

**VOLUME 1**

**The role of Disgust in  
Obsessive-Compulsive Disorder**

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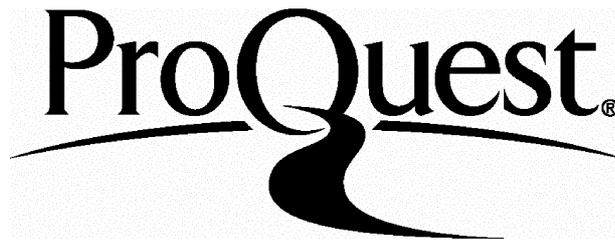
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## **Abstract**

**Aims.** The current study aimed to examine the role that the emotion of disgust plays in Obsessive-Compulsive Disorder (OCD). It has been proposed that washing and cleaning compulsions in OCD may be primarily derived from the emotion of disgust rather than fear or anxiety (Power and Dalglish, 1997). The study aimed to confirm previous findings that OCD checkers show a deficit in the ability to recognise the facial expression of disgust (Sprengelmeyer et al., 1997) but will also examine this ability in people with primarily washing compulsions (washers). The present study also aimed to test whether people with OCD show an attentional bias and an implicit or explicit memory bias towards disgust items.

**Methods.** The study compared 26 individuals with OCD with 26 non-clinical controls who were matched on age, gender and number of years in education. In addition, further comparisons were made within the OCD group comparing OCD washers with people with OCD without washing compulsions (non-washers).

**Results.** The OCD group showed significantly higher levels of disgust sensitivity than the control group. Furthermore, no differences between OCD washers and non-washers were found on a Disgust Scale. The OCD group was also significantly impaired in their ability to recognise facial expressions of disgust compared to controls. Although the OCD group was significantly slower to perform on a Stroop task, no evidence of an attentional bias towards disgust was found. In addition, there was no evidence of a memory bias in OCD.

**Conclusions.** The findings of heightened disgust sensitivity in both OCD washers and OCD non-washers goes against Power and Dalglish's (1997) argument that only washing in OCD is associated with disgust. During treatment, it may be important to consider that OCD patients might be oriented to reducing their disgust sensation. The current findings provide evidence that disgust plays a role in OCD and future research could aim to develop a model of disgust in OCD.

## **CHAPTER 1**

### **INTRODUCTION**

#### **Overview**

This chapter will initially define Obsessive-Compulsive Disorder (OCD) and present recent epidemiological data concerning the disorder. The following section will define the emotion of disgust and will present relevant literature implicating disgust as a relevant factor in various psychological disorders. The review will then focus specifically on the emotion of disgust in OCD and will then present research findings that suggest an inability to recognise facial expressions of disgust in people with Huntington's disease, a disorder involving degeneration of the basal ganglia (Sprengelmeyer, Sprengelmeyer, Young et al., 1996). Research evidence will be presented which has linked basal ganglia abnormalities with OCD (Abbruzzese, Ferri & Scarone, 1997; McGuire, 1995; Rapoport 1989) and a deficit in facial recognition of disgust in people with OCD (Sprengelmeyer, Young, Pundt et al., 1997).

The following section will present research on information-processing bias in anxiety disorders. Whilst biased processing of threat-relevant information is a central construct among contemporary theories of anxiety there has been limited study of processing bias in OCD. Relevant studies that have been carried out with people with OCD will be reviewed. The final section will examine evidence of a memory bias towards threatening material in anxiety disorders and in OCD.

At present, successful treatment of OCD can prove difficult. The potential role of disgust in the genesis of OCD may therefore have important clinical and practical implications.

## **Obsessive-Compulsive Disorder**

### **Definition of Obsessive-Compulsive Disorder**

In the Diagnostic and Statistical Manual for Psychiatric Disorders (DSM-IV; American Psychiatric Association, 1994) OCD is defined by the presence of obsessions or compulsions. A full copy of the DSM-IV criteria can be found in Appendix 1. Obsessions are defined as persistent thoughts, impulses or images that occur repeatedly and are experienced as intrusive, inappropriate and distressing. They are usually regarded as repugnant, unacceptable and difficult to dismiss by the individual experiencing them (Salkovskis, Forrester & Richards, 1998). Common examples include a fear of contamination and doubts about one's own actions. According to DSM-IV, obsessions are not simply worries about real life problems. In addition, individuals with OCD must recognise that their obsessions are products of their own mind.

Because obsessions are anxiety provoking and often accompanied by feelings of discomfort, individuals with OCD attempt to ignore or suppress the obsessions or have the urge to neutralise them by carrying out compulsive behaviour. Compulsions are repetitive behaviours such as washing, cleaning or repeating actions than an individual feels compelled to carry out in response to an obsession. Although compulsions are carried out to reduce discomfort or to prevent some dreaded event,

they are clearly excessive or are unconnected in a realistic way to the event they are aimed at preventing. To meet DSM-IV criteria, an individual must recognise that the obsessions or compulsions are excessive or unreasonable.

At present, all current psychiatric and diagnostic systems concur in describing OCD as an anxiety disorder. However, there is a growing body of literature that alludes to problems with OCD's diagnostic classification (e.g., Clark, Watson & Reynolds, 1995; Enright, 1996; Stein & Hollander, 1993). The uniqueness of OCD has been suggested by reports of the involvement of biochemical factors (Dolberg, Iancu, Sasson & Zohar, 1996), neuropsychological correlates (Alarhon, Libb & Boll, 1994), symptom severity profiles (Cameron, Thyer, Nesse & Curtis, 1986), Axis I comorbidity patterns (Crino & Andrews, 1996) and Axis II comorbidity patterns and prevalence (Mavisakkalian, Hamann, Haidar & de Groot, 1993). Furthermore, there is a growing body of data pointing to potential genetic, neurochemical and phenomenological links between OCD and distinct syndromes such as tic-related disorders and trichotillomania (e.g., Hollander, 1993b; Rasmussen, 1994; Stein & Hollander, 1993).

### **Epidemiology of Obsessive-Compulsive Disorder**

Epidemiological data on OCD in Britain has been collected in a survey carried out by the Department of Health (National Survey of Psychiatric Morbidity; Meltzer, Gill, Petticrew et al., 1995; Jenkins, Bebbington, Brugha et al., 1997). The Clinical Interview Schedule Revised (CIS-R) was completed by a random sample of approximately 10,000 of the general population of the United Kingdom. The results revealed prevalence rates of OCD in approximately 1% of males and in 1.5% of

females. The survey suggested that OCD is approximately twice as common as schizophrenia in the general population and less prevalent than major-depressive disorders, which occur in approximately 2-3% of the population.

It appears that most people in the general population engage in obsessive thinking and compulsive rituals at certain times. As many as 80% of people in non-clinical groups report experiencing unpleasant intrusions that are similar in content to clinical obsessions, although these normal obsessions are experienced less frequently, less intensely, and for a shorter duration relative to those in people with OCD (Rachman & de Silva, 1978; Salkovskis & Harrison, 1984). In addition, Muris, Merckelbach and Clavan (1997) reported that 55% of people in non-clinical groups engage in compulsive rituals.

In the National Survey of Psychiatric Morbidity (Meltzer, Gill, Petticrew et al., 1995; Jenkins, Bebbington, Brugha et al., 1997), no particular relationship was found between OCD and age, apart from a peak at about 20 to 24 years. Several studies have reported an earlier age of onset in males (e.g. Castle, Deale & Marks, 1995; Lensi, Cassano, Correddu, Ravagli, Kunovak & Akiskal, 1996; Nestadt, Bienvenu, Cai, Samuals & Eaton, 1998). Furthermore, the survey found no association between OCD and educational level (Meltzer, Gill, Petticrew et al., 1995; Jenkins, Bebbington, Brugha et al., 1997).

Pauls, Asobrock, Goodman, Rasmussen and Leckman (1995) found that OCD was five times as frequent in families of OCD probands compared to control families. In addition, investigation of ethnicity revealed that OCD was almost exclusively

restricted to the White British born population with very low rates in African, Afro-Caribbean and Asian populations.

The survey also identified characteristics of people who develop OCD. It revealed that there were slightly increased rates of OCD in people who were divorced and separated, in people who were unemployed and economically inactive, and in one-parent or single-person households. Bebbington (1998) proposed a theory to explain the increased rates of OCD in these groups. He suggested that obsessions tend to increase to fill available space or time and therefore, if a patient has unoccupied time, there is more opportunity to develop the full range of OCD symptoms.

OCD is often associated with various other psychiatric conditions. In their review of the relevant literature, Antony, Downie and Swinson (1998) reported that a consistent finding across most studies is that OCD commonly occurs with a mood disorder. In studies published over the last decade, comorbidity with Axis II diagnoses range from 33 – 83% and is typically between 50 and 65% (Summerfeldt, Huta & Swinson, 1998). Yaryura-Tobias, Todaro, Grunes, McKay, Stockman & Neziroglu (1996; cited in Antony, Downie & Swinson, 1998) found that 42.2% of their sample of 391 individuals with OCD had at least one other DSM-III-R disorder. The most common comorbid diagnoses were major depressive disorder (29.1%), specific phobia (27.9%), substance dependence (14.5%), schizophrenia (11%), body dysmorphic disorder (9.7%), hypochondriasis (9.7%), Tourette's disorder (7.2%), anorexia nervosa (7.2%), social phobia (5.5%) and agoraphobia (4.8%).

## **OCD Subtypes**

The most prominent subtypes of OCD involve patients who exhibit washing behaviours and those who exhibit checking behaviours (Rachman & Hodgson, 1980). Several researchers have examined differences between these subtypes and have examined gender-related differences in the clinical features of OCD.

In the DSM-IV field trial, Foa and Kozak (1995) found that in people with OCD that experience both obsessions and compulsions, contamination obsessions were the most common type of obsession (44.2%). They reported that in a sample of 425 OCD patients, 31.7% engaged in washing or cleaning compulsions, 26.7% engaged in checking compulsions, 7.8% carried out mental rituals, 12.9% engaged in repeating, 5% carried out ordering, 3.1% were hoarders and 2.4% engaged in counting.

Minichiello, Baer, Jenike and Holland (1990), reported that the onset of obsessional checking disorders tended to occur at approximately 18-19 years and that this group contained relatively more males than a group of people with cleaning obsessions who had a later age of onset (approximately 27 years) and who tended to be female. Similarly, Bogetto, Venturello, Albert, Maina and Ravizza (1999) reported a higher frequency of contamination obsessions together with cleaning/ washing compulsions in women whilst Khanna and Mukherjee (1992) found that individuals with OCD checking compulsions were more likely to be single males and to have an earlier age of onset.

The probable type of onset for these two groups also tends to be different, although evidence is sparse. Rachman and Hodgson (1980) reported that the later onset of cleaning disorders in women tends to be sudden and is sometimes associated with pregnancy and the transition to motherhood. Similarly, Bogetto et al. (1999) found that stressful events, especially pregnancy and delivery, exert an influence on OCD onset in women. Rachman and Hodgson (1980) reported an earlier onset of checking disorders in men which tended to be more gradual and to be associated with increases in responsibility in both work-related and social settings. However, Bogetto et al (1999), found that precipitant events had a lower impact in triggering OCD in men compared with women.

### **Summary**

In summary, OCD is characterised by intrusive and distressing thoughts, urges and images as well as repetitive compulsive behaviours such as washing or checking which are performed in order to decrease the discomfort caused by the obsessive thoughts. OCD is not uncommon with prevalence rates of 1 - 1.5% in the general population of the United Kingdom and is frequently associated with other psychiatric disorders. Differences between OCD washers and OCD checkers have been reported. Patients exhibiting washing compulsions are more likely to be female and tend to have an acute onset with a clear precipitating factor, with onset occurring later than the average age of onset of OCD. Patients exhibiting checking compulsions, on the other hand, tend to be male with a younger age of onset.

## **The emotion of Disgust**

The following section will first define disgust before discussing the relevance of disgust in various psychological disorders. Finally, evidence that disgust plays a role in OCD will be presented.

### **Defining Disgust**

Disgust has been identified as one of the basic emotions (Ekman, 1992) which has traditionally been defined in terms of a food-related emotion. In Darwin's 'The Expression of the Emotions in Man and Animals' (1872/ 1965), disgust was defined as "something revolting, primarily in relation to the sense of taste" (p. 253). Similarly, Angyal (1941), in his classic work on disgust, proposed that "disgust is a specific reaction towards the waste products of the human and animal body" (p. 395). He related the strength of disgust with the amount of intimacy of contact, with the mouth being the most sensitive focus.

Historically, definitions of disgust have focused on the mouth and real or imagined ingestion. Miller (1997) on the other hand, argued that taste has become associated with disgust more recently and that the senses of touch and smell are most closely related to disgust. Rozin and his colleagues (e.g. Rozin and Fallon, 1987) have provided the most comprehensive analyses of disgust to date. Rozin and Fallon (1987) argued for a "core disgust" and believe the arguments for a food origin of disgust are very convincing. Darwin (1872/ 1965) not only related disgust to the experience of revulsion but also to a characteristic facial expression.

The facial expression of disgust can be seen as functional in rejecting unwanted foods and odours, and nausea which is the most distinct physiological concomitant of disgust, is a food-related sensation inhibiting the ingestion of food (Rozin, Haidt and McCauley, 2000).

Activation of the disgust reaction comes about by way of both sensory and cognitive mechanisms. Physiologically, disgust reactions can be seen through the pursing of the lips, turning of the head, holding of the nose or narrowing of the nares, and is most evident in vomiting. Cognitively, disgust reactions can be seen in the wincing of an individual's face to imagined stimuli deemed disgusting (Quigley, Sherman & Sherman, 1997).

Rozin, Lowery and Ebert (1994) carried out three facial expression identification studies in which college students matched a variety of disgust faces to verbally described eliciting situations. They demonstrated that there are three principal components of the disgust facial expression and each of these carry different meanings. They found that the nose wrinkle is associated with a bad smell, and to some extent a bad taste. Secondly, the combination of the gape and tongue extension was most clearly associated with oral irritation and also communicates core disgust, in the sense that spoiled or ideationally contaminated foods tend to be attributed to this expression. From the point of view of communication, this expression indicates oral irritation.

Finally, the raised upper lip seen in disgust expressions was associated with a broader range of disgust elicitors, including stimuli that remind humans of their animal

origins, aversive interpersonal contacts and stimuli that were seen as morally offensive. Rozin et al. (1994) suggest these findings support a theory of disgust that posits its origin as a response to bad tastes and maps its evolution as a moral emotion.

Rozin, Haidt and McCauley (2000) argue that three components are required for the occurrence of disgust: a sense of oral incorporation; a sense of offensiveness; and contamination potency. Furthermore, Rozin and his colleagues believe that disgust may be organized by two laws of sympathetic magic, that were described by Frazer and Mauss at the beginning of the last century (Frazer, 1890/ 1959; Mauss, 1902/ 1972). According to the first, *the law of contagion*, once an item has been in contact with another (e.g., a hair in the soup), they may influence each other through transfer of some of their properties via an 'essence'. This influence remains after the physical contact has ceased, and may be permanent, hence the expression 'once in contact always in contact' (Rozin, Millman & Nemeroff, 1986).

Disgust may also be organised by a second law of sympathetic magic, *the law of similarity*, which holds that similarities in appearance mean deeper similarities in substance, such that appearance is reality, (hence, 'the image equals the object'). It accounts for the frequent observation that objects that look like something disgusting, but are known not to be, are often treated as disgusting. Rozin, Millman and Nemeroff (1986) for example, found that American students were reluctant to eat imitation dog faeces that they knew were made out of chocolate.

Disgust can be elicited by a number of stimuli. Haidt, McCauley and Rozin (1994) developed a measure of disgust sensitivity (the Disgust Scale). When analysing responses to their Disgust Scale, they identified eight specific domains of disgust that stimulate disgust reactions – hygiene, food, animals, body products, sex, body envelope violations (such as blood) and magical thinking. These domains go beyond viewing disgust reactions as a function of oral incorporation of offensive substances alone, and broaden disgust to areas exogenous to the organism.

Rozin and Fallon (1987) noted that disgust is one of the most powerful ways of transmitting cultural values not only in relation to acceptable and unacceptable foods, but also in relation to moral values. Rozin, Haidt and McCauley (1993), for example, reported that one of the most powerful stimuli they found to elicit disgust was Adolf Hitler's sweater. Disgust at certain beliefs or behaviours, such as sexual abuse of children, act as a powerful means of transmitting social values.

Freud (1908) placed disgust with shame and morality, treating them as “reaction formations”, whose function was to inhibit the consummation of unconscious desire. Miller (1993) sees disgust as a reaction against threats to the integrity of the self and as a means of imposing distance between self and object.

Power and Dalglish (1997) argued that complex emotions, such as shame, guilt, embarrassment and contempt, are derived from the emotion of disgust, with the focus being on the self. They argued that disgust focused on the self, forms the basis of a number of psychological disorders.

## **Disgust and Psychopathology**

Phillips, Senior, Fahy and David (1998) claimed that disgust sensitivity plays a role in a wide variety of psychopathological disorders. Over the last decade there have been numerous possible linkages in the literature between disgust and psychopathology. Haidt, McCauley and Rozin (1994) found a positive correlation between disgust sensitivity and neuroticism and a negative correlation between disgust sensitivity and psychoticism measured by the Disgust Scale and the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975). Among a sample of undergraduates, Quigley, Sherman and Sherman (1997) found disgust sensitivity on the Disgust scale was related to three DSM-III-R (American Psychiatric Association, 1987) personality types, Schizoid, Obsessive-Compulsive and Dependent, all of which are based in varying degrees on neuroticism and psychoticism.

Traditionally, anxiety disorders have been assumed to derive from the basic emotion of fear. However, the emotion of disgust has been proposed as a possible factor in the acquisition and maintenance of several phobias. A clear link between disgust and blood-injury phobia, for example, has been demonstrated using both disgust sensitivity measures and emotion-specific ratings of blood-injection-injury images by phobic patients (Tolin, Lohr, Sawchuk & Lee, 1997; de Jong & Merckelbach, 1998; Sawchuk, Lohr, Lee & Tolin, 1999).

A large body of evidence has also accumulated suggesting that disgust is involved in the aetiology and maintenance of small animal phobias. Davey and his colleagues argue that phobias involving animals that are predatory (e.g. lions) invoke fear, whilst phobias involving animals that do not pose serious physical threat to humans (e.g.

spiders, maggots) are motivated primarily by disgust (Matchett & Davey, 1991; Webb & Davey, 1993; Ware, Jain, Burgess & Davey, 1994). The authors proposed that the connection between phobias and disgust may have had adaptive value (Matchett & Davey, 1991; Davey, 1992 a, b, c, 1994). Humans are more likely to acquire disgust-based avoidance of stimuli which have been evolutionarily associated with disease or contamination. Rozin, Fallon and Mandel (1984) demonstrated an association between the perception of contamination, and avoidance of the object. Ware, Jain, Burgess and Davey (1994) found significant correlations between disgust sensitivity, 'fear' ratings towards revulsion animals and the washing subscale of the Maudsley Obsessive-Compulsive Inventory (MOCI; Hodgson & Rachman, 1977).

A link between disgust and eating disorders has also been suggested (Quigley Sherman and Sherman, 1996). Davey, Buckland, Tantow and Dallos (1998) reported heightened disgust sensitivity to food and related stimuli in females with eating disorders. In addition, Power and Dalglish (1997) relate various sexual dysfunctions including vaginismus, dyspareunia, premature ejaculation and erectile and orgasmic dysfunction to self-disgust.

Power and Dalglish (1997) also suggest that social phobia, in which the individual imagines that they will be humiliated in public or rejected by others, may also have as its basic emotion self-directed disgust in the form of shame rather than fear. In addition, Power and Dalglish (1997) proposed a major role for disgust in depression in the form of self-disgust.

In order to investigate Phillips et al.'s (1998) claim that disgust is implicated in a broad range of psychopathological disorders, Muris, Merckelbach, Nederkoorn, Rassin, Candel and Horselenberg (2000) examined the relationship between disgust sensitivity and symptoms of phobias, OCD, depression and eating disorders in a sample of psychology undergraduates. They found disgust sensitivity was only associated with symptoms of agoraphobia and OCD. However, the study had two major limitations. Firstly, they used a non-clinical sample who scored relatively low on measures of psychopathology and secondly, they used a measure of disgust sensitivity which only taps disgust of the contamination of food (Muris et al., 2000).

It has been shown that the emotion of disgust is implicated in the maintenance and aetiology of certain phobias and may play a role in a variety of psychological disorders. It therefore seems important to consider whether disgust may also be implicated in OCD.

### **Disgust and Obsessive-Compulsive Disorder**

OCD has a long history of being classified as an anxiety disorder in the main classification systems. However, Power and Dalgleish (1997) propose that certain types of OCD may be primarily derived from the emotion of disgust rather than fear or anxiety. A prominent theme of obsessional thoughts in people with OCD concerns dirt or contamination and this often results in cleaning rituals and repeated hand washing. Power and Dalgleish (1997) found that patients with compulsive washing tend to experience more disgust when perceiving supposed contaminants such as rubbish bags than patients with compulsive checking or normal controls. They

suggested that disgust is the principal motivator when cleaning rituals are salient, whereas when checking rituals are more salient, anxiety is the principal motivator.

In support of Power and Dalglish's (1997) claim that there may be a subgroup in OCD whose difficulties may not be motivated by anxiety are findings from the epidemiological studies discussed earlier which have shown that there may be two different subgroups of obsessional disorders. In addition, van Oppen, Hoekstra and Emmelkamp (1995), found that a factor analytic derived measure of 'washing' in OCD correlated significantly with measures of depression and with interpersonal sensitivity but did not correlate significantly with measures of anxiety or hostility.

Phillips, Marks, Senior et al. (2000) asked OCD washers, OCD checkers and normal controls to rate the emotion experienced (disgust, fear or anxiety) when viewing pictures which were deemed 'normally disgusting' or 'washer relevant' (rated as more disgusting by OCD washers compared to checkers or controls). They found that washers rated the normally disgusting pictures as significantly more disgusting, frightening and anxiety provoking than checkers while controls were intermediate on these three dimensions. Washers rated the washer-relevant pictures as more disgusting, frightening and anxiety provoking than controls or checkers who gave low ratings on these dimensions. However, the authors only had 7 subjects in each group and recommended that future studies should utilise larger samples. In addition, they suggested that the urge to ritualise provoked by viewing emotive pictures should be assessed to help clarify the relationship between the experience of emotion and obsessive-compulsive symptoms. This study adds further support to the claim that OCD washers are more motivated by disgust compared to OCD checkers.

However, at present there is no comprehensive theoretical model of disgust in OCD. This is in contrast to well-developed cognitive models of OCD (e.g. Rachman, 1997, 1998; Salkovskis, 1999) that propose that obsessions are caused by catastrophic misinterpretations of the significance of one's intrusive thoughts. The conclusions drawn by Power and Dalglish (1997) should therefore be seen as tentative at present.

Patients with OCD with washing or cleaning compulsions often continue to feel dirty despite numerous attempts to clean themselves (Rachman, 1994). Rachman (1994) distinguishes between feeling dirty and 'pollution of the mind'. Feeling dirty usually arises after direct physical contact with soiled material whereas mental pollution refers to a sense of internal uncleanliness, which can and often does arise and persist regardless of the presence or absence of external, observable dirt (Rachman, 1994). The pollution can be induced and exacerbated by unacceptable intrusive thoughts and impulses such as sexual or blasphemous urges. He argued there is often a moral element which tends to be associated with self-disgust and guilt. It is therefore plausible that intrusive thoughts in OCD are perceived as disgusting to the person experiencing them and that obsessive compulsions have developed in an attempt to ease the feeling of self-disgust.

As discussed earlier, Rozin, Millman and Nemeroff (1986) suggested that aspects of disgust follow two laws of sympathetic magic, notably the law of contagion and the law of similarity. Rachman (1994) believed some of Rozin et al's (1986) observations could equally be applied to obsessional contamination and to the sense of mental pollution in OCD. These include: 'once in contact, always in contact'; 'the

part is equal to the whole'; and 'negative contamination overwhelms positive contamination'. Features of magical similarity that crop up in mental pollution include a belief in action at a distance, and that 'the image equals the object' (Rachman, 1994).

### **Summary**

There is evidence in the literature that disgust plays a role in several psychological disorders including blood phobia and small animal phobias. It has also been argued that disgust directed at the self is involved in social phobia, depression and sexual dysfunction. Power and Dagleish (1997) have argued that disgust is the principal motivator in people with OCD with washing and cleaning compulsions. There is some evidence to suggest that OCD washers can be differentiated from other OCD subtypes in relation to disgust. However, at present there is a lack of research examining disgust in OCD and no theoretical model of disgust in OCD has been developed to support this claim.

### **Neurobiological aspects of Obsessive-Compulsive Disorder**

The following section will review neuropsychological and neuroimaging studies of OCD before discussing brain structures which are believed to be involved in recognising facial expressions of disgust and how this relates to OCD.

There has been a growing number of neuropsychological studies of OCD in recent years and evidence has mounted that OCD is a disorder of brain function associated with distinct patterns of cognitive impairment (Savage, Baer, Keuthen, Brown, Rauch & Jenike, 1999). Neuropsychological and neuroimaging studies have suggested that

OCD patients suffer from deficits in the orbitofrontal cortex (Saxena, Brody, Schwartz & Baxter, 1998; Schmidtke, Schorb, Winkelmann & Hohagen, 1998) and basal ganglia (Abbruzzese, Ferri & Scarone, 1997; McGuire, 1995; Rapoport 1989).

A variety of neuropsychological tests that are assumed to detect frontal lobe impairment, have been administered to patients with OCD. Deficits in people with OCD compared to normal controls have been demonstrated on tests of abstract thinking (Christensen, Kim, Dyksen & Hoover, 1992), visual attention (Nelson, Early & Haller, 1993) and response inhibition (Martinot, Allilaire, Mazoyer et al., 1990).

The most consistent performance deficits relative to normal controls arise on tests requiring the frequent shifting of mental set. Christensen et al. (1992) for example, reported that patients with OCD perform poorly on the Wisconsin Card Sort Test (WCST: Milner, 1963). However, there is accumulating evidence that the WCST may not be as differentially sensitive to frontal lobe problems as was originally thought (van den Broek, Bradshaw & Szabadi, 1993). In order to avoid the problems associated with the WCST, Veale (1994) employed the 'set-shifting' task taken from the Cambridge Neuropsychological Test Automated Battery (CANTAB; Owen, James, Leigh et al., 1992, Owen, Sahakian, Semple et al., 1995, Purcell, Maruff, Kyrios & Pantelis, 1998a). He also found that OCD patients showed significant impairment in the ability to 'shift set' relative to non-clinical controls. Tallis (1997) suggested that this inability to 'shift set' in OCD may correspond with the perseverative phenomena frequently observed in patients with frontal lobe lesions.

However, he noted several weaknesses in the evidence for set-shifting difficulties in OCD. It is difficult to understand why a general 'set shifting' problem should potentiate specific behaviours such as washing and checking. If OCD patients share a deficit with frontal lobe patients, for example, then one would expect such a deficit to affect a much wider range of behaviours (Tallis, 1997).

Further support for an impairment in the orbitofrontal cortex comes from evidence that patients with cerebral tumours and atrophy affecting the frontal lobes have displayed obsessional symptoms (Seibyl, Krystal, Goodman & Price, 1989; Tonkonogy & Barrera, 1989 cited in Tallis, 1997). Furthermore, psychosurgical lesions in ventral prefrontal cortical regions can markedly reduce obsessive and compulsive symptoms (Jenike, Baer, Ballantine, et al., 1991). However, Baxter, Phelps, Mazziotta, Guze, Shwartz and Selin (1987) reported that patients with frontal lobe damage exhibit personality features such as disinhibition and a lack of appropriate concern for others, that are the exact opposite of those characteristic of individuals with OCD.

Olfactory identification ability has been associated with processing in the orbitofrontal cortex. Barnett, Maruff, Purcell et al. (1999) reported a significant impairment in the ability to identify odours in patients with OCD compared to normal controls. They suggested that this finding was consistent with the hypothesis that there is a disruption to processing at the level of the orbitofrontal cortex in OCD.

Recently, Phillips et al. (2000) used functional MRI to compare the neural response to 'normally disgusting' and 'washer relevant' pictures (rated as more disgusting by washers than checkers or normal controls) in patients with washing compared with checking symptoms. They found that in all subjects, normally disgusting pictures activated visual regions implicated in perception of aversive stimuli and the insula, important in disgust perception. Only in OCD washers were similar regions activated by washer relevant pictures. Phillips et al. (2000) therefore, demonstrated a differential neural response to washer-relevant disgust in OCD washers compared to checkers. This finding adds neurophysiological evidence to Power and Dalglish's (1997) claim that OCD washing but not checking is linked to disgust.

Neurophysiological and neuropsychological studies of OCD have also highlighted abnormalities in the basal ganglia (Abbruzzese et al. 1997; McGuire, 1995; Rapoport 1989). Furthermore, there is a growing body of evidence suggesting that obsessive-compulsive behaviour is associated with basal ganglia disorders such as Gilles de la Tourette's syndrome (Pauls 1992), Huntington's disease (Anderson, Louis, Stern & Marder, 2001) and Parkinson's disease (Alegret, Junque, Valldeoriola, et al., 2001). In addition, early case studies reported lesions in the basal ganglia of patients with compulsive behaviour associated with brain disease (Cottraux & Gérard, 1998).

### **Facial Expressions of Disgust**

The reaction to a disgusting object includes a characteristic facial expression (Rozin & Fallon, 1987). This section will discuss brain structures relevant in recognising facial expressions of disgust.

Disgust experiences have been found to be associated with brain activation in the right frontal area of the brain (Davidson, 1992). Sprengelmeyer, Rausch, Eysel, and Przunter (1998) found that seeing facial expressions of disgust is paralleled by activation of the right putamen in healthy volunteers. Phillips, Young et al. (1997) also reported evidence using functional magnetic resonance imaging (MRI) data from normal subjects which suggested activation of basal ganglia structures in addition to selective activation of anterior insula, when subjects viewed disgust facial expressions. Disgust faces also activate the orbitofrontal cortex (Sprengelmeyer, Young, Sprengelmeyer et al., 1997). In addition, functional neuroimaging research has demonstrated that facial expressions of disgust consistently engage different brain areas than other facial expressions (Phillips et al., 1997; Phillips et al., 1998; Sprengelmeyer et al., 1998).

A specific deficit in the recognition of disgust faces has been reported in people with Huntington's disease, which is a hereditary disorder causing degeneration of the basal ganglia (Sprengelmeyer, Young, Calder et al., 1996). Furthermore, carriers of Huntington's disease who have not yet shown any symptoms of the disease have also been found to show a severe deficit in the recognition of disgust expressions (Gray, Young, Barker, Curtis & Gibson, 1997). This points strongly to the importance of the basal ganglia in the emotion of disgust. Gray et al. (1997) suggested that loss of disgust in Huntington's gene carriers may be an early sign of the disintegration of certain learning mechanisms, especially those involved in establishing associations to bad tastes or odours.

It has been suggested that the ability to identify odours and to recognise facial expressions of disgust may be part of a common brain system involving the basal ganglia and the orbitofrontal cortex (Barnett et al., 1999). The control of olfactory identification and disgust recognition by a common brain system is intuitively appealing as the risk of disease and contamination can be conveyed to individuals both by expressions of disgust on the faces of others and by odours emanating from the source of the risk (Rozin, Lowery & Ebert, 1994). As discussed in the previous section, both the basal ganglia and the orbitofrontal cortex have been implicated in OCD.

### **Obsessive-Compulsive Disorder and Facial Expressions of Disgust**

Sprenkelmeyer and colleagues suggested a role for disgust in OCD is plausible on neurological grounds given that the neurology of OCD compromises neural pathways involved in the mediation of disgust, (Sprenkelmeyer, Young, Pundt et al., 1997). They reasoned that if OCD involves a dysfunction of the appraisal of objects and events for their potential role in contamination and transmission of diseases (Rozin et al., 1993), then a poor correlation would result between the stimuli that evoke disgust in people with OCD, and the stimuli that evoke disgust in others.

Sprenkelmeyer et al. (1997) found a remarkable and specific deficit in the perception of disgust faces in 12 people with OCD with checking compulsions. To test whether these findings derived from impaired recognition of the configuration of facial features which signals the emotion of disgust or from an unwillingness to use 'disgust' as a response category, participants with OCD were asked to assign words to emotion categories. They carried out this task without difficulty, showing that their

problem with disgust is linked to a failure to recognise this emotion in others and not a comprehension or response criterion effect (Sprengelmeyer et al., 1997).

To account for their results, Sprengelmeyer et al. (1997) hypothesised that people with OCD will have little opportunity to learn to recognise facial expressions of disgust as they will experience disgust when others may not. Furthermore, others may show non-disgust expressions thereby weakening any learned association between the emotional experience of disgust and the corresponding facial expression displayed by others.

Barnett et al.'s (1999) finding, discussed earlier, of impairment in olfactory identification in patients with OCD accords well with Sprengelmeyer et al.'s (1997) findings. An abnormality in a common brain system controlling olfactory identification and disgust recognition in OCD makes sense given that contamination is a common feature of OCD symptoms (Barnett et al., 1999).

However, there are problems in interpreting the findings of a disgust face deficit in OCD. Rozin (1997) argues that one would expect hypersensitivity rather than a deficit of disgust in OCD given the prominence of disgust or contamination related symptomatology. In response to this argument, Young, Sprengelmeyer, Phillips and Calder (1997) suggest that emotional expressions serve an evolutionary function to protect us from danger and disgust serves the function of protecting us from the risk of contamination and disease. A clear signal of danger comes from the reactions of others. Young et al. (1997) posit that people who develop OCD are so frequently

disgusted by things that do not bother others that they lose the opportunity to learn to recognise the relevant expression, or perhaps even unlearn it.

A further criticism of Sprengelmeyer et al's (1997) findings is that they studied OCD patients with checking compulsions as opposed to those with washing and cleaning compulsions. According to Power and Dalgleish (1997) only cleaning compulsions are directly linked to disgust and contamination.

### **Summary**

To summarise, this section has reviewed evidence that the orbitofrontal cortex and the basal ganglia are implicated in OCD. These brain structures have also been linked to the ability to recognise facial expressions of disgust. There is evidence that people with OCD with checking compulsions are unable to recognise the emotion of disgust in facial expressions although there are difficulties in interpreting this finding.

### **Information-Processing Biases**

The following section will examine the evidence for an information-processing bias towards threat in anxiety disorders before reviewing the literature to date that examines processing biases in OCD in order to determine whether there is a similar bias towards threat in individuals with OCD.

### **Information-processing Bias in Anxiety Disorders**

Biased processing of threat-relevant information is a central construct among contemporary theories of anxiety. Evidence of an attentional bias for threat in anxiety has come from a range of studies using the modified Stroop task and dot probe tasks.

In the classic Stroop task (Stroop, 1935) the subject is asked to name the colour of the ink in which a colour word is printed. Subjects take longer to name the ink colour when the word is incompatible rather than the same colour ink (e.g. the word blue written in red ink). This phenomena is known as Stroop interference. Performance on the Stroop task is thought to reflect selective attentional capacity to maintain a course of responses despite intrusion by extraneous competing stimuli. The emotional Stroop task is a modified version of this classic paradigm and involves the presentation of differentially emotionally valenced words in different coloured inks. The subject's task is to name the colour of the words as quickly as possible whilst ignoring the meaning of the words.

Results from studies with anxiety disordered patients suggest that these patients show greater Stroop interference when the words are emotionally threatening as opposed to neutral, taking longer to name the colour of threat words (MacLeod, 1991). These interference effects have been demonstrated in patients with spider phobia (Watts, McKenna, Sharrock & Trezise, 1986), social phobia (Hope, Rapee, Heimberg & Dombek, 1990), generalised anxiety disorder (Mogg, Mathews & Weinman, 1989), panic disorder (Ehlers, Margraf, Davies & Roth, 1988; McNally, Riemann & Kim, 1990) and in post-traumatic stress disorder (PTSD; McNally, Kaspi, Riemann, Louro et al., 1992). Furthermore, in studies with normal subjects, those with higher trait anxiety compared to those with low trait anxiety showed increased Stroop interference effects for threat words relative to neutral words (Dawkins & Furnham, 1989; Richards, French, Johnson, Naparstek & Williams, 1992). This effect has not been observed in normal control subjects.

On the basis of the findings from these studies with anxiety disordered patients and normal subjects with high trait anxiety, it is thought that a bias for selectively processing threatening information is associated with anxiety states (Ruiter & Brosschot, 1994). Activation of such structures is thought to result in the preferential encoding of information that is either consistent with the individual's current mood (Bower, 1981) or with threat-related concerns of the individual (Kovacs & Beck, 1978).

Kovacs and Beck (1978) proposed that in anxiety disorders there are dysfunctional schema which are concerned with information relevant to threat or danger. The activation of such schema is presumed to result in the selective processing of schema-congruent information. Bower (1981) proposed an alternative model of the relation between emotion and cognition. He suggested that each emotion was represented as a node in an associative network in which it was linked with other representations within the network. Activation of the emotion node would lead to increased accessibility of mood-congruent material and hence to mood-congruent information-processing biases.

Both Kovacs and Beck's (1978) and Bower's (1981) models predict that in anxiety (and also in depression) there will be similar mood-congruent biases at all stages of processing. Operation of these processes forms the basis of the interpretation that interference on the Stroop task is the consequence of selective encoding of danger-related information.

However, a number of studies have demonstrated evidence that is contrary to the attentional bias interpretation of the emotional Stroop effect. Carter, Maddock and Magliozzi (1992) found that panic disordered patients showed significantly greater interference than normal controls on threat words, but also on depression words. Furthermore, McNally, Riemann, Louro, Lukach and Kim (1992) showed that positive words (e.g. happiness, joy) compared to neutral words, produced as much Stroop interference as threat words associated with fear and bodily sensations in panic disordered patients. In addition, Mogg and Marden (1990) found that high trait anxious subjects, compared to low trait anxious subjects, showed significantly more colour-naming interference on positive compared to neutral words. These findings are difficult to explain by either Beck's schema theory or Bower's network theory, since the information favoured in processing is clearly not congruent with the danger schemata assumed to exist.

Martin, Williams & Clark (1991) criticised the attentional bias studies that had been carried out arguing that threat was confounded with emotionality. They demonstrated using a Stroop task that, anxious subjects not only showed an attentional bias to threatening stimuli, but also to positive stimuli that were as emotional as the threatening words. They suggested that the threat-relatedness hypothesis should be replaced by an *emotionality hypothesis* as anxious subjects not only show an attentional bias for threatening stimuli but also for emotional stimuli in general.

However, Mathews and Klug (1993) criticised Martin et al's (1991) methodology. Several of the positive words used in their study were exact opposites of anxiety and Mathews and Klug (1993) argued that it was possible that antonyms of threatening

words are indirectly, via their threatening opposites, also associated with anxiety. Therefore, it remained unclear whether anxious subjects only showed attentional bias for cues associated with their personal concerns or for emotional concerns in general.

Mathews and Klug (1993) set up an experiment with anxious subjects with diverse diagnoses in order to clarify this issue. They constructed five sets of words to be colour-named: anxiety-related and anxiety-unrelated negative words, anxiety-related and anxiety-unrelated positive words and emotionally neutral words. They demonstrated that anxious subjects, compared to normal controls, did not show an attentional bias for emotional words that were unrelated to anxiety, but attended selectively to both positive and negative anxiety-related stimuli. They rejected the emotionality hypothesis of Martin et al. (1991) and concluded that anxious subjects show an attentional bias for stimuli which are semantically associated with their emotional concerns. They proposed the *concern-relatedness hypothesis*. However, Lavy, van Oppen & van den Hout (1994) criticised the statistical analyses carried out by Mathews and Klug (1993) which suggests the results should be interpreted with caution.

Ruiter & Brosschot (1994) proposed an alternative explanation for the Stroop interference effect. They suggested that Stroop interference may be the result of an attempt to *avoid* processing the stimuli because it contains emotionally valenced information. Ruiter & Brosschot (1994) suggested that early and late stages of processing are involved in the emotional Stroop task. Attentional bias occurs in the early stages, whereas cognitive avoidance occurs at later stages.

**Information-processing bias and Obsessive-Compulsive Disorder**

There has been limited study of information-processing biases associated with OCD despite clinical models of OCD stressing underlying cognitive abnormalities (e.g., Rachman, 1993; Salkovskis, 1985, 1989). Of the few studies that have been conducted the results have been inconsistent. Clinically, it is apparent that individuals with OCD do selectively attend to threat. For example, Rachman & Shafran (1998) discuss a patient who fears contracting AIDS and selectively attends to signs of blood.

Several studies have been carried out over the last decade to establish whether people with OCD show a similar cognitive bias towards threatening stimuli as shown in other anxiety disorders. In one of the first studies in this area, Foa and McNally (1986) administered a dichotic listening task to assess whether individuals with OCD showed a heightened auditory sensitivity to threatening stimuli. They found that people with OCD selectively attend to words that are relevant to their emotional concerns providing evidence for enhanced processing of threatening information in OCD. However, the sample used in the study may limit generalisability of results as seven out of the eleven OCD subjects in the sample reported contamination fears and washing rituals (Summerfeldt & Endler, 1998).

In their study of selective processing of threat in post-traumatic stress disorder (PTSD), McNally, Kaspi, Riemann and Zeitlin (1990) used a clinical control group of 10 individuals with OCD who all had contamination obsessions. They found that the OCD subjects did not display significant interference on the Stroop task for OCD relevant threat words.

McNally, Riemann, Luro, Lukach and Kim (1992) also used a group of OCD subjects as controls in a study on the differential contributions of global emotionality and threat-relevance of words to processing biases in patients with panic disorder (PD). They reported that between-groups comparisons were complicated by the fact that, in response to threat words believed to be panic-specific, the OCD group displayed Stroop interference similar to that found with the PD group. Furthermore, this interference was greatest for individuals with OCD in response to bodily sensation terms (e.g., breathless, choking). The authors noted that all clinical anxiety disorders are associated with unpleasant autonomic symptoms and therefore the threat words used were not completely unique to panic-related concerns. However, this sensitivity of subjects with OCD to words specific to other anxiety disorders was not found in the Stroop study with PTSD patients previously reported by these researchers (McNally et al., 1990). Nevertheless, these results are not generally consistent with the threat-specificity hypothesis.

A more recent study by McNally and his colleagues gives similarly inconsistent results. McNally, Amir, Louro, Lukach, Riemann and Calamari (1994) again used individuals with OCD as a control group in a study of individuals with PD. Neutral, general-threat, and both positive and threatening panic relevant words served as stimuli. Contrary to their earlier findings (McNally et al., 1992), they found that the OCD subjects did not show greater Stroop interference for panic-threat words than neutral ones. In addition, unlike PD patients, OCD subjects did not exhibit interference for general threat words relative to neutral ones. These findings failed to demonstrate selective processing of negatively-valenced material in OCD, at either the general or concern-specific level (Summerfeldt & Endler, 1998).

However, it should be noted that the above studies by McNally and associates (McNally et al., 1990; McNally et al., 1992; McNally et al., 1994) only included a small number of OCD subjects and therefore the results may have been due to a lack of statistical power.

Foa, Ilai, McCarthy, Shoyer and Murdoch (1993) carried out a study designed specifically to identify selective processing of threatening information by individuals with OCD using a modified Stroop task. They compared OCD patients with washing rituals with OCD patients without washing rituals and a normal control group. Subjects were asked to colour-name contamination words, general threat words, neutral words and non-words which were preceded by the prime words 'danger', 'disturb', 'fruit' and 'XXXX'. They found that washers evidenced longer response latencies to contamination words than to neutral words. They concluded that washers respond to threat information specific to their fear (i.e. contamination) in a manner similar to other anxiety-disordered individuals. They reported that specificity of the effect was demonstrated by the fact that OCD patients without washing rituals did not exhibit selective processing for contamination words, in spite of the fact that they did not differ in overall OCD symptom severity or in general measures of anxiety or depression.

Whilst the study by Foa et al., (1993) did find evidence of a processing bias favouring personally threatening material the evidence should be interpreted with caution. Firstly, the effect was limited to one word (unclean), and was not observed in the washer subgroup, with such generally symptom-relevant terms as anxiety, guilt and stress (Summerfeldt & Endler, 1998). Furthermore, the results of the non-

washers group, who did show interference in response to these general threat words, are contrary to the threat-specificity effect found with the washers group.

In addition, Summerfeldt & Endler (1998) criticise the methodology of the study. The measure of anxiety was completed by subjects with OCD one week prior to the study but was administered to the control group immediately prior to the study. There is therefore no way of reliably determining the contributions made by fluctuating anxiety levels.

Lavy, van Oppen and Van den Hout (1994) investigated different possible hypotheses for Stroop interference effects in a study utilising two versions of the Stroop: one test for OCD patients with washing rituals and one test for OCD patients with checking rituals. The OCD patients were compared with a normal control group. Both groups colour-named a Stroop card with five word sets: (neutral words, negative words, positive words and either OC washers positive, OC washers negative or OC checkers positive and OC checkers negative words). They found that OCD patients selectively attended to negative OCD-related words but did not show an attentional bias for positive OCD-related words. The authors concluded that their results provided evidence for the threat-relatedness hypothesis but not the concern-relatedness hypothesis proposed by Mathews and Klug (1993) discussed earlier. Lavy et al. (1994) suggested these contradictory findings might have been due to differences between patients with OCD and patients with other anxiety disorders.

Tata, Leibowitz, Prunty, Cameron and Pickering (1996) examined whether 13 OCD patients with significant contamination concerns, showed biases in attentional processing (interference and vigilance) linked to the presentation of threatening stimuli in a dot-probe task compared to normal controls with high trait anxiety. They reported that OCD subjects took longer to detect the dot-probe on trials when the preceding word pair contained a threatening word (contamination word) compared with trials containing only neutral words. They interpreted this interference effect as due to an interruption to ongoing information processing caused by the stimuli and when new processing demands (detecting the probe and co-ordinating the button press response) follow shortly after such an interruption, the cognitive system is slower to respond. Tata et al. (1996) argued that their results indicated content-specific threat biases in OCD.

However, the subjects used were chosen for their selective focus on issues of contamination and caution must therefore be used in extending their results to OCD patients with checking compulsions or other OCD symptoms who may have different cognitive abnormalities. The results of Foa et al. (1993) also indicated specificity of Stroop interference for contamination material in OCD washers but not in other OCD patients.

Kyrios and Iob (1998) suggested that OCD might be associated with two types of avoidant processing style: strategies that require extra processing capacity and those that require less processing capacity. Strategies requiring extra processing capacity are likely to operate at slower, more effortful, and later stages in the processing

continuum whereas faster colour-naming is likely to reflect the operation of more automatic avoidance that occurs in low-level stages of processing.

In an attempt to test these assumptions, Kyrios and Iob investigated the relationship of Stroop effects to avoidant cognitive strategies in 15 individuals with OCD (4 washers and 11 checkers) and normal controls. Contrary to their predictions, both groups were faster at colour naming OCD threat, general threat and positive words compared to neutral words at the strategic level of awareness. At the automatic level of awareness, faster colour naming was evident for OCD threat words, although the anticipated differences between the OCD group and the control group were not found. To account for these findings, Kyrios and Iob (1998) suggest that the concerns of individuals with OCD are not distinct and typically relate to a range of general themes of danger or negative outcomes. It may therefore be that the threat value of the OCD threat words used in the study was greater than that of the general-threat words for the control subjects.

Whilst several studies have reported that OCD patients with contamination fears selectively attend to relevant threat words the same has not been found for other OCD patients, such as checkers. It has also been demonstrated that the specific vigilance of OCD patients with contamination fears diminishes with successful treatment (Foa & McNally, 1986). As previous studies have mostly recruited subjects with contamination fears which has limited generalisability of results, the current study will compare individuals with contamination fears with those with checking concerns and other OCD symptoms.

Furthermore, in most of the studies outlined above, the materials used are treated as if they were anxiety based whereas in fact they may be disgust related. In the studies by Foa and McNally (1986), Foa et al. (1993), Lavy et al. (1994) and Tata et al. (1996), the researchers used a mix of anxiety-relevant and disgust-relevant materials, but only considered their results in relation to fear. In the study by Foa et al. (1993) the researchers were puzzled by the fact that the prime word 'danger' failed to have a priming effect on contamination words for the washer OCD group. Power and Dalglish (1997) suggest that this failure occurred because 'danger' is primarily fear-related rather than disgust-related and propose that the effect should occur with a disgust-derived prime such as 'dirt'.

A further criticism of previous studies of information processing bias in OCD and in studies of anxiety disorders concerns the use of words as stimuli. Words have an indirect relationship with real-life dangers (Bradley, Mogg, White, Groom and de Bono, 1999). Furthermore, individuals prone to anxiety are more familiar with threat-related words than non-anxious individuals and are more likely to describe themselves as tense or anxious. Bradley et al. (1999) argue that such differential frequency of use may act as a confounding variable in experimental studies using word stimuli. It is therefore possible that a potential flaw of previous research has been a lack of ecological validity.

## Summary

Evidence has been presented which suggests there is a selective information-processing bias towards threatening material in people with anxiety disorders. The evidence for a similar bias in OCD is inconsistent and there are methodological difficulties present.

## Memory Bias

In addition to research on information-processing bias in anxiety, several studies have examined whether there is also a memory bias for threatening information. This section will examine the literature on memory bias in anxiety disorders before focusing on the literature that has examined memory bias in OCD.

## Memory Bias in Anxiety

There are reports of a memory bias in depression, and good reason to expect a memory bias associated with anxiety (Radomsky & Rachman, 1999). Depressed subjects are more likely to remember sad words and events than are non-depressed subjects (Williams, Watts, MacLeod & Matthews, 1997). Intuitively, one would expect anxious arousal to play a significant role in determining recall (Rachman, 1998). Radomsky and Rachman (1999) suggested that if an individual feels threatened by some object or situation they would be hypervigilant to it and, in addition, would have a *better* memory for threatening aspects of the object or situation. However, the results of studies to date have been inconsistent.

As discussed in the preceding section, there are numerous reports of an attentional bias in anxiety towards threatening stimuli which has also been demonstrated in OCD. These results suggest that there should be a memory bias in anxiety, since it is unlikely that greater attention would not result in greater subsequent memory.

However, although a number of studies have shown that there are attentional biases in anxious patients, there is only weak and contradictory evidence of memory biases in these subjects. Some studies find evidence of a bias in favour of better recall for threatening words (McNally, Foa & Donnell, (1989), while others find the reverse. Bradley, Mogg and Williams (1995), for example, produced evidence of memory biases in depressed patients but found no evidence of these biases in anxious patients. Several studies have failed to find a relationship between anxiety and memory bias (Chambless & Hope, 1996; Dalgleish, 1994; Rapee, McCallum, Melville, Ravenscroft & Rodney, 1994). These inconsistencies may reflect the use of different strategies. For example, some participants may choose to use negative self-descriptors (or some other category) as an aid to recall, and thus generate many words of that type, while others may use different strategies, or none at all (Mathews, 1997).

In order to control for the influence of strategic processes on memory performance, researchers have employed implicit memory paradigms. Implicit memory is revealed when performance on a task is influenced by previous experience without conscious awareness of that experience. It can be measured using word stem completion tasks and perceptual identification procedures. Explicit memory on the other hand, requires conscious recollection of a previous experience and is frequently measured using recall and recognition tasks.

In some studies of implicit memory, stronger priming effects on threatening words have been reported for anxious subjects (e.g., MacLeod, 1990; MacLeod & McLaughlin, 1995). Cloitre, Shear, Cancienne and Zeitlin (1994) found that patients with panic disorder showed both explicit and implicit memory biases for catastrophic associations to bodily sensation words. However, several studies have also yielded negative results (see Mathews, Mogg, Kentish & Eysenck, 1995 for a review).

To account for previous failures to find a memory bias in anxiety disordered subjects, Radomsky and Rachman (1999) argue that the bulk of the research in this area has focused on people with generalised anxiety disorder (GAD). One of the distinguishing features of GAD is that the anxiety involved is by definition non-specific (American Psychiatric Association, 1994). Radomsky and Rachman (1999) suggested that if the primary cause of a memory bias is the result of the activation of an associative network, then the more elaborate and clear the network, the greater the memory bias. The lack of specificity in GAD might reflect the presence of an associative network with a large number of weak connections. The authors suggested that research subjects should be selected that are sensitive to specific threats such as the threat of contamination in OCD. Arousal may then produce a stronger activation of fewer associations that may in turn produce a memory bias.

### **Memory Bias in Obsessive-Compulsive Disorder**

It is common for patients with OCD to report cognitive intrusions of negative memories during a fearful or anxious event (Rachman & de Silva, 1978). These cognitive intrusions themselves are evidence of a memory bias.

Foa, Amir, Gershuny, Molnar and Kozak (1997) examined implicit and explicit memory bias in 15 subjects with OCD with contamination fears compared with normal controls. They measured implicit memory using a task developed by Jacoby, Allan, Collins and Larwill (1988). In the first phase of the task, subjects hear sentences that they repeat aloud. In the second phase of the task, they hear a set of sentences accompanied by different levels of noise; half of the sentences are from phase one, and the remaining half are new. Jacoby et al., (1988) found that subjects rate the noise accompanying old sentences as softer than the noise accompanying new ones. Explicit memory was measured with a recognition task. Foa et al. (1997) hypothesised that OCD patients would exhibit a bias for contamination sentences compared to neutral sentences.

However, their hypothesis was not supported by either measure of implicit or explicit memory. OCD patients rated noise accompanying both contamination and neutral sentences as louder than the control group. Both groups rated noise accompanying contamination sentences as louder than noise accompanying neutral sentences. Jacoby et al. (1988) suggested that noise ratings may reflect perceptual fluency. Foa et al. (1997) suggest that their data may therefore show that OCD patients may have some perceptual deficit rather than a memory deficit.

Radomsky and Rachman (1999) argued that a further possible explanation for the lack of evidence of a memory bias in anxiety is that most studies of memory biases and affective arousal have used negative and neutral or positive *words* as stimuli to be learned by subjects. A potential flaw in previous research has been a lack of

ecological validity leading the authors to suggest researchers should strive to use the strongest stimuli that is ethically viable.

A study by Constans et al. (1995) used non-word stimuli to test memory for task completion in obsessive checkers. They reported a significant, positive memory bias for the last action completed by the subjects. Compared with non-clinical controls, obsessive checkers had a superior memory for experimental events.

Radomsky and Rachman (1999) assessed memory bias for contamination in 10 individuals with OCD with a fear of contamination and/or washing compulsions compared with 10 subjects with other anxiety disorders and an undergraduate student control group. Subjects were shown 50 objects, 25 of which were contaminated by the experimenter, and 25 of which were touched but not contaminated. They then completed the Wechsler Memory Scale - Revised (WMS-R; Wechsler, 1987), after which the participants were asked to recall all the objects touched by the experimenter. The results demonstrated that the OCD group had a better memory for contaminated objects than for clean ones. This result was not demonstrated in the anxiety group or control group.

Furthermore, the OCD group remembered contaminated objects better than clean ones without being able to correctly remember which objects were clean and which were dirty. The authors suggested this may be evidence for an implicit memory bias in favour of remembering threatening material. Although the recall task was an explicit memory task, the actual threat in the study was not the dirty objects but the

dirt itself. These results were not attributable to general differences in memory ability as no differences between groups were found on the WMS-R.

Radomsky and Rachman (1999) suggested that the threatening information in their study paradigm activated more than just a semantic network and was sufficiently elaborated upon to enable future recall of threatening stimuli in the OCD group. The authors argued that there was no evidence that individuals with OCD were displaying avoidance of processing this information. This goes against arguments by Ruiter and Brosschot (1994) presented earlier. Instead, their results provided support for earlier theories of emotional processing and emotional arousal (e.g. Beck, 1976; Bower, 1981) which predict a memory bias in association with threatening stimuli and have been well supported by attentional bias research discussed earlier.

### **Summary**

Despite strong evidence of an information-processing bias in anxiety disorders, evidence of a memory bias towards threatening material is inconsistent in studies with anxiety disordered patients. In OCD, there is some evidence of a memory bias towards threatening stimuli in people with washing and cleaning compulsions.

### **Aims of the Current study**

The current study aims to examine the relationship between OCD and the emotion of disgust and will compare levels of disgust sensitivity amongst individuals with OCD and a non-clinical control group. In addition, the study will examine the potential differences between people with OCD with predominantly washing compulsions (OCD washers) and individuals with predominantly checking compulsions or other symptoms of OCD such as mental rituals and hoarding (OCD non-washers).

Furthermore, the study aims to examine the ability to recognise facial expressions of disgust in OCD. In addition, as previous research has only examined OCD checkers, the study will also compare OCD washers with those with other OCD symptoms.

The study also aims to examine whether there is an attentional bias towards contamination/disgust words and general-threat words in OCD and will examine whether there is an attentional bias towards disgust photographs in relation to such words.

In addition to determining whether there is an attentional bias in OCD, the present study aims to examine whether people with OCD also show an implicit and explicit memory bias for disgust and general threat stimuli compared to a normal control group. As previous studies have focused *either* on OCD washers or OCD checkers, and no study to date has compared implicit memory in both OCD groups, the current study will also examine differences within the OCD group and will compare OCD washers with OCD non-washers.

Finally, the present study also aims to examine emotional reactions to disgust pictures and asked all participants to rate the intensity of disgust, anger, sadness, surprise, fear and happiness experienced when viewing disgusting photographs. In addition the urge to carry out a ritual provoked by the pictures will be measured.

### **Hypotheses**

The current study aims to test 5 main hypotheses which are described below. The main hypotheses compare individuals with OCD with a non-clinical control group. In addition, after testing each of the main hypotheses, a secondary hypothesis will be carried out within the OCD group comparing OCD washers with OCD non-washers.

#### **Hypothesis 1: Disgust sensitivity**

*Individuals with OCD will show higher levels of disgust sensitivity as measured by the Disgust Scale compared to a non-clinical control group.*

Although previous research has shown that the emotion of disgust is implicated in the maintenance and aetiology of certain phobias and may play a role in a variety of psychological disorders, no study has examined disgust sensitivity in an OCD sample. This hypothesis will allow conclusions to be drawn about the relevance of disgust in OCD.

#### **Hypothesis 1a**

*Within the OCD group, it was further hypothesised that OCD washers would show higher levels of disgust sensitivity on the Disgust scale than OCD non-washers.*

## **Hypothesis 2: Facial Expressions of Disgust**

*Individuals with OCD will show a deficit in recognizing the facial expression of disgust compared to a non-clinical control group.*

This hypothesis attempts to replicate previous findings by Sprengelmeyer et al. (1997) but will use a much larger sample size.

### **Hypothesis 2a**

*Within the OCD group, there will be no difference between OCD washers and OCD non-washers in their ability to recognize facial expressions of disgust.*

Sprengelmeyer et al. (1997) only examined OCD checkers ability to recognise expressions of disgust. The results were criticised by Rozin (1998) who argued that only washing in OCD has been implicated in disgust (Power and Dalgleish, 1997) and one would expect a hypersensitivity towards disgust faces rather than a deficit. This hypothesis will allow comparisons to be made between OCD washers and non-washers in their ability to recognise the emotion of disgust.

**Hypothesis 3: Attentional bias**

- *Individuals with OCD in comparison with a non-clinical control group, will show an attentional bias to both contamination/ disgust and general threat words compared to neutral and non-words. This will be evidenced by greater colour-naming response latencies on the Stroop task.*
- *Furthermore, the OCD group will show greater colour-naming response latencies when the words are preceded by a disgust picture as opposed to a neutral picture.*

As previous studies on information-processing bias in OCD have been inconsistent, the current study used the same modified Stroop used in the Foa et al. (1993) study but in addition, neutral and disgust photographs were incorporated as primes instead of words. As photographs are naturalistic and more ecologically valid, it was hypothesised that they would provide a more vivid and real threat than words alone. In addition, the photographs allow an examination of attentional bias towards disgust in addition to fear.

**Hypothesis 3a**

- *OCD washers will show greater response latencies towards contamination/ disgust items on the Stroop task compared to OCD non-washers.*
- *Furthermore, OCD washers will take longer than OCD non-washers to respond to all words preceded by a disgust picture compared to words preceded by a neutral picture on the Stroop task.*

As Power and Dagleish (1997) have linked disgust to OCD washers only, it is assumed that information-processing bias towards disgust will only be shown in the OCD washers group.

#### **Hypothesis 4: Memory Bias**

- *Individuals with OCD will show an implicit memory bias (i.e. improved memory) for threatening stimuli associated with contamination/ disgust words and general threat words on the Word Completion task compared to a non-clinical control group.*
- *In addition, the OCD group will continue to show a memory bias towards contamination/ disgust and general threat words in a delayed recall explicit memory task.*

Evidence of a memory bias in anxiety disorders is inconsistent. There has been very limited research examining whether there is a memory bias in OCD and these hypotheses aim to add to the current literature.

#### **Hypothesis 4a**

- *OCD washers will show an implicit memory bias for contamination/ disgust words on the Word Completion task compared to OCD non-washers.*
- *Furthermore, OCD washers will show an explicit memory bias for contamination/ disgust words on the delayed recall task compared to OCD non-washers.*

As previous studies have focused *either* on OCD washers or OCD checkers, and no study to date has compared implicit memory in both OCD groups, the current study will compare OCD washers with OCD non-washers.

### **Hypothesis 5: Picture ratings**

- *Individuals with OCD will rate the emotional content of disgust pictures as more disgusting than a non-clinical control group.*
- *In addition, the OCD group will have a greater urge to carry out a ritual in response to the disgust pictures compared to non-clinical controls*

These hypotheses aim to add to the results by Phillips et al. (2000) but with a much larger sample size. Furthermore, the urge to ritualise after viewing disgust pictures in OCD has not been examined previously.

### **Hypothesis 5a**

- *OCD washers will rate the emotional content of disgust pictures as more disgusting than OCD non-washers.*
- *Furthermore, OCD washers will show a greater urge to carry out a ritual after viewing these pictures than OCD non-washers.*

As Power and Dalglish (1997) argue that only OCD washing is linked to disgust it is expected that a difference between the groups will emerge. Furthermore, although Phillips et al. (2000) found that OCD washers can be differentiated from OCD non-washers by their responses to disgust pictures they only included 7 people in each OCD group and did not ask participants to rate their urge to ritualise after viewing such pictures.

## CHAPTER 2

### METHOD

#### **Overview**

The following chapter provides information on the participants used in the study and gives details concerning the procedure and measures employed to test the hypotheses posed.

#### **Issues of Statistical Power**

Due to the constraints of recruiting a clinical OCD sample, previous studies have frequently used small samples and the effect sizes are inevitably rather large. A precise statistical power analysis was difficult to conduct as no previous study encapsulated all the aims of the current study. Furthermore, the papers that would have been most useful in carrying out a power analysis lacked the required information for calculating power. According to Cohen (1992), in order to have 80% power to detect a large effect size a sample of 26 participants in each group is required if  $\alpha = .05$ . The current study therefore aimed to recruit 26 people with OCD and 26 non-clinical control participants.

#### **Participants**

A sample of 26 participants who fulfilled the Diagnostic and Statistical Manual for Psychiatric Disorders criteria (DSM-IV; American Psychiatric Association, 1994) for a diagnosis of Obsessive Compulsive Disorder was recruited. Diagnosis was determined by a semi-structured interview conducted by the principal investigator (see Appendix 2 for a copy of the interview schedule) and the results of the Obsessive-Compulsive Inventory (OCI). The mean age of the OCD group was 42.5 (S. D. = 8.70) and ages ranged from 20 to 68 years.

Participants with a past brain injury, primary psychotic diagnosis or a history of substance misuse were excluded although in reality, no participant came forward from any of these categories. Participants with comorbid neurotic conditions such as depression were allowed. Details of the OCD participants' treatment status (currently receiving psychological therapy, received psychological treatment in the past, no treatment) and current medication were recorded.

The OCD participants were divided into two groups. Twelve reported contamination obsessions and engaged in washing and cleaning compulsions. For the purpose of the current study they were labelled washers. The second group consisted of 14 participants who did not engage in washing or cleaning obsessions or compulsions. This group included people who engaged predominantly in checking rituals and people who engage in mental rituals in response to intrusive thoughts and were labelled non-washers.

The OCD washers sample included 6 women and 6 men. The mean age of the group was 41.33 (S.D. = 15.35; range 20 to 68 years) with 13.16 (S.D. = 2.16) mean years in education. The OCD non-washers consisted of 10 women and 4 men. The mean age of the non-washers group was 40.71 (S.D. = 9.27; range 24 to 57 years) with 14.42 (S. D = 2.5) mean years in education. Independent samples t-tests revealed no significant differences between the OCD washers and OCD non-washers in terms of age ( $t(24) = .12, p = .90$ ) or number of years in education ( $t(24) = .50, p = .18$ ). A chi-squared test revealed no significant effects of gender ( $\chi^2(1) = 1.25, p = .26$ ). The OCD subgroups were therefore equally matched on the variables gender, age and number of years in education.

A group of 26 participants who had no history of psychiatric illness were recruited as non-clinical controls. The group was matched with the OCD subjects on 3 variables - age, gender and number of years in education. The control group consisted of equal numbers of men and women as the OCD group (10 men and 16 women). Ages ranged from 28 to 57 with a mean age of 42.5 (S.D. = 8.7) and 14.23 (S.D. = 2.45) years in education. Independent samples t-tests revealed no significant differences between the OCD and control groups on age ( $t(36) = .082, p = .93$ ) or number of years in education ( $t(46) = 1.38, p = .17$ ). It can therefore be concluded that the groups were equally matched for gender, age and number of years in education.

It should also be noted that English was the first language of all participants. Furthermore, the control group were each paid £5 for their participation in the study and the OCD group had their travel expenses reimbursed.

### **Recruitment**

Twenty-two of the participants with OCD were recruited through a national charity for people with OCD. Advertisements were placed in the charity's quarterly newsletters and a research stand was set up at their annual conference. A further 4 OCD participants were recruited from a Psychology out-patient service within central London. The non-clinical control group were recruited through a convenience sample that included employees at a Health centre, voluntary workers and their peers. All participants who expressed an interest in the study were sent an information sheet giving details of the research. A copy of both the patient and volunteer information sheets can be found in Appendix 3.

**Location**

The investigation was carried out within the Psychology department of a local Health Centre in central London.

**Ethics**

Ethics approval was granted from two bodies. The Ethics of Human Research Committee for Camden and Islington Mental Health Trust covered participants from the Psychology trust and the joint UCL/ UCLH Committee on the Ethics of Human Research covered participants from the OCD charity and the control group. Letters of approval from these committees can be found in Appendix 4.

**Procedure**

Written, informed consent was obtained from all participants prior to taking part in the study (see Appendix 5 for a copy of the consent form). OCD participants were initially interviewed using a semi-structured interview to ensure that they fulfilled the DSM-IV criteria for a diagnosis of OCD (see Appendix 1 for DSM-IV criteria). A brief history of their OCD was obtained which included age of onset, details of psychological treatment, both currently and in the past, and current medication.

The first three questionnaires described (BAI, BDI and OCI) were sent by post to all participants to be completed on the day of testing prior to attending their appointment. All other measures were completed in one session that took approximately one hour. The measures were completed in the order presented below. All participants were given identical instructions for completing each task. After completion of the tasks, all participants were given feedback about the intentions of the study. On completion of the study, the experimenter wrote to all of the OCD

participants giving information about the results of the study to ensure that the OCD group felt that they were contributing to the understanding of OCD.

## Measures

### *Beck Anxiety Inventory (BAI; Beck, Epstein, Brown & Steer, 1988)*

The BAI is a self-report measure designed to assess the severity of anxiety symptoms. Participants were required to indicate how much they had been bothered by each of 21 symptoms of anxiety (e.g., feeling hot, nervous, shaky) during the preceding week.

Beck et al. (1988) identified two factors, Somatic and Subjective anxiety or panic, which were shown to have good internal consistency, test-retest reliability and convergent and divergent validity.

### *Beck Depression Inventory – II (BDI-II; Beck, Steer & Brown, 1996)*

The BDI-II was developed especially to assess the depressive symptoms listed as criteria for depressive disorders in DSM-IV (APA, 1994). The Inventory consists of 21 groups of statements and scores range from 0 to 63. Participants were instructed to choose a statement in each group which best described the way they were feeling during the preceding fortnight.

The BDI-II showed improved clinical sensitivity over the BDI in a clinical sample of 500 with the relationship of the BDI-II ( $\alpha = .92$ ) higher than the BDI ( $\alpha = .86$ ). In the validation studies, the BDI-II was positively correlated with the Beck Hopelessness Scale (BHS; Beck & Steer, 1988) ( $r = .68$ ) and the Scale for Suicide Ideation (SSI; Beck, Kovacs & Weissman, 1979) ( $r = .37$ ). The correlation between the Beck

Anxiety Inventory (BAI; Beck & Steer, 1990) and the BDI-II was .60 ( $p < .001$ ). The BDI-II was also positively correlated with the Hamilton Psychiatric Rating Scale for Depression (HRSD; Hamilton, 1960). These correlations are evidence of the convergent and discriminant validity of the BDI-II.

*The Obsessive-Compulsive Inventory (OCI; Foa, Kozak, Salkovskis, Coles & Amir, 1998).*

The OCI is a self-administered measure of the frequency of OCD symptoms and a measure of the amount of distress caused by those experiences. It was developed by Foa, Kozak, Salkovskis, Coles and Amir (1998) to address various limitations of the available instruments in order to determine the diagnosis and severity of OCD. The OCI consists of 42 items composing 7 subscales: Washing, Checking, Doubting, Ordering, Obsessing, Hoarding and Mental Neutralizing. These categories correspond to the content domains of the six most common primary obsessions and the six most common compulsions. The sub-scales for the most common symptoms (e.g., washing, checking, obsessions) contained more items than those for less common symptoms (e.g., hoarding, doubting). Each item is rated on a 5-point (0-4) Likert scale of the frequency of symptoms (never, almost never, sometimes, often, almost always) and associated distress these experiences had caused them in the preceding month (not at all, a little, moderately, a lot, extremely).

In the OCI validation study which utilised a sample of 147 individuals diagnosed with OCD, 58 with generalised social phobia, 44 with PTSD and 194 non-clinical individuals, the scale demonstrated high internal consistency. The alpha coefficients of the full scale ranged from 0.86 to 0.95. Regarding the subscales, all but 6 of the 56 coefficients exceeded 0.60. In addition, the OCI was highly correlated with other

measures of OCD symptoms (Maudsley Obsessive Compulsive Inventory (MOCI), Hodgson & Rachman, 1977; the Compulsive Activity Checklist (CAC), Freund, Steketee & Foa, 1987) showing good convergent validity. Furthermore, the OCI has demonstrated good discriminative validity when distinguishing individuals with OCD from those with other anxiety disorders and normal controls (Foa et al., 1998).

In addition, Simonds, Thorpe and Elliott (2000) examined the psychometric properties of the OCI in a non-clinical sample. Statistical analyses indicated adequate test-retest reliability for the full scales and the sub-scales (coefficients ranged from 0.69 to 0.88) and high internal consistency (all coefficients exceeding 0.7). Convergent validity with the MOCI was adequate for the full scales and for the Washing and Checking subscales (coefficients ranged from 0.61 to 0.75).

*Facial Expression Recognition task (Calder et al., 1996)*

The procedure used by Calder et al. (1996) and Sprengelmeyer et al. (1996, 1997) was replicated in the current study. Computer-interpolated ('morphed') images were used. These had been prepared by blending two prototype facial expressions (e.g. happiness and surprise) posed by JJ (Ekman & Friesen, 1976) in proportions 90: 10 (i.e. 90% happy: 10% surprised), 70: 30 (i.e., 70% happy, 30% surprised), 50: 50 (i.e., 50% happy: 50% surprised), 30: 70 (30% happy, 70% surprised) and 10: 90 (10% happy, 90% surprised).

Facial expressions had been ordered by placing each adjacent to the one it was most likely to be confused with in Ekman & Friesen's (1976) norms; this gave the sequence happiness to surprise, surprise to fear, fear to sadness, sadness to disgust,

disgust to anger and from anger back to happiness. The ends of this sequence were joined to create an emotional hexagon. The morphed faces are shown in Appendix 6.

The images were presented one at a time on a computer screen for 5 seconds each, in pseudo-random order. Participants were asked to decide whether each image was most like happiness, surprise, fear, sadness, disgust or anger. The names of the six emotions were printed on a card, which could be consulted throughout the test. There were four blocks of trials; in each of these blocks all of the 30 morphed faces were presented once.

#### *Modified Stroop colour-naming task*

A modified Stroop task incorporating a semantic and pictorial manipulation was employed to study processing of disgust and contamination related information in addition to general threat information. The basic procedure replicated a design used by Foa et al. (1993) discussed in the introduction. In addition, priming photographs were shown prior to each word instead of a priming word.

#### Stimulus items

The words used as experimental stimuli were drawn from four classes of words: contamination, general threat, neutral (fruits) and non-words and are presented overleaf. Non-word stimuli were utilised in order to control for the effect of semantic content on colour-naming latencies. They were generated by Foa et al. (1993) by changing one vowel in each of 5 common English words. The lists of true words were matched with regard to mean numbers of syllables and perceived frequency of usage.

<b>Contamination words</b>	<b>General threat words</b>	<b>Neutral words</b>	<b>Nonwords</b>
AIDS	anxiety	apple	gosp
contaminate	cancer	banana	bord
dirt	coffin	cherry	fices
poison	death	grape	foint
rat	funeral	melon	narvous
shit	guilt	peach	
toilet	nervous	pear	
unclean	panic	prune	
germs	stress	raisin	
rubbish*	tumour	strawberry	

\* amended from the American word trash used in Foa et al., (1993) experiment.

Each target word was primed by either a neutral picture or a disgust picture. There were 10 pictures in each set. Copies of the neutral pictures are provided in Appendix 7 and copies of the disgust pictures can be found in Appendix 8. The pictures were chosen from the International Affective Picture System (Lang, Bradley & Cuthbert, 1997). The neutral pictures were the same as some of the pictures used by Phillips et al. (2000) as they had previously been rated as neutral by the authors. The pictures included stimuli that were thought to be unrelated to symptoms of OCD (e.g., Boats, umbrella, clouds) whilst the disgust pictures were selected as being disgusting to most people (e.g., dirty toilets, rubbish, cockroaches).

The Stroop program was constructed using Visual Basic 6 with an Exacticks 1.0 plug-in for microsecond accurate timing. Following written instructions on the computer screen, participants were given a practice session where they were required to name the colour of 20 neutral words (see Appendix 9) presented in the centre of the screen by pressing a coloured key on the computer keyboard which corresponded to the colour of the word on the screen. Words were presented in uppercase letters

approximately 2cm high. The words were presented either in red, yellow, blue, green or white ink. Accuracy of 80% on the practice session was required before the main task was started.

Within the main task, each word in each word category (contamination, general threat, neutral, nonword) was randomly presented four times, twice with each priming picture type (neutral or disgust). The colours of the words were randomly assigned so that each word did not appear in the same colour more than once and could not appear twice in succession. The priming pictures were presented first for a fixed 1 second period, 600 milliseconds later the target word was presented on the screen. The word was removed from the screen when the participant pressed the coloured key on the keyboard. The computer recorded response latencies for each trial in microseconds.

#### *Implicit memory task*

An implicit memory task was administered following a one minute interval after presentation of the Stroop task when participants were asked to give their date of birth and number of years in education. A word-stem completion task was chosen to determine whether significant priming effects would be observed without the participants awareness they were being tested. Each stem has a number of possible completions. The increased tendency to respond with a word that has been seen previously is thought to reflect a contribution from implicit memory (Lewandowsky, Kirsner & Bainbridge, 1989).

A word-stem completion task was compiled using the first three letters from eighteen out of the thirty true words used in the Stroop task. Six words were chosen from each

of the contamination, general threat and neutral word categories ensuring that each group had the same mean number of possible word endings. Words were excluded if there were less than 5 possible word endings. A further eighteen word stems matched for possible number of word endings were incorporated as distracters. A copy of the task can be seen in Appendix 10. Participants were given the first three letters and asked to add some letters to make the first English word that came to mind. The number of words generated that were taken from the Stroop task in each category were scored.

*The Disgust Scale (DS; Haidt, McCauley & Rozin, 1994)*

The DS was chosen as a measure of disgust sensitivity. The DS is a 32 item self-report scale that measures disgust sensitivity across 7 domains of disgust elicitors: animals, body products, death, envelope violations (blood, injuries etc.), food, hygiene and sex. An 8th subscale, sympathetic magic, is also included in the overall DS score. This item elicits disgust only to the extent that a respondent obeys the laws of magical thinking (i.e., similarity or contagion).

Each domain of the DS contains 4 statements: the first 2 items are answered true/false (coded 0,1), with reversed scoring for disgust-absent items. The remaining 2 items are answered on a 3 point likert scale ranging from 0, “not disgusting at all” to 1, “extremely disgusting” (coded 0, 0.5, 1). Scores range between 0 and 32 with higher scores indicating greater disgust sensitivity.

In their validation study where the DS was given to four different samples, Haidt et al. (1994) provided evidence of both convergent and discriminant validity. The DS was negatively correlated with Sensation Seeking, especially with Thrill Seeking

( $r = -.47$ ) and Experience Seeking ( $r = -.49$ ) on Zuckerman's (1979) Sensation Seeking Scale. The DS was also positively correlated with Fear of Death ( $r = .39$ ) and with Neuroticism on the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), ( $r = .23$ ) which suggests the DS has good convergent validity. Evidence of discriminant validity was found in the absence of correlation with the EPQ lie scale ( $r = .08$ ) and the Self-Monitoring Scale ( $r = -.10$ ). Furthermore, the DS was not found to be correlated with the EPQ Extraversion Scale ( $r = .06$ ), nor with the Boredom Susceptibility subscale of the Sensation Seeking Scale ( $r = -.16$ )

Using the Spearman-Brown formula, the reliability of the whole DS was estimated as 0.79. Alpha for the DS was 0.84 for the combined scores of four samples and 0.81 for the confirmation sample.

#### *Neutral Picture Rating Task*

In order to be sure that the neutral pictures were indeed seen as neutral for both groups, participants were shown each of the 10 neutral pictures taken from the Stroop task on the computer screen and asked to describe the first thought that came to their mind. They were then asked to rate on a Likert scale ranging from 0 to 8 how much of each of the following emotions they experienced when viewing the picture; anger, fear, disgust, happiness, sadness and surprise. A score of 0 represented no emotion felt and a score of 8 represented an extreme amount of emotion. Furthermore, participants were asked to rate on the same scale whether they had an urge to carry out a ritual such as washing their hands, checking or carry out a mental ritual in response to viewing the picture.

*Explicit Memory Recall*

After completing the above task, participants were asked to recall any words they remembered from the earlier Stroop task. Responses were noted for each word category (contamination, general threat or neutral).

*Disgust Picture Rating Task*

The same procedure was followed as implemented with the neutral picture rating task but substituting each of the 10 disgust pictures.

## CHAPTER 3

### RESULTS

#### Overview

The following chapter details the results of the study. It opens with a description of the OCD sample variables before providing information on both OCD and Control groups levels of anxiety, mood and OCD symptoms in order to verify expected group differences on these measures. The results are then reported for each of the experimental hypotheses tested. All data was analysed using The Statistical Package for the Social Sciences (SPSS) version 10 for windows.

#### OCD sample variables

Information was collected for each OCD participant detailing age of onset of OCD symptoms, whether they were taking anti-depressant medication or benzodiazepines, and whether they were receiving psychological treatment at the time of the study or had received treatment in the past. This information is presented in Table 1 overleaf.

An independent samples t-test was computed in order to determine whether there was a difference between the groups in terms of age of onset. No significant difference between the OCD subgroups ( $t(24) = 1.32, p = .19$ ) was found. It should be noted however, that most of the ages were given retrospectively and therefore relied on memory as most OCD participants were not diagnosed with OCD until much later. The results should therefore be interpreted with some caution.

Chi-square tests were carried out to examine whether there were any differences between the OCD groups on the other variables.

**Table 1:** Table illustrating OCD sample variables (standard deviations in brackets) for OCD washers and non-washers.

	washers	non-washers	Total
Mean age of Onset of OCD	15.58 (9.39)	21.57 (13.03)	18.80 (11.68)
Number taking anti-depressant medication	8	9	17
Number taking benzodiazepine medication	4	2	6
Currently receiving psychological therapy	6	5	11
Psychological therapy in past	11	12	23
N	12	14	26

No significant differences with respect to number taking anti-depressant medication ( $\chi^2 (1) = .01$ ,  $p = .89$ ), benzodiazepine medication ( $\chi^2 (1) = 1.32$ ,  $p = .25$ ), numbers currently receiving psychological treatment ( $\chi^2 (1) = .54$ ,  $p = .46$ ) or numbers who had received therapy in the past ( $\chi^2 (1) = .22$ ,  $p = .63$ ) were found. It can therefore be concluded that both OCD washers and non-washers were similarly matched in terms of the age of onset of OCD, current medication and whether they were currently receiving psychological treatment or had received treatment in the past.

### Symptom Measures

All participants in both OCD and control groups completed the BAI, BDI-II and OCI symptom measures. The mean scores and standard deviations on the BDI-II and BAI for each group are reported in Table 2. Independent samples t-tests were conducted to determine whether there were significant differences between the participant groups on the results of these measures.

**Table 2:** Mean scores on the Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI-II) for all groups (standard deviations in brackets).

	Control Group	OCD Group	OCD washers	OCD non-washers
BDI	3.76 (3.56)	19.34 (13.12)	20.83 (14.44)	18.07 (12.29)
BAI	4.11 (3.82)	19.23 (11.51)	18.58 (10.10)	19.78 (12.95)
N	26	26	12	14

As expected, the OCD group scored much higher than the non-clinical control group on all the symptom measures. To ensure that the groups were within expected ranges, the self-reported symptom ratings were compared to cut-off scores and normative data. In the control group, both depression (Beck et al. 1996) and anxiety (Beck, 1987) scores were within the no to minimal range. As one might expect of an OCD sample, the mean score on the BDI-II indicated elevated levels of depression which fell within the mild cut-off range. The OCD group scored significantly higher than controls on the BDI-II ( $t(27) = 5.83, p < .001$ ). Furthermore, as one might anticipate, the mean score on the BAI in the OCD group fell within the moderate anxiety range. Participants with OCD scored significantly higher on the BAI than controls ( $t(30) = 6.35, p < .001$ ).

In order to examine whether there were any differences in levels of anxiety and depression within the OCD group, further independent samples t-tests were computed between the OCD washers and OCD non-washers. No significant differences were found between the OCD subgroups on the BDI-II ( $t(24) = .52, p = .60$ ) or the BAI ( $t(24) = .26, p = .79$ ). This confirms that both OCD washers and non-washers were matched for levels of depression and anxiety.

On the OCI, the mean total frequency of symptoms score was 67.57 (S. D. = 23.45) in the OCD group and 12.26 (S. D. = 10.65) in the control group. The mean total distress ratings were 59.07 (S. D. = 24.81) in the OCD group and 4.88 (4.73) in the control group. As expected, independent samples t-tests showed the OCD group scored significantly higher than the control group on the frequency of symptoms on the OCI ( $t(35) = 10.94, p < .001$ ) and distress ratings ( $t(27) = 10.93, p < .001$ ). The OCD group rated experiencing considerably more OCD symptoms and greater distress as a result of these symptoms on the OCI than the control group.

Table 3 overleaf reports the mean scores for total and subscale scores for both frequency and distress ratings on the OCI for OCD washers and OCD non-washers. To determine whether there were any significant differences between the OCD washers and non-washers in terms of their OCD symptoms, independent samples t-tests were computed for the total frequency and distress scores on the OCI. Levene's test for equality of variances was significant which suggests there was unequal variance between the groups. The results of the unequal variance t-test are therefore reported. No significant differences between the OCD groups were found for total frequency of symptoms ( $t(18) = .81, p = .42$ ) or the total distress ratings of symptoms ( $t(16) = .69, p = .49$ ). The OCD subgroups were therefore matched in terms of frequency and distress of overall OCD symptoms.

**Table 3:** Mean frequency and distress ratings on each subscale of the OCI and total score for OCD washers and OCD non-washers (standard deviations in brackets).

OCI Subscale	Frequency Ratings		Distress Ratings	
	OCD washers	OCD non-washers	OCD washers	OCD non-washers
Obsessions	1.22 (.83)	2.09 (.67)	1.37 (1.16)	2.16 (.85)
Washing	2.48 (1.05)	.66 (.35)	2.22 (1.11)	.47 (.27)
Checking	1.82 (.97)	1.90 (.79)	1.44 (.92)	1.68 (.78)
Neutralising	1.20 (.94)	1.36 (.80)	.93 (.90)	1.08 (.78)
Ordering	1.65 (.95)	1.25 (1.15)	1.28 (1.01)	1.02 (1.08)
Hoarding	1.63 (1.28)	1.38 (1.41)	1.09 (1.31)	.95 (1.28)
Doubting	1.80 (1.13)	1.99 (1.11)	1.80 (1.17)	1.71 (1.08)
Total Score	71.66 (29.02)	64.07 (17.80)	62.75 (31.95)	55.92 (17.24)

**Note:** Subscale scores range from 0 to 4 and represent the mean rating for that subscale. The total score ranges from 0 to 168.

In order to determine whether there were significant differences between the OCD washers and non-washers in relation to the frequency and distress caused by the different OCD symptoms measured by the OCI a 2 x 7 x 2 mixed model ANOVA was carried out using a multivariate approach. There was one between subjects factor of group (OCD washers, OCD non-washers) and 2 within-subjects factors of subscale (Obsessions, Checking, Neutralising, Ordering, Hoarding, Doubting, Washing) and ratings (frequency, distress). No significant difference was found between the OCD groups ( $F(1,24) = .63, p = .43$ ). Highly significant main effects of subscale (Wilks' Lambda = .11;  $F(6,19) = 24.36, p < .001$ ) and ratings (Wilks' Lambda = .65;  $F(1,24) = 12.58, p = .002$ ) were found.

Furthermore, significant interactions between subscale and group (Wilks' Lambda = .24,  $F(6,19) = 9.81$ ,  $p < .001$ ) and subscale and rating were found (Wilk's Lambda = .39;  $F(6, 19) = 4.76$ ,  $p = .004$ ). There were no significant interactions between the ratings and group (Wilks' Lambda = .99,  $F(1,24) = .08$ ,  $p = .77$ ) or between subscale and rating and group (Wilks' Lambda = .75;  $F(6,19) = 1.01$ ,  $p = .44$ ).

In order to understand the significant interactions between subscale and group, pairwise comparisons were carried out. Sidak adjustment for multiple comparisons was utilised in order to reduce the likelihood of a type 1 error. Significant differences were found between the OCD washers and non-washers on the frequency of obsessions subscale ( $p = .007$ ). The OCD non-washers experienced significantly more obsessions than the OCD washers. As anticipated, a significant difference also emerged on the frequency ratings of washing compulsions ( $p < .001$ ) and the distress ratings for washing compulsions ( $p < .001$ ). The OCD washers experienced significantly more washing compulsions than the non-washers and rated their distress on the washing subscale much higher.

As expected, the results confirm that the OCD subgroups were differentiated by both frequency and distress of washing compulsions. In addition, the OCD non-washers experienced significantly more obsessions than the OCD washers. The results of the independent samples t-tests also confirm that both OCD washers and non-washers were matched in terms of overall frequency of OCD symptoms and level of distress caused by the symptoms.

## Results of Hypotheses

### Hypothesis 1: Disgust Sensitivity

It was hypothesised that people with OCD would show higher levels of disgust sensitivity as measured by the Disgust Scale compared to a non-clinical control group. Mean scores on each domain of disgust measured by the Disgust Scale and mean total scores are provided in table 4. In order to test this hypothesis, independent samples t-tests were computed and the results are also shown in table 4 below.

**Table 4:** Mean scores (standard deviations in brackets) on each domain of disgust measured by the Disgust Scale and results of independent samples t-tests between OCD and control groups.

Subscales on the Disgust Scale	OCD group	Control group	t (50)	p.
Food item	2.38 (.93)	1.75 (.96)	2.41	.005
Animals item	3.11 (.88)	2.48 (.99)	2.42	.005
Body Products	2.50 (1.02)	1.73 (1.05)	2.66	.005
Sex item	2.42 (.96)	2.32 (.96)	.35	.36
Envelope Violations	2.82 (1.20)	1.82 (1.19)	2.99	.002
Death item	1.76 (1.10)	.96 (1.01)	2.73	.004
Hygiene item	1.63 (1.02)	1.00 (.70)	2.59	.005
Magical thinking item	2.09 (1.04)	1.05 (.97)	3.70	<.001
Total Score	18.75 (4.72)	13.13 (5.15)	4.09	<.001

**Note:** Maximum score on each subscale = 4  
Maximum total score = 32.

As can be seen from table 4 the OCD group scored significantly higher than the control group on the total score on the Disgust scale and the hypothesis that the OCD group would be more sensitive towards disgust compared to a normal control group was supported. Furthermore, on the various sub-scales of the Disgust Scale, significant differences between the OCD and control groups were found on all subscales apart from the subscale measuring disgust towards sex.

### **Hypothesis 1a**

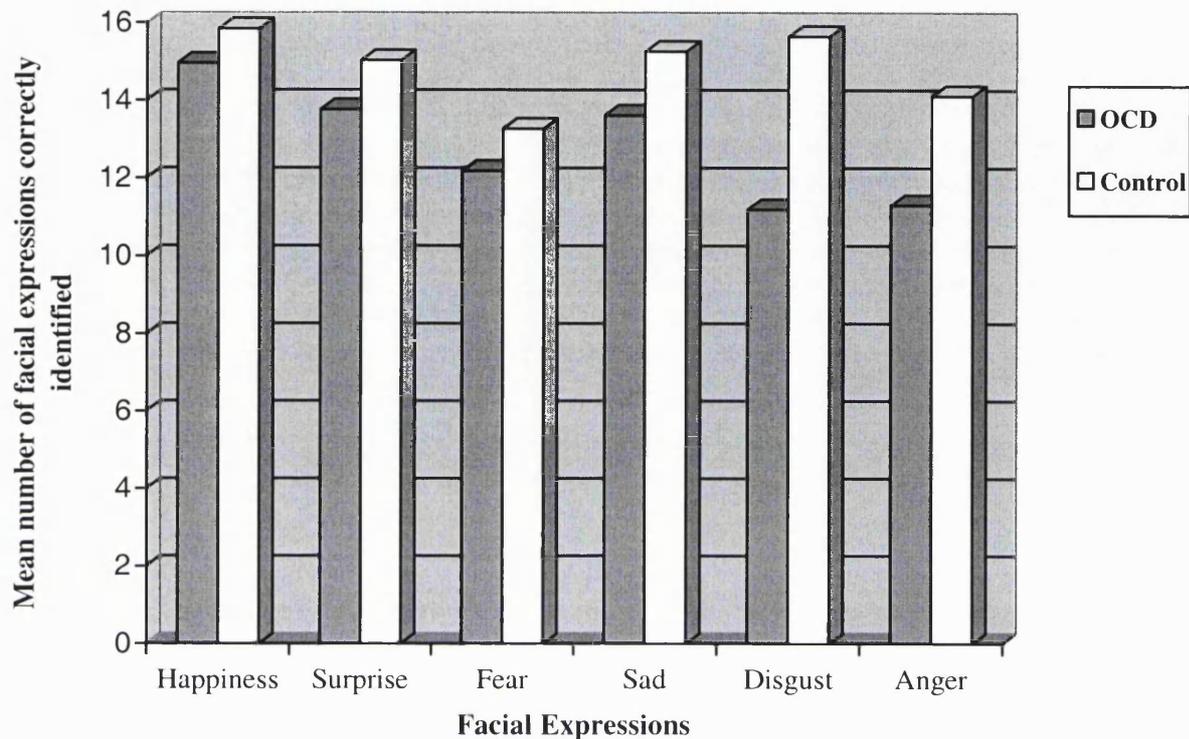
It was further hypothesised that within the OCD group, OCD washers would be more sensitive to disgust than OCD non-washers and would therefore score higher on the Disgust scale compared to OCD non-washers. The mean total score on the Disgust scale was 18.04 (S.D. = 4.92) for the OCD washers and 19.35 (S.D. = 4.63) for the OCD non-washers. An independent samples t-test revealed no significant difference between washers and non-washers on the total score of the Disgust scale ( $t(24) = .70$ ,  $p = .24$ ).

Further independent samples t-tests were carried out to examine potential differences between the OCD sub-groups on each subscale of the Disgust scale. The washers group did not score significantly different from the non-washers group on any of the Disgust subscales except for the Magical thinking item in which OCD non-washers scored significantly higher than OCD washers ( $t(21) = 2.07$ ,  $p = .02$ ). Contrary to expectations, the OCD non-washers were as sensitive to disgust as OCD washers on the Disgust Scale and the secondary hypothesis that OCD washers would be more sensitive to disgust was not supported.

## **Hypothesis 2: Facial Expressions of Disgust**

It was hypothesised that individuals with OCD would show a deficit in the ability to recognize the facial expression of disgust compared to a non-clinical control group. In order to evaluate performance on this task, the facial stimuli (see Appendix 6) were divided into six sections which corresponded to regions containing morphs that have been consistently identified with one of the six emotion labels (happiness, surprise, fear, sadness, disgust and anger) by normal controls in previous studies (Calder et al., 1996; Sprengelmeyer et al., 1997). Four such stimuli were identified for each emotion which comprised the 4 morphs that were closest to the relevant prototype of each emotion (for example, the disgust section contained the morphs 70% disgust: 30% sad, 90% disgust: 10% sad and 70% disgust: 30% anger, 90% disgust: 10% anger). Each stimuli was presented four times leading to scores out of a maximum of 16 correct for each emotion. The mean scores for each emotional facial expression recognised in each group are illustrated in a histogram in Figure 1 overleaf.

The results of the Facial Expression Recognition task were analysed using a multivariate 2 x 6 mixed model ANOVA with a between-subjects factor of group (OCD, control) and a within-subjects factor of emotion (happiness, surprise, fear, sadness, disgust, anger). Prior to carrying out the analysis, the data was checked for outliers. Computed standardised scores revealed three individual scores which were higher than 3 standard deviations from the mean (1 from the OCD group and 2 from the control group). To reduce the likelihood of a type 1 error, the outliers were assigned a score 1 unit lower than the next lowest score within the group as outlined by Tabachnick and Fidell (2001).

**Figure 1:** Mean facial expression recognition scores by OCD and control groups.

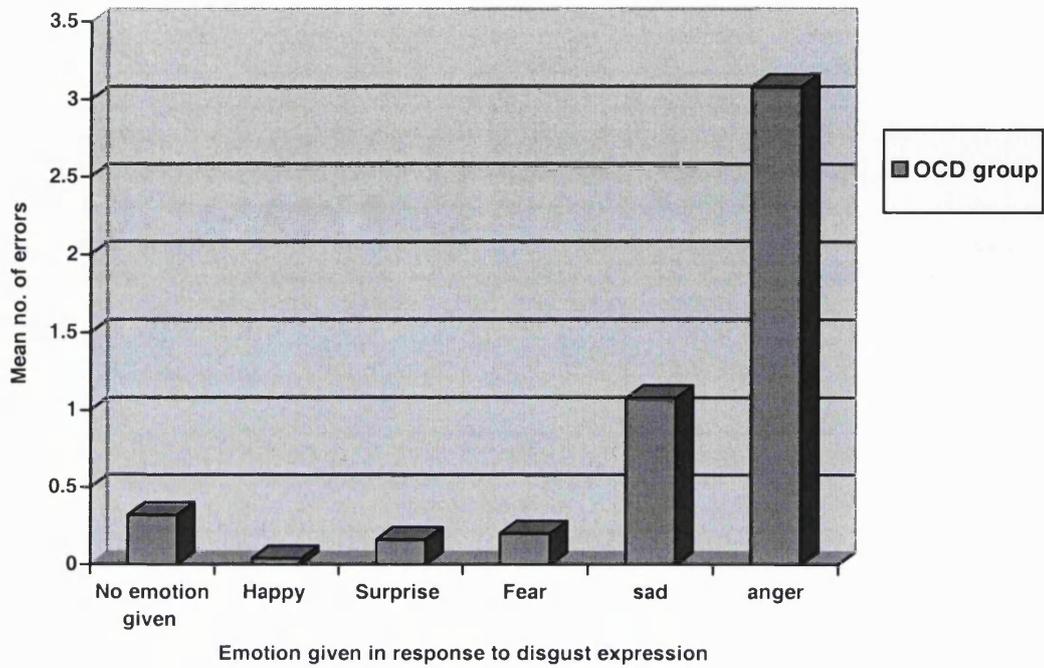
A highly significant difference between the OCD and control groups was found ( $F(1,50) = 16.41, p < .001$ ). In addition, a highly significant main effect of emotion (Wilks' Lamda = .33,  $F(5,46) = 18.29, p < .001$ ) and a significant interaction of group and emotion (Wilks' Lamda = .76,  $F(5,46) = 2.85, p = .01$ ) were found. Pairwise comparisons were carried out to determine the nature of the interaction. Sidak adjustments for multiple comparisons were employed in order to control for type I errors. As predicted, a highly significant difference was found on the ability to recognise disgust between the groups ( $p < .001$ ). The individuals with OCD were significantly impaired in their ability to recognise disgust compared to the control group.

Contrary to expectations, a significant difference also emerged between the two groups on the ability to recognise the emotion of anger ( $p = .004$ ), surprise ( $p = .02$ ), happiness ( $p = .005$ ), and sadness ( $p = .01$ ). The OCD group was impaired in their ability to recognise anger, surprise, happiness and sadness compared to controls. In contrast, no differences were found on the ability to recognise the emotion of fear in the two groups ( $p = .06$ ).

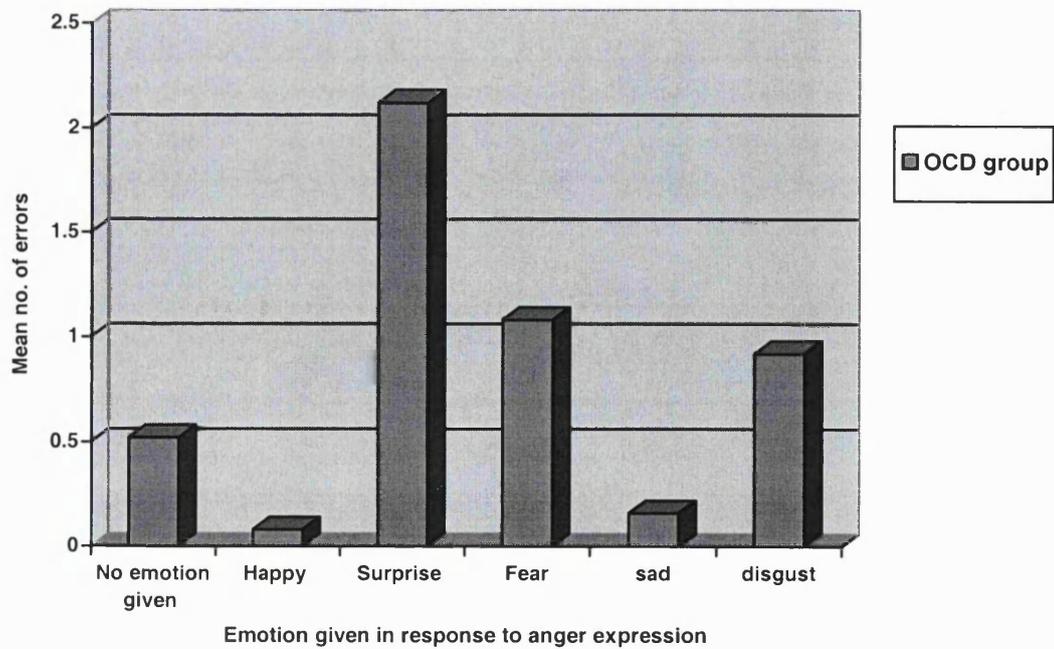
In order to determine whether there was a larger discrepancy between the OCD group's deficit in recognising disgust compared with the other emotions, a 2 x 2 mixed model ANOVA was carried out with a between-subjects factor of group and a within subjects factor of emotion (disgust vs. all other emotions). A significant main effect of group ( $F(1,50) = 20.60, p < .001$ ) was found. The main effect of emotion was not significant (Wilk's Lambda = .97;  $F(1,50) = 1.35, p = .12$ ). A significant interaction between emotion and group (Wilk's Lambda = .82;  $F(1,50) = 10.91, p = .001$ ) was found. This suggests that the OCD group were significantly more impaired in their ability to recognise the emotion of disgust compared to their ability to recognise the other emotions and the main hypothesis that individuals with OCD are impaired in their ability to recognise facial expressions of disgust was supported.

Out of interest, the nature of errors made by the OCD group when identifying disgust and anger faces was examined. Figure 2 illustrates the mean number and type of errors given in response to disgust faces and figure 3 shows the mean number and type of errors given in response to angry faces. Figure 2 shows that OCD participants were most likely to mistake disgust facial expressions for anger, and to a lesser extent sadness. Figure 3, on the other hand shows that anger faces were most likely to be mistaken for surprise and to a lesser degree fear or disgust.

**Figure 2:** Histogram of mean number of errors and emotions given in response to disgust faces



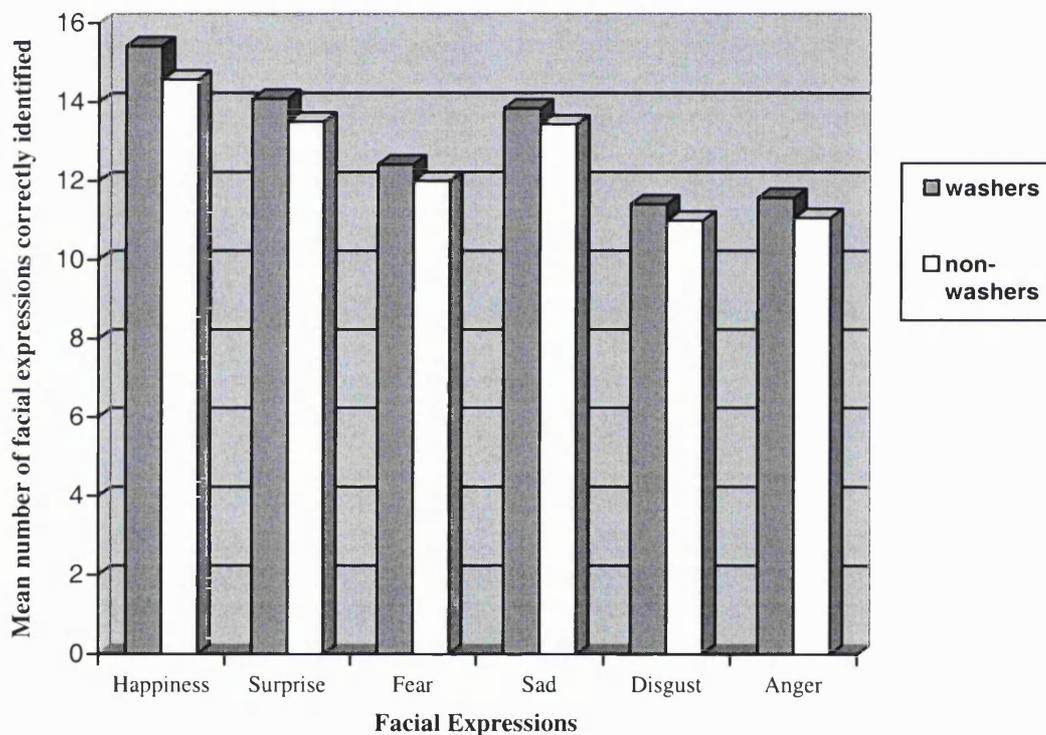
**Figure 3:** Histogram of mean number of errors and emotions given in response to anger faces



### Hypothesis 2a

It was further hypothesised that OCD washers would show a deficit in the ability to recognise facial expressions of disgust in addition to OCD non-washers. The mean scores for each facial expression correctly identified by the OCD washers and non-washers on the facial expression recognition task are presented in figure 4.

**Figure 4:** Mean correct responses on the facial expression identification task for OCD washers and OCD non-washers.



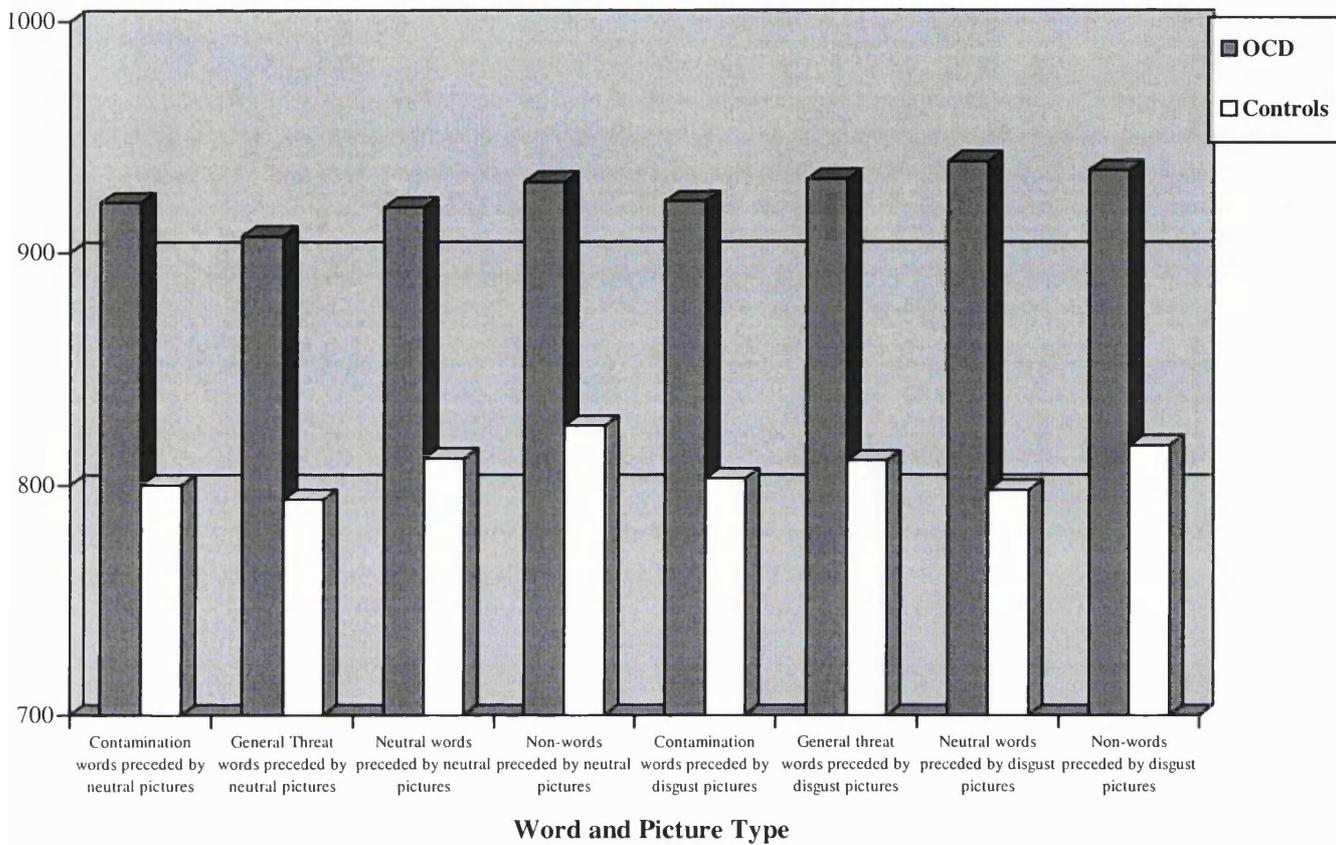
To determine whether there were any differences in the ability to recognise disgust between OCD washers and non-washers a further mixed multivariate 2 x 6 ANOVA with group as a between-subjects variable and emotion as a within-subjects variable was computed between the two subgroups. No significant difference between the OCD subgroups was found ( $F(1,24) = .28, p = .60$ ). A significant main effect of emotion was found (Wilks' Lambda = .33,  $F(5,20) = 7.82, p < .001$ ). Figure 4

highlights that both OCD washers and non-washers were most impaired in their ability to recognise disgust and anger compared to their ability to recognise the other emotions. There were no significant interaction effects between emotion and group (Wilks' Lambda = .98,  $F(5,20) = .04$ ,  $p = .99$ ). Both OCD washers and OCD non-washers were therefore equally impaired in their ability to recognise the emotion of disgust and the secondary hypothesis was supported.

In order to determine whether the results may have been affected by the use of anti-depressant medication, a further comparison using a 2 x 6 mixed model ANOVA was carried out between individuals with OCD who were taking anti-depressants and those who were not. As above, a significant main effect of emotion was found (Wilks' Lambda = .33;  $F(5,20) = 8.03$ ,  $p < .001$ ). However, no main effect was found for the interaction between emotion and anti-depressant medication (Wilks' Lambda = .91;  $F(5,20) = .39$ ,  $p = .84$ ). Furthermore, no significant differences were found between the medicated and non-medicated OCD groups ( $F(1,24) = .93$ ,  $p = .34$ ). It can therefore be concluded that the use of anti-depressant medication did not confound the results on the facial expression recognition task.

### **Hypothesis 3: Attentional Bias**

It was hypothesized that individuals with OCD would show longer colour-naming response latencies towards contamination/disgust words and general threat words on the Stroop task compared to a non-clinical control group. It was further assumed that compared to the control group, the OCD group would show longer colour-naming response latencies to all words which were preceded by a disgust picture compared to words preceded by a neutral picture. Mean colour-naming latencies on the Stroop task are illustrated overleaf in figure 5.

**Figure 5:** Histogram of mean colour-naming response latencies on the modified Stroop task.

The results were analysed using a 2 x 4 x 2 mixed ANOVA using a multivariate approach with 1 between-subjects factor of group (OCD, control) and 2 within-subjects factors of word type (contamination, threat, neutral, non-word) and prime pictures (disgust, neutral). The results are provided in table 5 overleaf.

**Table 5.** Results of 2 x 4 x 2 mixed ANOVA comparing OCD group with control group on the Stroop task

Source	Wilks' Lambda	F	df	p
Group		18.12	1,50	< .001
Picture	.93	1.9	1,50	.08
Word	.82	3.41	3,48	.01
Picture x Group	.96	2.3	1,50	.06
Word x Group	.97	.48	3,48	.34
Picture x Word	.88	2.08	3,48	.06
Picture x Word x Group	.91	1.47	3,48	.11

A significant difference was found between the groups on the Stroop task. From figure 5 it can be seen that the OCD group were much slower at colour naming all the items in the Stroop task regardless of word type or picture type compared to the control group. The results of the ANOVA in table 5 show that there was a significant main effect of word type. This suggests that both groups varied in their response latencies to the different word categories. However, contrary to expectation, there was no effect of the picture categories or any significant interactions.

Although the OCD group was slower at colour-naming contamination/ disgust and general threat words compared to the control group they were also much slower at colour-naming neutral and non-words and the hypothesis that there would be an attentional bias towards the contamination/ disgust and general threat words was not supported. The hypothesis that all words preceded by a disgust picture would produce longer colour-naming latencies in OCD was also not supported.

### Hypothesis 3a

It was further hypothesised that within the OCD group, OCD washers would show a longer response latency towards contamination/ disgust words than OCD non-washers. In addition, it was predicted that OCD washers would show longer response latencies to words preceded by disgust pictures compared to the OCD non-washers.

A further mixed model 2 x 4 x 2 multivariate ANOVA with 1 between-subjects factor (group; OCD washers, OCD non-washers) and 2 within-subjects factors (word type; picture type) was conducted. The results are provided in Table 6 below.

**Table 6:** Results of 2 x 4 x 2 mixed ANOVA comparing OCD washers and OCD non-washers on the Stroop task

Source	Wilks' Lambda	F	df	p
Group		.88	1,24	.17
Picture	.86	3.65	1,24	.03
Word	.88	.95	3,22	.21
Picture x Group	.90	2.66	1,24	.06
Word x Group	.79	1.93	3,22	.07
Picture x Word	.78	2.06	3,22	.06
Picture x Word x Group	.84	1.34	3,22	.14

Table 6 shows there was a significant main effect of picture type but no significant main effects of words or groups or significant interactions. There were no significant differences in colour-naming response latencies between OCD washers and OCD non-washers regardless of picture or word type and the secondary hypotheses were not therefore supported.

#### Hypothesis 4: Memory Bias in OCD

It was hypothesised that individuals with OCD would show an implicit memory bias (i.e. improved memory) for threatening stimuli associated with contamination/disgust and general threat compared to normal controls on the Word Completion task which measures implicit memory. In addition, it was hypothesised that the OCD group would continue to show a memory bias towards contamination and general threat words in a delayed memory task. The mean scores for all groups on the word completion task can be found in Table 7 below.

**Table 7:** Mean scores on the Word Completion Implicit Memory Task (standard deviations in brackets).

	Control group	OCD group	OCD washers	OCD non-washers
Contamination words	2.61 (1.20)	2.46 (1.30)	2.50 (1.31)	2.42 (1.34)
Threat words	2.61 (1.32)	2.26 (1.40)	2.08 (1.72)	2.42 (1.08)
Neutral words	3.26 (1.48)	2.38 (1.38)	2.16 (1.64)	2.57 (1.15)
N	26	26	12	14

The results of the word completion task were analysed using a mixed 2 x 3 multivariate ANOVA with 1 between subjects factor of group (OCD, control) and 1 within-subjects factor of word type (contamination, threat, neutral). A significant difference was found between the groups ( $F(1,50) = 3.211, p = .03$ ). The OCD group remembered less words than the control group. However, no significant main effects were found of word type (Wilks' Lambda = .95,  $F(2,49) = 1.28, p = .14$ ) or word type and group interaction (Wilks' Lambda = .95,  $F(2,49) = 1.06, p = .17$ ). The implicit memory bias hypothesis was not supported by the data.

The OCD group did not show a bias towards contamination or general threat words compared to normal controls.

The results of the delayed recall task are provided in table 8 below. These results were also analysed using a 2 x 3 mixed ANOVA with a between-subjects factor of group (OCD, control) and a within-subjects factor of word type using a multivariate approach. No significant differences emerged between the OCD group and control group ( $F(1,50) = 2.00, p = .08$ ). A significant main effect of word type was found (Wilks' Lambda = .65;  $F(2, 49) = 12.97, p = < .001$ ). Furthermore, a significant effect was found for word type and group interaction (Wilks' Lambda = .90;  $F(2,49) = 2.51, p = .04$ ). From table 8 it can be seen that the OCD group remembered more contamination and neutral words than the control group.

**Table 8:** Mean scores on the Delayed recall task (standard deviations in brackets).

	Control group	OCD group	OCD washers	OCD non-washers
Contamination words	1.38 (.98)	2.19 (1.35)	2.16 (1.33)	2.21 (1.42)
Threat words	1.53 (1.30)	1.30 (1.49)	.75 (1.13)	1.78 (1.62)
Neutral words	.42 (.90)	.96 (1.79)	.33 (.65)	1.50 (2.27)
N	26	26	12	14

Both the OCD group and the control group differed in their ability to remember the different categories of word. From table 8 it can be seen that both the OCD and control groups remembered more contamination and general threat words compared to the neutral (fruit) words. The hypothesis that the OCD group would show a bias

towards contamination words was supported but the OCD group did not show the expected bias towards general threat words.

#### **Hypothesis 4a**

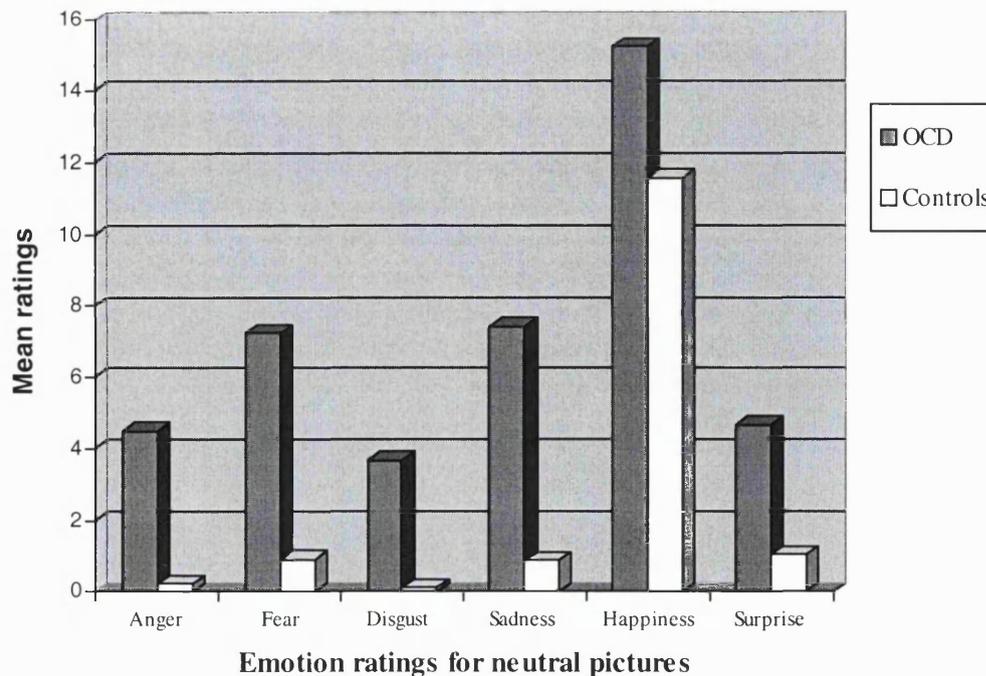
It was further hypothesised that OCD washers would show a greater memory bias towards contamination/disgust words compared to OCD non-washers on both the implicit and explicit memory tasks. The mean scores on the word completion task can be found in table 7. The results of the word completion task were also analysed using a 2 x 3 mixed ANOVA. No significant main effects were found for group ( $F(1,24) = .30, p = .29$ ), word type (Wilks' Lambda = .97;  $F(2,23) = .27, p = .38$ ) or word x group interaction (Wilks' Lambda = .97;  $F(2,23) = .25, p = .38$ ). It can therefore be concluded that there was no evidence of an implicit memory bias in OCD washers.

The mean scores on the delayed recall task are presented in table 8. The results of the delayed recall task were also analysed using a 2 x 3 mixed ANOVA. A significant difference was found between the groups ( $F(1,24) = 2.84, p = .05$ ). Table 8 shows that OCD non-washers remembered more words than OCD washers. A highly significant main effect was found for word type (Wilks' Lambda = .65;  $F(2,23) = 7.57, p = .00$ ). From table 8 it can be seen that both OCD subgroups remembered more of the contamination words. However, no significant main effect of word and group interaction was found (Wilks' Lambda = .87;  $F(2,23) = 1.67, p = .10$ ). OCD washers did not therefore show a greater memory bias towards contamination words either implicitly or explicitly compared to OCD non-washers and the secondary hypothesis was not supported.

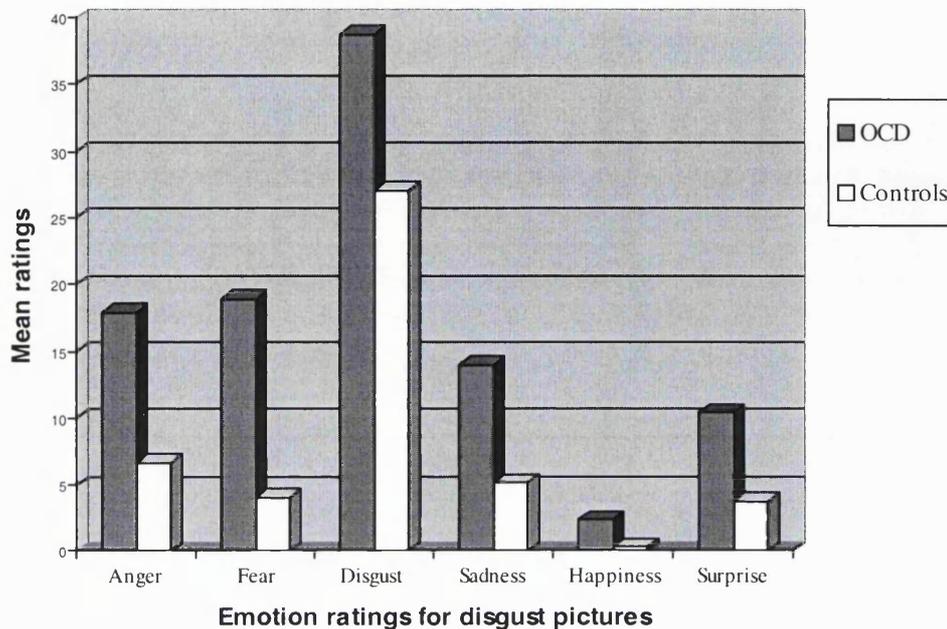
### Hypothesis 5: Picture ratings

It was hypothesised that individuals with OCD would rate the emotional content of disgust pictures as more disgusting than a non-clinical control group. Furthermore, it was hypothesised that they would show an urge to ritualise after viewing these pictures compared with the control group. All participants were asked to rate 10 neutral pictures and 10 disgust pictures on scales of 0 – 8 for each of the following emotions – happiness, surprise, fear, sadness, disgust and anger. The total ratings of each emotion for each set of pictures were combined to give total emotion scores for both neutral and disgust pictures. The mean ratings for each emotion in response to neutral pictures are shown in a histogram in figure 6 and the mean ratings for disgust pictures are presented in figure 7. It was predicted that all participants would rate the neutral pictures lower than the ratings of the disgust pictures.

**Figure 6:** Histogram of mean total scores of OCD and Control groups for each emotion rated after viewing neutral pictures



**Figure 7:** Histogram of mean total scores of OCD and Control groups for each emotion rated after viewing disgust pictures



The results were analysed using a multivariate  $2 \times 2 \times 6$  mixed ANOVA with 1 between-subjects factor of group (OCD, control) and 2 within-subjects factors of picture (neutral, disgust) and emotion (anger, fear, disgust, sadness, happiness, surprise). Prior to carrying out the analysis, it is important to note that the data was checked for multivariate outliers using Mahalanobis distance (Tabachnick & Fidell, 1996). There were no cases in the analysis where Mahalanobis distance was significant.

A significant difference between the two groups was found ( $F(1,50) = 15.62$ ,  $p < .001$ ). From figure 7 it can be seen that the OCD group rated the disgust pictures as much more disgusting than the controls. Figures 6 and 7 show that the OCD group also rated all other emotions higher than the control group on both types of picture. Highly significant main effects of picture type (Wilks' Lambda = .54;  $F(1,50) = 42.06$ ,  $p < .001$ ), emotion (Wilks' Lambda = .29;  $F(5,46) = 21.95$ ,  $p < .001$ )

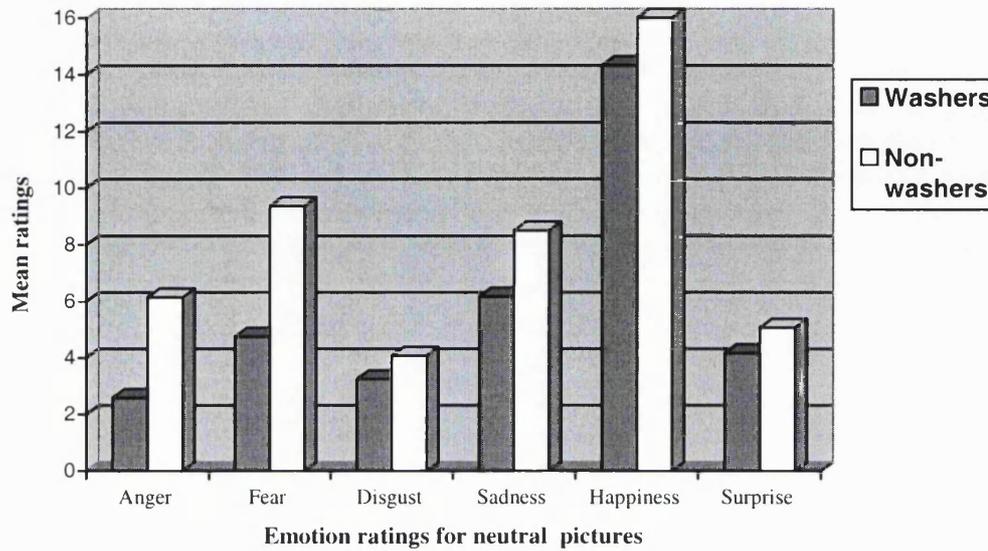
and a significant interaction between picture type and emotion (Wilks' Lambda = .23;  $F(5,46) = 30.24$ ,  $p < .001$ ) was also found. Significant interactions were found for picture type x group (Wilks' Lambda = .93;  $F(1,50) = 3.7$ ,  $p = .03$ ) and emotion x group (Wilks' Lambda = .82,  $F(5,50) = 2.02$ ,  $p = .04$ ). No significant interaction was found for picture x emotion x group (Wilks' Lambda = .87,  $F(5,50) = .13$ ,  $p = .13$ ).

The hypothesis that the OCD group would rate disgust pictures as significantly more disgusting than the control group was supported. In addition, the OCD group rated both neutral and disgust pictures as evoking more fear, anger, sadness, surprise and happiness than the control group.

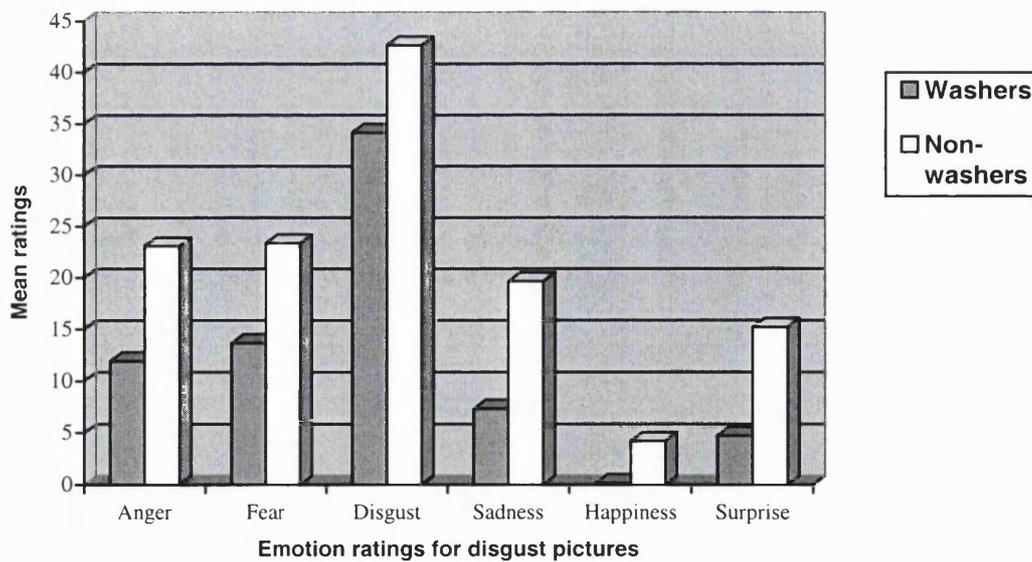
### **Hypothesis 5a**

Within the OCD group, it was predicted that OCD washers would rate disgust pictures as more disgusting than the OCD non-washers subgroup. The mean scores for OCD washers and non-washers for each emotion rated after viewing neutral pictures are presented in figure 8 and the mean emotion ratings for disgust pictures are presented in figure 9 overleaf.

**Figure 8:** Histogram of mean total scores of OCD washers and OCD non-washers for each emotion rated after viewing neutral pictures.



**Figure 9:** Histogram of mean total scores of OCD washers and OCD non-washers for each emotion rated after viewing disgust pictures.



A further multivariate  $2 \times 2 \times 6$  mixed ANOVA was computed with OCD washers and OCD non-washers as the between-subjects factor and picture type and emotion as within-subjects factors. A significant difference between the OCD washers and

non-washers was found ( $F(1,24) = 3.97, p = .02$ ). Furthermore, significant main effects were found for picture type (Wilks' Lambda = .50;  $F(1,24) = 23.94, p < .001$ ), emotion (Wilks' Lambda = .25;  $F(5,20) = 11.88, p < .001$ ) and picture x emotion interaction (Wilks' Lambda = .19;  $F(5,20) = 16.87, p < .001$ ). A significant interaction effect was found for picture type and group (Wilks' Lambda = .88;  $F(1,24) = 3.19, p = .04$ ). No significant interactions were found between emotion and group (Wilks' Lambda = .92;  $F(5,20) = .34, p = .43$ ), or picture and emotion and group (Wilks' Lambda = .94;  $F(5,20) = .25, p = .47$ ).

An examination of figure 9 shows that contrary to expectations, OCD non-washers rated disgust pictures as much more disgusting than OCD washers. Furthermore, OCD non-washers rated disgust pictures as evoking more anger, fear, sadness and surprise than the washers group. The secondary hypothesis was not therefore supported.

### **Urge to ritualise**

The urge to carry out a ritual after viewing each picture was analysed using independent samples t-tests. Levene's test for equality of variances was significant which suggests there was unequal variance between the groups. This was expected as it was anticipated that the control group would not have urges to ritualise to the pictures. The results of the unequal variance t-test are reported.

Contrary to expectations, six of the neutral pictures showed significant differences between the OCD and control group on the urge to carry out a ritual. The OCD group had a significant urge to ritualise after viewing the picture of the fan ( $t(26) = 2.44, p = .005$ ), the umbrella ( $t(25) = 2.1, p = .02$ ), the air vent ( $t(26) = 1.9, p = .03$ ), the

boat ( $t(25) = 1.78, p = .04$ ), the horse ( $t(25) = 1.75, p = .04$ ) and the lorry ( $t(25) = 1.8, p = .04$ ). No significant differences were found on the other four neutral pictures. Although the pictures were chosen to be neutral, six of the pictures gave participants with OCD an urge to carry out a ritual after viewing.

Independent samples t-tests were computed to compare OCD and control groups on the urge to carry out a ritual after viewing disgust pictures. The results of the disgust pictures are provided in table 9 below.

**Table 9:** Mean scores (standard deviations in brackets) and results of independent samples t-test comparing OCD and control group on urge to carry out a ritual after viewing disgust pictures.

Picture	OCD group	Control group	t value	p
Rusty cans	.65 (1.71)	.03 (.19)	$t(26) = 1.81$	.04
Cigarette butts	.65 (1.29)	.03 (.19)	$t(26) = 2.30$	.01
4 Cockroaches	1.50 (2.28)	.00	$t(25) = 3.34$	.001
Dirty crockery	.69 (1.76)	.03 (.19)	$t(25) = 1.88$	.04
Toilet 1	1.42 (2.38)	.00	$t(25) = 2.85$	.004
Cockroaches on food	.80 (1.76)	.00	$t(25) = 2.33$	.01
Burst Rubbish bag	.76 (1.65)	.00	$t(25) = 2.36$	.01
2 Cockroaches	.80 (2.09)	.00	$t(25) = 1.96$	.03
Flies on pie	.30 (.83)	.00	$t(25) = 1.87$	.04
Toilet 2	1.84 (2.72)	.07 (.27)	$t(25) = 3.29$	.001

Table 9 shows that all of the 10 disgust pictures revealed a significant difference in the urge to ritualise between the OCD and control group. The OCD group had a strong urge to ritualise after viewing all of the disgust pictures compared to the control group. The hypothesis that people with OCD would have an urge to ritualise after viewing disgust pictures was confirmed.

To determine whether there were any differences between OCD washers and non-washers on the urge to ritualise after viewing neutral and disgust pictures further independent samples t-tests were computed between the OCD subgroups. No significant differences emerged between the OCD subgroups of urge to ritualise after viewing any of the neutral or disgust pictures. The hypothesis that OCD washers would have a greater urge to ritualise after viewing disgust pictures was not, therefore, supported.

## DISCUSSION

### Overview

The following chapter will discuss the findings of the current study. The results of each of the five main hypotheses and the secondary hypotheses will be given followed by an interpretation of each finding. Criticisms of the methodology will be reviewed. The scientific and treatment implications will then be discussed. Finally, suggestions will be given for future research.

### Disgust Sensitivity

#### *Hypothesis 1:*

*Individuals with OCD will show higher levels of disgust sensitivity as measured by the Disgust Scale compared to a non-clinical control group.*

The results of the current study supported the above hypothesis. The OCD group showed higher levels of disgust sensitivity than the control group. In addition, the OCD group showed higher levels of disgust sensitivity on subscales that measured disgust elicited towards food, hygiene, animals, death, body products, envelope violations and the extent to which disgust is elicited by magical thinking.

#### *Hypothesis 1a*

*Within the OCD group, the OCD washers will show higher levels of disgust sensitivity on the Disgust scale than OCD non-washers.*

No significant differences were found on the total score of the Disgust scale between the OCD washers and non-washers. The OCD washers did not therefore, show higher levels of disgust sensitivity than the OCD non-washers and hypothesis 1a was

not supported. The only subscale of the Disgust Scale where significant differences between the OCD groups was found was on the scale measuring the extent to which disgust is elicited by laws of sympathetic magic. On this subscale, OCD non-washers scored significantly higher than OCD washers.

### **Interpretation of disgust sensitivity findings**

The results of the present study have highlighted differences between individuals with OCD and normal controls in terms of disgust sensitivity. The results have also shown that it is not only washing compulsions in OCD that are associated with disgust sensitivity. Individuals with a variety of OCD symptoms show higher levels of disgust sensitivity towards a range of disgust elicitors.

One possible explanation for the finding of higher levels of disgust sensitivity in people with OCD compared to normal controls may be linked to the age of onset of OCD. Epidemiological studies have shown that OCD typically develops during adolescence in checkers and after childbirth in female washers (e.g., Rachman and Hodgson, 1980; Bogetto et al., 1999). Miller (1997) described adolescence as “a period of aggravated sensitivity to shame, humiliation, and embarrassment and of exceptional sensitivity to disgust, primarily provoked by the vertigo of sexual awakening and bodily changes” (p.14). In addition, adolescence is often the time that individuals start to acquire morals. Rozin and Fallon (1987) argue that disgust is linked to moral values and it is possible that intrusive thoughts that go against one’s values will elicit feelings of disgust. It is possible that OCD develops as a way of dealing with heightened feelings of disgust during adolescence.

Furthermore, looking after a child after giving birth naturally involves cleaning up faeces and vomit. It is possible that individuals who are more sensitive towards disgust may go on to develop OCD as a way of coping with the disgust evoked with child-caring duties. It is therefore possible that OCD develops in individuals who are highly sensitive towards disgust as a strategy to cope with disgust in daily life. Conversely, it may be that heightened disgust sensitivity develops as a result of OCD symptoms. OCD is characterised by intrusive, unacceptable thoughts that are often seen as repulsive to the individual experiencing them. It is possible that such thoughts leave a person highly sensitive towards disgust.

It has been argued that the emotion of disgust follows laws of magical thinking, namely, the law of contagion and the law of similarity (Rozin et al., 1986). Although this type of thinking has been shown to be prevalent in the general adult population (Rozin et al., 1986), the current study showed that individuals with OCD score significantly higher than normal controls on the extent to which they obey such laws. Furthermore, OCD non-washers scored significantly higher than OCD washers which may help to explain why non-washers are also highly sensitive towards disgust.

These results add support to Rachman's (1994) suggestion that obsessional thinking in OCD may be organised by such laws. It is possible that these laws of magical thinking influence both obsessions and compulsions in OCD and may be carried out to reduce the likelihood of experiencing disgust. This may be in a similar way that anxiety disordered individuals carry out safety behaviours in an attempt to reduce anxiety.

There is ample evidence in the literature of a relationship between OCD and a cognitive thinking bias known as thought-action fusion (Rachman, 1993; Shafran, Thordarson & Rachman, 1996). This bias takes two forms – the belief that having an unacceptable thought may actually influence the probability that such a repugnant event will occur, and the belief that having an unacceptable thought is morally equivalent to carrying out that particular action. It has been argued that this particular cognitive bias is a likely contributor to anxiety (Rachman, 1997). The results of the current study suggest that disgust may also be involved in OCD and one could argue that thought-action fusion bears a resemblance to the laws of magical thinking.

To conclude, the current study has shown that it is not only washing compulsions that are associated with high levels of disgust sensitivity. These findings do not support Power and Dalgleish's (1997) claim that disgust is only associated with washing and cleaning compulsions in OCD and not checking compulsions. One reason why OCD non-washers may be as sensitive towards disgust as washers may lie in their increased tendency to obey laws of magical thinking. The results of higher levels of disgust sensitivity in OCD compared to normal controls, lends support to the theory that disgust may be implicated in the pathology of OCD.

## **Disgust Facial Recognition in OCD**

### ***Hypothesis 2:***

*Individuals with OCD will show a deficit in recognizing the facial expression of disgust compared to a non-clinical control group.*

The OCD group showed a severe deficit in the ability to recognise disgust compared to the normal control group. Contrary to expectations, the OCD group was also impaired in their ability to recognise anger, happiness, surprise and sadness compared to the normal control group. Further analyses revealed that the ability to recognise disgust was significantly more impaired than the ability to recognise all the other emotions and the above hypothesis was supported.

### ***Hypothesis 2a:***

*Within the OCD group, OCD washers will also show a deficit in recognizing facial expressions of disgust in addition to OCD non-washers.*

No differences between OCD washers and OCD non-washers were found in the ability to recognise disgust. OCD washers were therefore equally impaired in their ability to recognise disgust and the secondary hypothesis was also supported.

### **Interpretation of findings on facial expression recognition task**

This section will first discuss the interpretation of the finding of a deficit in the ability to recognise disgust before discussing the findings of an impairment in the ability to recognise other emotions compared to controls.

The current study confirmed the previous finding by Sprengelmeyer et al. (1997) who showed that 12 OCD checkers were impaired in their ability to recognise the facial expression of disgust. The current study also provided new evidence that the deficit is not just confined to OCD checkers but is equally apparent in OCD washers.

To account for this deficit, Sprengelmeyer et al. (1997) argued that the origin of OCD is usually in childhood when facial expression recognition is being learnt. The authors hypothesised that people with OCD have little opportunity to learn to recognise facial expressions of disgust as they experience disgust towards stimuli that others around them may not find disgusting. Furthermore, other people may show non-disgust expressions to such stimuli that are found disgusting to the person with OCD, thereby weakening any learned association between the emotional experience of disgust and the corresponding facial expression displayed by others. The current findings lend support to this argument. The OCD group showed a heightened sensitivity to disgust compared to the normal control group in addition to a marked deficit in the recognition of disgust facial expressions.

It could also be argued that if what is most disgusting to the individual with OCD is the content of their intrusive thoughts, then others cannot see such thoughts and respond with a disgust facial expression. It is also possible that the person with OCD may not associate a disgust facial expression with their internal thoughts as opposed to their reactions or other people's reactions to external stimuli such as faeces.

A further explanation to account for the deficit in disgust recognition, which would also explain the deficit in the ability to recognise anger is that seeing a disgusted or angry facial expression may have been perceived as a threat to the individuals with

OCD. An angry face staring directly at the person, is a direct sign of hostility towards them (Bradley, Mogg, White, Groom & de Bono, 1999). Furthermore, recent theories of anxiety suggest that the automatic detection of environmental threat is mediated by a biologically prepared mechanism, and that this is sensitive to innate stimuli (Ledoux, 1995) such as threatening faces in humans.

Several studies have investigated information-processing biases in non-clinical samples, using pictures of facial expressions varying in threat value (e.g. Bradley, Mogg, Millar, Bonham-Carter, Fergusson, Jenkins & Parr, 1997b; Bradley, Mogg, Falla & Hamilton, 1998). Bradley et al. (1997b) demonstrated an avoidance of threat faces in individuals with low levels of dysphoria whilst Bradley et al. (1998) on the other hand, showed a vigilance for such faces in individuals with high trait anxiety. In addition, Bradley et al. (1999) demonstrated that individuals with GAD show an attentional bias towards threatening faces.

It is therefore possible that the OCD group attempted to avoid processing the disgust faces which may have interfered with their ability to name the emotion. In addition, because of the OCD groups heightened sensitivity towards disgust it is possible that they may have avoided using the response category of disgust in order to avoid thinking about disgust. However, in the study by Sprengelmeyer et al. (1997) the researchers asked their OCD participants to classify words that were synonyms for happiness, surprise, fear, sadness, disgust and anger. They found the OCD group had no difficulty assigning disgust-related words which suggests the OCD group did not have difficulty using disgust as a response category.

The current findings add further support for the involvement of the orbitofrontal cortex and basal ganglia in OCD and in disgust. The OCD group were unable to recognise disgust facial expressions and disgust faces have been shown to activate the orbitofrontal cortex (Sprengelmeyer et al, 1997). Evidence for the role of the basal ganglia in disgust has come from studies that have shown a deficit in the recognition of disgust faces in people with Huntington's disease (Sprengelmeyer et al., 1996) and carriers of Huntington's disease who have not yet shown any symptoms of the disease (Gray et al., 1997). The current findings therefore also add to the evidence for a role of the basal ganglia in OCD.

In the introduction it was noted that people with OCD have also been shown to have a deficit in the ability to identify odours. This is believed to be due to a disruption to processing at the level of the orbitofrontal cortex. Barnett et al. (1999) argued that the ability to identify odours and recognise disgust expressions may be part of a common brain system. It is possible that people with OCD believe there is an increased risk of contamination because they are unable to read signs in others or identify odours. Furthermore, heightened sensitivity towards disgust may result from a dysfunction of the appraisal of objects and events for their potential role in contamination.

The right orbitofrontal cortex has also been implicated in the response to angry faces using functional imaging (Blair, Morris, Frith, Perrett & Dolan, 1999). As discussed in the introduction, the orbitofrontal cortex has been implicated in OCD and it is therefore not surprising that the OCD participants were also significantly impaired in their ability to recognise facial expressions of anger. In the study by Sprengelmeyer et al. (1997), a near significant impairment was also found for the recognition of

anger. Angry expressions are thought to curtail the behaviour of others in situations where social rules or expectations have been violated (Blair et al., 1999). If people with OCD have a deficit in the ability to recognise anger in others this will have implications for social interactions and may lead people with OCD to feel more anxious in situations where others are angry.

Recently, Kornreich, Blairy, Philippot, et al. (2001) examined the ability of alcoholic patients to recognise different facial expressions (happiness, anger and fear) compared with a control group of OCD patients and a normal control group. They found no difference between the OCD group and the normal control group. This finding goes against the current finding of a deficit in the ability to recognise anger and happiness in individuals with OCD compared to controls. However, Kornreich et al. (2001) employed a different facial expression recognition task than the current study and only compared three expressions.

Furthermore, the researchers did not limit the presentation time of the facial expressions and admit that a limited presentation time could have induced more deficits in the OCD groups' ability to recognise emotional expressions. It is possible that the time limit in the current study can account for the impairments noted in the ability to recognise the other emotions. As patients with OCD have been shown to take longer when completing tasks (Jenike, Baer & Minichiello, 1998) it is possible that a longer presentation time may have provided different results and the deficits in the ability to recognise some of the other emotions may not have been found.

A further possible explanation for the deficits in the OCD group's ability to recognize the emotions as well as controls may reflect a visuospatial deficit. This would fit with previous research which shows a deficit in the ability to 'shift set' in OCD. Once the OCD group had decided which emotion they felt a particular face was expressing, they may have been unable to 'shift set' and change their mind when confronted with a face that showed a lesser amount of that particular emotion but showed more of another emotion. For example, when confronted with an image which showed 90% happy and 10% angry, they may have identified the face as showing happiness but then, when confronted with an image which shows 30% happy and 70% angry, they may have been unable to shift attention away from the happy part of the expression, and consequently still identify the expression as happy which would be classed as incorrect.

It is also possible that the deficit in disgust recognition and to a lesser extent anger, happiness, surprise and sadness, could be attributed to a more general visuospatial deficit such as the ability to recognise faces. However, the OCD subjects in the Sprengelmeyer et al. (1997) study also completed the Benton facial discrimination task (Benton Hamsher, Varney & Spreen, 1978) and no deficits were noted. This suggests that a relationship between the inability to recognise certain facial expressions and face recognition per se in people with OCD is unlikely. This is confirmed by other studies showing that the ability to identify faces can be differentiated from the ability to recognise emotional expressions (Ellis, 1992).

Katsikitis (1997) produced evidence against a classification consisting of six discrete emotion groups. Katsikitis (1997) asked two groups of observers to match photographs of posed emotions with emotion words (happiness, surprise, fear,

disgust, anger, sadness and neutral). A multidimensional-scaling procedure was applied to the judgement data in an attempt to investigate the underlying structure of these emotional states. The responses from the judges resulted in a two dimensional structure with the six emotions positioned along the perimeter of a circular model. One dimension resembled a pleasant-unpleasant dichotomy with happiness and surprise at one end, and fear, sadness, disgust and anger at the other end. The second dimension, which may be of interest with relation to the present results, resembled an upper-face – lower-face dominance. This dimension indicated that the raters judgements were influenced by the movement of the facial landmarks, with the eyebrows featuring prominently in surprise, fear and sadness, and the mouth region for anger, disgust and happiness.

It is possible that the deficits observed in the OCD group in the current study are not confined to discrete emotions but reflect a visuospatial deficit in distinguishing the most important features of the facial expression. It is also possible that the OCD subjects may have been attending to only one part of the face such as the eyes or mouth. It is possible that the OCD group may have been unable to attend to different parts of the face due to the limited time available.

Baren-Cohen, Jolloffe, Mortimore and Robertson (1997) have developed the Eyes Task, which is a test of theory of mind competence. The Eyes Task involves inferring the mental state of a person just from the information in photographs of a person's eyes. This task has been used with high functioning adults with autism and Asperger Syndrome who have been shown to be significantly impaired on the task compared to normal controls. The authors suggested this was evidence for subtle mindreading deficits. It is also possible that impairment in the ability to recognise

facial expressions in OCD reflects a similar theory of mind deficit. Although there is no evidence of a theory of mind deficit in OCD, similarities between characteristics of OCD and Asperger's syndrome have been identified (e.g. Ryan, 1992). Furthermore, Bejerot, Nylander and Lindstroem (2001) found that 20% of their sample of people with OCD, were also identified as having autistic traits. Future research using the Eyes Task and other tests of theory of mind could be carried out to determine whether these deficits are apparent in OCD.

A further consideration to account for the current findings is whether the results could be attributed to a task difficulty effect. Johnston Katsikitis & Carr (2001) suggest that identification of negative emotions represents a more difficult task than the discrimination of positive emotions. However, the most difficult facial expression to be recognised is considered to be fearfulness (Ekman & Friesen, 1976). The OCD participants did not differ significantly from the normal control group in their ability to recognise fear. It is therefore unlikely that the deficit in the recognition of disgust was due to a task difficulty effect, as a deficit in the recognition of fear would also be expected.

It should be noted that the overall level of depression in the OCD group was in the mild range. It is known that depression is associated with overestimation of sadness expressions (Hale, 1988). Patients with social phobia have been shown to overestimate anger expressions (Winton, Clark, Edelman, 1995). In line with this research one would expect that if people with OCD are highly sensitive towards disgust then they should overestimate disgust faces rather than underestimate them.

One possible explanation for the finding of a deficit in the ability to recognise disgust and possibly other emotions in the OCD group that should be noted is that seventeen of the OCD participants were taking selective serotonin reuptake inhibitor (SSRI) anti-depressant medication. This may have affected their ability to recognize certain facial expressions. In the study by Sprengelmeyer et al. (1997) no information was given regarding medication of the OCD sample thereby making it impossible to draw any conclusions concerning the effects of medication. In the study by Kornreich et al. (2001), which did not find any differences between OCD participants and normal controls on the ability to recognise anger, happiness or fear, all the OCD participants were taking SSRI's. It is possible that SSRI's actually help in the ability to detect these emotions.

There are some indications that SSRI's could have an impact on emotional sensitivity. They have been shown to reduce negative affect and hostile sentiments, but not positive affects. Furthermore, it has been suggested that they may influence interpersonal relationships (Knutson, Wolkowitz, Cole, et al., 1998). However, the specific role of SSRI influence on the ability to recognise different emotional facial expressions has not been studied. In the current study separate analyses were carried out comparing medicated versus unmedicated participants and no significant differences were found between the two groups. It seems unlikely, therefore, that the deficits in the ability to recognise the emotion of disgust and indeed other emotions, can be accounted for by the effects of SSRI medication. However, future studies should be carried out with a larger sample size to examine possible effects of SSRI's on the ability to recognise facial expressions. It would also be interesting to include a depressed control group in future studies.

It is also important to point out that six of the OCD participants were also taking benzodiazepine medication. Using the same facial recognition task employed in the current study, Blair and Curran (1999) demonstrated that diazepam selectively impaired healthy volunteers' ability to recognise angry expressions but did not affect the recognition of other emotional expressions. However, as there were only six OCD patients taking benzodiazepine medication, it is unlikely to have influenced the current results.

It is noteworthy that when negative emotions are misidentified, the erroneous identification is usually of another negative emotion (Johnston et al., 1999). As shown in the current study, disgust was often mistaken for anger. In Ekman and Friesen's (1976) norms, anger is the emotion most often confused with disgust by normal subjects at a rate of 6.4%, so it is reasonable that the OCD group would misidentify disgust as anger.

This may be considered adaptive from an evolutionary perspective. As negative emotions, disgust and anger stimuli provoke a similar response, requiring autonomic activation and flight-avoidance behaviours. From an evolutionary point of view, the most important decision to be made when reading another's facial expression is 'good thing versus bad thing' (Johnston et al., (2001). If one is faced with a 'bad thing' the exact nature of the bad thing is a secondary concern since all the possibilities probably require a similar response. However, if people with OCD are also misreading happy signals then this may have a profound impact on their ability to weigh up the intentions of others.

It is important to point out that the facial expression recognition task may not be ecologically valid since recognising facial expressions is usually done in a general context with other non-verbal and verbal clues to help clarify the meaning of facial expressions. It is possible that people with OCD are able to compensate for their deficit in recognising disgust, and to a lesser extent other emotions, through the use of contextual cues.

### **Attentional Bias**

#### ***Hypothesis 3:***

- *Individuals with OCD, in comparison with a non-clinical control group, will show an attentional bias to both contamination/ disgust and general threat words compared to neutral and non-words. This will be evidenced by greater colour-naming response latencies on the Stroop task.*
- *Furthermore, the OCD group will show greater colour-naming response latencies when the words are preceded by a disgust picture as opposed to a neutral picture.*

A significant difference was found between the OCD group and normal control group on the Stroop task. This was shown by increased response latencies by the OCD group who took longer to colour-name all the word categories compared to the normal control group. However, the hypothesis that the OCD group would show longer response latencies to contamination/ disgust and general threat words was not supported as the control group showed the same pattern of response as the OCD group. In addition, no effect of picture was found and the second hypothesis was not supported.

***Hypothesis 3a***

- *OCD washers will show an attentional bias towards contamination/ disgust words compared to OCD non-washers.*
- *Furthermore, OCD washers will show an attentional bias to all words preceded by a disgust picture compared to words preceded by a neutral picture in comparison with OCD non-washers.*

Contrary to expectations, OCD washers did not show an attentional bias towards contamination/ disgust words or towards disgust pictures compared to OCD non-washers. No difference between the OCD subgroups was found and the above hypotheses were not supported.

**Interpretation of findings on the Stroop task**

The lack of an attentional bias towards threat found in the current study is inconsistent with previous findings. Lavy et al. (1994), for example, also compared OCD washers and non-washers but found a significant difference between the two sub-groups. However, Lavy et al. (1994) used a card format of the Stroop task in which word categories are simultaneously presented on one card. This blocked format may obscure the source of interference. Kyrios and Iob (1998) suggested that interference found using card versions of the modified Stroop may not be due to the selective encoding of threat-related information but may be a consequence of post-attentional rumination over the meaning of the blocked words. An alternative explanation may be that the blocked format may be more conducive to triggering threat-related schema, resulting in more robust biased processing effects.

The current study utilised a computerised format where words were presented individually in a randomised order and therefore, could not have been influenced by the blocked presentation of semantic categories. Kyrios and Iob (1998) argue that computerised versions of the Stroop task may lead to partial, sub-threshold, or inconsistent activation of threat-related schemata in people with OCD which allows for the operation of avoidant strategies. However, this does not account for why the OCD group also took much longer to respond to the neutral and non-words in the Stroop task. The current study used the same computerised format as used by Foa et al. (1993) who did find an attentional bias towards contamination in OCD washers.

However, the current study differed from Foa et al's (1993) by the addition of photographs as primes rather than words. This is considered a strength of the current study as previous research has been criticised for the use of words in information-processing tasks (e.g. Radomsky and Rachman, 1999). Several other studies have also failed to find information-processing biases in OCD (e.g. McNally et al., 1990; McNally et al., 1994) and it is therefore a possibility that OCD is not characterised by attentional biases towards threat as found in studies of anxiety disorders.

It has been suggested that a global deficit in the ability to attend selectively to relevant stimuli while concurrently screening out unimportant competing environmental and internal stimuli such as random thought processes is central to the aetiology of OCD. Enright and Beech (1990, 1993b) proposed this was because people with OCD appear to give excessive consideration to unimportant environmental details and to somewhat arbitrary cognitive associations. This may help to explain why the OCD group took longer to name the colour of all words compared to the control group as they were unable to ignore picture stimuli or

irrelevant non-words. Enright and Beech (1990, 1993b) argued that the symptoms of OCD may arise out of a deficit in cognitive inhibition, leaving the person with OCD unable to suppress effectively their intrusive thoughts, at a nonconscious level. Disgust pictures may have led to frequent intrusions in the OCD group which were difficult to ignore leading to increased response times.

Clayton, Richards and Edwards (1999) reported evidence for a specific deficit in selective attention in OCD compared with an absence of a similar deficit in people with panic disorder and normal controls using the Test of Everyday Attention (TEA; Robertson, Ward, Ridgeway & Nimmo-Smith, 1994). They interpreted their results as evidence supporting the hypothesis of a diminished ability of people with OCD to ignore selectively unimportant external and internal stimuli, especially intrusive thoughts.

However, the differences between groups in Clayton et al's (1999) study were only found on the timed tasks and not on the untimed tasks. The authors suggest the effects may have been due to excessive caution or slow responding possibly due to the effect of medication. Christensen, Kim, Dyksen & Hoover (1992), showed that when time penalties are excluded from analyses, performance differences between OCD patients and normal controls are greatly reduced.

It seems likely that the OCD group in the present study may have performed slower on the Stroop task due to an inability to ignore intrusive thoughts. Intrusive thoughts are well recognised in the test anxiety literature as task-irrelevant processing (Flett & Blankstein, 1994) and it is quite likely that performance on the task was slowed by the frequent interruption by intrusive thoughts. Slowed colour-naming in the OCD

group may also have been due to increased anxiety in response to the disgust pictures which may have diminished available cognitive capacity, thereby increasing general distractibility. In addition, the presence of obsessional traits such as meticulousness and indecisiveness (Veale, 1993) may also account for the much slower performance by the OCD group.

Although it is likely that slower scores on the Stroop task reflect the influence of non-neurological factors such as cognitive intrusions and obsessional traits, it should also be recognised that a biological causation cannot be ruled out. It is possible, for example, that diminished information-processing capacity in people with OCD may arise from reduced arousal in prefrontal cortex, accompanied by enhanced arousal in limbic circuits (McNally et al., 1994). Evidence of increased fronto-striatal blood flow has been detected in patients with OCD at rest (Tallis, 1997). McGuire, Bench and Frith et al. (1994) for example, carried out a PET study which included anxiety provocation conditions and found that symptom intensity was significantly and positively correlated with blood flow to the inferior frontal gyrus and several basal ganglia structures.

A further consideration when accounting for the lack of an attentional bias towards threat in the current study is that although presentations of OCD are characterised by stereotyped obsessions and compulsions, the particular feared contaminant of OCD washers varies. For some individuals the feared contaminant is germs, whereas for others this extends to a wide variety of substances including poison and toxic chemicals (Rasmussen & Eisen, 1992). It is possible that the stimuli in the current study only activated some of the OCD participants' schema and had no effect on others. One participant for example, stated that their feared contaminant was saliva,

whilst another stated it was semen, neither of which featured as a word or picture in the stimuli in the present study. Whilst the photographs were chosen to be threatening to OCD washers, it is possible that they were only threatening to some participants in the washers group. McNally, Kaspi, Riemann and Zeitlin (1990) found that OCD participants with strange contamination obsessions showed no interference with standard contamination words using a card-administered Stroop.

Heterogeneity in the content of obsessional concerns has been named as a major impediment to research into attentional bias in OCD (Obsessive Compulsive Cognition Working Group, 1997, cited in Summerfeldt & Endler, 1998). The current results may therefore reflect difficulties in identifying standardised threat-congruent lexical stimuli for OCD subjects. Future studies should utilise more idiographic stimulus matching-techniques to ensure that specific threat-related schema of people with OCD are activated.

However, it should be noted that there is some evidence that specific personal relevance of stimuli is not a sufficient explanation for observed biases in anxiety-disordered samples (Williams et al., 1997). Furthermore, clinical observations suggest that the apparent diversity of OCD symptoms is deceptive, and belies a limited number of basic stereotypic themes (Rasmussen & Eisen, 1992).

A further point to note is that the OCD participants' BDI-II scores in the current study fell in the range suggestive of mild depression. Depression is a well-documented concomitant of OCD and it has been suggested that depressed mood in OCD may heighten participants' general reactivity to affect laden stimuli (Foa, Grayson, Steketee, Doherty, Turner & Latimer, 1983). This may have had a

confounding effect on the results of the Stroop task. The disgust stimuli may have increased feelings of disgust which may have interfered with the ability to respond to all stimuli as fast as the control group.

The results of the current study contrast with the robust results obtained with other clinical anxiety disorders. If disgust rather than fear characterises OCD, then it is plausible that disgust may mediate processing biases in OCD differently from other anxiety disorders that are characterised by fear. This would also add support to the notion that OCD is different to other anxiety disorders and may not belong in the same diagnostic category (Summerfeldt and Endler, 1999). Future studies on information-processing bias in OCD could compare people with OCD with other psychiatric control groups in order to examine these issues.

### **Memory Bias**

#### ***Hypothesis 4***

- *Individuals with OCD will show an implicit memory bias (i.e. improved memory) for threatening stimuli associated with contamination/ disgust words and general threat words on the Word Completion task compared to a non-clinical control group.*
- *In addition, the OCD group will continue to show a memory bias towards contamination/ disgust and general threat words in a delayed recall explicit memory task.*

No difference was found between the OCD group and the control group on the word completion task and therefore an implicit memory bias was not found. On the delayed recall task, the OCD group showed a bias towards contamination/ disgust

words but not general threat words. The hypothesis that there would be an explicit memory bias for contamination/ disgust and general threat words was therefore only partially supported

#### ***Hypothesis 4a***

- *OCD washers will show an implicit memory bias for contamination/ disgust words compared to OCD non-washers on the Word Completion task.*
- *Furthermore, OCD washers will show an explicit memory bias for contamination/ disgust words compared to OCD non-washers on the delayed recall task.*

No differences were found between the OCD washers and non-washers on either the word completion task or the delayed recall task. Neither an implicit nor an explicit memory bias was found in either OCD group and the hypotheses were not supported.

#### **Interpretation of findings on memory tasks**

The current results are inconsistent with findings by Radomsky and Rachman (1999) of a memory bias in OCD. Although a bias towards contamination/ disgust and general threat words was noted, no difference between the OCD and control groups was found.

It is possible that this reflects methodological difficulties in the current study. While it has been demonstrated that words are sufficient stimuli to detect attentional biases in anxiety (Mathews & MacLeod, 1994), it may be that these stimuli may not produce sufficient arousal to enable appropriate elaboration and subsequent recall.

The current study may have yielded higher explicit memory scores if the subjects had been asked to recall the photographs they had seen in the Stroop task.

Furthermore, the inability to remember many of the words from the Stroop task may have been due to the long period of distraction between viewing the words during the Stroop task and being asked to recall them. In addition, this period of time may have varied between subjects who took longer to fill out interim measures which may have biased the results. The study may have been improved by ensuring that the delayed recall task was carried out after the same period of time for each subject. It should be noted, however, that the proportion of words recalled by both groups was extremely low. Future research could ask participants to recall words from the Stroop task immediately after completing the task instead of carrying out the implicit memory task. This would also allow direct comparisons between immediate and delayed recall.

To conclude, the current study did not find evidence of a memory bias in OCD compared to a control group. This may reflect methodological difficulties. However, it should also be borne in mind that previous research has also failed to provide consistent evidence of a memory bias in anxiety disorders and it is therefore also possible that people with OCD do not have a memory bias towards threat.

## Picture Ratings

### *Hypothesis 5: Picture ratings*

- *Individuals with OCD will rate the emotional content of disgust pictures as more disgusting than a non-clinical control group.*
- *In addition, the OCD group will have an urge to carry out a ritual in response to the disgust pictures compared to non-clinical controls*

The OCD group rated disgust pictures as more disgusting than the control group and the first hypothesis was supported. In addition, the OCD group rated both neutral and disgust pictures as evoking more fear, anger, sadness, surprise and happiness than the control group.

Furthermore, the OCD group had a strong urge to ritualise after viewing all of the disgust pictures compared to the control group. The hypothesis that people with OCD would have an urge to ritualise after viewing disgust pictures was confirmed. Unexpectedly, the OCD group also had a significant urge to ritualise after viewing six of the neutral pictures.

### *Hypothesis 5a*

- *OCD washers will rate the emotional content of disgust pictures as more disgusting than OCD non-washers.*
- *Furthermore, OCD washers will show a greater urge to carry out a ritual after viewing these pictures than OCD non-washers.*

A significant difference between the OCD washers and non-washers was found. However, contrary to expectations, OCD non-washers rated disgust pictures as more disgusting than OCD washers and the hypothesis was not therefore, supported.

No significant differences emerged between the OCD washers and non-washers of urge to ritualise after viewing any of the neutral or disgust pictures. The hypothesis that OCD washers would have a stronger urge to ritualise after viewing disgust pictures was therefore not supported.

### **Interpretation of Picture rating findings**

The finding that people with OCD rate disgust pictures as significantly more disgusting than a normal control group adds to the earlier finding of higher disgust sensitivity in people with OCD. Furthermore, disgust pictures also evoked more fear, sadness and anger in the OCD group compared to the normal control group.

It was expected that OCD washers would rate the disgust pictures as much more disgusting than OCD non-washers and the photographs had been chosen to reflect the concerns of OCD washers. The findings that the OCD non-washers rated the pictures as significantly more disgusting than the OCD washers are in contrast to those by Phillips et al. (2000) who found washers had higher ratings than OCD checkers on both 'normally disgusting' and 'washer-relevant' pictures. However, Phillips et al. (2000) only had 7 subjects in each OCD group and it is possible the results reflected a lack of statistical power. As the OCD subgroups were also small in the current study, it is possible that the results reflect a type 1 error. Future studies should utilise larger samples in order to clarify this issue.

On the whole, the neutral pictures used in the current study, which had been rated as neutral by Phillips et al. (2000), were rated as neutral by the control group but not by the OCD group who rated some of the pictures as eliciting anger, fear, disgust, sadness and surprise. It is therefore possible that during the Stroop task the neutral pictures may have been seen as threatening to the OCD group.

Furthermore, the current results suggest that six of the neutral pictures elicited an urge to carry out a ritual in response. After viewing the picture of the fan, several of the OCD participants expressed concern about the dirty carpet and the wiring in the electric socket. In addition, the picture of the umbrella, which had been erected indoors, led several of the OCD group to comment that this was unlucky. Several of the OCD participants commented that although several of the disgust pictures did not give them a strong urge to ritualise, this was because they knew they were just pictures but if they were confronted with the scenes in reality then this would give them a stronger urge to ritualise.

The significant urge to ritualise after viewing the neutral pictures, in addition to ratings of negative emotions in response to the neutral pictures may have been a confounding variable in the Stroop task. The lack of a significant attentional bias towards the disgust pictures may be because the neutral pictures were also seen as threatening by the OCD group.

The results of the picture rating task have shown that people with OCD rate disgusting pictures as significantly more disgusting than non-clinical controls. This adds to the finding of heightened disgust sensitivity on the Disgust Scale.

Furthermore, disgust pictures were also shown to elicit more of the other negative emotions in the OCD group.

### **Limitations of Study**

This section will discuss the potential limitations of the current study including the effects of selection bias, the sample size and the possibility of type 1 errors. In addition, this section will discuss the possible limitations of the measures used.

#### **Selection Bias Effects**

It is important to consider any potential effects of selection bias in order to be able to generalise the findings of this study to the wider OCD population. In OCD research this is a particular problem as epidemiological studies have shown that only a small minority of individuals with OCD ever present to services or volunteer for research.

As most of the subjects in this sample were recruited from the voluntary sector, it is possible that they represent only a small minority of individuals with OCD. In addition, it is likely that those people who volunteer for research have more mild OCD symptoms which enable them, for example, to leave the house. Future research should aim to include participants with more moderate to severe levels of OCD. The current study suffered from difficulties in recruitment. Most of the sample came from the voluntary sector and there were difficulties in getting Psychologists working in the Health Service to refer potential subjects. However, there is no reason to believe these factors would significantly confound the current findings.

It is important to note that OCD is often associated with other psychiatric conditions. It is possible that the results were confounded by accompanying depression. Seventeen of the OCD sample were on SSRI medication. However, no differences on the facial expressions task were found between the medicated and unmedicated OCD groups. Furthermore, while a medication free cohort would be desirable, it would be unrepresentative of a cohort of people with OCD.

### **Sample size**

Whilst the sample size in the current study was adequate to detect some of the key findings, undoubtedly a larger sample size would have allowed greater statistical power. The non-significant results on the Stroop task and memory tasks may have been due to a lack of statistical power. However, it should be noted that previous published studies of information-processing bias and memory bias in OCD have typically used sample sizes much smaller than the current sample. Tata et al. (1996) for example, used a sample size of 13 and Kyrios and Iob (1999) had 15 subjects in their OCD sample. In addition, studies to date have frequently confined their sample to individuals with OCD with washing and cleaning compulsions.

However, the results of the within-subjects comparisons between the OCD washers and OCD non-washers should be viewed as preliminary due to the relatively small samples. The potential for a type 1 error are higher for the comparisons between the OCD subgroups and future research should aim to replicate the current findings with larger sample sizes.

If recruitment difficulties had not been an important constraint, it would have been interesting to compare 3 OCD groups - OCD washers, OCD checkers and those with predominantly mental rituals. However, although there appear to be distinct dimensions in OCD it should be noted that many patients report multiple symptoms that cut across dimensions. For example, individuals who are concerned about contamination will often wash a particular number of times or check their surroundings for contaminants. In the current study, no differences were found between the OCD washers and non-washers on the frequency or distress ratings of checking symptoms. It is possible that no significant differences were found between the OCD groups due to the lack of homogeneity of symptoms in each group.

### **Type 1 error**

As in any research, there is a possibility that the significant results found in the current study may be due to a type 1 error. In order to minimise this possibility, the analyses carried out in the current study were restricted to the hypotheses presented with the exception of the further analyses described which were adjusted using Sidak correction for multiple comparisons. Whilst acknowledging the possibility of a type 1 error, the OCD sample size in the current study is considered large in comparison to previous research. In the only other study of facial expression recognition, for example, Sprengelmeyer et al. (1997) had a sample size of 12.

### **Limitations of Measures**

There were several potential limitations of the measures used in the current study that should be noted. A limitation of the facial expression recognition task was that the current study did not include a practice trial and it is possible that errors occurred during the first trial as participants familiarised themselves with the task.

However, this does not explain differences between the OCD and control groups as conditions were equal for both groups. A further possible limitation is that due to time restrictions the task only contained four trials compared to five trials in the study by Sprengelmeyer et al. (1997). However, the current task lasted 16 minutes and it is also possible that a further trial would have affected participants' concentration leading to more errors.

A limitation of the Stroop task is that the non-words which were taken from a previous study by Foa et al. (1993) included the words 'fices' and 'narvous'. These words are very similar to 'faeces' and 'nervous' which could be seen as threatening by participants with OCD. Furthermore, during the delayed recall task several of the participants remembered the word 'faeces' which suggests that some of the non-words did contain a semantic meaning. Furthermore, the word AIDS in the contamination/ disgust category could also be associated with death and therefore would also fit in to the general threat category. It is possible that these limitations may have interfered with information-processing in the Stroop task.

Although the current study added photographs to the modified Stroop, the study may have been improved if pictures had been used instead of words throughout the task. Difficulties in the use of words in attentional bias studies were noted in the introduction. Future studies could use dot probe tasks with neutral and disgusting photographs as an alternative to the use of words. Similarly, disgusting and threatening pictures could be presented in different coloured inks using a Stroop format. The participant would have to respond to the colour of the ink of the picture.

Finally, the use of word stem completion tasks as a measure of implicit memory has been criticised. Because a word stem can serve as a cue for the complete word, it is possible that the measure can become contaminated by explicit memory processes (Foa et al., 1997). This may happen if the participant becomes aware that some of the word stems correspond to the previously learned list. However, in the current study all participants were debriefed after they had carried out all the tests. Most of the participants expressed surprise that the task had been measuring memory and only two said that they had been aware of this.

### **Implications of Current Research**

The following section will discuss the general scientific implications of the findings in the current study before discussing the implications for treatment.

#### **Scientific implications**

The implications of a deficit in the ability to recognise the facial expression of disgust and possibly other emotions may have important implications for social behaviour. Facial expressions are non-verbal communicative displays that signal emotional states and regulate others' behaviour (Darwin, 1965, Ekman, 1992). Clinical implications of a deficit in the ability to interpret emotional facial expressions could involve difficulties in interpersonal relationships since the decoding of non-verbal cues constitutes an essential process in normal communication and interaction regulation (Patterson, 1999).

Furthermore, the ability to recognise different facial expressions allows rapid transmission of information to others concerning intentions of future behaviour. Reciprocal expressions between sender and recipient have evolved for social

communication. Correct interpretation of the emotional meaning of facial expressions is therefore important in relationships and it is possible that such deficits in people with OCD will have a detrimental effect on their interpersonal relationships.

The findings of heightened disgust sensitivity in both OCD washers and OCD non-washers goes against Power and Dagleish's (1997) argument that only washing in OCD is associated with disgust. At present there is no model of disgust in OCD. The current findings provide evidence that disgust plays a role in OCD and future research could aim to develop such a model.

Power and Dagleish (1997) have also argued that the complex emotion of guilt is derived from the basic emotion of disgust. Salkovskis (1985) and Rachman (1993) have focused on the role of responsibility and guilt in OCD. However, Power and Dagleish (1997) argue instead that *shame*, as a more extreme disgust-based reaction to the self may be more appropriate than responsibility and guilt. This assumption provides evidence for the role of a disgust-derived emotion in OCD.

Salkovskis and Rachman's theories of the role of responsibility and guilt provide a possible explanation for why disgust may play a role not only in the more obvious cleaning and washing compulsions but also in checking compulsions because of a disgust-based reaction towards particular intrusions (Power and Dagleish, 1997).

Power and Dagleish (1997) suggest that shame rather than guilt should be the disgust-based emotion given more prominence in OCD. Even in cases that are primarily anxiety-based, however, there still appears to be a secondary role for

disgust in relation to the individual's attempts to eliminate a thought, image or impulse that is experienced as ego-alien. Power and Dalglish (1997) provide an analogy that in the process of feeling distressed about such thoughts, images or impulses, the individual attempts to rid the self of this unacceptable material in a manner analogous to the gut eliminating its own unacceptable contents. Future studies should examine the links between disgust and shame in OCD.

At present, all current psychiatric and diagnostic systems concur in describing OCD as an anxiety disorder. However, in their recent review of the relevant literature, Summerfeldt and Endler (1998) argue that the role that anxiety plays in OCD is unclear. There is growing empirical evidence that suggests that, although anxiety may be one of the mood states experienced by those with OCD, anxiety may not have a primary and potentially aetiological role like it does in other disorders (Summerfeldt & Endler, 1998).

In a review of the literature at the time, Reed (1985) concluded "there appears to be no convincing evidence that anxiety plays a significant role in obsessional disorders.... where it can be identified it seems to be a result rather than a cause of compulsive activity" (p. 137). This secondary role of anxiety clearly differentiates OCD from other anxiety disorders. The results on the Stroop task suggest that people with OCD do not show the same information-processing bias as people with other anxiety disorders. Furthermore, the current findings of heightened disgust sensitivity and a deficit in the ability to recognise the facial expression of disgust suggest that disgust may play an important role in OCD.

**Implications for treatment**

The association between OCD and the emotion of disgust may have important clinical implications. During treatment, it may be very important to consider that OCD patients might be oriented to reducing their disgust sensation rather than their anxiety. If one agrees with Power and Dalglish's (1997) proposal that guilt and shame are derived from the emotion of disgust, then a focus of treatment should also be on shame and self-disgust in OCD.

At present the main treatment for OCD has been exposure to the avoided stimulus together with response prevention. The outcome literature has shown that exposure plus response prevention is the most effective form of treatment for OCD (e.g., Emmelkamp, 1994). However, it is apparent that the treatment may be more successful for those with cleaning and washing compulsions than for those with checking compulsions. Watts (1995) suggested that in compulsive washers the anxiety associated with contamination fears may be effectively reduced by compulsive washing whereas in compulsive checking there is less apparent anxiety reduction.

The current study has shown that disgust is not just implicated in people with OCD with washing compulsions but is also implicated in people with checking compulsions and other symptoms of OCD. This suggests that a reduction in feelings of disgust needs to be treated alongside anxiety reduction in both OCD washers and OCD checkers for whom traditional treatments do not work as well. If disgust arises as a result of cognitive processes which leave the individual with thoughts and feelings of disgust, then it follows that treatment can aim to teach the individual to exert a degree of control over the effects of disgust by modifying cognitive processes

through the use of cognitive-behavioural techniques such as cognitive restructuring. In addition, the current study has also highlighted that individuals with OCD follow laws of magical thinking in relation to disgust, it may also be important therefore to target this type of thinking within therapy.

The results of treatment outcome studies indicate that more active avoidance strategies may be a feature of disgust-based obsessions and phobias, because of attempts to rid the body of presumed contamination. This is in contrast to the more passive avoidance in anxiety-based phobias in which avoidance of the object or situation is sufficient (Power and Dalglish, 1997). This has important implications for the treatment of OCD.

The success of cognitive-behavioural interventions lies in the modification of cognitive structures that are thought to underlie emotions. To achieve this modification, such structures first need to be activated before information incompatible with their maladaptive assumptions can be incorporated (Foa & Kozak, 1986). If individuals with OCD use strategies to avoid feeling disgust then it is possible that this would undermine the therapeutic process by blocking modification to the cognitive structures.

### **Possible Future Investigations**

As mentioned in previous sections, future studies of disgust in OCD could compare OCD groups with other psychiatric groups, especially depression and anxiety-disordered groups. In order to increase the external validity of the study and support the current findings, the study should also be replicated with a larger sample. In order to increase the generalisability of the findings, future studies could aim to recruit

larger numbers of OCD out-patients preferably from a number of Psychology departments across the country. Furthermore, generalisability could also be increased by the inclusion of OCD patients with more severe symptoms, such as in-patients in order to sample the range of severity of OCD symptoms. In addition, future research in OCD could aim to use stimuli that are consistent with individual concerns of people with OCD to allow better comparisons between subgroups of OCD.

The impact of an inability to recognise disgust and possibly other emotions on interpersonal relationships could be assessed in future research by correlating deficits in expression recognition with interpersonal difficulties. It is possible there were gender-related interpretation biases in the current study and future studies of the ability to recognise emotions could also include a female person's face. Future studies could also use a response box where subjects press a button corresponding to the facial expression on the screen. This would avoid time constraints of response and would allow studies to measure reaction times to each expression and also examine whether there is an attentional bias towards certain expressions.

Future information-processing studies could measure response latencies to the pictures of facial expressions utilising a probe discrimination task. Neutral and disgust faces could be used for example, to determine whether there is an information-processing bias towards disgust faces due to their threatening nature which may interfere with the ability to name the emotion in OCD.

Finally, the inclusion of questionnaires to measure shame in OCD could also be included in future studies on disgust in order to examine the relationship between disgust, shame and OCD.

## CONCLUSION

The results of this study have shown that people with OCD show a heightened sensitivity towards disgust compared to a non-clinical population. Furthermore, it is not only washing compulsions in OCD that are associated with disgust sensitivity but individuals with a variety of OCD symptoms showed higher levels of disgust sensitivity towards a range of disgust elicitors. This finding goes against previous beliefs that only washing in OCD was associated with heightened disgust. Alongside traditional treatments, interventions should aim to reduce feelings of disgust in both OCD washers and those without washing compulsions.

The study has added to previous research and shown that individuals with OCD with predominantly washing compulsions and those with predominantly checking compulsions and other symptoms of OCD show a deficit in the ability to recognise facial expressions of disgust. This finding adds to the evidence for the involvement of the orbitofrontal cortex and the basal ganglia in OCD.

No evidence of a memory bias or an attentional bias towards disgust and general threat words or disgust pictures was found. The OCD group were, however, much slower at colour naming all words than the control group. Slowness on the Stroop may have been attributable to the frequent interruption of the task performance by intrusive thoughts.

The findings of this study have provided evidence which suggests that disgust plays an important role in OCD. Future research is needed in order to develop a comprehensive model of disgust in OCD.

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## **Appendix 1**

### **DSM-IV Criteria for Obsessive-Compulsive Disorder**

## APPENDIX 1

### Diagnostic criteria for Obsessive Compulsive Disorder (DSM-IV: APA, 1994)

A. Either obsessions or compulsions:

*Obsessions as defined by (1), (2), (3) and (4):*

- (1) Recurrent and persistent thought, impulses or images that are experienced, at some time during the disturbance, as intrusive and inappropriate and that cause marked anxiety or distress.
- (2) The thoughts, impulses, or images are not simply excessive worries about real-life problems
- (3) The person attempts to ignore or suppress such thoughts, impulses, or images, or to neutralise them with some other thought or action
- (4) The person recognises that the obsessional thoughts, impulses or images are a product of his or her own mind (not imposed from without as in thought insertion)

*Compulsions as defined by (1) and (2):*

- (1) Repetitive behaviours (e.g. hand washing, ordering, checking) or mental acts (e.g. praying, counting, repeating words silently) that the person feels driven to perform in response to an obsession, or according to rules that must be applied rigidly.

- (2) The behaviours or mental acts are aimed at preventing or reducing distress or preventing some dreaded event or situation; however, these behaviours or mental acts either are not connected in a realistic way with what they are designed to neutralise or prevent or are clearly excessive
- B. At some point during the course of the disorder, the person has recognised that the obsessions or compulsions are excessive or unreasonable.
- C. The obsessions or compulsions cause marked distress, are time consuming (take more than 1 hour a day), or significantly interfere with the person's normal routine, occupational (or academic) functioning or usual social activities or relationships.
- D. If another Axis I disorder is present, the content of the obsessions or compulsions is not restricted to it.
- E. The disturbance is not due to the direct physiological effects of a substance (e.g. a drug of abuse, a medication) or a general condition.

## **Appendix 2**

### **Screening Questionnaire**

**APPENDIX 2**

**DSM-IV Screening Questionnaire**

**Code:** \_\_\_\_\_

**Confidential**

**DSM-IV Criteria**

**A - Obsessions**

Are you bothered by recurrent, intrusive thoughts or impulses that seem inappropriate and are difficult to get out of your mind (For example intrusive repeated thoughts that you might hurt or kill someone you love even though you don't want to; that you will shout obscenities in public; that you are contaminated by germs or dirt)?

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How do you deal with these thoughts or impulses?

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Are these your own thoughts or do you believe they are put into your head by someone or some force or power from the outside?

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**A - Compulsions**

Some people are bothered by having to do something over and over that they can't resist when they try. For example, they wash their hands repeatedly, check whether the door is locked, or count things excessively. Have you had any difficulties like this?

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What do you think might happen if you didn't (*compulsion*).

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**B** – Does the (obsession / compulsion) seem unreasonable or excessive, but you still feel compelled to do it? \_\_\_\_\_

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(If No : Do other people think it's unreasonable or excessive? Do you think they're wrong?) \_\_\_\_\_

**C** – Does it bother you a lot that you have (Obsession/ Compulsion)? \_\_\_\_\_

Does it interfere with your life?

---

---

## **Appendix 3**

### **Patient & Volunteer Information sheets**

## APPENDIX 3

### CAMDEN AND ISLINGTON MENTAL HEALTH SERVICES NHS TRUST

#### PATIENT INFORMATION SHEET

#### CONFIDENTIAL

#### Title of study: The relationship between Obsessive-Compulsive Disorder and emotions

Investigators: **Ms Sally Fletcher**, Professor Chris Brewin  
Contact Details: Sub-dept. of Clinical Health Psychology, UCL, 1-19 Torrington Place, London WC1E 6BT  
Tel : \*\*\*\*\*  
Email: \*\*\*\*\*

---

You are invited to take part in a research study which looks at the relationship between Obsessive Compulsive disorder (OCD) and human emotions such as happiness, sadness, fear, anxiety and disgust and whether or not emotions have an effect on memory and attention. We are looking for volunteers with OCD and are interested in looking at the possible differences between people whose OCD predominantly takes the form of washing compulsions and people with OCD with predominantly checking compulsions or intrusive thoughts. By taking part you will be helping to further understanding about how certain emotions may have an effect on obsessive thoughts and compulsions in people with OCD with either predominantly washing or checking behaviours. This information may help to design appropriate treatments in the future.

Before you decide whether to take part it is important that you understand what the study will involve. Please take time to read the following information carefully and discuss it with friends or relatives if you wish. Please feel free to ask any of the investigators if there is anything that is not clear or if you would like more information.

The study will take up to 1 hour and will take place within the Psychology Department at Hunter Street Health Centre, on Hunter Street near Russell Square tube station. Your tube or bus fares will be reimbursed.

The study will involve completing some tasks on a computer and filling in some short questionnaires.

We are interested in the ability to identify facial expressions of different emotions. You will be asked to look at pictures of different emotional expressions which will flash on the computer screen and asked to say whether you think the expression on the face is happy, sad, angry, fear, disgust or surprise. You will also be shown some photographs on the computer screen followed by some words. You will be asked to name the colour of the word afterwards and will be asked to fill in some rating scales about the scenes in the photographs.

All information collected for this study will be kept strictly confidential and will only be studied by the research investigators named above.

You do not have to take part in this study if you do not want to. If you decide to take part you may withdraw at any time without having to give a reason. Your decision to take part or not will not affect your care and management in any way.

**NB: All proposals for research using human subjects are reviewed by an ethics committee before they can proceed. This proposal was reviewed by the Joint UCL/ UCLH and the Camden & Islington Committees on the Ethics of Human Research.**

# CAMDEN AND ISLINGTON COMMUNITY HEALTH SERVICES NHS TRUST

## VOLUNTEER INFORMATION SHEET

CONFIDENTIAL

### Title of study: The relationship between Obsessive-Compulsive Disorder and emotions

**Investigators:** Professor Chris Brewin, Ms Sally Fletcher

**Contact Details:** Sub-dept. of Clinical Health Psychology, UCL, 1-19 Torrington Place, London  
WC1E 6BT

**Tel :** \*\*\*\*\*

---

You are invited to take part in a research study which looks at the relationship between Obsessive Compulsive disorder (OCD) and human emotions such as happiness, sadness, fear and disgust and whether or not emotions have an effect on memory and attention. We need healthy volunteers who do not have Obsessive Compulsive Disorder to act as a control group.

Before you decide whether to take part it is important that you understand what the study will involve. Please take time to read the following information carefully and discuss it with friends or relatives if you wish. Please feel free to ask any of the investigators if there is anything that is not clear or if you would like more information.

The study will take up to 1 hour and will take place within the Psychology Department at Hunter Street Health Centre near Russell Square tube station. Your tube or bus fares will be reimbursed.

The study will involve completing some tasks on a computer and filling in some short questionnaires.

We are interested in the ability to identify facial expressions of different emotions. You will be asked to look at pictures of different emotional expressions which will flash on the computer screen and asked to say whether you think the expression on the face is happy, sad, angry, fear, disgust or surprise. You will also be shown some photographs on the computer screen and will be asked to fill in some rating scales about the scenes in the photographs. You will also be asked to read some words on the computer screen and you will be asked to name the colour of the word afterwards. You will be given the opportunity to practice these tasks first.

All information collected for this study will be kept strictly confidential and will only be studied by the research investigators named above.

You do not have to take part in this study if you do not want to. If you decide to take part you may withdraw at any time without having to give a reason.

**NB: All proposals for research using human subjects are reviewed by an ethics committee before they can proceed. This proposal was reviewed by the Joint UCL/ UCLH and the Camden & Islington Committees on the Ethics of Human Research.**

## **Appendix 4**

### **Ethics Committee Approval Letters**

**The Joint UCL/UCLH Committees on the Ethics of Human Research**

Committee A Co-Chairmen:  
Mr Michael Harrison and Dr Raymond MacAllister

Please address all correspondence to:  
Iwona Nowicka  
Research & Development Directorate  
UCLH NHS Trust  
1st floor, Vezey Strong Wing  
112 Hampstead Road, LONDON NW1 2LT  
Tel. 020 7380 9579 Fax 020 7380 9937  
e-mail: iwona.nowicka@uclh.org

Professor C Brewin  
Professor of Clinical Psychology  
Sub-Department of Clinical Health Psychology  
UCL  
Gower Street

September 3, 2001

Dear Professor Brewin

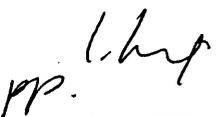
**Study No:** 01/0087 (*Please quote in any correspondence*)  
**Title:** The role of disgust in Obsessive-Compulsive Disorders

Further to a letter from Miss Sally Fletcher dated 14<sup>th</sup> August, there are no further objections on the grounds of ethics to this study going ahead.

The Joint UCL/UCLH Committees on the Ethics of Human Research: Committee A and Committee Alpha are in compliance with the ICH GCP Guidelines.

Please note that it is important that you notify the Committee of any adverse events or changes (name of investigator etc) relating to this project. You should also notify the Committee on completion of the project, or indeed if the project is abandoned. **Please remember to quote the above number in any correspondence.**

Yours sincerely

  
pp.  
**Dr R MacAllister**  
**Co-Chairman**

cc. Miss Sally Fletcher ✓



UCL Hospitals is an NHS Trust incorporating the Eastman Dental Hospital, Elizabeth Garrett Anderson and Obstetric Hospital, Hospital for Tropical Diseases, The Middlesex Hospital, National Hospital for Neurology & Neurosurgery and University College Hospital

# Camden and Islington Community LOCAL RESEARCH ETHICS COMMITTEE

Research & Development Unit, 3<sup>rd</sup> Floor, West Wing, St. Pancras Conference Centre  
St Pancras Hospital, London NW1 OPE  
tel: 020 7530 3376 fax: 020 7530 3235  
e-mail: ayse.ali@cichs-tr.nthames.nhs.uk  
Chair: *Stephanie Ellis* Administrator: *Ayse Ali*

10 July 2001

Ms Sally Fletcher  
Sub Dept of Clinical Psychology  
University College London  
Gower Street  
London  
WC1E 6BT

Dear Ms Fletcher

**LREC Ref: 01/41** (please quote in all further correspondence)

**Title: The role of the emotion of disgust in OCD**

Thank you for your letter dated 15 June 2001 addressing the concerns raised by the Committee, I apologise for the delayed response. I am pleased to inform you that after careful consideration the Local Research Ethics Committee has no ethical objections to your project proceeding. This opinion has also been communicated to the Research and Development Unit of Camden & Islington Mental Health NHS Trust.

## **PLEASE NOTE THAT THIS OPINION ALONE DOES NOT ENTITLE YOU TO BEGIN RESEARCH.**

Camden and Islington Community LREC considers the ethics of proposed research projects and provides advice to NHS bodies under the auspices of which the research is intended to take place. It is that NHS body which has the responsibility to decide whether or not the project should go ahead, taking into account the ethical advice of the LREC<sup>1</sup>. Where these procedures take place on NHS premises or using NHS patients, the researcher must obtain the agreement of local NHS management, who will need to be assured that the researcher holds an appropriate NHS contract, and that indemnity issues have been adequately addressed.

**N.B.** Camden and Islington Community LREC is an independent body providing advice to the North Central London Community Research Consortium. A favourable opinion from the LREC and approval from the Trust to commence research on Trust premises or patients are **NOT** one and the same. Trust approval is notified through the Research & Development Unit.

### **The following conditions apply to this project:**

- ◆ You must write and inform the Committee of the start date of your project. The Committee (via the Local Research Ethics Committee Administrator or the Chair at the above address) **must** also receive notification:
  - a) when the study commences;
  - b) when the study is complete;
  - c) if it fails to start or is abandoned;
  - d) if the investigator/s change and
  - e) if any amendments to the study are made.
- ◆ The Committee **must** receive immediate notification of any adverse or unforeseen circumstances arising out of the project.

<sup>1</sup> Local Research Ethics Committees Health Service Guidelines (91)5, NHS Management Executive, 19 August 1991 (*commonly known as The Red Book*).

- ♦ It is the responsibility of the investigators to ensure that all associated staff, including nursing staff, are informed of research projects and are told that they have the approval of the Ethics Committee and management approval from the body hosting the research.
- ♦ The Committee will require a copy of the report on completion of the project and may request details of the progress of the research project periodically (i.e. annually for longer projects).
- ♦ If data is? to be stored on a computer in such a way as to make it possible to identify individuals, then the project must be registered under the Data Protection Act 1998. Please consult your department data protection officer for advice.
- ♦ Failure to adhere to these conditions set out above will result in the invalidation of this Letter of no objection.

**Please forward any additional information/amendments regarding your study to the Local Research Ethics Committee Administrator or the Chair at the above address.**

Yours sincerely

  
Stephanie Ellis  
Chair, LREC

## **Appendix 5**

### **Patient & Volunteer Consent forms**

**APPENDIX 5**

**CAMDEN AND ISLINGTON MENTAL HEALTH SERVICES NHS TRUST**

**CONFIDENTIAL**

**PATIENT CONSENT FORM**

**Title of study: The relationship between Obsessive-Compulsive Disorder and different human emotions**

Investigators: Ms Sally Fletcher, Professor Chris Brewin  
Contact Details: Sub-dept. of Clinical Health Psychology, UCL, 1-19 Torrington Place, London WC1E 6BT  
Tel : \*\*\*\*\*

---

1. Have you read the information sheet about this study? YES/ NO
2. Have you had an opportunity to ask questions and discuss this study? YES/NO
3. Have you received satisfactory answers to all your questions? YES/NO
4. Have you received enough information about this study? YES/NO
5. Which health professional have you spoken to about this study?  

---
6. Do you understand that you are free to withdraw from this study.....  
at any time  
without giving a reason for withdrawing  
without affecting your future medical care? YES/NO
7. Do you agree to take part in this study? YES/NO

Name: .....

Signature .....

Date .....

Signature of Investigator .....

Date .....

CAMDEN AND ISLINGTON MENTAL HEALTH SERVICES NHS TRUST

CONFIDENTIAL

VOLUNTEER CONSENT FORM

Title of study: The relationship between Obsessive-Compulsive Disorder and different human emotions

Investigators: Professor Chris Brewin, Ms Sally Fletcher  
Contact Details: Sub-dept. of Clinical Health Psychology, UCL, 1-19 Torrington Place,  
London WC1E 6BT  
Tel : 07957 316169

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1. Have you read the information sheet about this study? YES/ NO
2. Have you had an opportunity to ask questions and discuss this study? YES/NO
3. Have you received satisfactory answers to all your questions? YES/NO
4. Have you received enough information about this study? YES/NO
5. Which health professional have you spoken to about this study?  

---
6. Do you understand that you are free to withdraw from this study.....  
at any time  
without giving a reason for withdrawing YES/NO
7. Do you agree to take part in this study? YES/NO

Name: .....

Signature .....

Date .....

Signature of Investigator .....

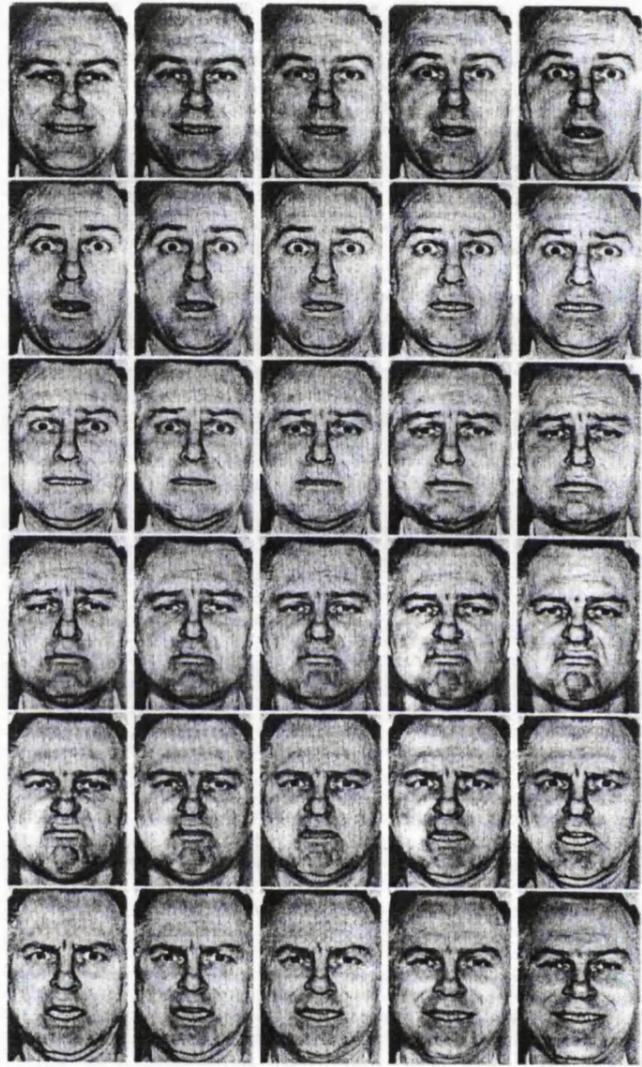
Date .....

## **Appendix 6**

### **Photographs from Facial Recognition Task**

## APPENDIX 6

### Faces used in Facial Recognition task



**The emotional hexagon.** Computer-interpolated images forming the perimeter of an emotion hexagon which runs (left to right) from happiness to surprise (top row), surprise to fear (second row), fear to sadness (third row), sadness to disgust (fourth row), disgust to anger (fifth row) and from anger back to happiness (bottom row).

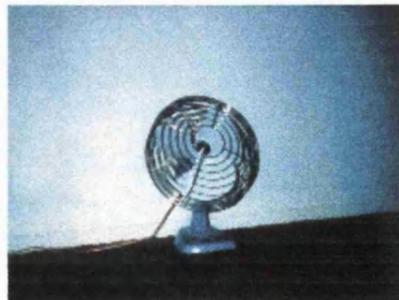
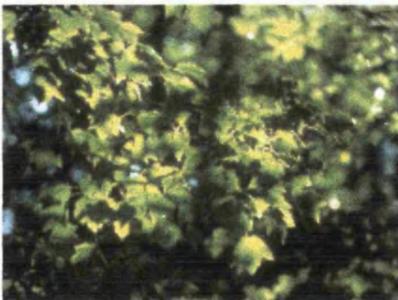
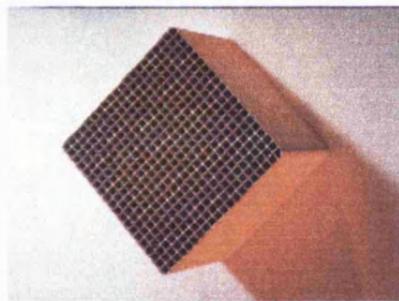
Taken from study by Calder, Young, Rowland, Hodges & Etcoff (1996).

## **Appendix 7**

### **Neutral Pictures used in the Stroop task and Picture Rating task**

APPENDIX 7

Neutral Pictures used in the Stroop task and Picture rating task



## **Appendix 8**

### **Disgust Pictures used in the Stroop task and Picture Rating task**

APPENDIX 8

Disgust pictures used in the Stroop Task and Picture rating task



## **Appendix 9**

### **Practice words from Stroop Task**

## APPENDIX 9

### Neutral words used in the practice trial on the Stroop Task

TWIST	DETAIL
SCALE	THROW
RECORD	REST
STEP	BALLOON
DESIGN	SLIDE
SHOW	HARVEST
BUTTER	TRIP
FLOWER	DRIVE
WEATHER	CLOTH
PLASTIC	SAND

## **Appendix 10**

### **Word Stem Completion Task**

## APPENDIX 10

### WORD COMPLETION TASK

Code : \_\_\_\_\_

**Confidential**

Each set of 3 letters in the list below is the beginning of an English word.  
Add a few letters to make each into a complete word – the first word that comes into your head. Please work as quickly as you can.

MEA.....

CAN.....

DIR.....

HUS.....

RAI.....

SHI.....

DRA.....

HOS.....

TUM.....

SUL.....

ALI.....

PAN.....

BEA.....

WRI.....

MEL.....

UNC.....

SHA.....

DON.....

DEA.....

PRU.....

GER.....

FLI.....

WID.....

HON.....

RUB.....

BAN.....

PAS.....

QUA.....

SHU.....

FUN.....

PEA.....

SCR.....

GUI.....

CON.....

FEA.....

CHE.....