The implication that the ACC is an important part of the extended network that mediates separation-distress is intriguing, as research shows that it is also recruited during overactive conflict-monitoring (as demonstrated by imaging studies of OCD patients dealing with incongruent cognitive trials; e.g., van Veen & Carter, 2002). Additionally, there is some evidence that the ACC (specifically its dorsal subdivision: dACC) is crucial to experiencing the distressing nature of pain; it is reported that chronic pain patients who have their dACC lesioned, are no longer bothered by pain, although they can still detect it on a sensory level (Eisenberger & Lieberman, 2004).

Similarly, the significance of social pain is mediated by the dACC and ablation thereof in various animal species eliminates distress vocalizations on separation from caregivers (Eisenberger & Lieberman, 2004). Such research supports the hypothesis that the brain bases of social and physical pain are similar (Eisenberger, Lieberman & Williams, 2003). However, it does also need to be noted that at this point in the development of the neurosciences, it is highly unlikely that clear dissociations between brain regions according to function can be made. In the case of the ACC, although imaging studies point to its unequivocal function in the genesis and experience of pain and emotion, they fail truly to show dissociable activation and deactivation patterns consistent with any *particular* emotion. Although the dACC appears to contribute to the affective experience of pain (e.g., Mohr, Binkofsky, Erdmann, Buchel, & Helmchen, 2002; Rainville *et al.*,

1997 in Mullins, Rowland, Jung, & Sibbitt, 2005), it may well be part of an extended network – comprising multiple limbic, paralimbic and brainstem areas – that does so, similar to the apparent multi-level functioning characteristic of all brain activity. However, the fact that ACC activation is associated with the affects of pain and sadness, as well as with a tendency to hyper-monitor conflict, is encouraging for the hypotheses of this study.

Considering the tentative evidence discussed above, regarding damage to certain areas of the ACC resulting in a diminution of the emotional significance of pain to a person, a possible implication for OCD would be a reverse trend, that is, a vast *overestimation* of the emotional importance of social pain: since the ACC is hyperactive, it is plausible that this could contribute towards the immense difficulty patients have letting go of what makes them feel safe (that is, their obsessive thoughts and the compulsions that supposedly negate them). Eisenberger and Lieberman (2004) propose the ACC as a "neural alarm system" that both detects discrepancies, and signals a warning about the error. Panksepp (1998) advocates a similar concept, suggesting that perhaps shared neural components of the panic and anxiety systems constitute a "hypersensitized 'alarm' system." Neuroanatomically, the FEAR basic-emotion command system extends from the central and lateral areas of the amygdala in the temporal lobe to the anterior and medial hypothalamus, and then to the lower brainstem, which mediates typical autonomic fear-related responses (Panksepp, 1998).

2.5.2. Effect of medication on PANIC system

Although separation-distress and fear arise largely from complex and as yet incompletely understood neural processes, which no doubt share much overlap, it may nevertheless be possible to notice some neurochemical distinctions between the brain systems responsible for their production. Perhaps it is more accurate to say that, while multiple, interrelated systems (both neurochemical and neuroanatomical, as discussed above) are active in the generation of the emotions, it may be possible and also useful, from a research perspective, to note that the specific emotion systems perhaps rely more heavily on certain paths, sometimes giving the illusion that separate networks govern their

mediation. First, anticipatory anxiety is apparently chiefly generated by the FEAR neural system, while panic attacks arise from the PANIC neural system (Panksepp, 1998). Whereas opiates can be instrumental in decreasing separation-distress, research has shown that they may fail to diminish fearful behaviours; likewise, benzodiazepines have led to significantly decreased fear responses whilst remaining ineffectual in reducing separation-distress (Panksepp, 1998).

Similarly, research has suggested that panic attack frequency is decreased by imipramine but that the attendant anticipatory anxiety has to be treated with benzodiazepines, in order to produce a complete subjective sense of improvement in panic attack patients. Thus the fear and panic systems perhaps merit a dissociable approach, if only to enable research progress, and as long as the basic principle of interconnectivity and multiple-system brain function is remembered. OCD has long been classified as an anxiety disorder (DSM-III-R, 1987), and it therefore makes intuitive sense that the FEAR/anxiety system be implicated in this neuropsychiatric disorder: this is the emotion that drives obsessions and compulsions, from a phenomenological point of view. However, the fact that both panic attack frequency and OCD are decreased by the same medication provides good evidence for the intuition that panic is crucially implicated in obsessive-compulsiveness.

2.5.3. Psychoanalytical and phenomenological evidence

Cognitive models have hypothesized that the slavish repetition of compulsions or rituals in OCD is the result of negative reinforcement: the tendency to execute compulsions is strengthened exponentially by their ability to remove the intense anxiety that attends intrusive emotions in OCD. This may be the role that FEAR plays in OCD, but it is also phenomenologically clear that PANIC is implicated. People with OCD exhibit fear of detachment from objects, people or ideas that make them feel safe. They must have things 'just so', or they panic. The fact that the panic system involves feelings of loss also recommends it to OCD, since panic at the prospect of letting go of or losing a love object seems central to the pathological thought processes and behaviour characteristic of this psychopathology.

As discussed, the fact that the neural networks of the separation-distress and fear systems may be dissociated does not discount their probable interaction, probably especially in lower areas such as the mesencephalic PAG (Panksepp, 1998). This overlap may be illustrated on a phenomenological level with evidence from introspective experience: for example, we often feel anxiety in anticipation of situations that will provoke in us intense feelings of separation-distress, as in children who experience anxiety at the prospect of leaving their parents to attend school for the first time (Panksepp, 1998). This fits well with the intuition that relates separation-distress to OCD, as people with OCD are beset with immense anxiety at the prospect of not being able to check a door, for example – in other words, at the thought that they will be separated from interacting with the object or from carrying out the process that makes them feel safe.

Therefore separation-distress can apparently generate activity in FEAR circuits, but behavioural data suggests that the converse is not true: animals exhibit specific fear responses (such as freezing and fleeing) that explicitly omit the distress vocalizations characteristic of separation-distress, as these would make them more vulnerable to predators (Panksepp, 1998). Similarly, humans who are frightened do not typically cry in response; rather, they perform actions likely to help them evade danger. Autonomically, fearful anxiety evokes responses of sweating, gastrointestinal symptoms, tachycardia and elevated muscular tension, whereas separation distress (especially in its most intense form, grief) manifests autonomically in parasympathetic symptoms such as chest tightness, the feeling of having a lump in the throat and a strong urge to cry (Panksepp, 1998). This symptomatic distinction between fear and panic – the former dominated by a generalized apprehensive tension; the latter by feelings of depression and weakness – further dissociates the two emotion command systems. Thus PANIC has still to be investigated as the emotion possibly most directly associated with OCD.

2.5.4. Conclusion

Panksepp proposes that the emotional distress of major psychiatric disorders is probably more closely linked to the changing dynamics of the underlying *emotional* systems than to the *cognitive* systems in which the symptoms are most commonly seen, and points out

that the role of the separation-distress system in "the creation of affective turmoil is not yet well recognized" (1998, p. 278). This provides further reason to hypothesize, as this dissertation does, that separation-distress is the affective covariant of overactive conflict-monitoring in OCD, based on the evidence that both centre on overactivity of the ACC.

2.6. Other emotions in OCD

The second part of the study will involve assessing the two groups of participants (those towards the high and low ends of the O-C tendency spectrum) with the Affective Neuroscience Personality Scales (ANPS; Davis, Panksepp, & Normansell, 2003). The primary purpose of this assessment is to gauge their scores on the SADNESS component of the scale, which provides the measure for the PANIC emotion system (Davis, Panksepp, & Normansell, 2003). However, data that assesses all three other emotion systems in each participant will also necessarily be collected during the administration of this questionnaire, and may prove far from incidental. Close attention will be paid to – and analyses carried out on – the scores participants attain for the other six subscales of the ANPS (ANGER, CARE, FEAR, PLAY, SPIRITUALITY, and SEEKING) that collectively represent the other three main emotion systems of the mammalian brain: ANGER/RAGE, FEAR/ANXIETY, and SEEKING (Davis, Panksepp, & Normansell, 2003). It may be that one or more of these subscale measures correlate highly with O-C tendency, in which case, the link will be further explored in relation to the other results. In fact, it is expected that there will be a close connection between the subscales that gauge ANXIETY and O-C tendencies, owing to the fact that anxiety is the chief emotion subjectively experienced in OCD and reported by sufferers of this disorder. As discussed in an earlier section (**2.5.3.**), however, this is hypothesized to be the result of an interaction between the emotions of separation-distress and anxiety, whereby anticipatory anxiety is experienced at the prospect of the intense separation-distress that OCD involves.

Chapter 3: Research design and methodology

3.1. Research hypotheses

This study was approached methodologically according to the three key research hypotheses that evolved throughout the conceptualization and literature review. They are as follows:

Hypothesis One (H_1):

Conflict-monitoring (as measured by a meta-cognitive Stroop task) is a cognitive mechanism of obsessive-compulsiveness (as evaluated by combined scores on two OCD questionnaires – the Meta-Cognitions Questionnaire and the Padua Inventory). It is hypothesized that higher scores on the MCQ and the PI – indicative of a greater tendency towards obsessive-compulsiveness – will be predictive of higher scores on the Stroop task used in this study, hence providing evidence for the role of cognitive conflict-monitoring in the pathology of OCD.

Hypothesis Two (H_2):

PANIC/separation-distress is significantly heightened in those who also display an increased tendency towards obsessive-compulsiveness, compared with the normal population. Separation-distress will be assessed with the PANIC Affective Neuroscience Personality Scale (ANPS), and significant increases in scores on this measure are expected to correspond to significantly higher score outcomes on obsessive-compulsiveness, as measured by the MCQ and the PI. Confirmation of this hypothesis would provide reason to investigate separation-distress further, as an emotion of primary importance in obsessive-compulsiveness.

Hypothesis Three (H_3):

Conflict-monitoring and separation-distress are significantly correlated. Therefore, scores on the meta-cognitive Stroop task and on the ANPS PANIC subscale are hypothesized to be significantly correlated.

H_1, and especially H_2, were the primary foci of interest in this research study: the former sought to confirm previous research that has led to the establishment of conflict monitoring as a cognitive indicator of 'obsessive-compulsive' brain activity; the latter aimed to make a new contribution to this field of knowledge by investigating whether the affective experience of separation-distress – generated by certain neurobiological emotion system networks primarily concerned with mediating PANIC responses – is more prevalent or intense in those with obsessive-compulsive affective profiles. This would point towards separation-distress as an important possible emotional contributor to obsessive-compulsive tendencies.

3.2. Design/Issues of measurement

Three questionnaires and one short cognitive task were given to gather data. Questionnaires were considered the most time-effective means of data-collection in a study such as this, which required a large sample, and it was also hoped that their nature would strengthen the possibility of capturing the vast spectrum of behavioural, cognitive and emotion symptoms that may be included under the broad banner of obsessive-compulsiveness. The first two questionnaires are validated and widely used assessments of OCD and were used to position participants on a spectrum in terms of their O-C tendencies. The Meta-Cognitions Questionnaire (Cartwright-Hatton & Wells, 1997) was developed using non-clinical as well as clinical populations and its subscales have been found to predict worry proneness, proneness to obsessional symptoms, and anxiety. It has been included because it was developed using both clinical OCD patients and, importantly for the approach of this dissertation, members of the normal (non-OCD) population who demonstrate a particular predilection for obsessive-compulsiveness.

The Padua Inventory (Sanavio, 1988) is a more conventional clinical diagnostic tool for the disorder, discriminating well between OCD patients and those with other neurotic disorders. These two scales were carefully chosen from amongst the many OCD measures in existence, specifically for their complementary strengths: since a non-clinical sample was used, the MCQ seemed well suited to detect general worry-proneness, while it was thought that sub-clinical OCD would be better gauged by the PI. In no way was a

clinical diagnosis sought to be established for the participants in this study; their *proneness* towards obsessive-compulsiveness served as an adequate means to investigate the hypotheses proposed.

Separation-distress was evaluated by one of the Affective Neuroscience Personality Scales (ANPS; Davis, Panksepp, & Normansell, 2003). The ANPS assesses participants' affective profiles in terms of seven basic-emotion categories – SEEK, FEAR, CARE, ANGER, PLAY, SADNESS and SPIRITUALITY. The questionnaire consists of 110 items; 14 pertain to each of the six main subscales of emotion, whilst 12 provide the measurement for SPIRITUALITY. There are 14 criterion items, evenly dispersed after each section of seven authentic items: that is, items 1 to 7 are one each of the factors listed above, following each other in that order, and item 8 is a criterion. The second SEEK item follows as item 9, and so on. Participants are required to respond to the items using a 4 point Likert scale, with 1 = *Strongly Agree*, 2 = *Agree*, 3 = *Disagree*, and 4 = *Strongly Disagree*. To guard against response sets and transparency of item meaning, the questionnaire has been structured so that scoring of sets of items alternate between negative and positive. For the negatively-scored sets, scoring is reversed so that an answer of *Strongly Agree* is scored as 4 instead of as 1, as it appears on the questionnaire sheet. Similarly, *Agree* is scored as 3 instead of 2, *Disagree* as 2 instead of 3, and *Strongly Disagree* as 1 instead of 4. Preservation of scoring integrity is achieved by manipulation of item phrasing. The positively scored sets simply require the participants' actual response to be recorded. The resultant overall scores are a maximum of 56 for each of the six main subscales, and of 48 for the SPIRITUALITY measure.

This research was carried out with the possibility in mind that it may be extended: either as an imaging study in which the cognitive and affective assessments used here could be implemented, or as a more detailed examination of one or more of the aspects that may emerge from the results of this study. Thus the focus of such an extended study – neuroimaging or otherwise – will be derived from the results and conclusions of the current piece of research.

The design of this study was limited in that no qualitative, subjective data was systematically collected, which restricted analysis to a relatively superficial level in the context of the complex and highly clinically significant phenomenon of OCD. The flaw was, to an extent, unavoidable in a study of this magnitude, and is acceptable in the sense that all empirical research involves focus on a sample of the subject of research, necessarily limiting the perspective gained. Qualitative methods can make systematic evaluation difficult (Mouton, 2001), and from this point of view such methods would have been unsuitable for the current study.

Additionally, a non-clinical sample was used to investigate cognitions and emotions specific to OCD, which decreased the need for specific qualitative symptom description for the purposes of clinical diagnosis. As discussed previously, a clinical diagnosis of OCD would have been unnecessary for this study: tendencies towards obsessive-compulsive cognition were used to establish an OCD spectrum, which was used to answer the research questions. It should, however, be noted that non-clinical populations are generally considered in the literature as acceptable research analogues for OCD (Burns, Formea & Keortge, 1986). The questionnaires selected to position members of the normal population as more or less inclined towards OCD, necessarily have limitations, posing concern regarding capturing the entire symptom scope of the participants. To counter this possible problem, an extensive review of the various available questionnaires was conducted and care was taken to select those questionnaires considered most likely to achieve a faithful representation of participants' overall obsessive-compulsive profiles.

3.3. Sampling

A clinical OCD sample was initially considered, but because of the time and availability constraints involved in recruiting OCD patients, it was decided that participants should be sampled on a convenience basis. This decision is defensible on the basis of research on obsessions showing that "obsessional ruminations and unpleasant cognitive intrusions" (Sanavio, 1988, p. 1) are common in non-clinical groups (e.g., Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). Wells & Papageorgiou (1998) point out that worry

and obsession, although associated with significant distress and often partly diagnostic of emotional disorders such as OCD and Generalized Anxiety Disorder (GAD), occur frequently and normally in the non-clinical population. Therefore non-clinical samples are generally accepted as adequate OCD research analogues (Burns et al., 1986), and it was proposed that a non-clinical, college sample be used for this dissertation.

In consultation with an experienced statistician and professor of the Psychology Department at UCT, and from careful study of the development and norming of the MCQ and the PI, it was decided that an initial sample (those targeted to complete the MCQ and the PI) of 1000 college students should be located, based largely on the fact that OCD has a lifetime prevalence of two to three percent worldwide (Weissman et al., 1994 in Whiteside et al., 2004). In order to obtain significantly high- and low-scoring groups on the O-C spectrum on which to continue with conflict-monitoring and separation-distress research, a sufficiently large enough sample had to be tested. It was hoped that such a score distribution – as opposed to a clinical diagnosis of OCD – would serve to support any conclusions drawn from the research.

Individuals' scores were used to construct a spectrum of tendencies ranging from normal to sub-clinical obsessive-compulsiveness. A highest- and lowest-scoring group were then chosen on which to carry out the second stage of the testing. The exact number of participants in each of these groups was decided upon according to analysis of the distribution, standard deviations and statistical power of the data collected from the eventual 1119 students. However, based on preliminary research of previously obtained data distribution resulting from use of the MCQ and the PI (Cartwright-Hatton & Wells, 1997; Sanavio, 1988), it was possible to estimate that the groups would consist of between 15 and 25 participants each. These two groups constituted the non-clinical student sample. All participating students were informed that they might be called back to participate in the second stage of the testing process, depending on their test scores.

3.4. Measures

3.4.1. The initial concern of this study was to locate the non-clinical (college) sample participants on the continuum of obsessive-compulsiveness. In line with the vast body of OCD research, a multitude of measures exist. A single, established questionnaire would have been the simplest and most time-efficient manner of initial data collection; however, it seemed best to include at least two in this study, as all the questionnaires have specific strengths and weaknesses and it was hoped that including two would better capture the entire scope of participants' obsessive-compulsive (O-C) symptoms, and help minimize any weaknesses the individual questionnaires have.

The Meta-Cognitions Questionnaire (Cartwright-Hatton & Wells, 1997; see **Appendix A**) is a 65-item self-report measure that assesses beliefs about worry, intrusive thoughts and cognitive functioning, as well as individual differences in the ability to monitor thought processes. Participants respond to each item on a 4 point Likert scale (1= 'do not agree'; 4= 'agree very much'). The MCQ consists of 5 subscales derived from repeated factor analytic studies. These are: 1. Positive beliefs about worry, 2. Negative beliefs about the uncontrollability of thoughts and corresponding danger (e.g., my worrying thoughts are uncontrollable; worrying is dangerous for me), 3. Lack of cognitive confidence (e.g., I do not trust my memory), 4. Negative beliefs about thoughts in general, including themes of superstition, punishment and responsibility (e.g., it is bad to think certain thoughts; I will be punished for not controlling certain thoughts; if a bad thing happens which I have not worried about, I feel responsible), and 5. Cognitive self-consciousness (e.g., I pay close attention to the way my mind works).

The MCQ has good psychometric properties of reliability and validity (Wells & Papageorgiou, 1998): Cartwright-Hatton and Wells (1997) report Cronbach coefficient alphas for the individual subscales ranging from 0.72 to 0.89 as well as test-retest reliability coefficients after a 5-week interval ranging from 0.76 to 0.89 in a non-clinical sample. Significant correlation with the subscale of uncontrollable mental activities of the Padua Inventory (PI) (Cartwright-Hatton & Wells, 1997) is also reported, and suggests that these two scales may be used effectively in combination. Wells and Papageorgiou

(1998) report that "in accord with [their] theoretical predictions, MCQ subscales were positively correlated with a range of O-C symptoms".

The MCQ appeared well suited to investigating O-C tendencies in a non-clinical sample, as it is not a clinically-based OCD measure, as such; its focus on worries and obsessions normal in everyday life made it highly suitable for the sample. The items themselves were derived not only from outpatients with OCD, GAD, Panic Disorder and Hypochondriasis, but also from normal undergraduate students. It is literally designed to detect worry-*proneness* (Cartwright-Hatton & Wells, 1997), and as such it was a good fit as an assessment for the non-clinical sample. This said, its non-clinical nature may have been disadvantageous, posing the danger of shifting the focus away from OCD. It was therefore proposed that it be used in conjunction with the Padua Inventory, to gain an acceptable rating of O-C symptoms in the non-clinical sample.

The MCQ was used in conjunction with the Padua Inventory (Sanavio, 1988; see **Appendix B**), which is becoming popular as a way to measure O-C symptoms (Wells & Papageorgiou, 1998). Internal consistency and reliability are satisfactory (Sanavio, 1988). During development of the 60-item scale, four factors were identified: impaired control of mental activities (e.g., lower ability to remove undesirable thoughts, difficulty dealing with simple decisions and doubts), becoming contaminated, checking behaviours, and urges and worries of losing control over motor behaviours (Sanavio, 1988). These factors provided well-delineated OCD categories, which were likely to be useful during data analysis, in the case of conflict-monitoring and separation-distress being more particularly correlated with *specific aspects* measured by the OCD questionnaires than with *overall* obsessive-compulsive tendencies. The PI correlates well with other O-C symptom scales and effectively discriminates between OCD patients and those with other neurotic disorders (Sanavio, 1988).

3.4.2. Secondly, the participants needed to be evaluated in terms of the activity of their conflict-monitoring and separation-distress systems, in order to gauge 1) whether these two components were closely related, as expected, and, potentially, *how* this might

be so, as well as 2) whether there was a significant correlation between O-C tendencies and the cognitive and affective components under investigation. To assess separation-distress, the ANPS (Davis, Panksepp, & Normansell, 2003; see **Appendix C**) was used. The SADNESS scale of this instrument is the measure of PANIC/separation-distress (Davis, Panksepp, & Normansell, 2003); it consists of 14 items, each scored from 1 to 4, rendering a maximum overall score of 56.

The other emotion subscale scores provided fertile ground for data analysis secondary to the main hypotheses of the study. For example, as discussed in the introductory chapters, anxiety is well established as a crucial emotion in OCD; in this study, scores on the FEAR subscale (an evaluation of participants' FEAR/ANXIETY basic-emotion systems) could be scrutinized in order to examine their relationship to PANIC/separation-distress scores. Such investigation offered the possibility of shedding light on whether, in this sample, fear-anxiety and separation-distress were related to obsessive-compulsiveness to a dissociable degree.

To assess conflict-monitoring, the Stroop Test was adapted to the purposes of this study. There are numerous variations on the Stroop Test, but ultimately it assesses divided (or selective) attention and inhibition and how the mind and brain deal with incongruency between automatic and effortful cognitive processing skills; that is, the ability to inhibit an overlearned verbal response is tested (Stroop, 1935). In the Colour/Word Stroop, participants are presented with the names of colours printed in non-corresponding coloured ink – such as the word 'BLUE' written in green. Participants are instructed to respond to the colour of the ink and *not* to the written word (as one is automatically inclined to do). Thus there is conflict between one's unavoidable, immediately activated response and the response one is required to think carefully about and attempt to impose wilfully over automatic urges. A variation called the 'Emotional Stroop' follows the same procedure but uses words charged with negative emotion or words that provoke thought about symptoms relevant to OCD.

Participants were administered the pencil-and-paper form of the Delis-Kaplan Executive Function System (D-KEFS) Colour-Word Interference (Stroop) Test (Delis, Kaplan & Kramer, 2001). Their performance was recorded by the researcher according to the standardized procedure (Total Time to Complete, Total Uncorrected Errors and Total Self-Corrected Errors was recorded for each of the four stimulus conditions of the task: Colour Naming, Word Reading, Inhibition, and Inhibition/Switching). The participant was then asked to provide an estimate of their overall performance on the four stimulus conditions, in the form of a percentage (the percentage of items they thought they answered correctly).

Such data presented various possibilities for analysis, but the central concern was how accurately participants' *actual* and *perceived* scores accorded, providing a crude but arguably viable and adequate (for the purposes of this study) measure of meta-cognitive conflict-monitoring. This method also addressed the problem of lack of symptom-relevance in previous studies of cognition in OCD: the current approach ensured that meta-cognition – essential to the nature of OCD – was assessed in the context of conflict. A pilot study was carried out with individuals not participating in the actual study, in order to refine the method and scoring of this 'Meta-cognitive Stroop', and to ensure that the researcher was competent in its standardized administration before beginning the formal data collection section of the dissertation.

3.5. Data collection/Procedure

3.5.1. A vast number of participants were needed to complete the initial questionnaires (MCQ and PI), in order to ensure a sample size that would allow significant differences between the two extreme scoring groups to emerge. Thus, the following recruitment measures were decided upon: 1) Entry into a R1 000 raffle reward was offered for participation in the research study, and 2) A system was devised whereby the college students were informed of the study and of the R1 000 reward being offered for participation, and were then directed to complete the questionnaire on the Internet in their own time, as it seemed that this would be the most practical and efficient data collection technique.

A program called *Perseus SurveySolutions 3.0* (1997-2000) was used to create the web questionnaires for the Internet. Class lists for nine 2005 undergraduate courses at UCT were accessed through the UCT staff and administration internet system, with the help of the Psychology Department secretaries. Class lists consisted of student numbers, which were then edited in Microsoft Excel to form email addresses by concatenating the student numbers with the standard UCT email address post-script: "@mail.uct.ac.za". The address lists were then transported into Microsoft Word and converted into paragraph form, to allow copying and sending of multiple addresses at a time. A copy of the email sent to all prospective participants is included in **Appendix D**. The classes were chosen for volume and also to represent the wide variety of faculties at UCT undergraduate level. They included first-year Statistics, Economics, English, Mathematics and Psychology courses; second-year Mathematics and Economics courses; and a third-year Accounting course.

A consent form was included on the questionnaire web page created for data collection. It included a brief explanation that the research study was to form a neuropsychology Masters dissertation that aimed to investigate the way specific thoughts and emotions are interrelated. Participants were asked to fill in their name, telephone numbers and e-mail address as contact details, so that they could be contacted if they were required for the second round of testing or to claim the R1 000 raffle reward. In order to safeguard participant recruitment for the conflict-monitoring and separation-distress testing to follow in the second stage of the research, it was made clear that should they fail to respond to a request to participate in the further testing, it would not be possible to keep their names in the draw for the R1 000 raffle reward. Aside from the reasons cited above regarding OCD prevalence and data distribution in previous research using the MCQ and PI, the very large sample was also a precaution taken in light of the knowledge that some participants might have declined from further involvement in the research; the sample size was large enough to have ensured enough of a response range to allow a high- and low-scoring group to be collected even in the event of some participant drop-out. Lastly, the consent form specified that all participants agreed to take part in the study on a voluntary basis and that anonymity is guaranteed.

The Internet system proved extremely effective. Data bases of nine undergraduate courses were accessed and emails were sent to 10 000 students, advertising the study and urging their participation, with the possible reward as encouragement. 1119 valid responses were obtained (after deletion of repeat entries and of incomplete questionnaires).

3.5.2. The 50 participants selected for the second stage of testing were contacted by telephone and a time convenient to both themselves and the researcher was arranged in which the testing could be completed. All testing was carried out in the UCT Psychology Department, in tutorial rooms available at the testing times. Participants were instructed to collect the ANPS questionnaire from the Psychology Department secretary's office and to fill it in in their own time before their appointments, when they could hand it back to the researcher. This procedure was aimed at shortening the appointment time considerably and thus ensuring greater co-operation. At their appointment, participants had the Stroop Test procedure explained to them, and the administration thereof followed. They were then allowed and encouraged to ask any questions they had regarding the research procedures specifically, or the nature and purpose of the research study as a whole and the motivations behind it. They were given the option of a report-back on their individual data in relation to others in the study, and of having access to the entire dissertation on its completion. 41 of the 50 participants completed the second stage of testing: 21 from the non O-C group and 20 from the O-C group. It was decided that this was an acceptable sample size for a study of this magnitude.

3.6. Data capturing and editing

3.6.1. The web page was created so that all questionnaire responses would be emailed to a main UCT server in a Psychology Department computer lab, in the form of response.tsv files: each question (numbered from 1 to 65 and from 1 to 60 on the web page, but from 1 to 125 in the survey program setup for purposes of response collection) appeared as a file, and contained all the responses received for that item. These results were then imported into Microsoft Excel, in order to calculate the overall O-C scores for

each participant and create a range of scores from which the two extreme-scoring groups could be selected.

3.6.2. Data collected from the ANPS questionnaires was scored manually: all individual participant scores were entered into a Microsoft Excel spreadsheet; the items that required reverse scoring were altered and input as raw data to facilitate more straightforward summing of factors using Excel formulas. The seven factors were summed to obtain an affective profile for each of the 41 participants.

3.7. Data analysis

Descriptive and inferential statistics were used to analyze the quantitative data. The MCQ and the PI were scored according to their manuals, in order to obtain a range of tendencies towards obsessive-compulsiveness displayed by the participants. The cognitive and affective tests were scored to position the participants in terms of these tendencies. Overall obsessive-compulsive scores as well as scores for each of the nine individual factors that make up the MCQ (five factors) and the PI (four factors) were calculated for each participant. Correlational analyses were used to rank the nine factors from highest to lowest in terms of their correlation with overall O-C score; such descriptive information may have been needed in subsequent analyses, and was also useful in its own right, simply in terms of providing a more detailed description of the data that was gathered.

Independent t-tests were performed on the two extreme groups drawn from the sample, to determine whether they were significantly different (that is, that they truly represent different sample populations) and hence so that further analyses could be conducted using these two sets of scores. Independent t-tests were used to calculate whether O-C versus non O-C grouping had a significant effect on participants' separation-distress and conflict-monitoring scores. Score sets were also correlated to determine whether each group differed significantly in terms of its scores on separation-distress and its scores on conflict-monitoring. It was kept in mind that further correlations might be employed to probe more specific relationships that could possibly exist between various O-C factors

(measured by the initial two questionnaires) and conflict-monitoring, depending on the outcome of the preceding analyses. These analyses were performed with the aim of investigating whether separation-distress is significantly implicated in obsessive-compulsiveness, and also to re-establish the link between conflict-monitoring and obsessive-compulsive mental activity.

3.8. Limitations

Perhaps the most striking apparent pitfall that pervaded this design was that the data analysis employed was simplistic. Correlational relationships formed a substantial part of the analysis, and it may be argued that this kind of statistic cannot provide enough evidence to support results that claim to offer insight into weighty psychological matters such as the relationships between emotion and cognition. However, with the addition of the inferential statistic – the independent t-test – to data analysis, it is argued here that the correlational analyses may also be considered fit to answer the research questions to which they are assigned and that perhaps the greater mistake would be to overcomplicate statistical methods and techniques in order to bestow research with false depth. In the case of the current dissertation, although the empirical research and conceptual questions surrounding the key elements (cognition and emotion) are admittedly exceptionally complex and fundamental, care must be taken not to confuse this well of information, with all its intrigues and inconsistencies, with the fairly simple and straightforward research question that was asked: does hyperactivity in specific cognitive and affective tendencies co-vary with a heightened tendency towards obsessive-compulsiveness, and further, do such cognitive and emotional aspects co-vary to such an extent that they could be considered manifestations of the disorder in their respective domains? Independent t-tests were an adequate tool to detect significant differences between the groups, whilst correlation assisted in providing the researcher with the best indication of relationships amongst the three elements under investigation.

It is always a shortcoming to use a convenience sample of college students in order to collect data that one hopes to generalize – even weakly – to some larger population, especially when it is one so specialized as the population of people with OCD. However,

it must be remembered that the stance in this dissertation was not so much that OCD is a strictly defined mental illness that must include certain symptoms and exclude others to be considered a definable entity (the difficulties with defining OCD at all, owing to its heterogeneity, have been discussed in Chapter 1). The quality of the question here (and the answer that this dissertation provides, or contributes toward) is not diminished by the fact that the participants were not clinically diagnosed with OCD, as this was not the central focus of the empirical inquiry. Hyperactivity in brain circuits that is correlated with OCD is not necessarily 'pathological' – that seems a simplistic and possibly flawed deduction. It is more an indication of something interesting occurring at the complex interface of cognition and emotion in the brain, which has thus far eluded a sophisticated understanding on the scientist's part during the course of empirical investigation.

Brain circuits apparently fluctuate in all people all the time and therefore those without a diagnosis of OCD might reach 'pathological' levels of metabolic activity in their orbitofrontal circuits, caudate nuclei and anterior cingulate cortices at some point in their existence, but just as soon return to normal or even *hypo*metabolism in terms of these circuits. The focus of this dissertation was centred more on the relation of such hyperactivity to similarly raised activity in the other sphere of interest: the separation-distress emotion system; and the intuition that led to linking the two brain functions is embedded in their close relationship with both the ACC and OCD (the latter providing a good platform from which to investigate these interrelations).

Finally, it should be taken into account that using web-based data collection techniques does introduce the possibility of data corruption: errors may occur in the response collection files or when importing the files into Excel. However, owing to the need for such a large sample for the first part of the study, Internet-based questionnaires were the only practical possibility. Data corruption is a danger of research regardless of the method of collection, and the utmost care was taken in this case to avoid error – by carefully excluding duplicate entries, scanning the entries for missing data using the statistical program, and generally remaining alert to any apparent inconsistencies in the data.

3.9. Ethical considerations

All participants were informed of the nature and purposes of the dissertation and their consent was obtained on the consent form attached to the web-based questionnaires. The consent form explained clearly that participation in this research was voluntary and that subjects were completely within their right to withdraw at any point in the research process. It was not expected that the three questionnaires and the cognitive task used to collect data would upset the participants (since a non-clinical sample was being investigated), but the consent form advised that participants could ask for any further information regarding what was being studied, should it have raised any doubts in their minds as to their own mental health; they were encouraged to email the researcher with any queries they had.

A few queries were received from participants who were slightly concerned by the relevance some of the questionnaire items seemed to hold for them. These were dealt with by explaining the nature of the questionnaires and how they were being used in this dissertation. All questions asked at the testing appointments during the second stage of data collection were answered in full. The participants were offered any further help or knowledge they might have required and were encouraged to email or to set up an appointment with the researcher should they have felt this to be necessary. Plans were made to refer participants to the appropriate professionals, should this need have arisen. In terms of participants being rewarded for their time, all who participated were entered into a draw for the substantial monetary prize of R1 000. After the second stage of testing and data collection had been completed, the draw was done and the winner was awarded the cash prize.

Chapter 4: Results

After the first stage of data collection (MCQ and PI web-based questionnaires), preliminary correlational analyses were carried out to obtain a better descriptive overview of the data. For each of the 1119 valid responses, scores on each of the nine factors (see section **3.4.1.**) inherent in the two questionnaires were calculated. Participants' scores on the individual factors were then correlated with their overall O-C score, in order to gauge how indicative of obsessive-compulsiveness (as measured in this study) each of the factors were. Following are the factors and their attendant correlations, ranked from highest to lowest in terms of their accordance with overall obsessive-compulsiveness in this sample: PI Factor 1, *Impaired control over mental activities* (**.89**); PI Factor 3, *Checking behaviours* (**.73**); MCQ Factor 2, *Uncontrollability and danger* (**.69**); MCQ Factor 4, *Themes of superstition, punishment and responsibility* (**.68**); MCQ Factor 1, *Positive beliefs* (**.65**); PI Factor 2, *Becoming contaminated* (**.63**) and PI Factor 4, *Urges of losing control over motor behaviours* (**.63**); MCQ Factor 3, *Cognitive confidence* (**.59**); MCQ Factor 5, *Cognitive self-consciousness* (**.34**). Should more detailed correlations need to be conducted deeper into data analysis, in order to determine whether specific aspects or sub-components of obsessive-compulsiveness are related to separation-distress or to conflict-monitoring (should the overall correlations between these factors reveal no significant relationship), then this ordering of the OCD scale factors will be used to organize the approach to such further investigations.

Howell (2002) does not recommend performing post-hoc power calculations, and especially in the case of significant results, there is no need to provide any further statistical support from this perspective. Based on previous research with the MCQ and PI, a sample size of either 20 or 25 from each end of the O-C spectrum was estimated to provide adequate power for the statistical analyses to be conducted. 25 participants were contacted for each of the two groups, but participant drop-out resulted in an end total of 42 participants for the second stage of testing (21 from the non O-C group and 20 from the O-C group).

4.1. The two sample groups (O-C vs non O-C)

Before performing any statistical analyses on the sample groups drawn from the two extreme ends of the O-C spectrum (which was constructed with the numerous questionnaire responses), it was decided that the two groups should be analyzed to determine whether they are significantly different; that is, whether their means reflect separate sample populations. An independent t-test was performed on the two sets of scores (non O-C versus O-C): $X_1 = 158.619$, $X_2 = 404.6$; Levene F (1, 39) = 17.34 at $p<.01$, therefore t for separate variances = -41.62 at p (2-sided)<.00. The significance of these results is strengthened further by the fact that the t-test is one-tailed (it was specified *before* data collection that the mean of the O-C sample group was expected to be greater than the mean of the non O-C group, and on examination of the results it is apparent that the population means are indeed different in the hypothesized direction). Thus the two groups (non O-C versus O-C) are significantly different and this finding strengthens any conclusions that may be drawn from further analyses using this data.

4.2. O-C, separation-distress and conflict-monitoring

After the second and final stage of data collection was complete, initial statistical analyses were aimed at detecting the effect that the O-C (top-scoring) versus non O-C (bottom-scoring) grouping had on separation-distress and conflict-monitoring scores, in order to begin to address two of the three main hypotheses (see section **3.1.**). Inferential analyses were carried out to investigate these relationships, as well as possible differences between the O-C and non O-C group in terms of the other subscales of emotion evaluated by the ANPS. Independent t-tests were carried out on the scores of the two extreme groups, for each of the emotion subscales and for the differential scores obtained on the meta-cognitive Stroop test. Population means for the two groups will be referred to throughout the results section as X_1 (non O-C) and X_2 (O-C). For the statistical tests in which the means were hypothesized to differ in a specific direction (prior to commencement of data collection), one-tailed t-tests were performed.

Firstly, it was found that scores of conflict-monitoring from the non O-C group did not differ significantly from those in the O-C group: $X_1 = 21.21$, $X_2 = 26.08$; Levene (.98, 39)

= .34, therefore the variances did not differ significantly and t = -1.16 at p = .13. It should be noted, however, that the means did differ in the hypothesized direction, with the O-C group scoring slightly higher on average than the non O-C group on conflict-monitoring. Since a significant finding was hypothesized on this measure, descriptive statistical analyses were carried out on the conflict-monitoring score set, in order to determine its suitability for analysis:

N	X (Mean)	Confidence (-95.00%)	Confidence (+95.00%)	Min.	Max.	Variance	St. dev.	Skewness
41	**23.59**	19.33	27.84	-.50	55.50	181.50	**13.47**	.17

Table 1: Descriptive statistics for conflict-monitoring measure

It is apparent from **Table 1** that the standard deviation (**13.47**) of the total group of conflict-monitoring scores is large enough relative to the population mean (**23.59**) to represent a normally distributed population. Therefore, any relationship between conflict-monitoring and obsessive-compulsiveness should be revealed by correlational or any other analyses on this data. The data set is suitable for analysis, and is sound enough to answer the questions posed by the research hypotheses. A normal probability-plot was constructed with the data to re-confirm this conclusion:

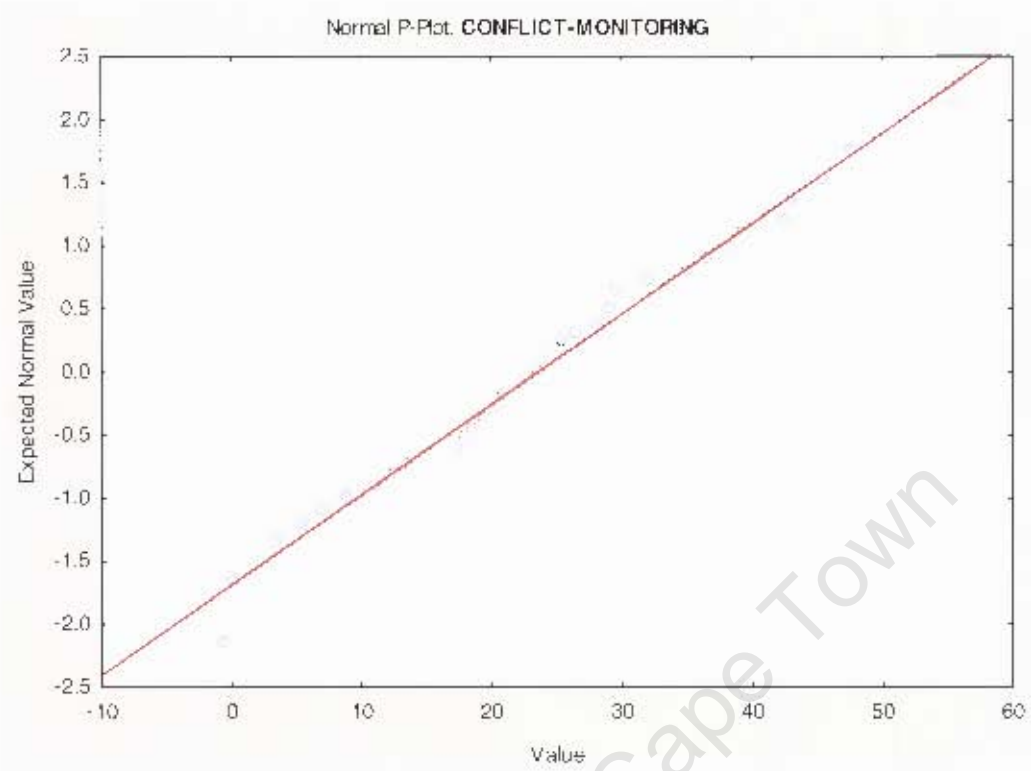

Figure 1: Normal probability-plot of score distribution for conflict-monitoring measure

Figure 1 further illustrates the normality of the data and the fact that it is adequate to draw conclusions from the analyses performed on it. Effect size for the data set is .37, which indicates a relatively substantial difference between the two groups, reflecting something between a small (.20) and a medium (.50) effect size, as proposed by Cohen (1988 in Howell, 2002).

Secondly, it was found that separation-distress scores (as assessed by the ANPS SADNESS subscale) differed significantly between the two groups: $X_1 = 30.90$, $X_2 = 40.55$; Levene (3.17, 39) = .08 and therefore t = -6.59 at $p<.01$.

4.3. O-C and other ANPS emotion subscales

Scores on the ANPS subscale SEEK did not differ significantly between the two groups: $X_1 = 40.81$, $X_2 = 38.45$; Levene (10.88, 39) = .00, t-value for separate variance estimates

= 1.61 at p = .12. This t-test was 2-sided, as no direction was hypothesized for the differing population means prior to data collection.

FEAR subscale scores on the ANPS differed significantly between the two groups: $X_1 = 29.76$, $X_2 = 43.50$; Levene (3.76, 39) = .06, t = -8.19 at $p<.01$.

ANGER subscale scores on the ANPS differed significantly between the two groups: $X_1 = 32.86$, $X_2 = 39.45$; Levene (3.62, 39) = .06, t = -3.04 at p = .004.

CARE subscale scores on the ANPS did not differ significantly between the two groups: $X_1 = 40.38$, $X_2 = 41.60$; Levene (1.81, 39) = .19, t = -.68 at p = .50.

PLAY subscale scores on the ANPS did differ significantly between the two groups: $X_1 = 44.00$, $X_2 = 37.65$; Levene (.26, 39) = .61, t = 3.91 at $p<.01$.

SPIRITUALITY subscale scores on the ANPS did not differ significantly between the two groups: $X_1 = 30.19$, $X_2 = 31.30$; Levene (.71, 39) = .40, t = -.67 at p = .51.

In summary, from these initial analytical investigations, it emerges that scores on separation-distress, anxiety, anger and seriousmindedness (as evaluated by the ANPS subscales SADNESS, FEAR, ANGER and PLAY, respectively) are significantly influenced by whether the participant falls into the non O-C or O-C group.

4.4. Conflict-monitoring and separation-distress

Two sets of correlations were carried out to determine whether separation-distress and conflict-monitoring were related. For both groups, correlational analyses were carried out on overall conflict-monitoring scores as related to SADNESS subscale scores on the ANPS. Neither group showed significant evidence of a relationship between separation-distress as measured by SADNESS and conflict-monitoring: $r^2 = .05$, t = -.99, p = .33.

4.5. MCQ and PI factors related to conflict-monitoring and separation-distress

As discussed at the beginning of the results section, it will now be relevant to investigate whether any of the specific factor items of the MCQ and PI are significantly related to either separation-distress or conflict-monitoring, since overall scores on obsessive-compulsiveness fail to reveal any such relationships. It may also be worthwhile to analyze possible relationships between these factors and the other emotion subscales of the ANPS (especially those that were found to be significantly influenced by the O-C versus non O-C grouping: FEAR, ANGER and PLAY). Again, to strengthen any differences found between groups with regards to the OCD questionnaire scale factors, independent t-tests were performed on the scores from the two groups, for each of the nine factors:

Factor	Valid N	X_1	X_2	T	df	p
MCQ 1	41	24.24	53.55	-18.39	30.41	<.01
MCQ 2	41	23.19	50.80	-19.22	39	<.01
MCQ 3	41	11.33	27.90	-13.92	21.92	<.01
MCQ 4	41	19.33	37.70	-17.21	39	<.01
MCQ 5	41	14.00	20.20	-6.56	39	<.01
PI 1	41	18.14	66.30	-25.04	20.49	<.01
PI 2	41	13.29	37.10	-12.41	22.24	<.01
PI 3	41	9.23	29.15	-13.71	20.32	<.01
PI 4	41	7.48	22.75	-11.29	19.67	<.01

Table 2: Independent t-test results for O-C vs non O-C group on all nine OCD factors

Table 2 demonstrates that participants from the two groups scored significantly differently on all nine factors.

4.5.1. MCQ and PI factors as related to conflict-monitoring

More detailed correlations between conflict-monitoring scores and the nine separate OCD questionnaire factors were carried out; since an independent t-test showed no significant differences between the O-C and non O-C group on this measure. It was decided before any analyses were performed that, should the t-test not reveal significant differences, correlations between each of the factors and the overall conflict-monitoring scores would be carried out in order to determine whether any of the specific factors are indeed related to the conflict-monitoring measure. Analyses were performed for each of the two groups separately, as well as for the two groups combined. Previous results indicating the rank of factors in terms of their correlation with overall O-C scores (see introduction to **Results** section) were used to guide the order in which these factors were analysed; based on this order, each factor was considered less likely than the preceding one to reveal a significant relationship to conflict-monitoring. In **Table 3** below, the factors are reordered as they occur in the questionnaires. **Valid N = 41** for all factors; conflict-monitoring has been abbreviated to **C-M**; direction of correlation is shown in the last column, **r(X,Y)**:

FACTOR		r^2	t	p	St. dev.		X (Mean)		R(X,Y)
					C-M	OCD factor	C-M	OCD factor	
MCQ 1	Combined	.02	.81	.43	13.47	15.65	23.59	38.54	.13
	Non O-C	.09	-1.39	.18	14.98	3.63	21.21	24.24	-.30
	O-C	.00	-.15	.88	11.54	6.19	26.08	53.55	-.04
MCQ 2	Combined	.04	1.26	.21	13.47	14.69	23.59	36.66	.20
	Non O-C	.05	.95	.35	14.98	4.50	21.21	23.19	.21
	O-C	.01	-.40	.70	11.54	4.70	26.08	50.80	-.09
MCQ 3	Combined	.05	1.41	.17	13.47	9.16	23.59	19.41	.22
	Non O-C	.00	-.02	.98	14.98	1.46	21.21	11.33	-.00
	O-C	.06	1.04	.31	11.54	5.13	26.08	27.90	.24
MCQ 4	Combined	.01	.64	.52	13.47	9.89	23.59	28.29	.10
	Non O-C	.06	-1.11	.28	14.98	3.57	21.21	19.33	-.25

	O-C	.02	-.63	.54	11.54	3.25	26.08	37.70	-.15
MCQ 5	Combined	.02	.93	.36	13.47	4.33	23.59	17.02	.15
	Non O-C	.03	.71	.48	14.98	2.83	21.21	14.00	.16
	O-C	.02	-.16	.55	11.54	3.22	26.08	20.20	-.14
PI 1	Combined	.04	1.21	.23	13.47	25.08	23.59	41.63	.19
	Non O-C	.01	.40	.69	14.98	1.71	21.21	18.14	.09
	O-C	.00	.29	.78	11.54	8.44	26.08	66.30	.07
PI 2	Combined	.05	1.41	.17	13.47	13.44	23.59	24.90	.22
	Non O-C	.01	.40	.69	14.98	2.47	21.21	13.29	.20
	O-C	.02	.63	.54	11.54	8.24	26.08	37.10	.15
PI 3	Combined	.02	.85	.40	13.47	11.03	23.59	18.95	.14
	Non O-C	.01	.36	.72	14.98	1.22	21.21	9.24	.08
	O-C	.02	-.67	.51	11.54	6.38	26.08	29.15	-.16
PI 4	Combined	.01	.52	.61	13.47	8.78	23.59	14.93	.08
	Non O-C	.05	-.96	.35	14.98	.81	21.21	7.48	-.22
	O-C	.06	-1.04	.31	11.54	6.00	26.08	22.75	-.24

Table 3: Correlational statistics for the relation between OCD factors and C-M

Table 3 illustrates that there are *no* significant effects. Again it is noted that these results are based on the normally distributed C-M score population, which should reveal any significant differences that do occur in the data. It is also noted that, although none of the results reported in **Table 3** are significant, the effect size for this measure is .37, which represents a moderate difference between the scores of the two groups (see section **4.2.**, pp.50-51).

4.5.2. Correlations of MCQ and PI factors with separation-distress

Valid N = 41 for all factors; separation-distress has been abbreviated to **S-D**; direction of correlation is shown in the last column, **r(X,Y)**; all significant results are highlighted in red:

FACTOR		r^2	t	p	St. dev.		X (Mean)		R(X,Y)
					S-D	OCD factor	S-D	OCD factor	
MCQ 1	Combined	.55	6.91	.00	6.73	15.65	35.61	38.54	.74
	Non O-C	.00	-.06	.96	3.83	3.63	30.90	24.24	-.01
	O-C	.13	1.64	.12	5.44	6.19	40.55	53.55	.36
MCQ 2	Combined	.58	7.27	.00	6.73	14.69	35.61	36.66	.76
	Non O-C	.01	.41	.69	3.83	4.50	30.90	23.19	.09
	O-C	.24	2.37	.03	5.44	4.70	40.55	50.80	.49
MCQ 3	Combined	.37	4.75	.00	6.73	9.16	35.61	19.41	.61
	Non O-C	.07	-1.18	.25	3.83	1.46	30.90	11.33	-.26
	O-C	.05	-.95	.35	5.44	5.13	40.55	27.90	-.22
MCQ 4	Combined	.41	5.20	.00	6.73	9.89	35.61	28.29	.64
	Non O-C	.01	.31	.76	3.83	3.57	30.90	19.33	.07
	O-C	.16	-1.83	.08	5.44	3.25	40.55	37.70	-.40
MCQ 5	Combined	.25	3.65	.00	6.73	4.33	35.61	17.02	.50
	Non O-C	.24	-2.47	.02	3.83	2.83	30.90	14.00	-.49
	O C	.06	1.09	.29	5.44	3.22	40.55	20.20	.25
PI 1	Combined	.55	6.97	.00	6.73	25.08	35.61	41.63	.74
	Non O-C	.13	1.68	.11	3.83	1.71	30.90	18.14	.36
	O-C	.06	1.11	.28	5.44	8.44	40.55	66.30	.25
PI 2	Combined	.37	4.79	.00	6.73	13.44	35.61	24.90	.61
	Non O-C	.01	.38	.71	3.83	2.47	30.90	13.29	.09
	O-C	.04	-.85	.40	5.44	8.24	40.55	37.10	-.20
PI 3	Combined	.44	5.59	.00	6.73	11.03	35.61	18.95	.67

PI 4	Non O-C	.17	1.97	.06	3.83	1.22	30.90	9.24	.41
	O-C	.00	-.18	.86	5.44	6.38	40.55	29.15	-.04
	Combined	.42	5.30	.00	6.73	8.78	35.61	14.93	.65
	Non O-C	.09	-1.40	.18	3.83	.81	30.90	7.48	-.31
	O-C	.00	.27	.79	5.44	6.00	40.55	22.75	.06

Table 4: Correlational statistics for the relation between OCD factors and S-D

The results in **Table 4** support the earlier report that participants' scores on separation-distress are in fact significantly influenced by their grouping as either O-C or non O-C (see section **4.2.**). Values in **Table 4** illustrate that when the two groups' O-C scores are correlated with their S-D scores, these two measures are significantly correlated, for all nine factors. Further, for **MCQ Factor 2** (*Negative beliefs about the Control of Thoughts and Corresponding Danger*), the O-C group's S-D and O-C scores are significantly correlated when treated as a separate group, whereas the non O-C group's scores are not. Similarly, for **MCQ Factor 5** (*Cognitive Self-Consciousness*), the *non* O-C group's S-D and O-C scores are significantly correlated when treated as a separate group, whereas the O-C group's scores are not.

4.6. Conflict-monitoring (raw scores), O-C and separation-distress

Given the unexpected results that failed to reveal any significant relationships (either causal or correlational) between the measure of conflict-monitoring used in this study and those of O-C and separation-distress, some further and final statistical analyses were carried out using the *raw scores* obtained on the Stroop test by participants of the second part of the study. First participants' overall score out of 200 (each of the four Stroop stimulus conditions consists of 50 items) was taken as a measure of conflict-monitoring, and correlated with (a) overall O-C scores (see **Table 5**) and (b) separation-distress scores (as measured by the ANPS SADNESS subscale; see **Table 6**):

	Mean	St. Dev.	r(X,Y)	r^2	T
C-M	193.56	4.10	1.00	1.00	-1.82
O-C	278.66	125.86	-.28	.08	-1.82

Table 5: Correlational statistics for the relation between overall O-C and C-M scores (out of 200)

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
S-D	35.61	6.73	1.00	1.00	-1.30	.20	41
C-M	193.56	4.10	-.20	.04	-1.30	.20	41

Table 6: Correlational statistics for the relation between overall S-D and C-M scores (out of 200)

Second, t-tests (independent by group) were carried out to investigate whether grouping in the study had an effect on C-M and S-D scores. In both analyses, GROUP (O-C vs non O-C) was used as the independent variable, with C-M (score out of 200) and O-C (overall score) serving as the two dependent variables. The results are shown below, in **Table 7** and **Table 8**, respectively:

	Mean non O-C	Mean O-C	t-value	df	p 2-sided	t separ. var. est.	Df
C-M	194.71	192.35	1.91	39	.06	1.89	34.65
O-C	158.62	404.70	-42.73	39	.00	-41.75	20.46

	p	Valid N non O-C	Valid N O-C	St. Dev. Non O-C	St. Dev. O-C	F	p	Levene F (1,df)	df Levene	p Levene
C-M	.07	21	20	3.32	4.56	1.89	.17	2.14	39	.15
O-C	.00	21	20	5.19	25.87	24.83	.00	17.14	39	.00

Table 7: t-test analyses of overall O-C scores and C-M scores (out of 200)

It is important to note that all the significant scores simply reflect and confirm previous findings (i.e. that the 2 groups are significantly different in terms of O-C).

	Mean non O-C	Mean O-C	t-value	df	p	t sep. var. est.	Df
S-D	30.90	40.55	-6.59	39	.00	-6.53	33.98
C-M	194.71	192.35	1.91	39	.06	1.89	34.65

	p 2-sided	Valid N non O-C	Valid N O-C	St. Dev. Non O-C	St. Dev. O-C	F-ratio variances	p variances	Levene F (1,df)	p Levene
S-D	.00	21	20	3.83	5.44	2.02	.13	3.18	.08
C-M	.07	21	20	3.32	4.56	1.89	.17	2.14	.15

Table 8: t-test analyses of overall S-D scores and C-M scores (out of 200)

Similarly, in **Table 8**, it is evident that S-D was found to be significantly different between the two groups (a finding already established), whilst analyses continue to reflect a non-significant effect in terms of the C-M measure.

Third, *Total Error Score* can also be considered a raw measure of participants' conflict-monitoring levels, and was included in these analyses for the purpose of thorough investigation. Results are presented in the following tables:

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
C-M	6.44	4.10	1.00	1.00	1.82	.08	41
O-C	278.66	125.86	.28	.08	1.82	.08	41

Table 9: Correlational statistics for the relation between overall O-C scores and Total Error Score (C-M)

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
S-D	35.61	6.73	1.00	1.00	1.30	.20	41
C-M	6.44	4.10	.20	.04	1.30	.20	41

Table 10: Correlational statistics for the relation between overall S-D scores and Total Error Score (C-M)

Similarly, *Total Completion Time* on the Stroop task may be used as a raw measure of conflict-monitoring, since "the primary method for analyzing performance on the D-KEFS Colour-Word Interference Test is based on the number of seconds that the examinee takes to complete each of the four conditions" (Delis et al., 2001, p. 97) and "the completion-time score for each condition provides a global measure of performance on that task" (Delis et al., 2001, p. 101):

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
C-M (Time)	164.02	27.04	1.00	1.00	1.46	.15	41
O-C	278.66	125.86	.23	.05	1.46	.15	41

Table 11: Correlational statistics for the relation between overall O-C scores and Total Completion Time (C-M)

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
S-D	35.61	6.73	1.00	1.00	.16	.87	41
C-M (Time)	164.02	27.04	.00	.00	.16	.87	41

Table 12: Correlational statistics for the relation between overall S-D scores and Total Completion Time (C-M)

The above results show that there is not a statistically significant difference, which adds weight to the conclusion that, in this sample at least, there really is no demonstrable effect of O-C versus non O-C grouping on the conflict-monitoring measure. The average total times for the two samples are 158.04 seconds (non O-C) and 170.30 seconds (O-C) – these descriptive statistics reinforce the conclusion of non-significance, since there is no obvious discrepancy between the averages (although they do differ in the hypothesized direction).

Finally, *Total Completion Time* (as a measure of conflict-monitoring) was correlated with a single O-C factor from the initial two questionnaires: *Cognitive self-consciousness* (correlation of **.34** with overall O-C score) was chosen, since it represented the factor

least correlated with the overall O-C measurement and therefore the one that would most likely reveal any kind of relationship with conflict-monitoring:

	Mean	St. Dev.	r(X,Y)	r^2	t	p	N
C-M (Time)	164.02	27.04	1.00	1.00	.02	.98	41
O-C (MCQ Factor 5)	17.02	4.33	.00	.00	.02	.98	41

Table 13: Correlational statistics for the relation between Total Completion Time (C-M) and MCQ Factor 5 (O-C)

Since no significant results were obtained with this factor, it can be concluded that none of the other factors (all of which are more closely related to overall O-C scores) will reveal anything contrary.

Use of t-tests confirmed that GROUPING (i.e. O-C vs non O-C) did not affect either (a) *Total Error Score* or (b) *Total Completion Time* (both of which were used as the dependent variable, C-M, in analyses): (a) $X_1 = 5.29$, $X_2 = 7.65$; $t = -1.91$ at $p = .06$, and (b) $X_1 = 158.05$, $X_2 = 170.30$; $t = -1.47$ at $p = .15$.

Chapter 5: Discussion

5.1. Conflict-monitoring and O-C

Based on the independent t-test and correlational analyses, there did not appear to be a significant difference between the non O-C and the O-C group on the measure of conflict-monitoring. Conflict-monitoring scores were not significantly different between the two groups when overall O-C scores were analysed, and no significant differences appeared between them on any one of the nine OCD questionnaire factors, either. Since the score distribution of the conflict-monitoring measure was concluded to be normal (see section **4.2.**, **Figure 1** and **Table 1**), there are various conclusions that may be drawn from this unexpected finding.

First, it must be considered that there is in fact no difference between people who are inclined towards obsessive-compulsiveness and those who are not, in terms of their levels of conflict-monitoring. This seems unlikely as a final and straightforward conclusion, however, since previous empirical research has established such a link using neuroimaging techniques. In light of the fact that most of the evidence for the correlation between conflict-monitoring and obsessive-compulsiveness is derived from the neuroimaging paradigm, a second and more realistic explanation for the lack of significance achieved in this area of the current research might be that such differences, should they exist, are subtle enough to escape evaluation by means of the meta-cognitive, pencil-and-paper task that was employed, and require neuroimaging analysis to demonstrate any differences between two such groups.

Third, it must be considered that the non-significance indicates not that there are no such differences between obsessive-compulsiveness and conflict-monitoring in reality, but that there is simply no significant difference between the two measures *in this sample*. Perhaps the non-clinical status of the two groups led to this insignificance. This is, however, unlikely, since such a large initial sample was obtained and the extreme high-scoring group drawn reflects the incidence of OCD in the world population: O-C

incidence in this sample is two percent, compared with the estimated OCD lifetime prevalence of two to three percent (Robins et al., 1984 in Maltby et al., 2004).

It is also possible that significance did not occur in this sample because the two groups drawn were too small; however, power calculations indicate that a sample size of 20 in each group is sufficient to obtain a respectable power statistic (see introduction to **Results** section). Fourth and lastly, it is possible that the conflict-monitoring measure used in this study (that is, obtaining differential scores on a 'meta-cognitive' type Stroop) is too weak to pick up any differences that may exist between the two groups. The reliability of the measure is unestablished, since no similar use of the Stroop test (nor any other suitable conflict-monitoring measure) could be found in the literature. It is not possible to establish the reliability, since there is only a single measure of discrepancy-detection in the study; therefore, reliability could be low, contributing to the lack of significance obtained using this measure. Based on the balance of all the evidence considered above, it seems most probable that the second and fourth considerations discussed here (that is, removing the measure from the neuroimaging paradigm and using a weak conflict-monitoring measure, respectively) are responsible for the lack of significance found for support of the first hypothesis. Thus for H_1, it is necessary to accept the null hypothesis that conflict-monitoring in fact does *not* constitute a possible mechanism of OCD, based on this research sample.

5.2. Separation-distress and O-C

Based on the independent t-test and correlational analyses, there is a significant difference between the non O-C and O-C group on the measure of separation-distress. Separation-distress scores were significantly different between the two groups when overall O-C scores were analysed, and significant differences were also revealed between the groups when further, detailed correlational analyses of the nine OCD questionnaire factors were carried out. Additionally, the groups scored significantly differently on the separation-distress factor in the hypothesized direction ($X_1 = 30.90$, $X_2 = 40.55$) and the t-value ($t = -6.59$ at $p<.01$) was of sufficient magnitude to enhance this finding further. Thus it is possible to reject the second null hypothesis and accept H_2: PANIC/separation-

distress is significantly implicated in obsessive-compulsiveness, and could be conceptualized as an affective correlate of OCD and of tendencies towards the disorder. The psychoanalytical perspective of OCD as an obsessional neurosis involving heightened separation-distress (i.e., pathological difficulty with letting go and accepting loss) is therefore supported by the findings of this dissertation. Furthermore, the link between conflict-monitoring and separation-distress, although not vindicated by the conflict-monitoring results in this study, cannot be dismissed, especially considering that previous research implicates heightened ACC activity in OCD, and that the PANIC or separation-distress emotion system appears to overlap largely with this same extended neuroanatomical and neurochemical network in the mammalian brain.

Regarding further statistical analyses carried out to investigate the relationship between separation-distress and OCD or obsessive-compulsiveness, detailed analyses were conducted to determine to what extent each of the nine OCD questionnaire factors are related to separation-distress scores. Results showed that when the two groups' O-C scores are correlated with their separation-distress scores, these two measures are significantly correlated, for all nine factors. The factors are ranked in the following order, in terms of what percentage they contribute to the significantly higher scoring on separation-distress: obsessive-compulsiveness as represented by MCQ Factor 2, *Uncontrollability and danger*, explains 58% of the variance of separation-distress scores between the two groups ($\mathbf{r^2 = .58}$); MCQ Factor 1, *Positive beliefs about worry*, and PI Factor 1, *Impaired control over mental activities*, both explain 55% ($\mathbf{r^2 = .55}$); PI Factor 3, *Checking behaviours*, explains 44% ($\mathbf{r^2 = .44}$); PI Factor 4, *Urges and worries of losing control over motor behaviours*, explains 42% ($\mathbf{r^2 = .42}$); MCQ Factor 4, *Superstitions of punishment and responsibility*, explains 41% ($\mathbf{r^2 = .41}$); PI Factor 2, *Becoming contaminated*, and MCQ Factor 3, *Cognitive confidence*, both explain 37% ($\mathbf{r^2 = .37}$); and MCQ Factor 5, *Cognitive self-consciousness*, explains 25 % ($\mathbf{r^2 = .25}$). Such statistics demonstrate that whether participants were in the non O-C or the O-C group had a substantial effect on their affective profile in terms of their separation-distress scores as measured by the SADNESS subscale of the ANPS. The r^2 statistics obtained in these analyses are large (Howell, 2002) and provide an exceptionally high percentage of the

explanation in the score variance between the groups, which strongly supports the hypothesis that PANIC or separation-distress is implicated as a central emotion in OCD or in tendencies towards the disorder. The power calculations for Pearson's *r* in these analyses reveal power coefficients as follows, using the same ranked order as factors are given in above: .99, .98, .98, .95, .94, .93, .90, .90 and .72. These are high power coefficients for Pearson's *r* (Howell, 2002), a fact which further strengthens the conclusion that separation-distress is significantly related to obsessive-compulsiveness. Further, for **MCQ Factor 2** (*Negative beliefs about the Control of Thoughts and Corresponding Danger*), the O-C group's S-D and O-C scores are significantly correlated when treated as a separate group (with a power coefficient of .87), whereas the non O-C group's scores are not. Similarly, for **MCQ Factor 5** (*Cognitive Self-Consciousness*), the *non* O-C group's S-D and O-C scores are significantly correlated when treated as a separate group (with a power coefficient of .78), whereas the O-C group's scores are not. These two results – represented by the O-C factors most and least correlated with S-D, respectively – strengthen the evidence that, in terms of separation-distress, the score populations are independent.

5.3. Conflict-monitoring and separation-distress

No significant relationship was found between the measures of separation-distress and conflict-monitoring in this dissertation. This is to be expected, based on the preceding analyses that show a non-significant relationship between O-C and conflict-monitoring, but a significant relationship between O-C and separation-distress. It follows logically that no significant results would be obtained by correlating separation-distress with conflict-monitoring. It is debatable to what extent this result affects the conclusions that may be drawn from this dissertation (see section **5.5.** below).

5.4. The other emotions and O-C

Analyses not central to the hypotheses of this dissertation but nevertheless beneficial in understanding and drawing conclusions from the findings, involved the six affective categories that were assessed by the ANPS in addition to separation-distress: FEAR (anxiety), SEEK (curiosity-driven, goal-directed behaviour), ANGER, CARE, PLAY

(seriousmindedness), and SPIRITUALITY. Independent t-tests showed that anxiety, anger and seriousmindedness (as evaluated by the ANPS subscales FEAR, ANGER and PLAY, respectively) are also significantly related to obsessive-compulsiveness, whereas curiosity/goal-directed behaviour, spirituality and caring (assessed by SEEK, SPIRITUALITY and CARE, respectively) are not. For the FEAR subscale, the means differed in the expected direction (based on the substantial body of empirical literature regarding anxiety in OCD, e.g., Dorfan & Woody, 2006; Kim & Gorman, 2005; Mancini & Gangemi, 2004; Whiteside, Port, Deacon & Abramowitz, 2006); with those in the O-C group scoring significantly higher on FEAR than those in the non O-C group. Participants in the O-C group scored significantly higher on the ANGER subscale than those in the non O-C group, whereas this result was reversed for scores on the PLAY factor: O-C participants scored significantly lower on this subscale than those in the non O-C group.

Although no directional hypotheses were specified for the latter two results, they are in accordance with general expectations of O-C mentality: anger is invariably linked to frustration and fear, predicting a higher score on the ANGER subscale for those inclined towards obsessive-compulsiveness (e.g., Offer, Lavie, Gothelf and Apter (2000) found that several defences distinguished different groups of psychiatric patients from controls, and that a few defences – namely projection, displacement and regression – correlated significantly with anger and especially distinguished the OCD patients from other psychiatric groups and from controls); and seriousmindedness is predicted by the characteristic rigidity, obsessive attention to detail and goal-setting – as well as, again, heightened levels of fear – in those with or inclined towards OCD (Cassin & von Ranson, 2005; Nelson, Abramowitz, Whiteside & Deacon, 2006; Spano, 2001), which leads to the inverse characteristic of a significantly lower tendency towards playfulness.

It is crucial to notice that, in this sample, there was in fact a larger differential score between the two groups on the FEAR subscale (X_1 = 29.76, X_2 = 43.50) than on the SADNESS subscale (X_1 = 30.90, X_2 = 40.55), as well as an larger attendant t statistic (-8.19 vs -6.59); both analyses were significant at the level of $p<.01$. The factors ANGER (X_1 = 32.86, X_2 = 39.45) and then PLAY (X_1 = 44.00, X_2 = 37.65) followed in terms of

their respective differential sizes, completing the rank of the four affective scales that yielded significant differences in this sample. The important observation here, however, concerns the FEAR and SADNESS scales, since the former is traditionally established as the central emotion in OCD and the latter is the pivotal affect under investigation in this study. It was considered that separation-distress (SADNESS), rather than anxiety (FEAR), is the central emotion in OCD or O-C cognitions and behaviour, and that fear-anxiety – while clearly fundamental in the disorder – is more likely closely related to, and possibly a result of, the catalyst PANIC emotion. Though scores on the FEAR subscale of the ANPS implemented in this study did yield a greater differential than the SADNESS scale, this unfortunately does not confirm which of the two affects is the catalyst and which is the resultant emotion (or whether indeed the two are even related in this manner). However, the dissertation does provide evidence both to re-confirm the importance of anxiety in the disorder (or in such disordered ways of thinking, feeling and behaving) and to argue that PANIC or separation-distress is just as critical in the affective manifestation thereof. The fact that anxiety *was* found to be so convincingly significant adds great weight to the significant findings of this dissertation for separation-distress, since it serves to support the new findings with established research, in the same set of data.

5.5. Considerations

It is important to put the lack of significance obtained for H_1 in perspective – this relationship between factors was needed to rationalize investigation of the connection between S-D and O-C, which was indeed significant (and which forms the main thrust of the thesis), so from this point of view, it is less relevant that no significant effect was found. However, critics will argue that the finding for H_1 is indeed *very* significant, precisely because the rationale for proposing H_2 in this study was based upon it. It remains to be debated whether the significance of the finding regarding H_2 in any way relies upon a positive finding in H_1; however, the value of this dissertation is not at the mercy of the outcome of such a debate, since alternative explanations have been provided for the non-significance of H_1 that stand independently of this consideration.

5.6. Implications for emotion in OCD

It appears that separation-distress (or the basic emotion, PANIC, which underlies the consciously experienced feeling of separation-distress at a neurophysiological level) is strongly implicated in tendencies towards obsessive-compulsiveness and, based on the strong sampling procedures in this study, very possibly in OCD. Clearly, FEAR is also crucial in the experience of obsessive-compulsive mental states; however, the established knowledge that it is the *central* or driving emotion is brought into question by the current findings. This study provides motivation to investigate more closely whether a pathological sensitivity to or activation of the PANIC/separation-distress basic emotion system could indeed be an important mechanism of OCD.

Chapter 6: Conclusions and recommendations for future research

6.1. Limitations

It is important to consider the conclusions discussed above, drawn from the statistical findings, with the shortcomings of research design that unfortunately attend the study. First, a college sample was used in this dissertation: although care was taken to sample from a wide variety of undergraduate disciplines in order to achieve some sense of cross-sectionality in the sample, it was ultimately homogeneous by necessity (given the accessibility of undergraduate university students). College students represent a unique, select portion of the larger population, and hence conclusions made on the basis of such a sample must be considered in this light. However, in defence of the sample, it is reiterated that the strong sampling procedures (in terms of number of participants tested initially and then secondarily), in which OCD lifetime prevalence figures of two to three percent (Robins et al., 1984 in Maltby et al., 2004) were matched by drawing 20 participants from each end of a spectrum of 1119 respondents (creating a two percent "OCD incidence rate" in this sample) at least to some extent counteract this limitation and lend the conclusions greater persuasive power than a college sample would otherwise merit.

Second, practical constraints on this empirical study demanded that a limited array of specific questionnaires and tests be employed in an attempt to investigate exceptionally complex cognitive and affective characteristics of the participants. Time and resource constraints, as well as the sheer implicit complexity of the subject of research, inevitably posed the insurmountable challenge of obtaining a completely accurate idea of the cognitive and affective profiles of participants. Ideally, quantitative data would be supplemented by an in-depth qualitative research component, which could assist in placing the obsessive-compulsive tendencies of each subject under investigation in their individual contexts. It would also be useful to conduct the same investigations on participants diagnosed with clinical OCD, and on non-clinical participants (such as those in this study) evaluated by a different set of questionnaires and cognitive tasks. Such considerations may be useful in strengthening an extended version of this study.

6.2. Suggestions for future research

The current dissertation could usefully be extended into a neuroimaging study, in which separation-distress could be focused on, given the present significant results. Perhaps a sample of clinical OCD patients could be recruited in order to study ACC activity in response to affective – as opposed to cognitive (for example, conflict-monitoring) – tasks, specifically those that elicit separation-distress, as well as the fear-anxiety response (again, to strengthen any evidence obtained with regard to PANIC). To further investigate the degree of difference between those clinically diagnosed with OCD and those with strong tendencies towards it – and so to investigate the merit of a *spectrum* conceptualization of the disorder or group of disorders – a series of cross-sectional studies of the kind briefly mentioned above (in section **6.1.**) could be carried out. For example, clinical, sub-clinical and non-clinical samples could be tested using the same constellation of assessments; followed by new samples of clinical, sub-clinical and non-clinical participants tested with evaluations that may capture different aspects of their obsessive-compulsiveness.

More detailed investigation of how PANIC and separation-distress are implicated in OCD could be attempted, not necessarily within the neuroimaging paradigm. It would be useful to devise a study to research the interconnection demonstrated in this dissertation between FEAR and SADNESS on the ANPS subscales, that is, one that tries to ascertain whether one emotion may be the primary, instigating affect of the disorder whilst the other constitutes more of a secondary affect, since they are clearly closely related and both are crucial to the experience of obsessive-compulsive cognition and emotion. Such findings would be valuable in terms of their implications for cognitive-behavioural as well as for psychiatric treatment of the disorder, and could also make a significant contribution to understanding the mechanism that operates this pathological and debilitating state of mind.

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Appendices

APPENDIX A: The Meta-cognitions Questionnaire (MCQ)

Instructions:

This questionnaire is concerned with beliefs people have about their thinking. Listed below are a number of beliefs that people have expressed. Please read each item and indicate how much you generally agree with it by circling the appropriate number. Please respond to all of the items, there are no right or wrong answers.

	"do not agree" 1	**"agree slightly" 2**	**"agree moderately" 3**	**"agree very much" 4**
1. Worrying helps me to avoid problems in the future.				
2. Worrying is dangerous for me.				
3. I have difficulty knowing if I have actually done something, or just imagined it.				
4. I think a lot about my thoughts.				
5. I could make myself sick with worrying.				
6. I am aware of the way my mind works when I am thinking about a problem.				
7. If I did not control a worrying thought, and then it happened, it would be my fault.				
8. If I let my worrying thoughts get out of control, they will end up controlling me.				
9. I need to worry in order to remain organized.				
10. I have little confidence in my memory for words and names.				
11. My worrying thoughts persist, no matter how I try to stop them.				
12. Worrying helps me to get things sorted out in my mind.				
13. I cannot ignore my worrying thoughts.				
14. I monitor my thoughts.				
15. I should be in control of my thoughts all the time.				
16. My memory can mislead me at times.				
17. I will be punished for not controlling certain thoughts.				
18. My worrying could make me go mad.				
19. If I do not control my worrying thoughts, they could come true.				
20. I rarely question my thoughts.				

21. Worrying puts my body under a lot of stress.
22. Worrying helps me to avoid disastrous situations.
23. I am constantly aware of my thinking.
24. I have a poor memory.
25. I pay close attention to the way my mind works.
26. People who do not worry have no depth.
27. Worrying helps me cope.
28. I imagine having not done things, and then doubt my memory for doing them.
29. Not being able to control my thoughts is a sign of weakness.
30. If I did not worry, I would make more mistakes.
31. I find it difficult to control my thoughts.
32. Worrying is a sign of a good person.
33. Worrying thoughts enter my head against my will.
34. If I could not control my thoughts I would go crazy.
35. I will lose out in life if I do not worry.
36. When I start worrying, I cannot stop.
37. Some thoughts will always need to be controlled.
38. I need to worry in order to get things done.
39. I could be punished for not having certain thoughts.
40. My thoughts interfere with my concentration.
41. I it alright to let my thoughts roam free.
42. I worry about my thoughts.
43. I am easily distracted.
44. My worrying thoughts are not productive.
45. Worrying can stop me from seeing a situation clearly.
46. Worrying helps me to solve problems.
47. I have little confidence in my memory for places.
48. My worrying thoughts are uncontrollable.
49. It is bad to think certain thoughts.
50. If I do not control my thoughts, I may end up embarrassing myself.
51. I do not trust my memory.
52. I do my clearest thinking when I am worrying.
53. My worrying thoughts appear automatically.
54. I would be selfish if I never worried.
55. If I could not control my thoughts, I would not be able to function.
56. I need to worry in order to work well.
57. I have little confidence in my memory for actions.

58. I have difficulty keeping my mind focused on one thing for a long time.
59. If a bad thing happens which I have not worried about, I feel responsible.
60. It would not be normal if I did not worry.
62. If I stopped worrying, I would become glib, arrogant, and offensive.
63. Worrying helps me to plan the future more effectively.
64. I would be a stronger person if I could worry less.
65. It would stupid and complacent not to worry.

APPENDIX B: The Padua Inventory (PI)

Instructions:

The following statements refer to thoughts and behaviours which may occur to everyone in everyday life. For each statement, choose the reply that best seems to fit you and the degree of disturbance which such thoughts or behaviours may create. Rate your replies as follows:

0 – not at all
1 – a little
2 – quite a lot
3 – a lot
4 – very much

1. I feel my hands are dirty when I touch money.
2. I think even slight contact with bodily secretion (perspiration, saliva, urine, etc.) may contaminate my clothes or somehow harm me.
3. I find it difficult to touch an object when I know it has been touched by strangers or by certain people.
4. I find it difficult to touch garbage or dirty things.
5. I avoid using public toilets because I am afraid of disease and contamination.
6. I avoid using public telephones because I am afraid of contagion and disease.
7. I wash my hands more often and longer than necessary.
8. I sometimes have to wash or clean myself simply because I think I may be dirty or 'contaminated'.
9. If I touch something I think is 'contaminated', I immediately have to wash or clean myself.
10. If an animal touches me, I feel dirty and immediately have to wash myself or change my clothing.
11. When doubts or worries come into my mind, I cannot rest until I have talked them over with a reassuring person.
12. When I talk, I tend to repeat the same things and the same sentences several times.
13. I tend to ask people to repeat the same things to me several times consecutively, even though I did understand what they said the first time.
14. I feel obliged to follow a particular order in dressing, undressing and washing myself.
15. Before going to sleep, I have to do certain things in a certain order.
16. Before going to bed, I have to hang up or fold my clothes in a special way.
17. I feel I have to repeat certain numbers for no reason.
18. I have to do things several times before I think they are properly done.
19. I tend to keep on checking things more often than necessary.
20. I check and recheck gas and water taps and light switches after turning them off.
21. I return home to check doors, windows, drawers, etc., to make sure they are properly shut.

22. I keep on checking forms, documents, cheques, etc., in detail, to make sure I have filled them in correctly.
23. I keep on going back to see that matches, cigarettes, etc., are properly extinguished.
24. When I handle money I count and recount it several times.
25. I check letters carefully many times before posting them.
26. I find it difficult to take decisions, even about unimportant matters.
27. Sometimes I am not sure I have done things which in fact I know I have done.
28. I have the impression that I will never be able to explain things clearly, especially when talking about important matters that involve me.
29. After doing something carefully, I still have the impression I have either done it badly or not finished it.
30. I am sometimes late because I keep on doing certain things more often than necessary.
31. I invent doubts and problems about most of the things I do.
32. When I start thinking of certain things, I become obsessed with them.
33. Unpleasant thoughts come into my mind against my will and I cannot get rid of them.
34. Obscene or dirty words come into my mind and I cannot get rid of them.
35. My brain constantly goes its own way and I find it difficult to attend to what is happening around me.
36. I imagine catastrophic consequences as a result of absent-mindedness or minor errors which I make.
37. I think or worry at length about having hurt someone without knowing it.
38. When I think about a disaster, I think it is somehow my fault.
39. I sometimes worry at length for no reason that I have hurt myself or have some disease.
40. I sometimes start counting objects for no reason.
41. I feel I have to remember completely unimportant numbers.
42. When I read I have the impression I have missed something important and must go back and reread the passage at least two or three times.
43. I worry about remembering completely unimportant things and make an effort not to forget them.
44. When a thought or doubt comes into my mind, I have to examine it from all points of view and cannot stop until I have done so.
45. In certain situations I am afraid of losing my self-control and doing embarrassing things.
46. When I look down from a bridge or a very high window, I feel an impulse to throw myself into space.
47. When I see a train approaching I sometimes think I could throw myself under the wheels.
48. At certain moments, I am tempted to tear off my clothes in public.
49. While driving I sometimes feel an impulse to drive the car into someone or something.
50. Seeing weapons excites me and makes me think violent thoughts.
51. I get upset and worried at the sight of knives, daggers and other pointed objects.
52. I sometimes feel something inside me which makes me do things which are really senseless and which I do not want to do.
53. I sometimes feel the need to break or damage things for no reason.

54. I sometimes have an impulse to steal other people's belongings, even if they are of no use to me.
55. I am sometimes almost irresistibly tempted to steal something from the supermarket.
56. I sometimes have an impulse to hurt defenceless children or animals.
57. I feel I have to make special gestures or walk in a certain way.
58. In certain situations I feel an impulse to eat too much, even if I am then ill.
59. When I hear about a suicide or a crime, I am upset for a long time and find it difficult to stop worrying about it.
60. I invent useless worries about germs and diseases.

APPENDIX C: The Affective Neuroscience Personality Scales (ANPS)

Multi-Dimensional Inventory (ans) Name: _____

Age: ___ Sex: ♂ ♀ Please mark bubbles like this ●

	Str Agree	Agree	Disagree	Str Disagree
1. Almost any little problem or puzzle stimulates my interest.	○	○	○	○
2. People who know me well would say I am an anxious person.	○	○	○	○
3. I often feel a strong need to take care of others.	○	○	○	○
4. When I am frustrated, I usually get angry.	○	○	○	○
5. I am a person who is easily amused and laughs a lot.	○	○	○	○
6. I often feel sad.	○	○	○	○
7. Feeling a oneness with all of creation helps give more meaning to my life.	○	○	○	○
8. I make an effort to remain aware of my feelings and emotions.	○	○	○	○
9. I do not get much pleasure out of looking forward to special events.	○	○	○	○
10. I do not often struggle over making decisions.	○	○	○	○
11. I think it is ridiculous the way some people carry on around baby animals.	○	○	○	○
12. If I am blocked from getting what I want, I usually just accept it.	○	○	○	○
13. My friends would probably describe me as being too serious.	○	○	○	○
14. I seem to be affected less by personal rejection than most people.	○	○	○	○
15. The meaning in my life does not come from feeling connected to other living things.	○	○	○	○
16. I will gossip a little at times.	○	○	○	○
17. I really enjoy looking forward to new experiences.	○	○	○	○
18. I often think of what I should have done after the opportunity has passed.	○	○	○	○
19. I like taking care of children.	○	○	○	○
20. My friends would probably describe me as hotheaded.	○	○	○	○
21. I am known as one who keeps work fun.	○	○	○	○
22. I often have the feeling that I want to cry.	○	○	○	○
23. I am often spiritually touched by the beauty of creation.	○	○	○	○
24. When listening to music, I sometimes become so absorbed in the music that I lose track of everything else going on around me.	○	○	○	○
25. I like to set very practical goals rather than grandiose plans.	○	○	○	○
26. I would not describe myself as a worrier.	○	○	○	○
27. Caring for a sick person would be a burden for me.	○	○	○	○
28. I cannot remember a time when I became so angry that I wanted to break something.	○	○	○	○
29. I generally would not enjoy vigorous games which required physical contact.	○	○	○	○
30. I seem to be less sad than most other people.	○	○	○	○
31. I rarely rely on spiritual inspiration to help me meet important challenges.	○	○	○	○
32. I always tell the truth.	○	○	○	○
33. Seeking an answer is as enjoyable as finding the solution.	○	○	○	○
34. I am frequently more tense inside than others realize.	○	○	○	○
35. I love being around baby animals.	○	○	○	○
36. When I get angry, I often feel like swearing.	○	○	○	○
37. I usually think about good times and have happy thoughts.	○	○	○	○
38. I often feel lonely.	○	○	○	○
39. For me, experiencing a connection to all of life is an important source of inspiration.	○	○	○	○
40. I like to take pleasure in small things, such as the colors in soap bubbles.	○	○	○	○
41. I often feel little eagerness or anticipation when thinking about my goals.	○	○	○	○
42. I have very few fears in my life.	○	○	○	○
43. I do not especially enjoy being around children.	○	○	○	○
44. When I am frustrated, I rarely become angry.	○	○	○	○
45. I dislike humor that gets really silly.	○	○	○	○
46. I am very attached to my family.	○	○	○	○
47. For me, spirituality is not a primary source of inner peace and harmony.	○	○	○	○
48. Sometimes I feel like swearing.	○	○	○	○
49. I enjoy anticipating and working toward a goal almost as much as achieving it.	○	○	○	○
50. I sometimes can not stop worrying about my problems.	○	○	○	○
51. I often feel softhearted towards stray animals.	○	○	○	○
52. When someone makes me angry, I tend to remain fired up for a long time.	○	○	○	○
53. People who know me would say I am a very fun-loving person.	○	○	○	○
54. I often think about people I have loved who are no longer with me.	○	○	○	○
55. Contemplating spiritual issues, often fills me with a sense of intense awe and possibility.	○	○	○	○

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Please mark bubbles like this ● and not like this ⊠ or ⊘

	Str Agree	Agree	Disagree	Str Disagree
56. I have never attempted to express myself by writing poetry.	①	②	③	④
57. I am usually not interested in solving problems and puzzles just for the sake of solving them.	①	②	③	④
58. My friends would say that I am courageous and that it takes a lot to frighten me.	①	②	③	④
59. I would generally consider pets in my home to be more trouble than they are worth.	①	②	③	④
60. People who know me well would say I almost never become angry.	①	②	③	④
61. I do not particularly enjoy kidding around and exchanging "wisecracks."	①	②	③	④
62. It does not particularly sadden me when friends or family members are disapproving of me.	①	②	③	④
63. My sense of significance and purpose in life do not come from my spiritual beliefs.	①	②	③	④
64. I have never "played sick" to get out of something.	①	②	③	④
65. My curiosity sometimes drives me to do things that others might consider a waste of time.	①	②	③	④
66. I often worry about the future.	①	②	③	④
67. I feel sorry for the homeless.	①	②	③	④
68. I tend to get irritated if someone tries to stop me from doing what I want to do.	①	②	③	④
69. I feel happiness most of the time.	①	②	③	④
70. I tend to think about losing loved ones often.	①	②	③	④
71. Feeling a connection with the rest of humanity motivates me to make more ethical choices.	①	②	③	④
72. I am not typically impressed by poetic language or fancy speech.	①	②	③	④
73. I rarely feel the need just to get out and explore things.	①	②	③	④
74. There are very few things that make me anxious.	①	②	③	④
75. I do not like to feel "needed" by other people.	①	②	③	④
76. I rarely get angry enough to want to hit someone.	①	②	③	④
77. I do not tend to see the humor in things many people consider funny.	①	②	③	④
78. Moving away from my friends would not upset me.	①	②	③	④
79. The goals I set for myself are not influenced by my spirituality.	①	②	③	④
80. There have been times in my life when I was afraid of the dark.	①	②	③	④
81. Whenever I am in a new place, I always like to explore the area and get a better feel for my surroundings.	①	②	③	④
82. I often worry about whether I am making the correct decision.	①	②	③	④
83. I frequently do little things for others that make them feel good.	①	②	③	④
84. When things do not work out the way I want, I sometimes feel like kicking or hitting something.	①	②	③	④
85. I enjoy all kinds of games including those with physical contact.	①	②	③	④
86. I frequently feel distressed when I cannot be with my friends.	①	②	③	④
87. Spiritual inspiration helps me transcend my limitations.	①	②	③	④
88. While watching a movie or the like, I may become so involved it is as if I were actually part of it.	①	②	③	④
89. I am not the kind of person that likes probing and investigating problems.	①	②	③	④
90. I rarely worry about my future.	①	②	③	④
91. I do not especially want people to be emotionally close to me.	①	②	③	④
92. I hardly ever become so angry at someone that I feel like yelling at them.	①	②	③	④
93. I enjoy playing games less when it is just for fun and there is no clear winner.	①	②	③	④
94. I rarely think about people or relationships I have lost.	①	②	③	④
95. The suggestion to "Treat other people as they want to be treated" does not arouse strong feelings in me.	①	②	③	④
96. I have never intentionally told a lie.	①	②	③	④
97. I often feel like I could accomplish almost anything.	①	②	③	④
98. I often feel nervous and have difficulty relaxing.	①	②	③	④
99. I am a person who strongly feels the pain of other people's losses.	①	②	③	④
100. Sometimes little quirky things people do really get on my nerves.	①	②	③	④
101. I see life as being full of opportunities to have fun.	①	②	③	④
102. I am a person who feels sorrow and the pain of loss strongly.	①	②	③	④
103. I sometimes feel "chills" or "goosebumps" when listening to music.	①	②	③	④
104. It often seems that life has no meaning.	①	②	③	④
105. I am not an extremely inquisitive person.	①	②	③	④
106. I almost never lose sleep worrying about things.	①	②	③	④
107. I am not particularly affectionate.	①	②	③	④
108. When people irritate me, I rarely feel the urge to say nasty things to them.	①	②	③	④
109. Playing games with other people is not especially enjoyable for me.	①	②	③	④
110. I am almost always happy to interact with other people.	①	②	③	④

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APPENDIX D: Participant recruitment email

Initial emails:

Subject: Want to win R1 000?!

To stand a chance of winning R1 000*, go to the web site below and fill in two questionnaires as part of a Psychology Masters research project. It should only take you about 15 minutes. They must be filled in during the next 2 weeks (by 3rd October 2005). If yours is the lucky name drawn, you will be contacted either by phone or by email, to arrange transfer of funds...Good luck!

Web site: http://psyassign.psy.uct.ac.za/Michelle /Survey.htm

*Raffle prize drawn from Masters degree funding (dissertation completed in partial fulfilment of degree).