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Investigation of Attentional Bias in Obsessive-Compulsive Disorder

A thesis submitted to the School of Psychology, Queen’s University, Belfast, in fulfilment of the requirements for the degrees of Doctor of Philosophy (PhD)

July 2019

By

Rachel Ellen Johnston, BSc (Hons)

Supervisors: Dr Kevin Dyer, Dr Donncha Hanna and Dr Eugene O’Hare
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days it felt impossible to do so.
Abstract

Obsessive-compulsive disorder (OCD) is a prevalent mental health difficulty that has a substantive negative impact on quality of life. The leading psychological treatment, Exposure and Response Prevention (ERP), is highly effective but has high rates of treatment refusal and dropout resulting in a need for innovative, acceptable and effective interventions for OCD to be created. A potential avenue for therapeutic intervention is the reduction of an attentional bias for anxiogenic stimuli. Salkovskis’ (1999) model of OCD suggests that an attentional bias for symptom specific to OCD symptoms plays a role in the creation and maintenance of symptoms. However, the previous literature exploring attentional bias in OCD has produced inconsistent findings and as a result the attentional processes involved in OCD are unclear. An intervention that targets attention bias and has significant therapeutic potential is Attentional Bias Modification Training (ABMT). ABMT has demonstrated efficacy in treating symptoms of psychopathology, but little research has been carried out on the application of ABMT to OCD. The aims of this PhD project was to explore an attentional bias in OCD in order to: 1. discern if ABMT paradigms are acceptable, efficacious interventions for OCD; 2. improve the stimuli and paradigms used in the measurement of attentional bias; and 3. further explore the mechanisms of attentional bias using this improved measurement understanding.

Chapter 4 aimed to explore the perceived acceptability of ABMT by 66 individuals with a self-reported diagnosis of OCD and compared this with acceptability of ERP in order to ascertain if ABMT would be a preferable treatment option. The results indicated that ERP was rated higher than ABMT in terms of level of anxiety-provocation and how challenging it would be as a treatment modality. Despite this, ERP was also rated higher by participants for its effectiveness and ability to reduce OCD symptoms.
Chapter 5 aimed to compare the effects of ABMT with those of ERP on attentional bias, OCD symptoms and performance in a behavioural approach task (BAT) towards contamination related objects. A total of 77 participants without a diagnosis of OCD but with clinical levels of OCD symptoms took part. In contrast to what was hypothesised, the results of Chapter 5 found that ABMT had a negative influence on attentional bias. Inspection of BAT performance revealed that both ERP groups displayed significantly greater reduction of avoidance in the BAT task in comparison to the ABMT group. No differences were detected between acceptability of the ERP group and ABMT.

Chapter 6 sought to create and validate visual stimuli related to OCD symptoms of symmetry, checking and contamination as there are few visual resources available for OCD research which is problematic when investigating attentional biases and designing appropriate interventions. It also included a neutral category that could be employed as control images. The images were validated by three groups: individuals with OCD (N=25), clinical psychologists (N=5) and a control group (N=40). A high test-retest reliability and Cronbach’s alpha was found for the stimuli set.

The previous research exploring attentional bias in OCD has been filled with inconsistent and conflicting findings. Chapter 7 aimed to investigate the conditions in which an attentional bias in OCD can be observed by comparing different types of stimuli and methods of measuring attention. Participants were individuals with moderate obsessive-compulsive symptoms with contamination concerns (N=21) and control participants (N=21). The results found that the traditional approach for measuring attentional bias, reaction time, did not reveal any significant findings. However, the eye tracking data found that all participants displayed attentional biases
for aversive words, aversive images and contamination images. No attentional bias was detected for neutral stimuli or contamination related words. The results suggest that reaction time is not sensitive enough to detect an attentional bias. They also support the argument that verbal stimuli may not be enough to provoke anxiety in individuals with contamination concerns as neither reaction time nor eye tracking data found evidence of an attentional bias. Finally, Chapter 8 provides a discussion of the clinical implications of the empirical findings of the current thesis.
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Chapter 1 Attentional bias in Obsessive-Compulsive Disorder

1.1. Abstract
Symptoms in a significant number of individuals who experience Obsessive-Compulsive Disorder (OCD) remain resistant to the leading psychological interventions available; therefore, it is crucial that research continues to strive towards creating innovative and alternative modes of treatment for OCD. This chapter introduces OCD and provides information on the nature of symptoms, their impact upon quality of life, and prevalence rates. The chapter then focuses on the different theoretical models of OCD; psychodynamic, genetic, neuro, and cognitive. Attention is then maintained upon Salkovskis’ (1999) cognitive model, which is known to be the most influential and leading model in OCD. The different methods of intervention are then explored and evaluated, with particular emphasis on cognitive-behavioural therapy (CBT), the recommended treatment of OCD. Whilst CBT is effective, a large number of people with OCD do not respond to treatment. Alternative interventions are discussed, highlighting a potential pathway of treatment in attention re-training. Salkovskis’ (1999) model suggests an attentional bias for information related to OCD symptoms causes and maintains symptom. Research has indicated that in other psychopathologies attention bias modification training is an effective pathway to the reduction of symptoms, however, this is largely unexplored in OCD.

1.2. Introduction
OCD is a prevalent and debilitating mental health disorder affecting up to 1.1% of adults in the U.K (Torres et al., 2006). In the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM–5; American Psychiatric Association [APA], 2013) OCD is categorised under ‘Obsessive-Compulsive and Related Disorder’ and is described as having two distinct symptoms; obsessions and compulsions. Obsessions
are described as intrusive and recurrent thoughts, images or impulses that cause significant distress, agitation, and anxiety. Individuals with OCD try to suppress these intrusive thoughts as the result of the marked distress they cause. There is evidence to suggest that everyone in the general population experiences intrusive thoughts to varying degrees (Rachman, 1971), but only a small percentage go on to develop clinical obsessions (Salkovskis, 1999). It is thought that this minority group develop obsessions primarily due to their dysfunctional beliefs and misappraisals about these intrusions, including the fact that they require a neutralising action as a response (Salkovskis, 1999). These dysfunctional beliefs include an exaggerated sense of responsibility, sense of importance assigned to thoughts, overestimation of the likelihood of the threat, concern over controlling thoughts, perfectionism, and intolerance of uncertainty (Obsessive Compulsive Cognitions Working Group, 2005).

Compulsions, also referred to as neutralising actions, are voluntary repetitive behaviours that are used primarily to reduce the distress from obsessions (Salkovskis, Thorpe, Wahl, Wroe & Forrester, 2003). Compulsions can be either internal (e.g., covertly and mentally repeating a string of words) or external (e.g., tapping a surface until it feels safe or appropriate to stop). Compulsions are carried out with the aim of preventing a feared situation from occurring; however they are not always linked in a realistic way to the situation they are trying to avoid (e.g. tapping a surface a specific number of times to avoid a loved one being killed in a car accident on their way home from work).

To receive a diagnosis of OCD the obsessions and compulsions must be time consuming (more than one hour daily) or have a significant negative impact upon social, occupational or other areas of functioning (APA, 2013). OCD can vary on how much insight individuals have into their symptoms. Insight refers to the extent an
individual feels the obsession and compulsions to be true (Kozak & Foa, 1994). Good insight, or fair insight, refers to the individual recognising the OCD symptoms as definitely or probably not true. Poor insight is when the individual thinks they are probably not true. Absent insight or delusional beliefs occur when the individual completely believes the OCD symptoms to be true (Ravi, Kishore, Reddy, Chandrasekhar & Thennarasu, 2004) Poor insight into symptoms has been found to be a negative predictor of treatment response in OCD, possibly due to individuals being less open to corrective information against their obsessional beliefs (Himle, Van Etten, Janeck & Fischer, 2006).

OCD is a highly diverse mental health difficulty and the context of symptoms are highly idiosyncratic and varied. Nevertheless, the range of symptom themes present in OCD have been approximately grouped into several symptom dimensions and subtypes. Research using factor analysis suggests that individuals with OCD largely fall within three compulsion subgroups, namely: 1. checking, 2. symmetry and ordering and 3. contamination (Baer, 1994; Bloch, Landeros-Weisenberger, Rosario, Pittenger & Leckman, 2008; Denys, de Geus, van Megen & Westenberg, 2004; Katerberg et al., 2010).

1.2.1. Symptoms

Checking symptoms often stem from obsessions involving extreme doubt that actions have been performed and an intolerance for uncertainty (Tolin, Abramowitz, Brigidi & Foa, 2003). Checking compulsions involve repeatedly checking that certain actions have been performed (e.g. locking doors and windows, turning taps and lights off) or have not occurred (e.g. hurting a pedestrian while driving; Radomsky, Shafran, Coughtrey & Rachman, 2010). Checking symptoms are experienced by up to 15.4% of individuals with OCD (Ruscio, Stein, Chiu & Kessler, 2010).
Symmetry and ordering symptoms reflect a preference for objects or concepts to be organised in a symmetrical pattern, or in a ritualised fashion. Symmetry and ordering symptoms also include tapping and touching surfaces or objects until the level of distress is reduced (Stein et al., 2008). These symptoms are experienced by up to 9.1% of individuals with OCD (Rusico et al., 2010) and can be driven by a need to prevent harm, but the most common mechanisms behind symmetry or ordering symptoms are “perfectionistic” beliefs and an inherent need to reduce an internal sense of dissatisfaction (Pinto et al., 2008). High levels of perfectionism have been found to predict symmetry and ordering symptoms (Cordeiro, Sharma, Thennarasu & Reddy, 2015; Martinelli, Chasson, Wetterneck, Hart & Bjorgvinsson, 2014; Myers, Fisher & Wells, 2008).

Symmetry and ordering symptoms and high level of perfectionistic beliefs have been linked to the uncomfortable feeling of things not being right or being imperfect. They have often been referred to as ‘Not Just Right Experiences’ (NJREs; Coles, Frost, Heimberg & Rheaume, 2003; Leckman et al., 1994; Rasmussen & Eisen, 1992; Timpano, Carbonella, Zuckerman & Cek, 2016). NJREs have been found to be significantly associated with symmetry and ordering symptoms (Cole et al., 2003) as the compulsion is carried out until it feels right for the individual (Radomsky & Rachman, 2004; Timpano, Carbonella, Zuckerman & Cek, 2016). Symmetry and ordering symptoms are also thought to reflect the individuals’ desire for control (Radomsky & Rachman, 2004).

Contamination symptoms occur when in individual experiences an:

“intense and persisting feeling of having been polluted, dirtied, or infected, or endangered as a result of contact, direct or indirect, with an
item/place/person perceived to be soiled, impure, dirty, infectious, or harmful” (Rachman, 2006 p. 9).

Such fears can be triggered in the absence of a physical contaminant, which is referred to as mental contamination (Rachman, 2006). Common feared contaminates can be grouped into four categories: disease, dirt/pollution, mental pollution, and harmful substances (Rachman, 2004). Related obsessions include worries about bodily fluids; sticky substances; becoming ill from contaminate; and passing an illness onto others (Menzies & DeSilva, 2003). To alleviate distress emerging from contamination obsessions, individuals engage in a number of neutralising behaviours and rituals including excessive washing of self and environment, as well as avoidance of potential contaminants (Melli, Chiorri, Carraresi, Stopani & Bulli, 2015). Disgust has also been associated with contamination symptoms (Mancini, Gragnani & D’Olimpio, 2001; Moretz & McKay, 2008) and is theorised to play an important role in the etiology of contamination symptoms (Olatunji, Lohr, Sawchuk & Tolin, 2007). Overestimation of threat has also associated with contamination symptoms (Tolin, Woods & Abramotiz, 2003; Obsessive Compulsive Cognitions Working Group, 2005).

Contamination symptoms are assumed to be the most common manifestations of OCD. In a large study of 560 people with a diagnosis of OCD, 50% were found to have contamination concerns (Rasmussen & Eisen, 1992); however, research reporting the epidemiology of contamination symptoms in community samples have found this symptom subgroup to be less frequent than other subgroups, with a prevalence of 2.9% (Fullana et al., 2009; Ruscio et al., 2010). This may be due to contamination fears being a stereotypical presentation of OCD which means they are easily detected and diagnosed (Fullana et al., 2009). Whilst it is positive that they are
noticed, unfortunately this may result in an over representation in clinical samples (Mataix-Cols, Rosario-Campos & Leckman, 2005; Rasmussen & Eisen, 1992).

Another key phenomenon related to symptom presentation is “Thought-Action Fusion” (TAF). TAF is a term that describes the belief that thinking distressing thoughts carries the same weight as performing the action themselves and that by thinking a thought it can bring around the dreaded event (Rachman, 1993; Shafran & Rachman, 2004; Shafran, Thordarson & Rachman, 1996). Similar to TAF, is “Thought-Event Fusion” (TEF) which is the belief that thoughts have the power to change the course of events (e.g. if I think about my parents dying in a car crash, then they will die in a car crash). TAF and TEF are common maladaptive beliefs included in various cognitive theories of OCD (Shafran, Teachman, Kerry & Rachman, 1999).

TAF has been separated into two categories; moral and likelihood (Abramowitz, Whiteside, Lynam & Kalsy, 2003). Moral TAF is the belief that having an unwanted intrusive thought is morally equivalent to actually carrying out the act. Likelihood TAF describes the belief that by having an unwanted intrusive thought it increases the likelihood of the event taking place. TAF is theorised to lead to thought suppression, which increases the amount of thoughts, resulting in great distress and OCD symptoms (Rassin, Muris, Schmidt & Merckelbach, 2000). Empirical support has been found for the association of TAF to OCD symptoms (Amir, Freshman, Ramsey, Neary & Brigid, 2001; Berle & Starcevic, 2005; Rassin, Diepstraten, Merckelbach & Muris, 2001).

1.2.2. Quality of life impact

OCD severely impacts on quality of life. It has been cited as the tenth leading cause of disability by the World Health Organisation (Murray & Lopez, 1997). Research has found that the ability to work, perform daily domestic duties, maintain
social relationships and enjoy leisure activities is significantly depleted in those with 
OCD compared to those without the disorder (Bobes et al., 2001; Eisen et al., 2006; 
Grabe et al., 2000; Lochner et al., 2003). The severity of obsessive symptoms has been 
a significant predictor of the quality of life; with greater obsessive severity leading to 
substantively poorer quality of life and overall wellbeing (Masellis, Rector & Richter, 
2003).

1.2.3. Prevalence

Previously, it was thought that OCD was an uncommon occurrence with early 
research by Rudin (1953; as cited by Grabe et al., 2000) suggesting it would only 
impact 0.5% of the general population. However, more recent cross-national research 
indicates that OCD has prevalence rates of 1.9-2.5% in countries such as Canada, 
Puerto Rico, Germany, Taiwan, Korea and New Zealand (Weissman, 1994). The 
Epidemiological Catchment Area project examined across five USA communities for 
OCD, sampling over 18500 residents. They found that lifetime prevalence rates for 
OCD ranged from 1.9%-3.3% in the general population (Karno, Golding, Sorenson & 
Burnam, 1988). In Britain, findings from a community sample indicate a 1.1% 
prevalence rate (Torres, et al., 2006).

Interestingly, a larger scale population study by Bunting et al. (2012) reported 
a lower lifetime prevalence of OCD (i.e., 0.5%) in Northern Ireland relative to 
comparable epidemiological studies in other countries, however, this may be due to 
the high levels of post-traumatic stress disorder (PTSD) in Northern Ireland relative 
to other nations (8.8% lifetime prevalence); the overlap between some PTSD and OCD 
symptoms in “Troubles” conflict areas; and the preferential diagnosis of PTSD in 
Northern Ireland (Bunting et al., 2012, Morina et al., 2016).
1.3. Theoretical Models

The theoretical explanations of OCD are as diverse and as wide ranging as its symptoms, spanning across multiple psychological perspectives such as psychodynamic, genetic, neuropsychological and cognitive approaches.

According to the psychodynamic perspective of OCD, symptoms are defence mechanisms which are engaged in to reduce anxiety and to manage unacceptable impulses and urges from the subconscious (Gabbard, 2001). Freud (1909, 1949) suggested that this conflict of experiencing unwanted impulses originated in the anal stage of development during toilet training. If parents are overly strict during toilet training, pressuring the child not to act on the impulse of bowel movements, conflict arises between desire for gratification and the need for control. This results in children becoming fixated in this stage and developing an obsessive personality (Nemiah, 1988). The psychodynamic approach actively states that compulsions should not be suppressed or interrupted, least the client would experience psychosis due to the overwhelming urges from the subconscious (Leichsenring & Steinert, 2016). Treatment focuses on enhancing the clients’ understanding of the internal conflicts as an insight into the origins of symptoms is theorised to resolve them (Leichsenring & Steinert, 2016). A major limitation of the application of psychodynamic theory to treat OCD is the lack of evidence for its efficacy (Gabbard et al., 2001; Jenike, Baer & Minichiello, 1986; Perse, 1988). As a result, there is no evidence-based psychodynamic treatments currently available. Whilst the meaning behind OCD symptoms may be deemed by many to be fascinating, the lack of evidence for the abatement of symptoms and the active encouragement of carrying out compulsions during psychodynamic therapy is alarming.

Research on families and twins have suggested evidence of genetic factors are prominent antecedents to OCD (Nestadt et al., 2000). Genetic heritability rates of up
to 55% have been reported (Hudziak et al., 2004; Grootheest, Cath, Beekman & Boomsma, 2007; Rosario-Campos et al., 2005) with a higher rate of heritability in monozygotic than dizygotic twins. Whilst a small cluster of research suggests a link between genes and OCD symptoms, there is a lack of evidence to fully support genetics as a sole determinant of OCD (Nestadt, Grados & Samuels, 2010). A criticism of the genetic approach to OCD is its reductionist style and the exclusion of the possible influence of the familial environment on the resulting cognitive and behavioural symptoms. It is possible that OCD symptoms may be learned by observing family members with OCD engage in rituals or obsessional thinking (Mineka & Zinbarg, 2006. Instead, the literature suggests that genetic factors may predispose rather than cause OCD and that environmental factors are required alongside genes to create symptoms (Grootheest et al., 2007).

Abnormal brain structure and function including the orbito-frontal cortex, thalamus and basal ganglia have been linked to OCD (Guehl et al., 2008; Menzies et al., 2007). These areas of the brain are part of a circuit that brings impulses to attention. It is theorised that individuals with OCD have an overactive circuit which causes symptoms (Baxter, Clark, Iqbal & Ackermann, 2001; Whiteside, Port, & Abramowitz, 2004; Saxena & Rauch, 2000). Research has found that only selective serotonin reuptake inhibitors (i.e. not any other types of anti-depressant) have been found to treat OCD symptoms which suggests that an abnormality in serotonin, a neurotransmitter, plays a role in OCD symptoms (Barr, 1993; Issari, Jakubovski, Bartlry, Pittenger & Bloch, 2016; Soomro, Altman, Rajagopal & Browne, 2008). Unfortunately, the exact impact that serotonin has upon OCD symptoms is unknown (Sinopoli, Burton, Kronenberg & Arnold, 2017).
Based on the supporting evidence in the current literature, neither the genetic or psychodynamic approach is a predominant model in understanding and treating OCD. An approach which has gathered empirical support for its theoretical understanding of OCD and its efficacy as a treatment, is the cognitive perspective of OCD. Cognitive theories of OCD are the most prominent psychological models in this area and have led to evidence-based interventions (Abramowitz, Taylor & McKay, 2005; Clark, 2004; Taylor, Abramowitz & McKay, 2009). The majority of these approaches share the underlying assumption that the appraisals individuals assign to intrusive thoughts are pivotal in the generation of OCD symptoms; however, the exact pathways and mechanisms related these appraisals varies between models (Frost & Steketee, 2002).
Figure 1. The metacognitive model by Wells (2000) of obsessive-compulsive symptoms.

The metacognition theory of OCD suggests that an individual’s beliefs about their own cognitions results in OCD symptoms (Wells, 2000; 2013). Metacognition refers to the beliefs that influence the appraisal, monitoring and control of thoughts (Wells, 2000). These beliefs include the power of thoughts, including TAF, in bringing around dreaded outcomes and the need to carry out rituals and the criteria required to stop neutralizing.

The metacognitive model (Figure 1) suggests that the negative appraisal of the occurrence of intrusive thoughts, images and impulses transforms them into obsessive-
compulsive symptoms. Two categories of metacognitive beliefs are linked to the development of OCD: 1) beliefs around the power of thoughts and 2) beliefs around the importance of controlling one’s thoughts. TAF and TEF are examples of metacognitions about the power of thoughts; that by merely thinking about an event can increase its likelihood for happening and results in the emotional consequences as if it did occur. Beliefs around the importance of controlling one’s thoughts are theorised to perpetuate compulsive behaviours which are engaged in as a preventative to the feared event occurring. Research has found correlations between metacognitive beliefs and OCD symptoms (Gwilliam, Wells & Cartwright-Hatton, 2004; Rees & Anderson, 2013; Solem, Haland, Vogel, Hansen & Wells, 2009). A limitation of the metacognitive model is that it exclusively focuses on metacognitive beliefs and ignores other beliefs surrounding the content of thoughts which have also been documented to be linked to OCD such as perfectionisms and an intolerance of uncertainty (Obsessive Compulsive Cognitions Working Group, 2005). The model also excludes the presence of information processing biases which relate to symptoms, e.g. attentional bias.

Arguably, the most comprehensive and prominent model of OCD is Salkovskis’ Cognitive Behavioural model (1999; see Figure 2). Salkovskis’ (1999) model is centred on the premise that beliefs and appraisals of overinflated responsibility are the primary aetiological and maintaining factors in OCD symptomatology. Salkovskis’ theory emphasizes that the majority of individuals regularly experience distressing and unwanted intrusive thoughts images and impulses (i.e. an image of a loved one dead). Research supports this claim, finding that intrusive thoughts occur frequently among the general population (79.8%; Rachman & de Silva, 1978). Individuals with OCD often experience unwanted and aversive intrusions
related to their OCD presentation. Salkovskis model suggests that the difference between a benign and harmful intrusive thought is not the content of the intrusion, but the manner in which it is appraised with a specific focus on how this relates to levels of personal responsibility. It places TAF in the context of inflated responsibility - if a person feels that experiencing an intrusion could increase the likelihood of the event they feel personally responsible to prevent its occurrence. For example, if an individual with OCD experiences an intrusive image of their child becoming ill, overinflated responsibility beliefs may lead them to misappraise the intrusion as an indication that they could cause or prevent such an event from occurring (e.g., “I could make my child sick,” or, “If I don’t wash my hands, my child could die.”). Such misappraisals result in extreme distress and anxiety, which is relieved when the individual engages in the relevant compulsion or neutralising behaviour (e.g., handwashing rituals).

Excessive responsibility beliefs are borne from certain childhood experiences (e.g. being responsible for a chronically ill parent from a young age; Salkovskis, Shafran, Rachman & Freeston, 1999). These beliefs can by activated or exacerbated by key critical incidents and associated appraisals (e.g. parent’s death from illness and a perceived lack of preventative action by the client). These maladaptive responsibility beliefs result in negative responses which maintain obsessive-compulsive symptoms. These responses include a negative impact upon mood by increasing distress and anxiety; allocating attention to intrusive thoughts and any stimuli related to these phenomena in the environment; and engaging in counterproductive safety strategies such as neutralizing behaviours/compulsions. Each of these events contribute to the maintenance of responsibility beliefs and so, also obsessive-compulsive symptoms.
Research has provided empirical support for the various components in Salkovskis model (1999) and their cumulative effects as proposed causative pathways. It is well established in the literature that beliefs leading to an inflated sense of responsibility are associated with OCD (Foa, Amir, Bogart, Molnar & Prezworski, 2001; Salkovskis, 2001). Critical incidents, e.g. significant life events, have been linked to the onset of OCD (Cromer, Schmidt & Murphy, 2007; Gothelf, Aharonovsky, Horesh, Carty & Apter, 2004). Research exploring Salkovskis’ model (1999) found evidence for the link between critical incidents and beliefs relating to an exaggerated sense of responsibility in individuals with OCD (Speckens, Hackmann, Ehlers & Cuthbert, 2007). Using mediation analysis, Smari and Holmstein (2001) found that responsibility beliefs, TAF, and chronic thought suppression mediated the relationship between intrusive thoughts and obsessive-compulsive symptoms as Salkovskis’ model (1999) predicts. The empirical support for Salkovskis’ model (1999) has resulted in it becoming the leading theoretical approach when understanding and treating OCD (McKay et al., 2015).

Despite its pervasive adoption and clinical utility, Salkovskis model has been criticized for its emphasis on inflated responsibility and its lack of consideration for other maladaptive beliefs linked to OCD (Clark, 2004; Frost & Steketee, 2002; O’Kearney, 1998). The Obsessive-Compulsive Cognitions Working Group (2005) highlighted beliefs relating to perfectionism, intolerance for uncertainty, and overestimation of threat theorised to be involved in the etiology of OCD. Cognitive theorists argue that Salkovskis’ model needs to consider these other beliefs and focus less on responsibility (Clark & Purdon, 2016).
Figure 2: A diagram of Salkovskis’ (1999) cognitive-behavioural model of OCD.

The model considers compulsive behaviours (referred to as neutralising actions) as key maintaining and developmental processes of OCD. Compulsive behaviours are employed by the individual to reduce the distress of intrusions and provide relief (Salkovskis, 2007). Although compulsions provide relief from discomfort, this is short lived. Research has found that in the long-term, compulsive
behaviours increase discomfort and the likelihood of engaging in future compulsive behaviours (Salkovskis, Westbrook, Davis, Jeavons & Gledhill, 1997). This temporary relief contributes to the cyclic pattern of obsessions and compulsions.

Additional maintaining mechanisms in the model linked to misappraisals of intrusions include counterproductive safety strategies, mood changes, and attentional biases. Counterproductive safety strategies involve avoidance and generic attempts to repress intrusive thoughts (e.g., substance misuse); however, these actions remove the opportunity to have the misappraisal disconfirmed and, although they provide short-term relief from distress, they actually increase the occurrence of intrusions long-term (Salkovskis, 1999; Wenzlaff & Wegner, 2000). This cycle of intrusions, obsessions, compulsions, and counterproductive safety strategies understandably cause complex adverse mood changes in the form of distress, anxiety, and depression. Aversive mood states also contribute to the maintenance of symptoms as they provoke the need to engage in compulsions to ‘neutralise’ the feelings, which, in turn, further increase perceptions of responsibility, occurrences of intrusions, and estimation of the likelihood of the threat (Salkovskis, 1999).

A concept in Salkovskis’ model (1999), which is the focus of this PhD and which will be further expanded on in Chapter 2, is attentional bias for symptom specific stimuli in the environment. Salkovskis’ (1990) model suggests that an increase in attention to intrusions and/or stimuli related to these images or urges is thought to have a fundamental role in creating, exacerbating and maintaining OCD difficulties. Increased attention to stimuli related to OCD symptoms involves the preferential allocation of information-processing resources toward stimuli which are related to the individual’s obsessions (Cohen, Lachennmeyer & Springer, 2003). Attentional bias is a catalyst for intrusive thoughts, as being primed to orient to stimuli
related to OCD concepts could conceivably increase the frequency of intrusions (e.g., watching someone sneeze will trigger an intrusive thought about becoming ill). Although Salkovskis’ model suggests that attention is preferentially allocated to anxiety-provoking stimuli, it provides limited detail on the process and mechanisms involved in this bias. This is an under-researched part of the model, with little empirical investigation, however, as illustrated above, the increased allocation of attention to stimuli related to obsessions is an active agent in propelling obsessive-compulsive symptoms. For this reason, it seems particularly important that this part of the model is further investigated and better understood due to its implications as a potential pathway for treatment.

1.3.1. Treatment

Psychological therapy and/or antidepressant medication are the primary evidence-based OCD interventions (Gava et al., 2007; Skapinakis et al., 2016). The National Institute for Clinical Excellence recommend both individual and group CBT and ‘Selective Serotonin Reuptake Inhibitors’ (SSRI) as the leading treatment for OCD symptoms. SSRI have demonstrated efficacy in treating OCD symptoms (Soomro, Altman, Rajagopal & Browne, 2008). They are thought to improve OCD symptoms by altering and increasing the balance of serotonin levels in the brain, however, 40-60% of individuals either do not respond at all, or only note a small reduction in their symptoms (Kellner, 2010; Skapinakis et al., 2016). As SSRI’s do not treat the underlying perpetuating mechanisms involved in OCD, individuals who do respond to treatment are prone to relapse once the medication stops (Grant, 2014).

CBT treatment focuses on introducing new and alternative appraisals of intrusive thoughts and behavioural responses (Bream, Challacombe & Palmer, 2017). CBT has gained the most evidence for its efficacy in treating OCD across the

ERP aims to break down the cyclic nature of obsessions and compulsions by causing habituation to the triggers of symptoms (Abramowitz et al., 2003) and introduce alternative interpretations of intrusive thoughts by conducting behavioural experiments in which intrusive thoughts are tested. The continuing misinterpretation of the responsibility to prevent intrusive thoughts from occurring is a perpetuating factor of OCD symptoms e.g. having the intrusive thought of bringing germs in the family home “unless I wash my entire clothes and body when I come home, my whole family will become ill and die” (Salkovskis, 1999). The engagement of compulsions (e.g. ritualistic cleaning when coming home), counterproductive safety strategies (e.g. avoid family until cleaning has been completed, suppress thoughts of family becoming ill), mood changes (e.g. extreme anxiety until cleaning has been completed) and attentional bias (e.g. scanning body and environment for signs of germs) maintains the misinterpretation of intrusive thoughts (Salkovskis, 1999). Compulsions, however, are key to maintaining OCD symptoms. Engaging in compulsions increases the attentional bias which heightens the salience of triggers of obsessions in the environment. Performing compulsions in multiple settings increases the number of triggers across locations. The relief from having neutralized the compulsion reinforces the behaviour and prevents the disconfirmation of the obsessive thought being true. ERP aims to alter the misinterpretation by the individual directly exposing themselves to the trigger of their intrusive thoughts without carrying out compulsions (e.g. go and sit with family as soon as the individual gets home without cleaning self or clothes
first). This exposure provokes intrusive thoughts which cause significant distress and the urge to neutralize via a compulsion. The individual is asked to delay carrying out their compulsion for longer periods of time until gradually their anxiety reduces naturally until the need to carry out the compulsion is no longer there. By observing that the feared outcomes does not occur (e.g. family does not die) and the habituation to the once extremely distressing thoughts allows the cognitive restructuring of the significance of intrusive thoughts (e.g. “it’s just a thought, it can’t make my family ill”) can take place. This re-appraisal allows the cycle of symptoms to be broken as compulsions, counterproductive safety strategies and the need to reduce anxiety are no longer required; therefore, reducing OCD symptoms (Salkovskis, 1999; Veale, 2007).

1.3.2 Treatment resistance

Despite its demonstrated efficacy, there has been a high dropout rate and refusal rate of up to 15-30% recorded for ERP (Ong et al., 2016; Schruers, Koning, Haack, Luermans & Griez, 2005). The distressing nature of ERP is theorised to cause these poor attrition levels (Franklin & Foa, 2011). Even when individuals with OCD undergo ERP and/or SSRI up to 50% of service users only show 30% improvement (Marks, 2003) with 75% of clients still having OCD symptoms after therapy (Fisher & Wells, 2005). These figures highlight the difficulties in treating OCD. Due to the distressing and debilitating nature of OCD, it is associated with a high risk of suicide and depression with up to 11% of individuals having previous history of suicidal behavioural (Chaudhary, Kumar & Prasad-Mishra, 2016). It is crucial to continue exploring new interventions that could provide relief to obsessive-compulsive symptoms.
Alternative therapies have been designed to treat psychopathologies in individuals who do not respond to typical CBT therapy e.g. schema therapy (Young et al., 2003). Schema therapy is a third wave CBT approach that draws on different models including attachment, psychodynamic, emotion-focused and gestalt techniques. The foundation of schema therapy is that unmet core emotional needs in childhood result in the development of ‘Early Maladaptive Schemas’ (EMS) which result in maladaptive coping behaviours. EMS relating to social isolation, vulnerability to harm or illness, negativity or pessimism and dependence or incompetence, have been found to be significantly associated with OCD symptoms and severity (Atalay, Atalay, Karahan & Cakiskan, 2008). Schema therapy with ERP led to a significant reduction in OCD symptoms in individuals who had previously not responded to typical CBT (Theil et al., 2016). These results show promise for schema therapy in chronic and severe OCD, however, further research is needed confirm its efficacy.

‘Acceptance and Commitment Therapy’ (ACT; Hayes, Strosahl & Wilson, 1999) is another alternative intervention that is based on CBT principles but focuses more on targeting psychological inflexibility with additional techniques including acceptance, mindfulness, and dialectics. Psychological inflexibility has been found to be related to OCD symptoms (Abramowitz, Lackey & Wheaton, 2009). Research has found ACT produces significant reduction in OCD symptoms across subgroups of symptoms (Dehlin, Morrison & Twohig, 2013; Twohig et al., 2010).

While schema therapy and ACT indicate promise as an alternative intervention to treating OCD, alternative avenues of intervention have focussed on other elements of cognitive action involved in in maintenance of OCD. ‘Attention Bias Modification Training’ (ABMT) is a relatively new technique that may assist in OCD symptom
reduction that could be integrated alongside more intense therapies or help prepare clients for the therapeutic experience.

ABMT aims to specifically target an attentional bias for symptom-specific stimuli by attempting to retrain attention to neutral stimuli (Hakamata, 2010). According to Salkovskis cognitive-behavioural model of OCD (1999; 2007), excessive attention towards triggers of intrusive thoughts in the environment has a role in the creation and maintenance of symptoms. By reducing this bias in individuals with OCD, it aims for attention to move freely through the environment, decrease the number of triggers attended to and subsequently decrease anxiety and distress. As ABMT is delivered over a computer and involves no direct contact with triggers of symptoms, it can be considered as less anxiety provoking and accessible than typical CBT such as ERP and may provide an alternative intervention for OCD symptoms (Hakamata et al., 2010). As ABMT is designed to be delivered over the computer with little input from clinicians, it may be less expensive treatment than ERP which requires considerable input.

ABMT is a modified version of the dot-probe task and was created by Macleod and Matthews in 2002. In the original dot-probe task (Macleod, Mathews & Tata, 1986), two stimuli are presented together, one threatening and the other neutral (e.g. word or image pairs). Following these stimuli, a target (e.g. a dot or letter “E” or “F”), that the participants are asked to respond to (e.g., press a button to indicate which letter is displayed), appears in the previous location of one of the stimuli. Comparing the reaction times of trials where the target appears in the previous location of either the threatening or neutral stimuli can be used as an assessment of attentional bias. The ABMT differs from the dot-probe task as the neutral stimuli are always the cue for the target, therefore, attention is theorised to be redirected away from the threat and
towards the neutral stimuli (Matthews & Macleod, 2002; Macleod, Soong, Rutherford & Campbell, 2007). ABMT is delivered via a computer programme, although the format has differed between studies with the number of trails reported to range from 128-1080 across 1-15 sessions (Hakamata et al., 2010).

Previous literature found inconsistent evidence for attentional bias in OCD (Summerfeldt & Endler, 1998), however, research employing sensitive methodologies has repeatedly demonstrated its presence in OCD (Armstrong, Olatunji, Sarawgi & Simmons, 2010; Armstrong, Sarawgi & Olatunji, 2012; Bradley et al., 2016).

ABMT has been found to significantly reduced symptoms to non-clinical levels in generalised anxiety disorder (Amir, Beard, Burns & Bomyea, 2009) and social anxiety disorder (Amir et al., 2009; Schmidt, Richey, Buckner & Timpano, 2009; Schoorl, Putman & Van Der Werff, 2013). There has been little research carried out on the application of ABMT to OCD, however, what has been done has shown promise (Habedank, Lennartz, Arslan & Ertle, 2017; Najmi & Amir, 2010). ABMT may provide a new alternative intervention for OCD with a high acceptability rate for computer-based interventions being reported by individuals with OCD (Wootton, Titov, Dear, Spence & Kemp, 2011)’ however, further research is required into ABMT’s application to OCD to further support its development as an alternative or facilitatory intervention for OCD symptoms.

1.4. Conclusion
This chapter has aimed to illustrate the nature and prevalence of OCD, while highlighting its profound negative impact upon quality of life. Multiple models of OCD exist within the literature; however, it is clear that cognitive models such as Salkovskis’ Inflated Responsibility Model have the strongest evidence base and clinical utility. An overview of treatment highlights that CBT with ERP interventions
are highly effective, but the issue of non-response and drop-out demonstrates a need for further examination of alternative treatment modalities. An overview of alternative therapies has been explored with particular emphasis on ABMT, which is arguably the least distressing and accessible alternative intervention which may suit those individuals with chronic and severe OCD symptoms. Subsequent chapters of this thesis will explore the role of OCD attentional biases in more detail along with the potential applications of ABMT.
Chapter 2 Review of the Empirical Findings in the Area of Attentional bias in OCD

2.1 Abstract
Salkovskis’ (1999) model highlights an attentional bias towards stimuli relevant to obsessions as a part of the development and maintenance of OCD symptomology. Modification of an attentional bias may offer a new intervention for OCD symptomology, however, there has been little research carried out in this area and much is still unknown about the mechanisms involved in attentional bias in OCD. This current chapter will define attention and discuss the theorised mechanisms underlying attentional biases in psychopathology. It will then explore the multiple models of attentional bias, highlighting the different mechanisms theorised to be underlying the bias. A review of the different paradigms and materials employed in this research area is also provided as well as a critique of how methodological limitations have contributed to inconsistent evidence for attentional bias in OCD.

2.2 Introduction
Salkovskis’ (1990) cognitive-behavioural model suggests that an increase in attention to intrusions and/or stimuli related to these images or urges is thought to have a fundamental role in creating, exacerbating and maintaining OCD difficulties. Elevated attention to stimuli related to OCD symptoms involves the allocation of cognitive resources toward items in the environment which are concordant or related to the individual’s OCD presentation (Cohen, Lachenmeyer & Springer, 2003). Attentional bias is a catalyst for intrusive thoughts, as being primed to orient or fixate on stimuli related to OCD concepts could conceivably increase the frequency of intrusions (e.g., watching someone sneeze will trigger an intrusive thought about becoming ill). Although Salkovskis’ model suggests that attention is preferentially allocated to anxiety-provoking stimuli, it provides limited detail on the particular
process and mechanisms involved in this bias. As this bias is suggested to play a role in the development, maintenance and exacerbation of OCD symptoms, further exploration of this phenomena is important in the development of future psychological interventions for OCD (Hakamata et al., 2010).

2.2.1 Attention

Attention is a well-researched phenomenon and the term has many different connotations in the psychological literature (Nobre & Kastner, 2013). An individual’s environment typically provides a surplus of stimulation and information. As an individual is unable to attend to everything in the environment that they are presented with, attention is the process that allows that individual to selectively attend to what is relevant (Driver, 2001). Attention can be divided into multiple stimulants simultaneously (e.g., driving a car and having a conversation with a fellow passenger at the same time); however, the ability to do these attentional tasks has limitations (Pashler & Sutherland, 1999).

Selective attention is the term used to describe the ability to focus on specific salient stimuli in the environment while ignoring or deprivitising other stimuli (Driver, 2001). One of the first experiments to explore selective attention was by Cherry (1953) using an auditory shadowing task. In an auditory shadowing task, participants are asked to wear headphones so that two messages can be played (one through each ear) simultaneously. Participants are asked to pay attention (attend) to only one message repeating it aloud (shadowing) and to ignore the other message. Cherry’s (1953) study found that, despite shadowing only one message, the participants could detect changes in the tone of the message and the gender of the messenger that they were instructed to ignore. This experiment led to the ‘early selection theory’ of selective attention by Broadbent (1954) which suggested that all
stimuli from the environment is passed through a filter. In turn, this filter allows inputs to be tuned into based on their physical characteristics such as their pitch or tone. But, it is important to note that only the stimuli that attention is selectively focused upon (e.g. the attended message in shadowing task) is filtered through into attention and further processed. The stimuli that is not focused upon does not go any further.

Treisman (1969) explored attentional processes further by repeating the auditory shadowing task but using the same voices for each message. Participants were not only able to repeat the attended message but if it switched location to the opposite ear they would follow it. This challenged the early selection theory which suggests that the unattended message would not be processed for content but only for pitch and tone. Treisman (1960) created the ‘late selection theory’ which suggested that all messages received a low-level analysis that is not based on physical characteristics but rather information. Research has found that if information in the unattended ear is relevant to the individual’s goals, then it will receive attention (Stafford, McCance & Straw, 2008). An example of this is when an individual is hungry and finds that they pay more attention to food cues, or, if an individual is anxious and so they selectively attend to threats in the environment (Bar-Haim et al., 2007).

There is a well-documented relationship between threatening information in the environment dominating attention selection and psychopathology (Bar-Haim et al., 2007). A considerable amount of research has been generated on understanding attentional bias for threats and the processes underlying this bias (Weierich, Treat & Hollingworth, 2008). The proposed attentional processes involved are best understood in the context of Posner and colleagues orienteering network of spatial attention (Armstrong & Olatunji, 2012; Posner, 2012; Posner & Petersen, 1990; Posner & Rothbart, 2007). This is discussed in more detail below.
2.2.2 Orienteering network

Spatial attention refers to an individual’s ability to move attention around the visual field (Vecera & Rizzo, 2003). Posner’s theory suggest that an orienteering network is responsible for how selective attention is moved around the visual field (Posner, 2012; Posner & Petersen, 1990; Rueda, Posner, & Rothbart, 2005). Posner, Snyder and Peterson (1978) proposed a ‘spotlight’ model of spatial attention after a series of experiments investigating the orientation of attention using a ‘cueing task’. During this task, participants are asked to focus their gaze on a cross in the middle of a screen without moving their eyes before a symbol (cue), such as a dot or star, is displayed on the left or right side of the fixation cross. Following this cue a target, which participants are asked to detect, appears in either the previous location of the cue (a valid cue) or in the opposite side (invalid cue).

Posner et al., (1978) found that when the cues were invalid there was a delay in reaction time, however, when the cues were valid participants detected the target faster. These findings suggest that the cues were drawing attention to their location, therefore, if they were an invalid indication of the target the participants had to disengage and shift attention towards the correct location, resulting in delayed detection of the target and slower reaction times than valid trails. But, if the cue was a valid indication of the target, then the participants’ attention was already engaged in this area and no shift was required, resulting in faster detection. These results led to the development of The Spotlight Theory which suggests that attention is like a ‘beam of light’ that allows us to focus on specific areas within our field of vision (Posner et al., 1978). A core feature of ‘The Spotlight Model of Attention’ is the way attention moves in the visual field; the orienteering network is proposed to be the mechanism responsible for moving attention via three movements; “disengagement”, “shift”, and
“engagement.” Each of these movements is purported to have a distinct neural network (Zeng, Weidner, Fink & Chen, 2017). The orienteering of attention can be both covert and overt (Posner, 2012). Overt orientation of attention can be observed, e.g. when a person’s eyes are moving around the visual field (Posner, 2012), however, covert orientation of attention is not visible as it refers to the mental and internal shifting of focus (Posner, 2012).

The first cortical area involved is the temporal-partial junction located in the partial lobe; this activates to allow attention to disengage from a stimulus. Next, the superior colliculus located in the midbrain determines the next location that attention will orientate to and shifts attention towards this area. Finally, the pulvinar network in the thalamus activates supporting attentional processes to engage at the new location. These three movements; disengagement, shift and engagement, are the recommended model for understanding attention deployment and orientation to threatening stimuli (Armstrong & Olatunji 2012).

2.3 Theoretical accounts of attentional bias in psychopathology
Research has provided evidence for a link between anxiety disorders and Posner’s concept of attentional bias for threatening stimuli (Bar-Haim et al., 2007). Consequently, theoretical models of attentional process to threat can explain the cognitive mechanisms involved in mental health presentations including anxiety disorders and OCD (Cisler & Koster, 2010); however, many of the models differ on the exact attentional processes that are instrumental in the maintenance of anxiety and OCD symptoms. For example, a number of models assert that the ‘shift’ mechanism or pre-attentive or automatic facilitation of attention to threats in the environment is critical, i.e., attention is more rapidly engaged with threatening stimuli related to anxiety or OCD symptoms (Beck & Clark, 1997; Eysenck, 2007; Mogg & Bradley,
1998; Wells & Matthews, 1994). While others purport that they are problematic difficulties in Posner’s “disengagement” and “engagement” mechanisms, i.e., the ability to remove attention from threatening stimuli related to anxiety or OCD symptoms and engage attention elsewhere is reduced (Bar-Haim et al., 2007; Beck & Clark, 1997; Eysenck, 2007). To represent these two different theoretical positions, two hypotheses are frequently referred to in the literature with reference to attentional biases in mental health presentations: the Vigilance and the Delayed Disengagement/Maintenance hypotheses.

2.3.1 The Vigilance Hypothesis

The Vigilance Hypothesis suggests that a bias in processing threatening information is present in the early and pre-attentive stages of attention, resulting in a rapid shift and engagement towards threats in the environment (Beck & Clark, 1997; Eysenck, 2007; Matthews & Mackintosh, 1998; Mogg & Bradley, 1998; Wells & Matthews, 1994). Some models also include a subsequent avoidance away from threats which has led to The Vigilance Hypothesis sometimes being referred to as The Vigilance-Avoidance Hypothesis (Mogg & Bradley, 1998). This is thought to maintain anxiety as avoidance impedes habituation and reappraisal of threats (Foa & Kozak, 1986; Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Radomsky, Shafran, Coughtrey and Rachman (2010) provide a case example of hypervigilance in OCD, wherein a client, who was a professional engineer, felt excessive responsibility for protecting people from dangerous equipment. When in public, the client would intensively scan the environment for threatening materials and focus his attention excessively on objects similar to the feared stimuli. This case illustrates how personal beliefs of responsibility also contribute to elicit hypervigilance of attention for threats in the environment.
2.3.1.1 Models including the Vigilance Hypothesis

Wells and Matthews (1994) propose the Self-Regulatory Executive Function model (S-REF); which suggests that dysfunctional metacognitions, thoughts and understanding of one’s own cognitive processes, cause a pattern of maladaptive and rigid responses to internal experiences which maintains and strengthens them. This pattern is referred to as Cognitive Attentional Syndrome (CAS). The CAS consists of worry, rumination, unhelpful self-regulatory behaviours (e.g. avoidance), and an attentional bias for threatening information. The attentional bias in the CAS serves to monitor the environment for threats, resulting in the individual being vigilant for threatening stimuli. This is maladaptive as it increases the sense of danger, which in turn leads to an increase in the maladaptive thoughts. The S-REF differs from other models of attentional bias in psychopathology as it focuses less on the automatic and pre-attentive process, and more the individual's self-knowledge and goals (Wells & Matthews, 1994). The S-REF suggests that dysfunctional metacognition cause attention to focus on threat as a maladaptive coping style.

The S-REF model proposes that three different levels of cognition continuously interact to cause an attentional bias for threatening information. These three levels include an automatic and preconscious evaluation of all stimuli, controlled processing and appraisal and self-regulatory processes (S-REF). All stimuli are thought to be subjected to low level analysis, if the result of this analysis is deemed potential threat then the information will enter the participant’s consciousness as intrusive thoughts. These intrusions then activate the S-REF which appraises the intrusions and potential threat using information from an individual’s goals and self-knowledge. If the self-knowledge include maladaptive beliefs such as the exaggerated perception of danger and the individuals inability to cope with the threat then reactions
designed to promote self-regulation will be triggered such as threat monitoring. Threat monitoring is a voluntary engaged in conscious technique which results in the individual being vigilant for threatening stimuli.

Kaur, Butow and Thewes (2011) found support for the association between dysfunction metacognitions and attentional bias in individuals with health anxiety. They found that dysfunctional metacognitions were correlated with an interference for health-related words during an emotional stroop task in individuals with high levels of health anxiety; however, the Emotional Stroop Task cannot decipher if this interference stemmed from vigilance for health-related words. Butow et al., (2015) used a dot-probe task which is designed to detail if attention is biased in the earlier or later stages; they found that although metacognitions predicted clinical levels of fear of cancer returning in cancer survivors, there was no evidence of an attentional bias for cancer related words. More research is needed to support the association between metacognitions and attentional bias.

Mogg and Bradley (1998) proposed a theory which evaluates attention deployment in anxiety from a cognitive-motivational angle. Their theory involves two systems: Valance Evaluation and Goal Engagement systems. They suggest that each emotion has its own cognitive settings and typical responses. Anxiety has a cognitive setting that is future orientated and externally focused e.g. worrying about potential future threats and scanning the environment for present dangers. The Valence Evaluation System (VAS) assesses stimuli for the level of risk. It does this via a mixture of a rapid appraisal of features as well as using information from memory. The VAS in individuals with high trait anxiety is more sensitive and reactive. High trait anxiety is thought to influence the VAS to appraise an ambiguous or minor situation as highly threatening. The result of the VAS analysis is carried into the Goal
Engagement System (GAS). The GAS dictates the allocation of attention, deciding whether or not to orientate to stimuli deemed dangerous. If an element of the environment is perceived as highly threatening, the GAS stops other cognitive activates and allocates resources to the target. This hyper orientation is then thought to be followed by avoidance in an attempt to reduce distress. This theory suggests that all individuals, regardless of trait anxiety, will display an attentional bias for highly threatening stimuli, but individuals with a high trait anxiety will display a tendency to appraise mild or ambiguous stimuli as highly threatening resulting in the allocation of attention to such objects in the environment. Consequently, a pre-existing tendency to misappraise in this manner is also a potential vulnerability factor for developing anxiety.

The Mogg and Bradley (1998) model also acknowledges the role attentional bias has in maintaining anxious states. It suggests that vigilance for threat followed by avoidance removes the possibility of habituation and cognitive restructuring, thus maintaining the initial appraisal that mild stimuli are highly threatening, ultimately perpetuating anxiety. The theory suggests that instead of training attention away from stimuli that has been found threatening, it would be beneficial to focus on how the stimuli was appraised.

The inclusions of attentional avoidance in this model fits with the typical presentation of behavioural OCD symptoms, specifically contamination symptoms in which individuals avoid potential sources of contamination as a counterproductive safety strategy (Deacon & Olatunji, 2007; Rachman, 2004; Salkovskis, 1999). A limitation of this model is the lack of evidence for a highly sensitive VAS as evidence that individuals with high trait anxiety have a biased appraisal towards mild stimuli is
inconsistent (Philippot & Doulliez, 2005; Schofield, Coles & Gibb, 2007). Appraisal of mild stimuli has not yet been explored in individuals with OCD.

2.3.2 Delayed Disengagement and Maintenance Hypothesis

The Delayed Disengagement and Maintenance Hypothesis suggests that the bias occurs in the later stages of attention. The delayed disengagement bias suggests that individuals with high trait anxiety are unable to disengage and shift attention away from threatening stimuli (Eysenck et al., 2007; Derryberry & Reed, 2002; Fox et al., 2001). There is a significant overlap between delayed disengagement and maintenance; however, the maintenance bias describes the repeated re-orientation, greater fixation time, and overall maintained focus of attention to threatening stimuli (Weirich, Treat & Hollingworth, 2008). Both of these biases to threat are thought to maintain anxiety as individuals are unable to disengage attention from anxiety provoking stimuli, therefore, maintaining an anxious state.

The reduced ability to inhibit distressing materials such as thoughts, images and impulses in OCD is a well recorded core feature of OCD (Menzies & de Silvia, 2003). Neuropsychological studies have repeatedly found evidence of impaired inhibition in OCD (Chamberlain, Blackwell, Fineberg, Robbins & Sahakian, 2005; Rosenberg, Dick, O’Hearn & Sweeney, 1997) as well as deficits in shifting attention (Chamberlain, Fineberg, Blackwell, Robbins & Shakian, 2006; Veale, Sahakian, Owen & Marks, 1996; Watkins et al., 2005). Adams (2015) had participants with high contamination related obsessive-compulsive symptoms perform an inhibition task. The results showed these symptoms were negatively impacted by contamination related images. The inability to disengage from threatening stimuli and heightened maintenance of focussed attention towards OCD-related information may exacerbate
intrusive thoughts resulting in the need to neutralize in individuals with OCD via a compulsion.

Individuals with checking compulsions exhibit difficulty in disengaging. Rachman and De Silva (2009) note a client who had difficulty removing attention from their car – specifically, they continually checked it was locked several times. Individuals with checking concerns have been found to have a low tolerance of uncertainty (Tolin et al., 2003) which has been associated with diminished activity in the prefrontal cortex, which is linked to difficulties disengaging (Cisler & Koster, 2010).

### 2.3.2.1 Models Including Delayed Disengagement and Maintenance hypothesis

Fox, Russo, Bowels and Dutton’s (2001) theory differ from the majority of other models as they do not include a facilitation of attention towards threat. They suggest that a key feature of anxiety is not vigilance of attention towards threats, but difficulty disengaging from these objects in the environment once they are detected. They also suggest that all novel stimuli draw visual attention, but that a bias occurs when the stimuli are evaluated for further processing. This second step involves prioritizing allocation of attention. Fox et al. (2001) suggest that it is at this stage that anxiety biases individuals to allocate attention to threatening stimuli; therefore, attention is maintained upon the threat which may then perpetuate and escalate anxiety. Fox et al., (2001) do not specify which specific factors may be causing the maintained attention to threat; i.e., whether it is difficulty in inhibiting the threat or a coping mechanism.
2.3.3. Integrated Models

Beck and Clark (1997) proposed a three-stage schema-based information processing model of anxiety in which both vigilance and delayed disengagement/maintenance of attention are involved. This model focuses on the vulnerability an individual has to develop anxiety. This vulnerability is described as:

“… a person’s perception of himself as subject to internal or external dangers over which his control is lacking or is insufficient to afford him a sense of safety. In clinical syndromes, the sense of vulnerability is magnified by certain dysfunctional cognitive processes...” (Beck, Emery & Greenberg, 1985, pp. 67-68).

This vulnerability is developed through previously learned anxiety-related schema. Beck and Clark’s (1997) model includes both automatic and strategic processes in the preferential processing of threatening stimuli by individuals who have a predominant anxiety-related schema.

The first stage in this model is referred to as the ‘initial registration’ and involves automatic processing of potentially threatening stimuli, which is referred to as ‘Orienting Mode.’ This stage is described as an early warning detection system as anxiety-provoking stimulus are quickly detected and orientated to in the environment. During this stage, individuals with anxiety overestimate the level of danger and underestimate their ability to cope, and information processing resources are preferentially allocated to the threatening stimuli. This leads to stage two, which is referred to as ‘Immediate Preparation,’ where the primal threat mode is activated. This stage involves automatic and strategic processing. During this second stage, the behavioural, physiological, affective and cognitive responses that are designed to reduce the risk of danger and enhance safety are activated. These include
hypervigilance, preparation for flight or fight, avoidance behaviours and primal thinking (which is the repetitive and involuntary experience of thoughts and images relative to the threat). While these behaviours can help secure safety in actual dangerous situations, they can have adverse effects when a non-threatening situation has been misinterpreted.

The third and final stage is called ‘Secondary Elaboration.’ It is triggered by the primary threat mode. This stage involves further conscious processing of the stimuli as an individual assesses their ability to cope with the danger. Beck and Clark’s (1997) model suggest that attention is facilitated towards risks to safety in the environment by the primal threat mode and threat relevant schemas in secondary elaboration maintain attention to threat.

Research has shown support for this theory. Maladaptive schema relating to social isolation, vulnerability and pessimism were found to be elevated in individuals with OCD compared to a control group (Atalay et al., 2008). Individuals with depression who had negative self-referential schema displayed an attentional bias for negative words (Disner, Shumake & Beevers, 2017); however, research from neuropsychological studies suggest that as well as a slower more elaborate pathway of emotion to the brain there is also evidence to support a fast and automatic pathway involving the amygdala that does not require thought, e.g. independent of schema (LeDoux, 1996). This is contradictory to Beck and Clark’s (1997) model which suggests that threat-relevant schema direct cognitive processing. It is important to note that the three separate phases suggested in the model are based on clinical theory and not empirical evidence of their existence.

Attentional Control Theory (ACT) focuses specifically on the way in which anxiety influences cognitive functions in task performance. ACT considers the effect
of anxiety upon overall task performance and the amount of effort and resources required for the task. This theory assumes that trait anxiety influences attention by reducing attention control, subsequently effecting inhibition, shifting and updating of new information (Miyake et al., 2000). ACT refers to two different attention systems; a goal-directed system influenced by previous knowledge and expectations and a stimulus-driven system which is involved in a bottom-up processing and responds to salient stimuli (Corbetta & Shulman, 2002). ACT suggests that trait anxiety disrupts the balance between these two systems, causing an increase in the sensitivity of the stimulus-driven system which increases facilitation for threats. Once attention is engaged to threatening stimuli the ability to inhibit and shift attention away is reduced, resulting in difficulty disengaging, and attention being maintained upon threat.

A limitation of this theory is that it does not state what is required for anxiety to disrupt task performance. It suggests that if resources are available then task performance is less likely to be influenced, however it does not state what the resource is. Neuropsychological research has found support for ACT in increased activity for inhibition, shifting and updating in individuals with high trait anxiety when behavioural data has failed to do so (Berggren & Derakshan, 2013). A recent meta-analysis involving 110 studies found support for impaired executive functioning in OCD including ability to inhibit, switch and update (Snyder, Kaiser, Warren & Heller, 2014).

**2.3.4 Summary of Models**

Despite several theoretical models suggesting that the same attentional mechanisms are involved in the processing of threatening information, they differ on the precise cognitive components and interactive processes. Reviewing these models leads to an emergence of two forms of bias; an early, pre-attentive and unconscious
bias seemingly located in the automatic stages of attention, and a more deliberate and conscious bias occurring in the later stages of attention. This is concurrent with the Vigilance and Delayed Disengagement/Maintenance theories. However, it is not yet clear whether it is pre-attentive processing (Mogg & Bradley, 1998) or conscious deployment of attention resulting in a bias for threatening information (Wells & Matthews, 1994). Delayed disengagement and maintenance of attention are theorised to be tactics employed to cope with threats (Beck & Clark, 1997) or indicate reduced ability to inhibit and shift attention (Eysenck, 2007). Vigilance is thought to be the result of a lower threshold detection for threats (Mogg & Bradley, 1998). As these models vary on the catalyst for attentional bias, each of them would indicate that different aspects need to be altered for attentional bias to be removed, e.g. appraisal of stimuli (Mogg & Bradley, 1998), metacognitions (Wells & Matthews, 1994) or training inhibition and switching of attention (Eysenck, 2007). Understanding the mechanisms involved in attention bias in OCD would allow a formulation of an appropriate attentional intervention.

2.4 Experimental evidence of attentional bias in OCD

Unlike other psychopathologies, the evidence for an attentional bias to symptom specific stimuli in OCD has not always been clear or consistent. This inconsistency may be the result of methodological shortcomings. The inconsistency of the past research complicates their interpretation, see Table 1. for a brief overview of each study included in the review. Four main tasks have been used to research attentional bias in OCD: emotional stroop, dot-probe, emotional cueing task and eye tracking. Each of these are discussed in more detail below. The research on attentional bias and OCD is limited, the search for relevant literature in this area was framed
around these four main tasks as the majority of previous studies used these methodologies.

2.4.1 Emotional Stroop Task

The emotional stroop task is an adaption from the original Stroop Task (Stroop, 1935) and has been frequently used to research an attentional bias for threatening stimuli in individuals with OCD. The original Stroop Task emerged from a series of experiments that found significant cognitive interference when participants were asked to complete specific tasks. For example, when participants were asked to name the colour of ink that a name of a colour was written in, the time taken for participants to complete this task is significantly longer if the ink colour is incongruous to the colour word (e.g., the participants would be presented with the word ‘blue’ written in yellow ink, and they had to say ‘yellow’ as their answer because that is the colour of ink that was used). This delay in reaction time represents a conflict between two elements of processing: 1. the unconscious automatic processing of reading the written colour name; 2. the conscious processing of stating the colour of the ink. This conflict is a demonstration of how an individual’s previous knowledge can automatically influence the way they interact with the environment they are presented with. The interference between the two sources of information, the conscious and the unconscious processing, increases the cognitive load. This slows reaction time responses as the participant needs to inhibit the unconscious processing (what the word is saying) and focus on the conscious information (identifying the colour of ink). Research began experimenting with the emotional charge of the word stimuli in the stroop task (Williams, Matthews & Macleod, 1996). Matthews and McLeod (1985) found that individuals with high trait anxiety were significantly slower at naming the colour of threatening words compared to control participants. As a result, the
Emotional Stroop Task was created. This interference has been theorised to be linked to the activation of relevant schemas e.g. threat related (Beck et al., 1985) or to the display of avoidance of processing emotional information (de Ruiter & Brosschot, 1994). The Emotional Stroop Task is thought to indicate an attentional bias by excessive interference signified by delayed reaction time for threat words in comparison to neutral words.

### 2.4.1.1 Emotional Stroop Task and OCD

Previously, research using the Emotional Stroop Task has found evidence of an attentional bias in individuals with OCD. Foa, Ilai, Shoyer and Murdock (1993) found that only individuals with OCD who had contamination concerns had longer latencies for contamination related words; however, this effect was only found for one out of ten (10%) of the contamination related words (*unclean*), suggesting that the emotional stroop effect requires strong provocation to detect interference in OCD. Research has suggested that to cause interference in an Emotional Stroop Task the words need to have negative contentions in relation to OCD symptoms (e.g. germs, contamination, sickness), as previous research has failed to find an interference from OCD related words that are positively related (e.g. clean, healthy, sterile) (Lavy, van Oppen & van den Hout, 1994).

Interpretations of the performance of individuals with OCD on an Emotional Stroop Task has not always been clear, with contradictory and unexpected results occurring frequently in the literature. Words related to the main symptom concerns of individuals with OCD have not always produced interference (Moritz et al., 2008). The same OCD-related words that were used to detect an attentional bias in OCD participants (Lavy et al., 1994) have produced faster reaction times (Kyrios & Iob,
1998) or delayed responses in subliminal presentation only (Unoki, Kasuga, Matshima & Ohta, 1999).

Research has also found that individuals with OCD displayed delayed reaction times for panic related words, similar to participants with panic disorder, in an Emotional Stroop Task (McNally, Riemann, Luro, Lukach & Kim, 1992); however, this finding is also not consistent in the literature as Kampman, Keijers, Verbraak, Naring and Hoogduin (2002) did not find any evidence of attentional bias in individuals with OCD or panic disorder for stroop performance on words that were related to panic, OCD and generally threats in subliminal or supraliminal conditions. To further complicate the interpretations from the literature, research has also found that individuals with OCD demonstrated delayed reaction times for all stimuli in an Emotional Stroop Task that included words that are related to anxiety, depression, responsibility and consciousness, as well as positive and neutral words. (Moritz et al., 2004).

The inconsistent findings across the literature makes it difficult to draw conclusions from research that has used the Emotional Stroop Task. There is evidence that individuals with OCD have enhanced interference from OCD related words (Lavy et al., 1994, Unokie et al., 1999), however, this has failed to be consistently supported in the literature (Kampman et al., 2002; Moritz et al., 2008). With such inconsistent research findings, it is important to consider the paradigm of the Emotional Stroop Task and how this contributes to the mixed findings.

2.4.1.2 Limitations of the Emotional Stroop

Despite accounting for the main symptoms in individuals with OCD and using the same stimuli, research has failed to replicate evidence for a bias in attention to symptom specific words. But, rather than dismissing the evidence that has been found,
it is important to consider the nature of the Emotional Stroop Task and how this may have contributed to the conflicting research. It has been suggested that rather than representing a bias in attentional processing, the interference displayed in the emotional stroop is a generic slowing in response to emotional words. In a series of experiments, Algom, Lev and Chajut (2004) found that both reading and colour naming of emotional words were slower in comparison to neutral words and suggested that this was due to a threat response and not an attentional bias mechanism. It has also been theorised that the interference is caused by an avoidance of emotional material (de Ruiter & Brosschot, 1994). This may explain why individuals with OCD displayed an interference for threatening words unrelated to OCD (McNally et al., 1992; Unokie et al., 1999). Williams et al., (1996) also suggest the possibility that participants’ conscious strategies for optimum performance in the Emotional Stroop Task may interfere with results. This could be supported by the findings of Unokie et al., (1999) who found evidence of interference only in subliminal presentations when conscious strategies could not be employed.

The stroop effect can also be confounded by factors such as age (Houx, Jolles & Vreeling, 1993) and anxiety (Cohen et al., 2003). Cohen et al., (2003) found that individuals with OCD were generally slower than controls in a regular stroop task and that high state anxiety significantly slowed performance. Another important limitation of the Emotional Stroop Task to consider is that it is unable to depict what is causing the interference when it is detected. If the interference is caused by bias in attentional processes it would be impossible to discern whether it is early or late attentional processes that are involved (Williams, Matthews & Macleod, 1996).
2.4.2 Dot Probe Task

The Dot Probe Task was developed to avoid the interpretive issues of the Emotional Stroop Task (MacLeod, Matthews & Tat, 1986). It was designed with the aim of observing the deployment of visual attention in order to discern attentional processes when a threatening and neutral stimulus are presented simultaneously. The typical procedure of the dot probe is: 1. two stimuli are presented together for around 500ms (one threatening and the other neutral); 2. these stimuli disappear and a target, typically a dot or a letter, appears in the previous location of one of the stimuli; and 3. participants are asked to detect, and in some paradigms, identify the target. When a target appears in the previous location of the threatening stimuli it is referred to as a congruent trial. Whereas if the target appears in the previous location of the neutral stimuli it is referred to as an incongruent trial. A bias in the early stages of attention (vigilance) is indicated if the response to the target is quicker on congruent as attention is already directed to the area the threat was in. If response time is delayed on incongruent trials it is thought to be an indicator of a bias occurring in the later stages of attention and involving difficulty disengaging from threat as visual attention must be disengaged and relocated to the cue.

2.4.2.1 Dot Probe Task and OCD

Research using the Dot Probe Task to investigate attentional bias in OCD has shared the same inconsistency as the Emotional Stroop Task. Tata, Leibowitz, Prunty, Cameron and Pickering (1996) were the first to investigate attentional bias in individuals with OCD using the dot-probe paradigm. They found that individuals with OCD were faster to respond to probes that replaced contamination related words, suggesting a vigilance bias. This was not found in the high trait anxiety group, who displayed vigilance for social anxiety related words only. Tata et al., (1996) were able
to detect a bias using the dot-probe paradigm. More importantly, they could also link this to a specific mechanism in attentional processes. Amir, Najmi and Morrison (2009) found evidence of the attenuation of attentional bias by using the Dot-Probe Task in individuals with OCD; however, they found that only for the first one hundred trials did individuals with high obsessive-compulsive symptoms displayed an attentional bias for OCD related words and that this bias was positively correlated with their level of symptoms.

Not all research using the Dot Probe Task has found evidence of an attentional bias. Harkness, Harris, Jones and Vaccaro (2009) found no differences between individuals with OCD and a control group on checking, contamination, social threat and positive words paired with a neutral counterpart using the dot-probe paradigm. Other studies have also had similar null findings for attentional bias in OCD using the Dot Probe Task (de Putter & Koster, 2017; Schneier et al., 2016). However, similar to the Emotional Stroop Task, there are methodological factors that may contribute to this inconsistency rather than a lack of attentional bias in OCD.

2.4.2.2 Limitations of the Dot Probe Task

Although the Dot Probe Task has been able to discern to an extent the processes involved in an OCD attentional bias, the overall evidence continues to be variable and often contradictory. The reliability of the Dot Probe Task has been called into question in terms of its’ methodological rigour. Research using the Dot Probe Task has produced inconsistent results in both clinical (Harkness, Harris, Jones & Vaccaro, 2009) and non-clinical samples (Mogg et al., 2000). Schmukle (2005) explored this inconsistency by looking at the internal consistency and retest reliability over one week in the Dot Probe Task in a non-clinical sample using both images and words as stimuli. The results showed a low internal consistency and retest reliability
for both the words and images; however, Staugaard (2009) argue that the Dot Probe Task is reliable for use in a between-group design as the group results indicated a stable and consistent vigilance for emotional facial stimuli.

Another concern about the Dot Probe Task was raised by Fox et al., (2001) who suggested that the task does not truly allow for the delineation of the mechanisms in attention bias. As both the cues in the Dot-Probe Task provide potentially relevant information to the location of the target, it is likely that attention is shifted back and forth between them. Fox et al., (2001) argue that this makes it impossible to tell if the bias is from attention being drawn to the anxiety relevant cue or if it has been maintained, as both would produce latent reaction times. This criticism suggests that the Dot-Probe Task cannot truly identify if the bias is linked to Vigilance or Delayed Disengagement/ Maintenance. As one of the main goals in observing an attentional bias in OCD is to learn of its mechanisms in order to create a successful intervention; an inability to decipher if the bias is linked to either Vigilance or Delayed Disengagement/ Maintenance is a major limitation of the dot-probe. Similar to the Emotional Stroop Task, the Dot Probe Task has produced inconsistent and ambiguous evidence for an attentional bias in OCD.

2.4.3 Emotional Spatial Cueing Task

The Emotional Spatial Cueing Task is also frequently used to investigate attentional bias for anxiogenic stimuli. The Emotional Spatial Cueing Task has been proposed to be the optimum paradigm when investigating attentional bias when measuring attention in reaction time (Bar-Haim et al., 2007; Weierich, Treat & Hollingworth, 2008). This is because the layout of the procedure allows a more valid detailed delineation of the results than the Emotional Stroop Task or the Dot Probe Task. The Emotional Spatial Cueing Task is a modification from Posner’s cueing task
Posner’s cueing task (1980) begins with a fixation cross displayed in the centre of a screen, which is followed by a cue (e.g. word or image) being presented laterally before the target appears. When the target appears in the same location as the previous cue it is referred to as a ‘valid’ trial, the opposite being referred to as an ‘invalid’ trial. Valid trials facilitate faster target detection as visual attention is already engaged to the location (Posner & Peterson, 1990). Invalid trials are typically slower as attention must be disengaged and shifted towards target location. Fox et al., (2001) highlight the superiority of this paradigm in investigating attentional bias as it allows for the delineation of the attentional processes involved in the bias. If threatening cues on valid trials have a faster detection than neutral cues, this suggests a facilitation of attention to threat, supporting the vigilance hypothesis. If on invalid trials detection of the target is slower for threatening cues than neutral cues, this suggests that attention took longer to disengage, supporting the disengagement/maintenance hypothesis.

2.4.3.1 Emotional Cueing Task and OCD

Unfortunately, research using the Emotional Cueing task to investigate an attentional bias in OCD has shared the same inconsistency as the Emotional Stroop Task and the Dot Probe Task. Moritz and Muhlenen (2008) used words related to checking, paranoia and neutral content as cues in an Emotional Cueing Task. In this experiment, the participants were individuals with OCD with checking compulsions and a control group. The study found no evidence of attentional bias for any stimuli category. Following on from this, Moritz, Muhlenen, Randjbar, Fricke and Jelinek (2009) repeated the experiment with both checking and contamination participants, with the modification of images instead of verbal stimuli. They found that individuals with OCD displayed delayed disengagement from OCD relevant images compared to the control group. Interestingly, slower reaction times for OCD relevant cues were
found on both valid and invalid trials. The authors suggest that this is due to the heightened distractibility of OCD related images. Cisler and Olatunji (2010) also detected an attentional bias in an emotional cueing task using OCD related images. Both Mortiz et al., (2009) and Cisler and Olatunji’s (2001) research suggests that visual stimuli may be superior at evoking anxiety in comparison to verbal stimuli when researching attentional bias in OCD.

2.4.3.2 Limitations of the Emotional Cueing Task

Although the design of the emotional cueing task has been thought to compensate for reaction times inability to give a detailed temporal portrayal of attention, it is still possible that the results of the task are being misinterpreted. Weierich et al., (2008) point out that although the task is designed in order for the researcher to be able to link the results to either the vigilance or difficulty disengaging theory, it is limited in its ability to do this. As the threatening cue disappears before the target appears Weierich et al., (2008) suggest that attention is disengaging from the location where the cue previously was, rather than the cue itself.
Table 1

Summary of Previous Research on Attentional Bias in OCD

<table>
<thead>
<tr>
<th>Study Title and Authors</th>
<th>Task</th>
<th>Participants</th>
<th>Measures of attention</th>
<th>Stimuli</th>
<th>Outcome</th>
<th>Evidence of attentional bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>McNally et al., 1992 Cognitive processing of emotional information in panic disorder.</td>
<td>Emotional Stroop</td>
<td>Clinical sample- OCD group (N=24) Panic Disorder group (N=24) Control group (N=24)</td>
<td>Reaction time</td>
<td>1) Panic words 2) Positive words 3) General threat words 4) Non-words</td>
<td>OCD group had longer reaction times for panic related words similar to participants with panic disorder.</td>
<td>Yes</td>
</tr>
<tr>
<td>Foa, Ilai, Shoyer &amp; Murdock, 1993 Information processing in obsessive compulsive disorder</td>
<td>Emotional Stroop</td>
<td>Clinical sample- OCD group (contamination symptoms, N=23) OCD group (non-contamination symptoms (N=10) Control group (N=14)</td>
<td>Reaction time</td>
<td>1) Contamination words 2) General threat words 3) Neutral 4) Non words</td>
<td>Individuals with contamination concerns had longer reaction times to contamination words. Individuals without contamination concerns had longer reaction time to general threat words</td>
<td>Yes</td>
</tr>
<tr>
<td>Lavy, Van Oppen &amp; Van Den Hout, 1994 Selective processing of emotional information in obsessive compulsive disorder</td>
<td>Emotional Stroop</td>
<td>Clinical sample- OCD group (contamination symptoms N=13) OCD group (checking symptoms N=20) Control group (N=29)</td>
<td>Reaction time</td>
<td>1) Neutral words 2) Negative words 3) Positive words 4) Positive contamination words 5) Negative contamination words 6) Positive checking words 7) Negative checking words</td>
<td>OCD group displayed longer reaction times for negative OCD words but not for positive OCD related words.</td>
<td>Yes</td>
</tr>
<tr>
<td>Kyrios &amp; Iob, 1998, Automatic and Strategic Processing in Obsessive-Compulsive Disorder: Attentional Bias, Cognitive Avoidance or More Complex Phenomena</td>
<td>Emotional Stroop</td>
<td>Clinical sample- OCD group (N= 15 [contamination symptoms N=4, checking symptoms N=11]) Control group (N=15)</td>
<td>Reaction time</td>
<td>1) Contamination words 2) Checking words 3) Positive words 4) General threat words 5) Neutral words</td>
<td>All participants had faster reaction times to OCD words, general threat words and positive words in comparison to neutral words</td>
<td>No</td>
</tr>
<tr>
<td>Unoki, Kasuga, Matsushima &amp; Ohta, 1999, Attentional processing of emotional information in obsessive-compulsive disorder</td>
<td>Emotional Stroop (additional subliminal condition)</td>
<td>Clinical sample- OCD group (N= 14 [contamination symptoms N=5, checking symptoms N=9]) Control group (N=28)</td>
<td>Reaction time</td>
<td>1) Anxiety relevant 2) OCD words (does not state which subgroups they are related to) 3) Positive words 4) Neutral words</td>
<td>In the subliminal condition individuals with OCD had greater reaction times to OCD and anxiety words. This was not found in the supraliminal condition.</td>
<td>Yes (only in subliminal condition)</td>
</tr>
<tr>
<td>Study Title and Authors</td>
<td>Task</td>
<td>Participants</td>
<td>Measures of attention</td>
<td>Stimuli</td>
<td>Outcome</td>
<td>Evidence of attentional bias</td>
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<td>Kampman, Keijers, Verbraak, Naring &amp; Hoogduin, 2002, The emotional Stroop: a comparison of panic disorder patients, obsessive-compulsive patients, and controls</td>
<td>Emotional Stroop (additional subliminal condition)</td>
<td>Clinical Sample OCD group (N=20) Panic Disorder group (N=20)</td>
<td>Reaction time</td>
<td>1) OCD words 2) Panic words 3) General threat words 4) Neutral words</td>
<td>No significant findings for PD or OCD across stimuli groups either subliminal or supraliminal in presentation</td>
<td>No</td>
</tr>
<tr>
<td>Moritz, Jacobsen, Kloss, Fricke, Rufer &amp; Hand 2004: Examination of emotional Stroop interference in obsessive-compulsive disorder</td>
<td>Emotional Stroop</td>
<td>Clinical Sample OCD group (N=35) Control group (N=20)</td>
<td>Reaction time</td>
<td>1) Depression words 2) Anxiety words 3) Neutral words 4) Positive words 5) Conscientiousness words 6) Responsibility words</td>
<td>No significant findings across different word stimuli</td>
<td>No</td>
</tr>
<tr>
<td>Moritz, Fischer, Hottenrott, Kelmer, Fricke, Radjbar, Jelinek, 2008</td>
<td>Emotional Stroop</td>
<td>Clinical Sample OCD group (N=23) Control group (N=23)</td>
<td>Reaction time</td>
<td>1) Checking words 2) Contamination words 3) Anxiety words 4) Depression words 5) Positive words 6) Neutral words 7) Paranoia words</td>
<td>No significant findings across different word stimuli</td>
<td>No</td>
</tr>
<tr>
<td>Tata, Leibowitz, Prunty, Cameron &amp; Pickering, 1996, Attentional bias in Obsessional Compulsive Disorder</td>
<td>Dot-probe</td>
<td>Clinical Sample OCD group (N=13, contamination symptoms) High trait anxiety group (N=18) Low trait anxiety group (N=26)</td>
<td>Reaction time</td>
<td>1) Neutral words 2) Contamination words 3) Social threat words</td>
<td>Individuals with OCD were significantly faster than the other groups for contamination words but not for social anxiety words.</td>
<td>Yes</td>
</tr>
<tr>
<td>Amir, Najmi &amp; Morrison, 2009; Attention of Attention Bias in Obsessive-Compulsive Disorder</td>
<td>Dot-probe</td>
<td>Non-Clinical Sample High obsessive-compulsive symptoms (N=23) Control group (N=24)</td>
<td>Reaction time</td>
<td>1) Personalised OCD words 2) Neutral words</td>
<td>Evidence for attentional bias towards OCD words in the form of a vigilance bias this diminished over trials.</td>
<td>Yes</td>
</tr>
<tr>
<td>Study Title and Authors</td>
<td>Task</td>
<td>Participants</td>
<td>Measures of attention</td>
<td>Stimuli</td>
<td>Outcome</td>
<td>Evidence of attentional bias</td>
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<tr>
<td>Harkness, Harris, Jones &amp; Vaccaro, 2009; No evidence of attentional bias in obsessive compulsive checking on the dot probe paradigm</td>
<td>Dot-probe</td>
<td>Clinical Sample OCD group checking symptoms (N=18) Control group (N=18)</td>
<td>Reaction time</td>
<td>1) Checking words 2) Contamination words 3) Social threat words 4) Positive words 5) Neutral words</td>
<td>No attentional bias was detected towards checking or contamination words.</td>
<td>No</td>
</tr>
<tr>
<td>Schneier et al., 2016; Attention bias in adults with anorexia nervosa, obsessive-compulsive disorder, and social anxiety disorder</td>
<td>Dot-probe</td>
<td>Clinical Sample OCD group (N=50) Social anxiety disorder group (N=43) Anorexia nervosa group (N=30) Control group (N=74)</td>
<td>Reaction time</td>
<td>1) Angry facial images 2) Neutral face images</td>
<td>No attentional bias detected across the participants</td>
<td>No</td>
</tr>
<tr>
<td>De Putter &amp; Koster, 2017; The effects of obsessive-compulsive symptoms and disorder-relevant stimuli on the dynamics of selective attention</td>
<td>Dot-probe</td>
<td>Non-Clinical Sample High obsessive-compulsive symptoms with contamination symptoms (N=32) Control group (N=32)</td>
<td>Reaction time</td>
<td>1) Contamination images 2) Positive images 3) Neutral images</td>
<td>No significant differences in attentional bias between groups</td>
<td>No</td>
</tr>
<tr>
<td>Moritz &amp; Muhlenen, 2008; Investigation Of An Attentional bias For Fear-Related Material in Obsessive-Compulsive Checkers</td>
<td>Emotional spatial cueing task</td>
<td>Clinical Sample OCD group (N=28 [checking symptoms N=21, unspecified symptoms N=7]) Control group (N=23)</td>
<td>Reaction time</td>
<td>1) Checking words 2) Paranoia words 3) Neutral words</td>
<td>No evidence for an attentional bias in OCD group.</td>
<td>No</td>
</tr>
<tr>
<td>Moritz, Muhlenen, Randjbar, Fricke &amp; Jelinek, 2009; Evidence for an attentional bias for washing- and checking-relevant stimuli in obsessive-compulsive disorder</td>
<td>Emotional spatial cueing task</td>
<td>Clinical Sample OCD group (N=42 [checking symptoms N=15, contamination symptoms N=23, symmetry symptoms N=4]) Control group (N=31)</td>
<td>Reaction time</td>
<td>1) Contamination images 2) Checking images 3) General threat images 4) Neutral images</td>
<td>Individuals with OCD displayed attentional bias in the form of delayed disengagement towards contamination and checking images</td>
<td>Yes</td>
</tr>
<tr>
<td>Study Title and Authors</td>
<td>Task</td>
<td>Participants</td>
<td>Measures of attention</td>
<td>Stimuli</td>
<td>Outcome</td>
<td>Evidence of attentional bias</td>
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<td>Cisler &amp; Olatunji, 2010; Components of Attentional Biases in Contamination Fear: Evidence for Difficulty in Disengagement</td>
<td>Emotional spatial cueing task</td>
<td>Non-Clinical Sample High obsessive-compulsive symptoms with contamination symptoms (N=23) Control group (N=28)</td>
<td>Reaction time</td>
<td>1) Contamination images 2) General threat images 3) Neutral images</td>
<td>Individuals with high obsessive-compulsive symptoms displayed attentional bias towards contamination and general threatening images in the form of delayed disengagement</td>
<td>Yes</td>
</tr>
<tr>
<td>Armstrong, Olatunji, Sarawgi &amp; Simmons, 2010; Orienting and maintenance of gaze in contamination fear: Biases for disgust and fear cues</td>
<td>Free viewing task</td>
<td>Non-Clinical Sample High obsessive-compulsive symptoms with contamination symptoms (N=23) Control group (N=25)</td>
<td>Eye tracking</td>
<td>1) Disgusted facial images 2) Fearful facial images 3) Happy facial images 4) Neutral facial images</td>
<td>Individuals with high obsessive-compulsive symptoms displayed attentional bias towards contamination and general threatening images in the form of vigilance and maintenance bias.</td>
<td>Yes</td>
</tr>
<tr>
<td>Armstrong, Sarawgi &amp; Olatunji, 2012; Attentional Bias Toward Threat in Contamination Fear: Overt Components and Behavioural Correlates</td>
<td>Free viewing task</td>
<td>Non-Clinical Sample High obsessive-compulsive symptoms with contamination symptoms (N=23) Control group (N=25)</td>
<td>Eye tracking</td>
<td>1) Contamination images 2) General threat images 3) Pleasant images 4) Neutral images</td>
<td>A vigilance bias for contamination related images in individuals with contamination symptoms was detected.</td>
<td>Yes</td>
</tr>
<tr>
<td>Bradley et al., 2016; Obsessive–compulsive symptoms and attentional bias: An eye-tracking methodology</td>
<td>Free viewing task</td>
<td>Non-Clinical Sample Community sample (N=85)</td>
<td>Eye tracking</td>
<td>1) Contamination images 2) Checking images 3) Symmetry images 4) Hoarding images 5) General threat images 6) Neutral images</td>
<td>OCD symptoms correlated with vigilance and maintained attention on OCD related images</td>
<td>Yes</td>
</tr>
</tbody>
</table>
2.5 The Inconsistency of the Previous Research

Research using the Emotional Stroop, Dot Probe Task and the Emotional Cueing Task have produced some evidence for an attentional bias for symptom specific stimuli in OCD, however, there has been no consistent mechanisms identified due to differing study designs and limitations in experimental methodologies. Significant criticisms have been highlighted undermining each of these paradigms above for their ability to delineate processes that underlie biases in attention.

2.5.1 Limitations of verbal stimuli

The majority of previous research investigating attentional bias in OCD has employed verbal stimuli as a provocation of anxiety. A review by Armstrong and Olatinji (2012) point out that verbal stimuli may not be representative of OCD symptoms as OCD symptoms can be linked strongly to visual scenes (e.g. contamination fears can be represented by a filthy bathroom). The power of visual stimuli to elicit an attentional bias is exemplified in the work of Moritz et al., (2008) and Moritz et al., (2009). Using a similar paradigm as Moritz et al., (2008) with the modification of images rather than words. Mortiz et al., (2009) was able to detect difficulty disengaging from OCD related cues by using visual images. Research has found that emotional images are processed more elaborately than emotionally charged words (Hinojosa, Carretie, Valcarcel, Mendez-Bertolo & Pozo, 2009). It may be that the verbal stimuli may not be strong enough provoker of anxiety, reducing its ability to produce consistent evidence of an attentional bias in OCD.

2.5.2 Limitations of a reaction time measure of attention

Another potential reason behind these conflicted findings may also be that reaction time is not sensitive enough to consistently detect an attentional bias in OCD.
as the attentional bias in OCD may be more subtle and sensitive than in other disorders (Armstrong & Olatinji, 2012). Reaction time is also open to confounding variables such as age and gender (Der & Deary, 2006). As reaction time allows only a snapshot insight into attention it is difficult to confidently link reaction time to the attentional processes involved in the bias. For instance, in the Dot-Probe Task, the location of the target paired with the reaction time response was supposed to be indicative of either Vigilance or Delayed/Disengagement bias. However, attention could have been deployed to multiple areas between the target presentation and the behavioural response. Therefore, the Dot-Probe Task cannot inform on the precise mechanisms of attention at work as it is possible that attention was switching between the anxiety-provoking and neutral stimuli before the target presentation. However, as reaction time only details a snapshot in time, this deployment of attention to multiple areas is missed. Research has also suggested that a delay in reaction times in response to threatening stimuli may be the result of by ‘freezing’ as a defence mechanism (Algom, Lev & Chajut, 2004) rather than representing an attentional process.

2.6 Eye Tracking Methodology
A methodology which can provide a detailed examination of the mechanisms of attention and which is immune to the limitations of reaction time is eye tracking. Eye tracking methodology is a technique that measures the direction and movement of an individual’s gaze in order to discern attentional focus. The most common method of measuring eye movements uses infra-red light reflected off the pupil and cornea (Hansen & Ji, 2009). Infra-red light is directed to the eye. This light casts a reflection of the cornea and pupil which is recorded on the screen and used to record eye movements. As eye tracking technology has become more advanced and accessible,
this has resulted in a proliferation of using eye movements to discern attentional process when viewing anxiogenic stimuli (Armstrong & Olatunji, 2012).

Two main types of eye movements that are commonly of interest are saccades and fixations. A ‘saccade’ is the body’s most rapid physical movement, taking roughly 30-80ms to shift position. Its function is to move the point of gaze to different positions; however, recent research indicates that the eye is actually unable to take in any visual information during a saccade (Goldstein, 2016; Holmqvist et al., 2011). A ‘fixation,’ however, refers to the eye pausing on a select area of a visual scene. It is thought that during this pause, visual information from the select area is cognitively processed (Irwin, 2004). As no visual information is taken in during a saccade, a fixation is the main focus in the majority of eye tracking research (Holmqvist et al., 2011).

Research has repeatedly demonstrated a close link between fixations and covert attention with attention capture being reflected by fixation location (e.g. fixating on a symptom relevant image) (Rayner, 1998; Liversedge & Findlay, 2000; Hayhoe & Ballard, 2005). A major benefit of using eye tracking is its’ ability to link eye movements to specific attentional mechanisms, which allows researchers to pinpoint the nature of attentional bias to symptom relevant stimuli (Armstrong & Olatunji, 2012). Eye movements can indicate a vigilance bias if participants initially orientate their gaze more frequently and faster to threatening stimuli than to neutral stimuli. Delayed disengagement bias can be observed if the first fixation a participant makes upon threatening stimuli is significantly longer than an initial fixation on neutral stimuli. The overall time spent fixating and the number of fixations towards a threatening image can illustrate if there is a maintenance bias (Armstrong & Olatunji,

2.6.1 Eye Gaze and Attention

2.6.1.1 Initial Fixation Orientation

Eye tracking allows a continuous millisecond account of attention which provides the opportunity for initial capture of attention to be observed. By asking participants to fixate in the middle of the screen before presenting two competing stimuli, the researcher can observe what stimuli attention initially orientates too and the speed at which they are orientated to. Both of these actions can discern vigilance to specific types of stimuli e.g. individuals with contamination concerns were found to initially orientate to contamination related stimuli faster and more often than neutral stimuli. A meta-analysis including 33 studies (Armstrong & Olatunji, 2012) found that eye movements were able to provide evidence of the vigilance hypothesis in both free viewing and visual search task. Increased vigilance to threat has been found using eye tracking for spider phobia (Rinck & Becker, 2006), social anxiety disorder (Gamble & Rapee, 2010; Mogg, Bradley & Philippt, 2004) and post-traumatic stress disorder (Felmingham, Rennie, Manor & Bryant, 2011).

2.6.1.2 Initial Fixation Duration

In free viewing tasks, the duration of the initial fixation has been used as an index of disengagement (Bradley et al., 2016). Ability to disengage is assessed by comparing the durations of initial fixations made upon threatening and neutral images. Longer initial fixations on threatening stimuli are indexes of difficulty disengaging from threat (Mogg, Bradley, Field & De Houwer, 2003).
2.6.1.3 Fixation Duration and Count

The average fixation duration and fixation count to specific types of images are used to assess the maintenance of attention (Bradley et al., 2016; Quigley et al., 2012; e.g. a maintenance bias would be detected if participants with OCD had longer and greater number of fixations to OCD related images than the control group).

2.7 Application of Eye tracking in OCD

Unlike previous reaction time tasks, the application of eye tracking to the study of attentional bias in OCD has produced more consistent evidence of attentional bias towards symptom specific stimuli. It also allows the mechanisms involved to indicate the form of attentional bias e.g. Vigilance, Delayed Disengagement/ Maintenance. A study by Armstrong, Olatunji, Sarawgi and Simmons (2010 involved a subclinical sample of individuals with high contamination symptoms and a control group taking part in a free viewing task with emotional-neutral facial pairs. Emotional facial stimuli included expressions that were happy, disgusted and fearful. Results revealed that individuals with contamination concerns displayed initial orientation towards fearful facial stimuli, however this was no longer significant after controlling for trait anxiety across both groups. Individuals with contamination symptoms displayed longer fixation durations towards disgusted and fearful expressions in comparison to the control group. The data revealed a trend for individuals in the high contamination group to look less at the happy facial image across the trail, the opposite was found for the control group. The authors suggest that the maintenance of attention to both disgusted and fearful expressions may be due to the shared unpleasant valence of these stimuli; however, images of scenes related to OCD symptoms, instead of facial stimuli, have found vigilance bias for contamination related images in individuals with contamination concerns (Armstrong, Sarawgi & Olatunji, 2012). Armstrong et al.,
(2012) found that individuals with contamination symptoms initially orientated eye
gaze to contamination images more often than a control group. This vigilance bias also
predicted level of avoidance and anxiety in a behavioural avoidance task with a
contaminate, suggesting that the bias was linked to increased avoidance of a fearful
object related to OCD symptoms and anxiety in the task. However, this study did not
find any evidence of delayed disengagement/maintenance. These results highlight the
superiority of eye-tracking as a measure of attention. An attentional bias was detected,
but, more importantly, the stage of attention in which it was present (vigilance) was
also observed. Moreover, this form of bias – vigilance - could then be predictive of
other factors related to OCD, e.g. avoidance and anxiety in relation to an OCD related
object. The results of this study provide further empirical support for Salkovskis’

Most of the previous studies that have looked at eye tracking to observe
attentional bias in OCD have used samples with contamination concerns, however,
OCD symptoms asides from contamination concerns have been linked to attentional
bias using eye tracking. Bradley et al., (2016) also found consistent evidence of an
attentional bias to symptom specific stimuli using eye tracking. In this study there
were 85 students who viewed image pairs of OCD relevant (checking, contamination,
hoarding, order) images and aversive images paired with a neutral image. The OCD
related images were selected form The Maudsley Obsessive–Compulsive Stimuli Set
(MOCSS; Mataix-Cols et al., 2009), which is the only visual stimulus set related to
OCD available. The results found that the level of obsessive-compulsive symptoms
predicted the total duration and number of fixations made upon OCD relevant images,
but not for neutral or aversive images. These results suggest that while participants
with high obsessive-compulsive symptoms did not orientate to the OCD related
images faster than the images with other stimuli types; once their attention was deployed to the OCD images it was maintained. Individuals with high OCD symptoms also displayed difficulty re-orientating their attention away from the symptoms related images. These findings provide evidence for a link between the severity of OCD symptoms and a maintenance bias towards obsessive-compulsive related images.

As eye tracking provides continuous data, it enables the complexity of the relationship between attention and OCD to be observed. Mullen et al. (2017) compared attention deployment in individuals with a clinical diagnosis of OCD and a control group during a free viewing task. Similar to the Bradley et al., (2016) study, they asked participants to view OCD related and aversive images paired with a neutral counterpart. Individuals with OCD were found to have made significantly longer and a greater number of fixations on OCD relevant images (checking, contamination, symmetry) and aversive images than neutral images in comparison to the control group. These findings are concurrent with Bradley et al’s (2016) study, indicating that a maintenance bias in the deployment of individual with OCD’s attention towards OCD related images. However, they also found that individuals with OCD displayed a vigilance bias to all types of stimuli, including neutral images, followed by avoidance. These findings suggest that individuals with OCD were more hypervigilant towards all stimuli, yet they also shifted and disengaged their attention significantly faster from all stimuli in comparison to control group. This finding of hypervigilance to all stimuli in individuals with OCD could reflect the anxiety associated with OCD symptoms, resulting in lower perceptual detection threshold for all stimuli. As eye-tracking allows for continuous data collection, as well as the detection of the maintenance bias for OCD related images, this study also captured a pattern of hypervigilance specific to individuals with OCD.
A recent study conducted by Cludius, Wenzlaff, Briken and Wittekind (2019) explored attentional bias between subgroups of OCD symptoms. Cludius et al. (2019) compared individuals with OCD and a control group using a free-viewing task with contamination and checking related images paired with a neutral stimulus. They found that individuals with checking concerns had longer fixation times towards checking related images, which suggests a maintenance bias. However, there were no significant findings for individuals with OCD towards contamination related images.

In contrast to the previous research that has used reaction time as a measure of attention, the application of eye tracking has allowed the preliminary studies in this area to give an insight into the nature of attentional bias in individuals with OCD. Evidence for individuals with OCD being vigilant to OCD related images (Armstrong et al., 2010; Armstrong et al., 2012) and maintaining attention on OCD related images (Bradley et al., 2016; Cludius et al., 2019; Mullen et al., 2017) OCD has been found. Further research in this area is required to validate the previous findings and to generate additional details into the attentional bias in order to inform appropriate intervention design.

### 2.7.1 Limitations of Eye Tracking

A concern when using eye tracking to investigate attentional bias in OCD is the lack of validated visual resources available that are suitable for symptom concerns. A future challenge for this area is to create a scientifically validated stimulus set that recognises the diversity of OCD symptoms that will still allow generalisability across studies. Often, researchers create their own stimuli by drawing from previous validated sets such as the International Affective Picture System (IAPS, Lang, Bradley & Cuthbert, 2005). This raises the concern of images not being validated by individuals with OCD. There is a visual stimuli set related to OCD, which has been
published, called the Maudsley Obsessive–Compulsive Stimuli Set (MOCSS; Matiax-Cols et al., 2009). A drawback of this stimuli set is that only 50 images are available per symptom subgroup, which heightens the chances that researchers will have to repeatedly show images. As valid and reliable stimuli are the crux of attentional bias research, it is important for the future of OCD research that researchers continue to build validated and reliable stimulus set related to OCD symptoms.

2.8 Conclusion
Salkovskis leading cognitive-behavioural model of OCD stipulates that an attentional bias for OCD related stimuli triggers obsessive thoughts and is involved in the maintenance of symptoms; therefore, reducing this bias is a potential pathway to treat symptoms. But, the exact mechanises involved in the bias are unclear. The lack of knowledge on the nature of attentional bias is a significant blockade in the successful design of an intervention. Currently, there are two main theoretical perspectives into the potential nature of the attentional bias – the Vigilance Theory and the Delayed Disengagement/Maintenance Theory. The literature on attentional bias for OCD is fraught with inconsistency evidence, methodological concerns and limited resources of validated materials. Previously, the use of reaction time as a measure of attention limited the detection and delineation of attentional bias in OCD, however, research that has applied eye tracking to OCD has consistently produced evidence of a link between obsessive-compulsive symptoms and an attentional bias for symptom specific stimuli. They have also found that attentional bias is linked to avoidance of symptom specific materials and levels of symptom severity. Eye tracking enables not only the detection of an attentional bias for OCD related stimuli, but an insight into its nature too. Three out of the four studies examining attentional bias found evidence for the maintenance hypotheses, as greater and longer fixations were
made upon OCD related stimuli (Armstrong et al., 2010; Bradley et al., 2016, Mullen et al., 2016); however, in two of these studies this finding was also applicable to aversive stimuli. Evidence was also found for the vigilance to OCD related threat when there were more stimuli competing for attention (Armstrong et al., 2012). Further research using eye tracking to observe attentional bias is needed to understand the mechanisms at work. It is also important to note that stimuli applicable to OCD symptoms is being drawn from multiple sources. It would be beneficial for this area to have one source of validated and reliable images related to OCD that researchers can use.
Chapter 3 Rationale

3.1 Introduction
As discussed in the previous chapter, obsessive-compulsive disorder (OCD) is a prevalent mental health difficulty that has a substantive negative impact on quality of life (Eisen et al., 2006). The leading psychological treatment, Exposure and Response Prevention (ERP), is highly effective but has high rates of treatment refusal and dropout (Schruers, Koning, Haack, Luermans & Griez, 2005). Dropping out of treatment can result in individuals with chronic and severe OCD symptoms not benefiting from services (Pallanti et al., 2002) that they require. Research has also found that individuals often wait years before accessing support services for OCD (Stobie, Taylor, Quigley, Ewing & Salkovskis, 2007). Together, these findings indicate that it is reasonable to assert that alternative, effective, and acceptable OCD interventions that maximise clinical capacity are important avenues of investigation.

A potential avenue for therapeutic intervention is the reduction of an attentional bias for anxiogenic stimuli. Salkovskis’ (1999) model of OCD suggests that an attentional bias for symptom specific to OCD symptoms plays a role in the creation and maintenance of symptoms. An attentional bias increases the number of intrusion-related triggers an individual with OCD will cognitively prioritise, which potentially increases the likelihood of intrusive thoughts and reinforces the overestimation of threat (Bream, Challacombe, Palmer & Salkovskis, 2017). By employing an intervention which reduces this bias, a therapy could alter the way in which a person experiences their environment, thus allowing their attention to be freely engaged and disengaged without being preoccupied with threats (Hakamata et al., 2010). Further research is needed to understand mechanisms involved in this attentional bias, specifically if attention is hypervigilant, excessively maintained or
has difficulty disengaging from symptom relevant stimuli. By understanding the nature of this bias, appropriate interventions can be designed.

Technological advancements have opened new opportunities for computer-assisted interventions (e.g., computerised cognitive behavioural therapy (CBT; Gilbody et al., 2015), making them more accessible than traditional therapies. An intervention that targets attention bias and has significant therapeutic potential is Attentional Bias Modification Training (ABMT, Hakamata et al., 2010). ABMT is delivered via a computer and has demonstrated efficacy in treating symptoms of psychopathology (see Bar-Haim, 2010), but little research has been carried out on the application of ABMT to OCD. A concerning element of ABMT is that the exact attentional mechanisms being targeted are currently unknown (Bar-Haim, 2010; Hakamata et al., 2010). A primary reason for this lack of understanding is that the majority of ABMT studies use proxy indicators with limited validity (e.g., reaction times) as measures of attention (Hakamata et al., 2010). While reaction time can indicate a change in attentional bias by comparing pre and post latency scores in an attentional bias assessment, it is difficult to precisely pinpoint what has been altered to produce the difference in attention deployment and how this has been achieved. This is largely due to the fact that reaction time only provides a snapshot of attention, limiting the amount of detail available on attentional mechanisms. However, by using sensitive measures such as eye tracking technology, continuous eye gaze data can be collected across the experimental trials. Eye gaze is closely linked to covert attention deployment (Liversedge & Findlay, 2000), therefore, eye tracking would allow for a more descriptive measure of the influence ABMT has upon attention and for the changing mechanisms to be observed and understood (Armstrong & Olatunji, 2010).
As of yet, eye tracking has not been applied to measure attention following ABMT in an OCD sample.

A vital component required to enhance the application of ABMT and eye tracking in the area of OCD is appropriate visual images related to OCD symptoms. These images could be employed to evoke an attentional bias in order for it to be measured and better understood via eye tracking, and to also re-train attention to reduce this perpetuating mechanism of OCD symptoms. A stringent selection procedure to create a stimulus set related to OCD symptoms would allow images that were anxiety provoking for individuals with OCD but not anxiety provoking for control participants to be selected. This would allow differences in attentional processes and biases specific to OCD to be observed.

A frequently used stimulus set that was created specifically for individuals with OCD is referred to as the Maudsley Obsessive-Compulsion Stimuli Set (MOCSS; Mataix-Cols et al., 2009). Repeatedly, the MOCSS has been found to provoke anxiety in both individuals with OCD and control groups (Mataix-Cols et al., 2004; Mataix-Cols et al., 2009). Researchers that do not use the MOCSS often create their own visual images by drawing from pre-existing sets such as the International Affective Picture System (Armstrong & Olatunji, 2012). The major downside of this is that it reduces the comparability of studies. For this reason, it is important to develop an appropriate visual stimulus set to support the progression of research on OCD, whilst also enhancing the study of attentional bias in OCD and facilitating the creation of appropriate interventions which require symptom related images, a stimulus set that can discern attentional processes specific to OCD.

To summarize, ABMT shows promise in treating mental health symptoms (Linetzky, Pergamin-Hight, Pine & Bar-Haim, 2015), however, its’ benefit to
individuals with OCD requires more exploration. There is also a considerable lack of knowledge as to how ABMT is effective due to reaction time measures of attention providing little insight into changing mechanisms. Research in this area is greatly inhibited by the lack of valid visual image sets to draw from. This PhD project aims to explore these issues further across a series of four studies.

### 3.2 Study 1: Acceptability of ABMT and ERP by individuals with OCD

Research has found that computer-delivered interventions have been rated as highly acceptable by individuals with OCD (Wootton, Cuijpers, Craske, McEvoy & Titov, 2010); however, no research has explored how individuals with OCD view ABMT as a mode of therapy. As client motivation for therapy is a crucial component for a successful intervention (Raue et al., 2009), the current study explored the potential acceptability of ABMT by individuals with OCD and compared this to ERP. This study was conducted as an online survey describing the procedure and theoretical underpinnings of ABMT and ERP. Participants were asked to rate the respective interventions for how challenging, effective, anxiety-provoking and engaging they would find them. Participants were also asked to indicate how effective they believed ABMT and ERP would be at reducing OCD symptoms and how motivated they would be to take part in each intervention. The sample consisted of 66 individuals with a self-reported clinical diagnosis of OCD from a healthcare professional. The aim of this study was to determine if ABMT was an acceptable alternative intervention for ERP.

### 3.3 Study 2: Comparison of ABMT and ERP on attentional bias, avoidance and obsessive-compulsive symptoms in individuals with contamination concerns

Whilst the application of ABMT to OCD has not been fully evaluated, the research that has been carried out indicates ABMT has potential to be an effective therapeutic intervention for OCD. Research found that individuals with high contamination symptoms, who completed a single session of ABMT, decreased in
attentional bias towards contamination related words and increased contact with a contaminated object in comparison to a control group (Najmi & Amir, 2010). A limitation of this study by Najmi and Amir is that there were no pre-measures of contact with the contaminated object, so it is unclear if increased contact is the direct result of ABMT. The attentional mechanisms that were altered to reduce the bias are unable to be identified, as attention was measured by reaction time latency scores. An online study by Habedank et al. (2017) where individuals with a clinical diagnosis of OCD completed eight sessions of ABMT, found a reduction in attentional bias and symptoms, however, the control group, which completed a similar placebo computer task, also showed a similar reduction of symptoms (Habedank, Lennartz, Arslan & Ertle, 2017). These findings indicate that ABMT can lead to a reduction in OCD symptom severity; however, as both of these studies have used reaction time as their measure of attention it is unclear how ABMT changes attentional mechanisms to reduce biases. Reaction time measures make it difficult to ascertain if vigilance or delayed disengagement/maintenance biases are present. Using eye tracking to monitor attentional bias would provide a more detailed examination of attention and any changes that occur, allowing us to better understand the precise attentional biases at play and how they individually contribute to the efficacy of ABMT on OCD.

ABMT may serve as an alternative effective intervention for individuals who find ERP too distressing, thus increasing the treatment options available to this population. To date, ABMT has only been compared to control conditions in OCD research. The current study of this PhD compared the effect of a single session of ABMT and ERP on individuals with high levels of OCD symptoms and contamination concerns in tightly-controlled experimental conditions. It also explored the ability of each intervention to reduce attentional bias, obsessive-compulsive symptoms and
avoidance of contamination related objects. A total of 77 individuals with moderate obsessive-compulsive symptoms and high contamination concerns were randomly assigned to one of four groups: 1. ABMT (N =19); 2. Placebo computer task (PCT; N =19); 3, ERP (N =19) and 4. ERP with an attentional bias assessment (N =20). An ERP condition without attentional bias measures was included to control for the exposure to contamination related images during the pre-attentional bias assessment. This was due to the possibility of habituation from exposure to these images which could have had a facilitatory effect upon performance in tasks involving ERP and contact with contaminated objects. Eye tracking technology was used to deliver ABMT, PCT and to measure attentional bias to explore any changes in the attentional mechanism that may be relevant to treatment efficacy. This study aimed to further explore attentional bias using eye tracking to monitor how the tasks included in the study may influence any changes. Also, in order to explore if ABMT would be a more acceptable intervention than ERP, measures of acceptability and apparent effectiveness were recorded.

3.4 Study 3: Visual stimuli set related to obsessive-compulsive symptoms

The use of appropriate visual images related to OCD in attentional bias research is a crucial factor that requires consideration. Eye-tracking research is reliant upon valid and useful stimuli in order to explore the cognitive mechanisms of spatial attention (Winkler & Subramanian, 2013). Unfortunately, the amount of validated OCD stimuli available in the literature is severely limited. The MOCSS (Mataix-Cols et al., 2009) is a frequently used common standardised visual stimuli set related to OCD symptoms. But, the MOCSS may be limited in its ability to discern differences in attention deployment specific to OCD as these images have been repeatedly found to evoke anxiety in both participants with OCD and controls (Matiax-Cols et al., 2003;
Matiax-Cols et al., 2004; Matiax-Cols et al., 2009. In order to further this field, it is essential to create more validated visual stimuli related to OCD to progress of future theoretical and intervention research.

The majority of previous research in this area has used verbal stimuli related to OCD symptoms as anxiogenic stimuli. Using the verbal stimuli has been criticised for being too weak to elicit anxiety and being the source of inconsistent findings across the literature (Moritz & Muhlenen, 2008). From a review of the previous literature, it has been demonstrated that individuals with OCD have not always responded consistently to the same verbal stimuli set. Previously, research using the same verbal stimuli set tailored for participant symptoms found evidence for and against attentional bias in OCD (Lavy & Van Den Hout, 1994; Kyrios & Iob, 1998; Unoki, Kasuga, Matshima & Ohta, 1999). Previous research has also suggested that verbal stimuli are too weak to provoke anxiety in individuals with OCD (Armstrong & Olatunji, 2012); however, using verbal stimuli may suit sensitive measures of attention that are easily influenced by salience, colour and spatial orientation of images. The current study explored this further by comparing the ratings of contamination related words and images by individuals with OCD.

The current study aimed to create and validate visual stimuli related to OCD symptoms of symmetry, checking and contamination. It also included a neutral category that could be employed as control images. Scenes were staged to capture specific OCD subgroups and to prevent overlap between these categories. The images were validated by three groups: 1. individuals with OCD, 2. clinical psychologists and 3. A control group. The images were rated for how anxiety-provoking, unpleasant, attention grabbing and upsetting they were by individuals with OCD and the control group. The clinical psychologists rated the images for how likely they would be to
trigger an obsessive thought and compulsive neutralizing behaviours. They were also asked to indicate how anxiety-provoking they thought an individual with OCD would find them. Attentional bias research in OCD aims to highlight the differences in attention deployment to OCD related stimuli in order to discover its precise mechanisms that could be targeted by intervention. Ideally, stimuli related to OCD should only be anxiety provoking for individuals with OCD and not an analogue group. This is important in order to highlight the differences in attention deployment. Only images that were rated as anxiety provoking by the individuals with OCD and clinicians, but not anxiety-provoking for the control group, were included in the final OCD categories.

An additional consideration when designing an image set that will be used in eye tracking research is the physical features in the scenes. Attention deployment can be influenced by a variety of scene characteristics such as the colour, shape or complexity (Parkhurst, Law & Niebur, 2002). There are various computer programmes which can be used to assess the complexity and saliency of an image, such as the Feature Congestion Value (FCV; Rosenholtz, Li, Mansfeild & Jin, 2005). The FCV uses the colour and luminance contest to assess image complexity and then produces a value which can be used to compare different image complexity. It has been found that these values agree with ratings of perceived complexity (Rosenholtz e al., 2005). FCV figures were produced for the final stimuli set so that image complexity can be controlled and matched to appropriate non-emotive images in future research.
3.5 Study 4: Comparison of stimuli and measurement of attention in attentional bias research in individuals with contamination concerns

To get the information on attentional biases in OCD up to date and to avoid future inconsistency in the findings, it is important that future researchers consider methodological factors that are required to observe the bias regarding stimuli selection procedures, stimuli format and attention measures. The validation procedures for stimuli selection has differed significantly in the literature. This has the potential to confound results and reduces the comparability of findings. Stimuli format has also differed across the previous research - both verbal and visual stimuli have been frequently used. An issue when using visual stimuli, particularly in eye tracking, is that attention can be influenced by factors such as colour (Parkhurst, Law & Niebur, 2002), therefore, it may benefit future research if desaturated images can be used. However, there is the potential that images may lose their ability to provoke anxiety without the colour (e.g. a red light on an oven which is turned on would not be seen in an image that is black and white).

The aim of the current study was to compare stimuli selection procedures; stimuli format and attention measures. To explore different stimuli selection procedures attentional bias were compared between two image sets: 1. images selected as appropriate from clinicians, a typical procedure for past studies in this area and 2. a subset of images that have been validated by individuals with OCD, clinicians and a control group. Three types of different stimuli format were also compared: colour images, desaturated images, and words. Lastly, two different measures of attention were simultaneously collected and compared, reaction time and eye tracking.

Participants were individuals with moderate levels of OCD symptoms with contamination concerns and a control group. This study aimed to observe an
attentional bias in OCD and to make methodological recommendations for future studies.

3.6 Conclusions
The aims of this PhD project was to explore an attentional bias in OCD in order to: 1. discern if computer-assisted ABMT paradigms are acceptable, efficacious interventions for the reduction of OCD symptoms; 2. improve the stimuli and paradigms used in the measurement of attentional bias in OCD; and 3. further explore the mechanisms of attentional bias using this improved measurement understanding.

This thesis aimed to explore how acceptable individuals with OCD would find an intervention which targets an attentional bias in comparison to ERP. Following this, it explored the effects of a single session of ABMT and ERP on attentional bias, avoidance and OCD symptoms. To contribute to the visual resources available for research in this area, this thesis also involves the creation and validation of a visual stimulus set specifically for OCD. Finally, in an attempt to help determine the appropriate conditions under which an attentional bias for OCD can be observed by comparing multiple stimuli selection procedures, stimuli types and measures of attention were compared in order to guide future research in this area.
Chapter 4 Perceived Acceptability of Attention Bias Modification Training and Exposure-Response Prevention by Individuals with Obsessive-Compulsive Disorder

4.1 Abstract

Attention Bias Modification Training (ABMT) has been shown to be an efficacious treatment in various mental health disorders; however, there has been a limited application of this form of intervention to OCD populations. The most effective OCD intervention currently recommended by the majority of practice guidelines is exposure and response prevention (ERP). ERP is a cognitive-behavioural technique which involves exposure to a feared situation which triggers anxiety and distress, but not engaging in the urge to perform a neutralizing response. ABMT may serve as an alternative intervention for individuals who find ERP too distressing; hence, providing more treatment options for OCD. The current study adopted a mixed within-group correlation design wherein 66 individuals with a clinical diagnosis of OCD were recruited via opportunity sampling to take part in an online survey examining the perceived levels of acceptability of ABMT and ERP. The beginning of the survey consisted of a brief description of each intervention, including its theoretical underpinning and an example of its procedure. Perceived acceptability was measured by asking participants to rate each intervention for how effective, anxiety-provoking, challenging and engaging they felt they were on a 5-point Likert scale. They were also asked to rate the ability of each intervention to reduce OCD symptoms and how motivated they would be to undergo each treatment. The results revealed that there were no significant differences between the interventions on: 1. overall scores of perceived acceptability; 2. how motivated participants would be to take part in the interventions; and 3. how engaging they would find the interventions. ERP, however, was rated significantly higher than ABMT in terms of level of anxiety-provocation and how challenging it would be as a treatment modality. Despite this, ERP was also
rated higher by participants for its effectiveness and ability to reduce OCD symptoms. Regression analyses found no evidence of participant characteristics (e.g. gender or symptom severity) predicting ABMT perceived acceptability. Significant predictors of ERP acceptability were: 1. a previous experience of CBT; 2. lower age; 3. greater severity of symmetry and ordering symptoms; and 4. greater severity of washing symptoms. The findings suggest that ABMT may be a more acceptable alternative for individuals with OCD who find ERP too distressing as it is viewed as being less challenging and anxiety provoking; however, the results also indicate that individuals with OCD perceived the effectiveness of ABMT to be limited compared to established interventions such as ERP. Further research is required into the effectiveness of ABMT and the appropriate client populations for its application.

4.2 Introduction

OCD is a debilitating mental health disorder with a lifetime prevalence of up to 1.1% in Britain (Torres et al., 2006) and 0.5% in Northern Ireland (Bunting et al., 2012). The negative impact that OCD symptoms have on the quality of life often result in severe social and occupational dysfunction for the individual (Eisen et al., 2006; Lochner et al., 2003). Meta-analysis has found that individuals with OCD have lower social, emotional and occupational quality of life in comparison to the general population (Coluccia et al., 2016). Research has reported individuals with OCD experience an average loss of two years’ wages as a result of time taken off due to their mental health (Hollander et al., 1998). When compared to other prevalent mental health difficulties, including social anxiety disorder, panic disorder and schizophrenia, OCD has been found to have significantly greater impairment in family life and daily activities (Lochner et al., 2003; Moritz, 2008).
Despite the significant negative impact that OCD has upon overall functioning, there are high rates of individuals with OCD who avoid seeking treatment for their symptoms (Garcia-Soriano, Rufer, Delsignore & Weidt, 2014). The British National Psychiatric survey found that up to 38% of people with OCD were either not receiving or avoiding seeking treatment (Torres et al., 2007). Avoidance is a natural feature of OCD (Starcevic et al., 2011) and it has been linked to poor treatment outcomes (Cottraux, Messy, Markls, Mollard & Bouvard, 1993; Wheaton, Gershkovich, Gallagher, Foa & Simpson, 2018). The experiences of shame and stigma from having a diagnosis of OCD have been cited as a notable factor in this avoidance behaviour, with research illustrating that these negative emotional responses are substantive barriers to accessing treatment (Glazier, Wetterneck, Singh & Williams, 2015; Weingarden & Renshaw, 2015).

The National Institute for Clinical Excellence recommends Cognitive-Behavioural Therapy (CBT) as the leading psychological intervention for OCD. CBT is based on the premise that that thoughts, feelings, physical sensations and behaviours are interconnecting concepts (Beck, 2011). When maladaptive interactive patterns of these components develop (e.g., excessive negative automatic thinking) this creates a vicious cycle of mental health symptoms. CBT aims to treat OCD by breaking down the cycle of obsessions and compulsions using techniques that engender habituation to intrusions; cognitive restructuring with regard to unhelpful appraisals; and cessation of neutralising behaviours (Veale, 2007). The leading CBT technique which has the greatest empirical support for treating OCD is exposure-response prevention (ERP; Abramowitz, Foa & Franklin, 2003; Foa et al., 2005; Hofmann & Smits, 2008; Lindsay, Crino & Andrews, 1997). ERP involves the individual purposely exposing themselves to a stimulus which is normally avoided (e.g. dirt) and subsequently not
engaging in the corresponding compulsive response (e.g. engaging in handwashing rituals). By repeatedly carrying out such behavioural exercises and gradually escalating their level of difficulty and complexity, the anxiety and distress caused by the triggering stimulus decreases over time, causing habituation, cognitive restructuring regarding feared consequences, and ultimately reduction in OCD symptoms. Habituating to the once distressing intrusive thought linked to the stimulus (e.g., image of a relative getting sick) allows the individual to see the lack of validity of the appraisal that was previously assigned to this intrusion (e.g., “I could infect and kill my daughter.”) and in turn, illustrates the redundancy of carrying out a compulsion (Veale, 2007). This re-appraisal causes the perpetuating cycle of OCD symptoms to be undermined, which then reduces OCD symptoms.

While ERP has gained strong empirical support for treating OCD, there have been issues surrounding clients’ acceptability of ERP and their refusal to engage with this treatment (Gillihan, Williams, Malcoun, Yadin & Foa, 2012). ERP is a demanding therapy that requires the, albeit temporary, deliberate provocation of anxiety and distress. Some ethical concerns have been raised over ERP, but the general consensus is that the emotional cost of ERP does not outweigh the therapeutic gains for the client (Feeney, Hembree & Zoellner, 2003; Olatunji, Deacon & Abramowitz, 2009). Research has found that up to 25% of individuals with OCD refuse ERP treatment due to concerns over its difficulty (Franklin & Foa, 2007) or drop out prematurely (Abramowitz, Taylor & McKay, 2009). Considering the delay and the barriers involved in seeking support for OCD symptoms, it is concerning that up to 25-30% of individuals with OCD who do access clinical intervention ultimately drop out of ERP treatment (Abramowitz, 2006). Due to the high number of drop-outs and treatment refusal, it has been asserted that new, less challenging, and more acceptable treatments
for OCD should be developed (Koran & Aboujaoude, 2014; Middleton, Wheaton, Kayser & Simpson, 2018). As fear over the distress and difficulty of ERP have been recognised as reasons for drop-out rates, it would be beneficial to explore a less anxiety-provoking intervention for OCD symptoms.

Technological advancements have allowed for the evolution of effective computerised interventions for mental health presentations (O’Reilly, Coyle & Tunney, 2016; Newby, Twomey, Shi Yuam & Andrews, 2016; Twomey, Reilly & Meyer, 2017). These computerised interventions often create the opportunity for clients to easily access interventions without intensive contact with clinicians or feared situations (Andrews, Cuijpers, Craske, McEvoy & Titov, 2010; Ebert et al., 2015). Recent computerised interventions such as virtual reality (Kim, 2009) and online modules in CBT (Andersson et al., 2011) have been created to treat OCD. Research has demonstrated the potential of virtual reality as a dissemination of ERP for OCD, arguing that it is more acceptable and less anxiety-provoking than typical ERP procedures (Belloch et al., 2014); however, concerns have been noted regarding the feasibility of implementing virtual reality due to limited accessibility and the ecological validity of exposures (Krijn, Emmelkamp & Biemond, 2004). The online delivery of CBT has also demonstrated promising results in OCD populations (Andersson et al., 2012) but issues have been raised over the amount of clinical guidance that is necessary to ensure client well-being (Andersson & Titov, 2014).

A relatively new intervention which has received less empirical testing in clinical presentations is ABMT. ABMT is a computer delivered treatment which prior studies have found to reduce symptoms to non-clinical levels in populations of social anxiety and generalised anxiety (Amir, Beard, Burns & Bomyea, 2009; Schmidt, Richey, Buckner & Timpano, 2009). Typical CBT therapy for OCD aims to reduce
various cognitive bias such as overestimation of the likelihood of harm and intolerance to uncertainty (Veale, 2007). ABMT aims to specifically target an attentional bias for symptom-specific stimuli by attempting to retrain attention to neutral stimuli (Hakamata, 2010). According to Salkovskis’ cognitive-behavioural model of OCD (Salkovski, 1999; Salkovski, 2007), excessive attention towards triggers of intrusive thoughts in the environment has a role in the creation and maintenance of symptoms. By reducing this bias in individuals with OCD, it aims for attention to move freely through the environment, decrease the number of triggers attended to, and subsequently decrease anxiety or distress. As ABMT is delivered via a computer and involves no direct contact with triggers of symptoms, it can be considered as less anxiety provoking and more accessible than typical CBT such as ERP, and may provide an alternative intervention for OCD symptoms.

Originally, ABMT was developed Macleod and Matthews (2002) as a modified version of the Dot-Probe Task. In the original Dot-Probe Task, two stimuli are presented together - one threatening and the other neutral (e.g. word or image pairs). Following these stimuli, a target (e.g. dot or letter “E” or “F”), that the participants are asked to respond to (e.g., press a button to indicate which letter is displayed), appears in the previous location of one of the stimuli. Comparing the reaction times of trials where the target appears in the previous location of either the threatening or neutral stimuli can be used as an assessment of attentional bias. The ABMT dot-probe paradigm differs as the neutral stimuli are always the cue for the target, therefore, attention is, theoretically, redirected away from the threat and towards the neutral stimuli (Matthews & Macleod, 2002; MacLeod, Soong, Rutherford & Campbell, 2007). ABMT is delivered via a computer programme, and the format has differed among studies with the number of trials ranging from 128 to
1080 across 1-15 sessions (Hakamata et al., 2010). By tailoring stimuli to specific
cconcerns involved in psychopathologies, the ABMT task has been found to
significantly reduce an attentional bias and clinical symptoms (Bar-Haim, 2010;
Hakamata et al., 2010). A meta-analysis of 12 studies that applied ABMT to social
anxiety disorder, generalised anxiety disorder, and high trait anxiety, found that
ABMT produces significantly greater reductions in anxiety symptoms than control
training with a medium effect size (Hakamata et al., 2010). Patient-level meta-analysis
from over 600 socially anxious adults that took part in randomised controlled trials
found ABMT significantly reduced social anxiety but only when less than 1280 trails
were delivered (Price et al., 2017). Reviews of the literature have suggested that only
one session of ABMT is required to reduce attentional bias (Blairy, 2017).

There has been little research investigating the application of ABMT in the
treatment of OCD; however, the preliminary results indicate its potential efficacy.
Najmi and Amir (2010) found that participants who completed one session of ABMT
showed a decrease in attentional bias towards contamination-related words.
Participants also performed better in a behavioural approach task towards a
contamination related object than the control group. These results suggest that ABMT,
as well as reducing attentional bias and OCD symptoms, may serve a facilitatory
function by preparing individuals for more intensive therapies such as ERP. An online
study involving individuals with a clinical diagnosis of OCD, completed eight sessions
of ABMT. They found a reduction in attentional bias and symptoms; however, the
control group also showed a similar reduction of symptoms (Habedank, Lennartz,
Arslan & Ertle, 2017). Further empirical testing is required before the efficacy of
ABMT can be deduced.
As ABMT involves no direct contact with the clients’ most feared situations, it may be a viable and more attractive alternative to ERP. Although, it is important to empirically examine its’ acceptability to individuals with OCD as well as its’ efficacy, as previous investigations have assumed ABMT would be a preferred option over ERP without supporting evidence (Amir et al., 2009; Kuckertz & Amir, 2015; Macleod & Clark, 2015). The term ‘acceptability’ is frequently used to describe measures of client satisfaction, treatment adherence, perceived helpfulness of an intervention, and lack of adverse experiences such as causing excessive anxiety (Andrews et al., 2018; Gun, Titov & Andrews, 2011; Kazdin, 2000; O’Connor, Munnelly, Whelan & McHugh, 2017). Sekhon, Cartwright and Francis (2017) created a theoretical framework for developing measures of acceptability including perceived acceptability of interventions. Out of the seven constructs they identified as relevant to developing measures of acceptability, four factors appear particularly relevant to OCD treatments due to the high dropout rate from emotionally demanding therapies. These aspects are 1) affective alliance, 2) burden, 3) perceived effectiveness and 4) intervention coherence. Affective alliance refers to how an individual feels emotionally about undergoing an intervention e.g. anxious. Burden describes the perceived amount of effort required e.g. how challenging will an intervention be? Intervention coherence is the perceived face validity of a treatment, is its ability to reduce symptoms apparent or does the client struggle to understand how it works? Perceived effectiveness is the extent to which the participant feels the intervention will be able to treat symptoms. Acceptability is a key consideration when investigating a new intervention due to its heavy influence on retention and positive outcomes for treatment of various psychopathologies (Cipriani et al., 2017; Kaltenhaler, Parry, Rees & Ferriter, 2008; Pretorius et al., 2009; Soucy & Hadjistavropoulos, 2017.) Acceptability of a treatment
by service-users with OCD has been highlighted as a crucial component of a successful intervention and symptom reduction (Reid et al., 2017).

The term ‘perceived acceptability’ refers to the levels of anticipated acceptability and desirability a description of an intervention appears to have to individuals who have not yet experienced it (Fox, Sidani, Brooks & McHuge, 2018). By exploring the levels of perceived acceptability for a new intervention, it allows any potential blockades to intervention success to be noted and dealt with before real life application. Exploring perceived acceptability for computer-based interventions for depression has helped to shape the design of treatment before initial implementation (Walsh, Kaselionyte, Taylor & Priebe, 2018). Previous research exploring the perceived acceptability of computer-based interventions by individuals with OCD suggested that computer based treatment appeared highly acceptable (Wootton, Titov, Dear, Spence & Kemp 2011). To date, no study has explored the perceived acceptability of ABMT in individuals with OCD. It would be beneficial to explore perceived levels of acceptability in ABMT to help identify any perceived advantages and disadvantaged of the treatment by individuals with OCD and to adopt a proactive approach to any potential barriers to intervention success.

Previous research has found mixed reactions from clients regarding the acceptability of ABMT. A qualitative study found that 10 individuals with social anxiety reported a lack of understanding of how ABMT could help their symptoms (Beard, Weisberg & Primack, 2011). After experiencing ABMT, participants in the study were quoted as describing the procedure as weird and boring. Participants reported the need to understand the mechanisms of how ABMT works and the exact reasons for engaging in the various elements of the intervention. Participants have described ABMT as “boring and makes your eyes go a bit funny,” and felt themselves
“zoning out” during the task (Brosan, Hoppitt, Shelfer, Sillence & Mackintosh, 2011, p. 262). However, not all reports of ABMT are negative. Boutelle, Monreal, Strong and Amir (2016) assessed the acceptability of ABMT in nine individuals with binge eating disorder using appetitive stimuli. Out of the nine participants, five liked the program and six reported it to be successful in reducing their binge eating. Lichtenthal et al., (2017) found that out of 110 survivors of breast cancer, 90% reported being at least somewhat satisfied with ABMT.

When considering a new intervention for OCD it may also be beneficial to explore if it would suit a particular symptom presentation (Knopp, Knowles, Bee, Lovell & Bower, 2013). A difficulty when treating OCD is the varied and multiple obsession/compulsion manifestations (Bloch, Landeros-Weisenberger, Rosario, Pittenger & Leckman, 2008). Research has found common themes that can be used to subgroup symptoms including; contamination, ordering, symmetry and checking (Denys, de Geus, van Megen & Westenberg, 2004; Katerberg et al., 2010). Previous studies have looked at the relationship between symptom subgroups and treatment outcomes for OCD. ERP has been found to be effective for all symptom subgroups except for hoarding, which is now distinguished as a disorder separate from OCD, and taboo obsessions regarding sex and religion (Abramowitz et al., 2003; Williams et al., 2014). Symptom severity has also been linked to negative treatment outcomes in OCD (Keeley, Storch, Merlo & Geffken, 2008; Steketee et al., 2011). Demographic variables, such as age, have been found to predict treatment outcomes in ERP with younger adults benefiting more (Eisen, Pinto, Mancebo, Dyck, Orlando & Rasmussen, 2010). Due to older adults being more unlikely to access computers (Office of National Statistics, 2010) it may reduce the acceptability of a computer-based intervention such as ABMT for this population. The occurrence of a co-morbid mental health disorder
in OCD has been linked to reduced treatment effects (Overbeek et al., 2002; Pallanti, Grassi, Sarrecchia, Cantisani & Pellegrini, 2011). As ABMT is a relatively new intervention, there has been no research carried to explore if it is better suited to specific OCD symptoms. Based on the premise that ABMT involves no direct contact with OCD triggers, it may be better suited and appealing for individuals with serve symptoms.

4.2.1 Rationale

ABMT is a potentially a new and accessible treatment which may provide an alternative to the expensive and challenging recommended treatment for OCD symptoms, ERP; however, despite an intuitive clinical prediction that ABMT is perceived as more acceptable as an intervention than exposure-based modalities, the previous literature review reveals that the evidence is mixed and limited in this regard. To date, the perceived acceptability of ABMT by individuals with OCD is unexplored. Consequently, in order to fully understand the potential utility of ABMT as an alternative OCD therapy, the perceived acceptability of the intervention needs to be evaluated. The current study is an online survey of individuals with OCD and it compares their ratings on a series of items asking how challenging, anxiety-provoking, engaging and effective they would find ABMT and ERP. It also explores how willing participants would be to undertake ABMT and ERP and the perceived ability of these interventions to reduce obsessive-compulsive symptoms. The investigation also aims to examine if specific demographic and clinical factors (e.g., OCD symptom severity) predicted acceptability of each intervention. It is hypothesised that in comparison to ABMT, ERP will be rated as great for how anxiety-provoking and challenging it is; however, it is predicted that participants will indicate an increased willingness to participant in ABMT compared to ERP.
4.3 Method

4.3.1 Participants

Individuals with a diagnosis of OCD were recruited via opportunity sample from online support groups and OCD websites (OCD-UK, International OCD foundation). To take part in the study, participants were asked to indicate in the beginning of the survey that they were over the age of 18 and had a clinical diagnosis of OCD by a mental health professional. Sample size was calculated using G*POWER for paired T-test analysis. Using the prior assumptions of $p = .05$, $d=.50$ and Power = 80% the original G*POWER calculation yielded a minimum sample size of 34 participants. Sample size was calculated for Correlation analysis using prior assumptions of $p = .05$, $r=.30$ and Power = 80%, minimum sample size required was calculated as 64 participants. A total of 107 participants took part, however, 41 participants were excluded from the final analysis due to failing to indicate that they had a diagnosis of OCD by a mental health professional. Data was collected from 66 individuals with a clinical diagnosis of OCD (80.3% female). The age of participants ranged from 18-55 years ($M_{age} = 36.74; SD = 11.55$).

4.3.2 Materials

Yale-Brown Obsessive-Compulsive Scale Self-Report Severity Scale (YBOCS-SR): The YBOCS-SR (Goodman et al., 1989) severity scale was used to indicate the overall severity of OCD symptoms in the sample. The scale assesses compulsions and obsessions in terms of interference, distress, resistance and control. Items are rated from 0 (none) to 4 (severe). Scores range from 0-40. The internal reliability of the scale has been found to be good in non-clinical samples ($\alpha = 88$. for total score, $\alpha = 78$ for obsessions subscale and compulsions $\alpha = 84$ subscales; Frost, Steketee, Krause & Trepanier, 1995). High test-retest reliability over one week has been found for the YBOCS-SR ($\alpha = .88$; Steketee, Frost & Bogart, 1996). The
YBOCS- SR has good convergent reliability with the MOCI (Woody, Steketee & Chambless, 1995).

**Obsessive Compulsive Inventory-Revised (OCI-R; Foa et al., 2002):** The OCI-R was employed in the investigation to identify subtypes of OCD symptoms and to indicate if participants' symptoms were in the clinical range as having a score of 21 or more (Foa et al., 2002). The subgroups include contamination, checking, obsessions, mental neutralizing, ordering and hoarding symptoms. The measure consists of 18 self-report items asking participants to rate from 0 (not at all) to 5 (extremely) how much OCD symptoms have caused distress in the previous month. Hajcak, Huppert, Simmons and Foa (2004) found that the OCI-R had good internal consistency (\(\alpha = .88\)) and test-retest reliability (\(\alpha = .70\)) in a sample of college students. The OCI-R had been found to have good convergent validity with the MOCI (Hajcak et al., 2004).

**Online Survey:** The study utilised a bespoke online survey to assess the perceived acceptability of ABMT and ERP. In the initial section of the study, participants were asked to give demographic details and enquired if they had been diagnosed with OCD by a health professional and if they so, had they ever received treatment. If they indicated they had received treatment, participants were asked to clarify if they had been treated with CBT, medication and/or anything else. Participants were also asked if they had ever been diagnosed with any mental health illness other than OCD. The subsequent section of the survey consisted of a brief description of each intervention, i.e., ERP and ABMT. The description included its theoretical underpinning and an example of its procedure (See Appendix A for survey materials). To ensure that the descriptions of each intervention were representative and understandable, four individuals from a non-psychological background read the
materials and then described their understanding of each intervention and how they worked. All participants reported they could understand each intervention based on the description and gave an adequate explanation of their outline and function.

Beneath each intervention description, there were six variables upon which participants were asked to rate each intervention. These six items were based on four of the seven concepts from the theoretical framework for measures of acceptability (Sekhon et al., 2017). These four concepts were affective alliance (anxiety-provoking, motivated, engaging), burden (challenging), intervention coherence (ability to reduce symptoms) and perceived effectiveness (effective). Each item was included based on its relevance to challenges that participants may face when undergoing each intervention. Based on the previous literature exploring ERP, it appears that high levels of anxiety and challenge of undergoing this treatment may result in participant drop-out (Gillihan et al., 2012). As the previous literature on ABMT acceptability has cited client’s feedback of finding it boring (Brosan et al., 2011) this may impact how motivated clients are to undergo this sort of treatment and how engaging they find it. Participants have also reported struggling to understand how ABMT can reduce symptoms which may impact how effective they perceive it to be (Beard et al., 2011). Participants were asked to indicate on a 5-point Likert scale from 0 (not at all) to 4 (a lot) their views on ERP and ABMT in terms of the following variables: how anxiety-provoking, engaging, challenging, and effective they felt each intervention would be. Participants were also asked to indicate on the scale how motivated they would be to take part and their perception of each interventions’ ability to reduce symptoms.

4.3.3 Procedure

The research was granted ethical approval by Queen’s University School of Psychology ethical committee. All participants were invited to email the researcher if
they had any queries about the study. Following a link, participants were guided to the online survey. They were asked to read the information sheet before indicating consent to participate by selecting the ‘consent’ option. They were informed that they could take as many breaks as they felt necessary. An anonymous code was assigned to each person that would be used to identify their data. The first section of the survey asked participants questions on their demographics. In the second section of the survey, participants were given a description of each of the interventions and asked to complete the ratings below each one. The order of intervention descriptions was counter-balanced across the study. The study took approximately 15 minutes to complete.

4.4 Results

**Statistical Analysis:** Paired t-tests compared participant ratings of ABMT and ERP on how anxiety-provoking, engaging, challenging, and effective they felt each intervention would be. The same analysis was used to compare ratings that indicated how motivated participants felt they would be to take part in each intervention and for their perceived ability to reduce symptoms and overall score of acceptability. Overall scores of perceived acceptability were calculated by adding all of the rating variables together with ratings of anxiety and challenge being reversed scored, paired t-test analysis was also used to compare ratings of acceptability for ERP and ABMT. A correlation analysis was used to explore the relationship between symptoms severity and ratings for each intervention. Backwards stepwise regression was employed to detect any predictor variables of ABMT and ERP perceived acceptability.

**Participants:** A total of 64 (98.5%) of the sample had undergone treatment for OCD (See Table 1). The most common treatment was medication (86.4%), however,
CBT was also frequently reported (77.3%). It was found that 69.7% of the sample had another diagnosis of a mental health illness apart from OCD. The average YBOC-SR total score indicates a moderate severity of OCD symptoms.
Table 2
Demographic and Clinical Scores

<table>
<thead>
<tr>
<th>Demographic/ Questionnaire Variables</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age $M (SD)$</td>
<td>36.74 (11.55)</td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>13 (19.7)</td>
</tr>
<tr>
<td>Female</td>
<td>53 (80.3)</td>
</tr>
<tr>
<td>Treatment (%)</td>
<td></td>
</tr>
<tr>
<td>Received treatment</td>
<td>65 (98.5)</td>
</tr>
<tr>
<td>CBT</td>
<td>51 (77.3)</td>
</tr>
<tr>
<td>Medication</td>
<td>57 (86.4)</td>
</tr>
<tr>
<td>Other</td>
<td>17 (25.8)</td>
</tr>
<tr>
<td>YBOC-SR, $M (SD)$</td>
<td></td>
</tr>
<tr>
<td>Y Total</td>
<td>20.56 (5.93)</td>
</tr>
<tr>
<td>Compulsion</td>
<td>9.86 (3.65)</td>
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<tr>
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<td>10.70 (2.95)</td>
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<tr>
<td>Mild</td>
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<td>Severe</td>
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<td>OCI-R, $M (SD)$</td>
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<td>Checking</td>
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<td>Washing</td>
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<td>Ordering</td>
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<td>Obsession</td>
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<td>Symptom Severity OCI-R, % ($N =$)</td>
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<tr>
<td>Sub Clinical</td>
<td>24% (16)</td>
</tr>
<tr>
<td>Clinical</td>
<td>76% (50)</td>
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Paired T-Test Analysis: ERP had higher average ratings than ABMT for all variables with the exception of how motivated participants indicated they would be to take part. ERP was rated significantly higher for levels of how anxiety provoking and challenging participants felt the intervention would be. They also rated ERP higher for how effective they felt it would be as a treatment and its perceived ability to reduce OCD symptoms (see Table 2). There were no significant differences between ratings of how motivated participants felt they would be to take part in the interventions and for how engaging they felt they would be.

Table 3

<table>
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<tr>
<th>Rating Variable</th>
<th>ABMT Mean (SD)</th>
<th>ERP Mean (SD)</th>
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<th>Sig (p)</th>
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<td>Effective</td>
<td>1.89 (1.01)</td>
<td>2.56 (1.30)</td>
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<td>Reduce Symptoms</td>
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<td>4.15</td>
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<td>Total Acceptability</td>
<td>12.27 (3.40)</td>
<td>11.41 (4.67)</td>
<td>-1.37</td>
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</table>

Note: * indicate significant differences (p < .05), ** indicate significant differences (p < .01)

Correlation analysis: Tables 3 and 4 outline the inter-correlations between all variables measured in the investigation. Total scores of acceptability for ERP were found to significantly positively correlate with indicating undergoing CBT as a treatment and negatively correlate with age. All measures of OCD symptoms, with the exception of the OCI-R hoarding subscale, negatively correlated with total acceptability for ERP intervention. There were no significant relationships between ERP perceived acceptability and having had treatment for OCD, using medication or...
other treatments for OCD, with the exception of previous experience of CBT. Nor were there significant relationships between ERP perceived acceptability and co-morbidity, gender or OCI-R obsession subscale scores.

Total score of perceived acceptability for ABMT were found to significantly negatively correlate with age however, there were no other significant relationships between ABMT perceived acceptability and treatment for OCD including; CBT, medication or indicating undergoing a treatment other than CBT and medication. No significant relationships were detected between ABMT perceived acceptability and gender or co-morbidity. OCD symptoms, as indicated by the total and subscale scores of the YBOC-SR and OCI-R, were not found to have significant relationships with the perceived acceptability of ABMT.

In terms of other variable relationships, there were significant positive correlations between measures of OCD symptoms and age significantly correlated with YBOC-SR compulsion subscale. Undergoing treatment for OCD was positively correlated to YBOC-SR compulsion subscale. Indicating that this treatment had been CBT negatively correlated with YBOC-SR compulsion subscale, OCI-R total score, OCI-R hoarding subscale, OCI-R neutralizing subscale and OCI-R ordering subscale.
Table 4
Correlations of ERP Perceived Acceptability Scale and Clinical/Demographic Variables

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Note: * = p < .05, ** = p < .01
Table 5
Correlations of ABMT Perceived Acceptability and Clinical/Demographic Variables

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Note: * = p < .05, ** = p < .01
Regression analysis: Backwards stepwise regression analyses were run to identify significant predictor’s of total perceived acceptability for ERP intervention. As ABMT perceived acceptability scores had only one significant relationship with age, backwards stepwise regression analysis was not carried out.

In the regression analysis the independent variables were: 1) Age, 2) Gender, 3) OCI-R hoarding, 4) OCI-R washing, 5) OCI-R obsession, 6) OCI-R neutralizing, 7) OCI-R checking, 8) OCI-R symmetry, 9) YBOC-SR compulsion, 10) YBOC-SR obsession, 11) CBT, 12) medication, 13) other treatment and 14) co-morbidity. All assumptions were met for outliers, normal distribution, linearity, multicollinearity and homoscedasticity (see Appendix B).

For total perceived acceptability for ERP intervention one case was removed due to a centred leverage value that was three times larger than the mean. A statistically significant model was found ($F(4,64) = 6.54, p < .001$) for ERP acceptability with four significant predictors remaining (see Table 5.). The adjusted R² indicated that 26% of variance in total acceptability scores could be explained by having had CBT as a treatment for OCD, age, OCI-R ordering and OCI-R washing. The results found that age was the most significant predictor. Previous experience of CBT, younger age, and lower OCI-R ordering and washing scores predicted increased perceived acceptability of ERP.

Table 6

<table>
<thead>
<tr>
<th>Significant Predictors</th>
<th>Unstandardized Coefficients</th>
<th>Standardised Beta</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBT</td>
<td>2.81</td>
<td>.252</td>
<td>2.24</td>
<td>.029*</td>
</tr>
<tr>
<td>Age</td>
<td>-.12</td>
<td>-.294</td>
<td>-2.66</td>
<td>.010*</td>
</tr>
<tr>
<td>OCI-R Ordering</td>
<td>-.36</td>
<td>-.261</td>
<td>-2.27</td>
<td>.027*</td>
</tr>
<tr>
<td>OCI-R Wash</td>
<td>-.31</td>
<td>-.233</td>
<td>-2.07</td>
<td>.042*</td>
</tr>
</tbody>
</table>

*indicate significant predictor variables ($p < .05$)
4.5 Discussion

This is the first study to explore the perceived acceptability of ABMT as an intervention for OCD symptoms and compare participant ratings of this salient variable with those for the established evidence-based treatment of ERP. While there were no significant differences between ERP and ABMT for total scores of perceived acceptability, ABMT was rated significantly lower on levels of how anxiety provoking and how challenging it would be to complete. This finding is concordant with prior research that has found ERP to be associated with increased therapy dropout rates, client discomfort and distress (Franklin & Foa, 2007; Gillihan et al., 2012). Moreover, measures of OCD symptom severity were found to be negative predictors of ERP perceived acceptability, suggesting that severe OCD symptoms were linked to lower levels of perceived acceptability for ERP. This result supports the hypothesis that ABMT has higher levels of perceived acceptable in comparison to ERP, particularly for individuals with more severe OCD symptoms.

The finding that symptom severity was negatively related to ERP perceived acceptability indicates that the intervention may be more acceptable to participants with milder OCD symptoms. Previous research supports this assertion as greater symptom severity has been linked to reduced CBT effectiveness and non-response (Keeley, Storch, Merlo & Geffken, 2008; Knopp, Knowles, Bee, Lovell & Bower, 2013). The distress and anxiety produced from an exposure may be more pronounced in those with severe OCD symptoms in comparison to those with milder symptom severity, potentially resulting in extremely strong urges to neutralising; therefore, individuals with severe OCD symptoms may experience a greater desire to avoid triggers of obsessive thoughts and a situation which would prevent the carrying out of compulsions. This avoidance is a recognised feature of OCD, it is detrimental as it limits the opportunity to correct maladaptive beliefs and therefore maintains
symptoms (Purdon & Clark, 1999; Salkovskis, 1999; Rachman, 1997). This demonstrates the need for new and innovative interventions to treat severe OCD symptoms such as ABMT, which in theory should be significantly less distressing due to no direct contact with triggers of symptoms.

There was no relationship detected between symptom severity and ABMT perceived acceptability. The lack of a negative relationship between ABMT and OCD severity is encouraging that ABMT may still serve as an acceptable treatment option for individuals with severe symptoms who may find ERP too challenging; however, it is important to note that the acceptability of an intervention does not equate to effectiveness. While the results indicate that lowered perceived acceptability for ERP is negatively associated with symptom severity, ERP was still rated significantly greater for its perceived ability to reduce symptoms and its effectiveness as a treatment for OCD. This is unsurprising as ERP is a very well-established and highly publicised intervention for OCD, including TV documentaries on the topic (Cooke & Rubens, 2013), with a large evidence-base for its effectiveness in reducing OCD symptoms (Abramowitz et al., 2003; Foa et al., 2005). Based on previous research that has found participants struggle to understand how ABMT is helpful (Beard et al., 2011), perhaps the pathway of how ERP reduces symptoms is clearer than ABMT, increasing confidence in its ability to provide an effective treatment for OCD. The psychoeducation component of how ERP works to treat OCD is highlighted as a crucial step in treatment as this helps motivate clients to provide a rationale for the distress, therefore, increasing tolerance of discomfort (Abramowitz, 2006). On the other hand, despite the psychoeducation as to how ERP is effective, the research on ERP still suggests a high drop-out rate due to distress (Gillihan et al., 2012). As avoidance is such a core component and well-established factor of OCD (Salkovskis
there is a risk that those individuals who drop out of ERP may avoid other psychotherapy options. In this context, ABMT may be of help to individuals who could potentially find ERP too distressing, providing an opportunity for stabilisation before moving forwards with a more direct therapy. A potential limitation of ABMT compared to more traditional therapies such as ERP, may be the level of ambiguity and obscurity in its mechanisms of treating symptoms. To avoid this confusion becoming a barrier to treatment success, it may be beneficial to develop explanatory materials (e.g., information leaflets, psychoeducation video content) that provide insight into the how ABMT operates in training attention and can engender reductions in symptomatology.

Age exhibited negative relationships with perceived acceptability scores for both ABMT and ERP. This is also commensurate with previous ERP research. Several studies have found that older age at time of treatment has been linked to poorer outcomes with ERP (Eisen et al., 2010; Foe et al., 1983). As ERP is a physically taxing exercise due to high levels of stress, it may appear too physically demanding for older adults. There is also the risk of exacerbating medical conditions that are common in later life and effected by stress. The association between lower age and higher perceived acceptability of ABMT may be explained by computer literacy and usage, with older adults being less likely than younger adults to use computers (Office of National Statistics, 2010). Older adults have been found to report more technological challenges when completing online CBT interventions (Crabbe et al., 2012). Nevertheless, computerised interventions in older adults for anxiety and depression have been found to be acceptable and effective (Staples, Fogliati, Dear, Nielsen & Titov, 2016). It is also important to note that reviews of the literature have found no reliable relationship between age and treatment outcomes for OCD (Ribeiro &
Machado, 2014; Keely, Storch, Merlo & Greffken, 2008), leaving the relationship between these two variables unclear and requiring further research (Carmin & Wiegartz, 2000).

A positive relationship between previous experience of CBT and ERP perceived acceptability was obtained in the investigation. This suggests that previously undergoing CBT treatment increases the perceived acceptability of ERP, and when this result is combined with the findings that lower symptoms of OCD also predicted perceived acceptability of ERP it could suggest that those who have made therapeutic gains via CBT, are more likely to re-engage with ERP therapy. While the study did not specifically ask about previous ERP experience, ERP is the core component of CBT for OCD (Abramowitz, 2006) so it is likely that previous experience of CBT indicates previous experience of ERP. Perhaps, having seen the benefits of undergoing a therapy such as CBT/ERP which challenges beliefs and maladaptive behavioural responses, individuals have a clearer rationale for re-engaging in distressing, but beneficial, treatment such as ERP. This finding supports ERP’s premise as the leading evidence-based treatment for OCD.

The regression model was in concordance with the correlation analysis as it revealed that previous experience of CBT, younger age, lower scores for OCI-R ordering and washing scores were significant predictors of ERP’s perceived acceptability. As discussed previously, undergoing CBT may provide clients with a rationale for experiencing stressful therapeutic situations, and could be the reason it predicts ERP acceptability. Salkovskis’ model (1999) highlights avoidance of fearful materials and engaging in neutralising actions as maladaptive counterproductive safety strategies which maintain and strengthen symptoms; as those with previous CBT experience will have a high likelihood of confronting fearful material related to
obsession and resisting neutralizing. This experience has resulted in motivation to re-engage with distressing, but beneficial, therapy. The regression model suggests that elevated OCI-R ordering and washing scores result in lowered acceptability for ERP. As aforementioned, greater symptom severity may result in extreme distress from exposure to triggers of obsessions and prevention of neutralising discomfort, resulting in counterproductive avoidance (Salkovskis, 1999). Prior research has indicated that clients with ordering and washing symptoms do not differ from other symptom clusters, with the exception of sexual or religious symptoms, in ERP treatment adherence (Mataix-Cols, Marks, Greist, Kobak & Baer, 2007). However, symptom severity across subgroups of symptoms have been linked to poorer outcomes in ERP (Eisen et al., 2010), as has older age (Keeley et al., 2008).

As there was only one relationship between age and ABMT perceived acceptability, a regression analysis was not carried out resulting in no predictor variables being explored. However, the lack of relationship between ABMT perceived acceptability and the variables in the current study is unsurprising as it is a new intervention and trends may not be apparent at this stage. The lack of a negative association between OCD symptom severity and perceived acceptability of ABMT suggests promise for its application to those with extreme OCD symptoms. Salkovskis’ model (1999) suggests that an attentional bias for symptom specific stimuli increases the individual’s likelihood of experiencing triggers of obsessions in the environment. Previous research has found a positive relationship between attentional bias and symptom severity in OCD (Bradley et al., 2016). Potentially, individuals with greater symptom severity may have obsessions triggered in the environment more often, which may create a vicious cycle of greater symptom severity as this bias is a blockade to forming alternative and corrective cognitions. Therefore,
ABMT may serve as a stabilisation treatment, leading individuals to a place where they can partake in experiences that create corrective information such as ERP.

Based on this regression model for the predictors of perceived acceptability of ERP, coupled with the findings that ABMT is appraised as less challenging and anxiety provoking than ERP, ABMT may be a preferable therapeutic first step when treating individuals with severe OCD, helping individuals to transition onwards to more aggressive therapeutic approaches, such as ERP. In accordance with Salkovskis’ model (1999), undergoing ABMT could remove a perpetuating trigger of intrusive thoughts; which would free information processing resources that were previously engage with threats to allow their re-direction towards corrective information, such as is gained in ERP. By reducing the number of triggers of intrusive thoughts, in theory the number of compulsions and level of avoidance should also decrease. Allowing the individual the opportunity to become less reliant upon these maladaptive coping strategies and hopefully readying them for the process of ERP, which eliminates engagement with these factors.

The present study had a number of limitations. As the participants did not actually undergo ABMT or ERP treatment, the findings of this study can only give an indication of the levels of perceived acceptability for a description of each intervention. However, as the perceived acceptability in ABMT has not been previously explored, this initial indication of acceptability is beneficial. In order to work collaboratively and ethically with clients, the majority of evidence-based psychological therapies includes giving a description of the planned psychological intervention to the client beforehand to allow them to understand what is involved in the process and to gain informed consent to participate or to give the client the opportunity to refuse treatment (Barlow, 2014). As service-users initial introduction
to ABMT may be psychoeducation into its paradigm and function, similar to the
methods in the current study, it is beneficial to gain an insight into the perceived
acceptability of description ABMT. It is important to note that perceived acceptability
does not necessarily infer effectiveness of an intervention. While ERP may appear to
be less acceptable, it was regarded as having greater ability to reduce symptoms and
level of effectiveness in comparison to ABMT. The current study cannot draw
conclusions about the effectiveness of each intervention based on its appeared
acceptability. The current study also chose to create its own scale to measure perceived
acceptability, basing the items on four of the constructs relevant to measuring
acceptability as suggested by Sekhon et al., 2017. A limitation of this method is that
the scale is unvalidated. However, the items selected to measure perceived
acceptability in the current study were based on issues that may arise from ABMT and
ERP interventions specifically. The majority of the sample had previously
experienced CBT as a treatment and there is a high possibility that ERP may have
been a part of this therapy. On reflection, it was a limitation not to specifically ask if
participants had previous knowledge of ERP or ABMT to allow a clearer picture of
their earlier therapeutic experience and how this may have translated onto ratings of
perceived acceptability. The sample was predominately female, prior research has
indicated that OCD is associated with gender differences (Khandelwal, Aggarwal,
Garg & Jiloha, 2009), and so the lack of males in the sample may have skewed the
current findings. As the analysis included multiple paired t-tests the risk for type 1
error is heightened, however the p value of each significant result was 0.001 or lower,
suggesting that the chance of type was error was 1% or less.

Future research should aim at comparing the effectiveness of ABMT and ERP
for treating OCD symptoms as well as participant acceptability of these interventions
pre- and post-treatment. While perceived acceptability is important as it provides a motivation to engage in an intervention and prevents drop-out, effectiveness of an intervention is crucial. Albeit ERP may cause initial discomfort in clients and this may evoke reluctance to participate, but its ability to reduce OCD symptoms may improve its acceptability as an intervention as the distress leads to therapeutic gain. Whereas, ABMT may appear less distressing and therefore be an initially more attractive and acceptable intervention, if it does not have a therapeutic effect this may reduce its desirability. While the current findings provide an indication of what acceptability for ABMT may be like, it is only after participants have experienced it first-hand that actual acceptability can be established. It will also be valuable to research if ABMT will be effective for particular OCD symptom subgroups and severity. This will give clinicians an insight into what clients may best benefit from ABMT intervention. To date, there has been little research carried out on ABMT and OCD and further evidence is required to establish its effectiveness in treating this population. ABMT may provide an opportunity to engage individuals with OCD who find ERP too distressing, hopefully leading to a reduction of symptoms and a stabilization where further intensive therapeutic work can take place if required. This notwithstanding, there is still much to learn about the nature of attentional bias in OCD, and indeed the mechanism of change in biases as a result of ABMT. In order to expand our current knowledge of attentional bias in OCD, research should focus on observing attentional bias with sensitive methodologies e.g. eye tracking that allow the exact processes to be captured. Furthermore, a risk of using ABMT in treating OCD is that its exact influence on attentional processes remain unclear, therefore future research should focus on observing its influence on attentional processes.
In conclusion, the current study suggests that ABMT was rated less anxiety-provoking and challenging than ERP, supporting the premise that it may be a more acceptable treatment of OCD symptoms. However, ERP was also rated greater for its effectiveness and ability to reduce symptoms. Researchers applying ABMT to OCD should be mindful that the methodology in which ABMT uses to reduce symptoms is not apparent to clients and that this may lower their faith in the intervention and be a barrier to intervention success. Older participants may find ABMT less acceptable due to its technological mode of delivery, perhaps additional support for these clients is warranted when undertaking ABMT. Overall, the current study has found an indication that ABMT may be a more acceptable treatment for OCD symptoms than ERP, however further research into its effectiveness, acceptability and the client characteristics it may best be suited to is required.
5.1 Abstract
Attention bias modification training (ABMT) may provide a new intervention for obsessive-compulsive disorder (OCD) and serve as an alternative to traditional treatments such as exposure-response prevention therapy (ERP). To date, the effectiveness of ABMT on treating OCD symptoms has yet to be directly compared to another OCD intervention. The current study explored the effects of ABMT with those of ERP on attentional bias, obsessive compulsive symptoms (OCS) and performance in a behavioural approach task (BAT) towards contamination related objects. A total of 77 participants with clinical levels of OCS and contamination concerns were randomly assigned to one of four conditions: 1) ABMT ($N=19$); 2) placebo computer task ($N=19$); 3) ERP with an attentional bias assessment ($N=20$) and 4) ERP only ($N=19$). Attentional bias assessments were recorded by computerised eye-tracking methodology to monitor participant’s eye gaze during a dot-probe task using contamination and neutral image pairs as stimuli. In the ABMT condition, attentional biases were found to increase towards contamination images. The other groups did not exhibit any changes in attentional bias. Participants in both ERP conditions were found to have a significant reduction in avoidance towards contamination-related objects in comparison to ABMT. No change of OCS level was detected across the sample. This was the first study to use eye-tracking to observe attentional bias changes after ABMT in individuals with moderate OCS. The current findings provide further support for ERP as an effective intervention for the reduction of avoidance in OCD. They also indicate that ABMT is not as effective as ERP and may have some negative effects upon attentional biases towards OCD related stimuli. These results suggest that
further research is needed to understand the effects of ABMT on attentional mechanisms.

5.2 Introduction
As discussed in previous chapters, Obsessive-Compulsive Disorder (OCD) is a prevalent mental health issue that significantly impacts on the wellbeing and functioning of individuals with the disorder (Abramowitz, Taylor & McKay, 2009). Up to fifty percent of individuals who receive treatment for OCD exhibit no significant reduction in symptoms (Abramowitz, 2006; Eddy et al., 2004). Moreover, the most effective evidence-based psychological treatment, exposure-response prevention (ERP), is associated with high dropout rates due to its challenging nature (Gillihan, Williams, Malcoun, Yadin & Foa, 2012). Further research is required to develop alternative and effective treatments for OCD.

Attention training is a new innovative method of symptom reduction which aims to reduce information processing biases for symptom-related stimuli (Hakamata et al., 2010). Attentional bias to disorder-related stimuli has been theorised to elicit and maintain psychopathology (Bar-Haim et al., 2007). Van Bockstaele et al. (2014) argue that there is evidence for a small to moderate relationship between attentional bias for threatening stimuli and psychopathology. Their strongest support for this claim is based on experimental studies that have found attenuation of symptoms by training attention away from threatening stimuli (Hakamata et al., 2010). Salkovskis’ Cognitive-Behavioural Model of OCD (1999; 2007) suggests that excessive attention towards triggers of obsessive thoughts in the environment is a significant antecedent and perpetuating factor of OCD symptoms. As attention is activated by relevant triggers, it contributes to a maintenance cycle of obsessive thoughts and compulsive behaviours. The exact types of attentional bias involved in this mechanism are
somewhat equivocal; however there are two predominant theories referred to in the literature as the Vigilance and Delayed Disengagement/Maintenance hypotheses.

As explained in previous chapters in the current thesis, the vigilance hypothesis suggests that the primary bias in processing threatening information is present in the early and pre-attentive stages of attention, resulting in rapid orientation and engagement of attention to threats in the environment (Beck & Clark, 1997; Eysenck et al., 2007; Matthews & Mackintosh, 1998; Mogg & Bradley, 1998; Wells & Matthews, 1994). The delayed disengagement and maintenance hypothesis suggest that the bias occurs in the later stages of attention. The delayed disengagement bias proposes that attentional bias towards threatening information is the result of the individual being unable to disengage and shift attention away from threatening stimuli (Eysenck et al., 2007; Derryberry & Reed, 2002; Fox, Russo, Bowles & Dutton, 2001). There is a significant overlap between delayed disengagement and maintenance bias leading researchers to conflate these terms in the unified delayed disengagement/maintenance hypothesis; however, there are some distinct differences. For example, the maintenance bias originates from the “engage” process of spatial attention (i.e., the re-orientation, monitoring and sustained focus of attention to threatening stimuli) rather than the “disengage” mechanism (Weirich, Treat & Hollingworth, 2008). Despite a lack of consensus on whether the vigilance or disengagement/maintenance hypotheses explain the theorised attentional bias maintenance element of Salkovskis’ model, there is frequent support throughout the literature of the maladaptive effect that non-specific attentional bias has upon symptoms of various psychopathologies including OCD (Browning, Holmes & Harmer, 2010; Cisler & Koster, 2010; Tata, Leibowitz, Prunty, Cameron & Pickering, 1996).
A recently developed corrective method of redressing unhelpful attentional biases towards threatening stimuli in clinical presentations is attention bias modification training (ABMT; MacLeod, Rutherford, Campbell, Greg & Lin, 2002). By reducing bias towards threatening stimuli in individuals with OCD, attentional resources will move freely through the environment, decreasing the detection and orientation towards intrusive triggers, and subsequently interrupting the cycle of obsessive-compulsive symptoms.

In practice, ABMT is a modified dot-probe task that aims to retrain attention away from anxiogenic stimuli towards neutral stimuli (MacLeod & Matthews, 2002). In the original dot-probe task participants view two stimuli presented together (e.g. pair of images or words) on a computer screen. This stimuli pair is subsequently replaced by a target (e.g. symbol or letter), the target appears in the previous location of one of the stimuli and the participant is asked to indicate where the target appears by hitting a corresponding keyboard key. In some variants, participants are asked to discriminate between two targets (e.g. letter ‘E’ or ‘F’) rather than indicate their location. In the ABMT task, the stimuli pair includes one threatening and one neutrally valanced. The target always appears in the previous location of the neutral stimuli regardless of whether participants are asked to indicate the location or identify targets. This aims to reduce attention away from the threatening stimuli and reinforce its deployment to the neutral stimuli. The procedure of ABMT has differed among previous research with the number of trials reported to range from 128–1080 across 1-15 sessions (Hakamata et al., 2010). Typical ABMT measures attention and attentional bias using participant’s reaction time to detect or identify the target. Using reaction time to measure attentional bias causes difficulties when deciphering the mechanisms involved e.g. vigilance or delayed disengagement/ maintenance (Armstrong &
Olatinji, 2010) as it allows only a snapshot in time to be captured; however, innovative technologies for continuously measuring attention such as the tracking of eye movements show promise for detailing attentional processes.

ABMT has been found to reduce attentional bias and anxiety symptoms in double-blind, randomised controlled trials in clinical samples of individuals with anxiety disorders (Amir, Beard, Burns & Bomyea, 2009). Amir et al. (2009) found that eight sessions of ABMT led to fifty percent of participants no longer exhibiting clinical levels of generalised anxiety disorder. Similar findings were found by Schmidt, Richey, Buckner and Timpano (2009) who found that 72% of participants in the ABMT group no longer met clinical criteria for social anxiety disorder compared to 11% in the control group. These findings were still present at a four-month follow up. Single sessions of ABMT have also demonstrated beneficial effects on anxiety symptoms (Eldar & Bar-Ham, 2010). Based on these findings, researchers have asserted that ABMT may be an effective new intervention for the treatment of a range of mental health disorders and warrants further empirical study (Beard, Sawyer & Hofmann, 2012).

Despite the potential of ABMT, there has been little research on its application to the treatment of OCD. To date, only two studies have been conducted in this field. Najmi and Amir (2010) investigated the effects of a single session of ABMT and a Placebo Control Task (PCT; same as ABMT but no contingency between neutral stimuli and target) with contamination-related and neutral words on undergraduates with high OCS centred on contamination fears. As well as measuring attentional bias via the participant’s reaction time when identifying the target, they included a Behavioural Approach Task (BAT). The BAT is a real-world behavioural measure of the impact treatment has on previously feared objects related to the individual’s mental
health issue. In this study, the BAT was a series of increasingly challenging physical contacts towards contamination-related objects, where the level of interaction participants can tolerate with the item and their corresponding level of anxiety is assessed. The BAT has been found to be indicative of OCD symptom severity and has good convergent delivery with robust OCD symptom measures (Steketee, Chambless, Tran, Worden & Gillis, 1996; Woody, Steketee & Chambless, 1995). Participants in the ABMT group showed a significant reduction of attentional bias for contamination-related words and completed more steps in BAT involving contamination related objects than the control group. These findings demonstrate potential for the application of ABMT for reducing attentional bias and avoidance in OCD, however, support in its ability to reduce avoidance would be strengthened if pre and post measures of BAT performance and OCD symptomology were compared.

Not all research investigations into the efficacy of ABMT on OCD symptoms has provided clear evidence of positive effects. Research has reported no significant differences between ABMT and PCT conditions in the reduction of OCD symptoms (Habedank, Lennartz, Arslan & Ertle, 2017). Considering the specific mechanism of change that ABMT has upon attentional mechanisms is not clear, it is concerning when a similar task, with the obvious exception of the main component of attention training being absent, produces similar effects. This questions whether ABMT is efficacious because of the theorised attentional training element or, in fact, another indirect, unaccounted factor associated with its design is responsible, e.g. exposure and habituation to OCD images. Viewing OCD-related images in ABMT may provide repeated, brief exposures to anxiety-inducing content, which helps desensitise participants and reduces attentional bias through habituation/cognitive restructuring. While exposure to a feared stimulus initially causes distress, individuals become
desensitized and habituated to the stimuli over time, resulting in a decrease in fear. This habituation allows for re-appraisal of the initially fearful stimulus to be made (Abramowitz, 2006). For example, if an adult who has developed a phobia of dogs, is asked to interact with a non-aggressive friendly dog, over time their anxiety and distress will decrease as the feared outcome of being harmed from a dog does not occur. This habituation allows the individual to re-frame their initial interpretation of all dogs being dangerous, reducing their fear of dogs. Although stimuli are presented briefly during ABMT it is possible that this presentation serves as a form of exposure, and that this exposure, rather than the training, is causing habituation which is subsequently reducing attentional bias and symptoms.

An additional critique of ABMT is that it has the potential to encourage avoidance of anxiogenic stimuli as attention is continually reinforced away from the threatening stimuli (Koster, Baert, Bockstaele & Raedt, 2010). Avoidance of threat is acknowledged as a maladaptive behavioural response that contributes to the maintenance of symptoms and impedes long-term recovery (Aldao, Nolen-Hoeksema & Schweizer, 2010; Folkman & Lazarus, 1980; Hayes et al., 2004). Arguments against ABMT have centred on its potential to encourage avoidance and reduce the opportunity for participants to habituate to threatening stimuli, ultimately leading to the long-term exacerbation of symptoms (Koster et al., 2010). There have also been concerns raised over the level of participant awareness as to how ABMT works, which has relevance for informed consent and the collaborative nature of therapy (Beard, Weisberg & Primack, 2012). It has been argued that without the delineation of a precise link between the target and the neutral stimuli being explained to the participant limited symptomatology change can take place (Notebaert, Clarke, Grafton & MacLeod, 2015). The lack of knowledge on how ABMT influences attentional
process and symptom attenuation poses a risk for its clinical application. To understand how ABMT impacts upon attentional bias, its effects upon specific attentional mechanisms need to be observed via sensitive and continuous measurement such as eye-tracking (Armstrong & Olatunji, 2010).

Eye-tracking experimental methodologies represent a new opportunity to comprehensively explore the mechanisms of ABMT. These computerised paradigms allow a detailed examination of how ABMT manipulates attention; specifically, if it creates a balanced deployment of attention between threatening and neutral stimuli or creates an attentional bias towards neutral stimuli. By using eye movements to monitor how participants allocate attention to threatening and neutral stimuli before and after training, the precise type of attentional mechanism (e.g., reduction in vigilance or delayed disengagement towards threatening stimuli), can be observed. This facilitates an understanding of the effects ABMT has on attentional processes and how this reduces attentional bias towards threatening stimuli.

When considering ABMT as an intervention for OCD, it is important to be mindful that the exact role of attentional biases in cognitive mechanisms of OCD still requires refinement and further study. Attentional bias as a specific causal factor in perpetuation of anxiety has been questioned due to findings that attentional bias often reduces after therapy without being specifically targeted in the interventions (Tobon, Ouimet & Dozois, 2011; Van Bockstaele et al., 2014). This implies that mental health symptoms may elicit the attentional bias rather than the other way around, suggesting the possibility such biases are maintaining factors rather than discrete antecedents. This line of argument suggests that instead of specifically targeting attentional biases, it would be more appropriate to focus on the core perpetuator of OCD symptoms such as cognitive assumptions and beliefs (Salkovskis, 1999). The current dominant
psychological intervention for OCD, ERP, targets these cognitive constructs, which is often used to explain its clinical effectiveness. ERP provides the opportunity for habituation as well as cognitive restructuring of intrusive thoughts, maladaptive appraisals, and OCD-related beliefs (Abramowitz, Foa & Franklin, 2003). Researchers have concluded that ERP breaks down the cycle of obsessions and compulsions by eliciting desensitization and reinterpretation of feared objects related to obsessive thoughts. Such a process of habituation to intrusions provides the opportunity for a non-threatening reinterpretation of these images/thoughts via cognitive re-appraisal. If attentional biases are a consequence of having OCD symptoms, rather than a direct cause, then by reducing the core symptoms of OCD such as the cognitive reprisal of intrusive thoughts and maladaptive neutralization strategy, attentional bias should also be reduced without being specifically targeted. As ERP targets the core components of OCD by focusing on providing opportunity for the re-structuring of maladaptive intrusive thoughts and removing the urge to neutralize, if ABMT is indeed a consequence of OCD symptoms rather than a cause, then theoretically an additional result of ERP could be the reduction of attentional bias. Investigating the effects of interventions other than ABMT on an attentional bias in OCD has been largely unexplored in previous research.

To date, only two studies have focused on reduction of attentional bias as a response to cognitive-behavioural therapy in OCD (Direnfeld, Pato & Roberts, 2003; Foa & McNally, 1986). Direnfeld et al. (2003) used an emotional stroop task to chart an attentional bias for general threatening words across a 12-week cognitive-behavioural group therapy. Pre-therapy assessments found an attentional bias for threat-related stimuli that was correlated with symptom severity. They also found that attentional bias for threatening words significantly reduced across the course of
therapy, and that this reduction was correlated with a reduction in OCS; however, there is the possibility that this reduction in attentional bias was the result of practice effects as the emotional stroop task was carried out 12 times at the beginning of each weekly assessment. Foa and McNally (1986) used a dichotic listening task to explore if individuals with OCD would detect fear relevant words more readily than neutral words before and after ERP treatment. The authors wished to explore if symptom related words were more readily detected due to fear or familiarity. If OCD related words were more salient due to fear, then this saliency should be reduced following OCD. If instead symptom related words were more salient due to familiarity, then ERP should increase their likelihood of detection. The results found that after ERP individuals with OCD no longer exhibited attentional bias for symptom-specific words in an unattended audio feed, suggesting that fear had originally increased the saliency of these word but by removing the fear the bias had also been subsequently removed. These results suggest that interventions which target core symptoms such as obsessional beliefs have a reducing effect on attentional bias, however, further research is required to support this.

As ERP and ABMT have contrasting approaches to ameliorating symptoms, there are different factors that could influence their efficacy. ERP requires individuals to directly interact with stimuli associated with the source of anxiety, whereas ABMT involves a more indirect approach as participants briefly view symptom-related images on a computer screen before responding to a target that reinforces their attention towards neutral stimuli. One of the potential factors which might predict an individual’s success in ABMT is their ability to connect with the images related to their symptoms. ‘Mental contamination’ refers to feelings of contamination in the absence of a physical contaminate and has been described as an internal dirtiness
Mental contamination and contact contamination (the source of contamination being from a physical contact) have many overlapping features (Herba & Rachman, 2007). But, mental contamination is distinctive in that, feelings of contamination are reported all over the body or internally and washing does not reduce anxiety as the feelings of contamination are not from a physical source but rather triggered internally via thought or memory (Herba & Rachman, 2007; Rachman, 2006). As mental contamination does not involve a tangible external trigger, interventions with a cognitive focus, instead of exposure-based work, are recommended to deal with the sense of internal contamination (Rachman, 2006). Arguably, a participant who scores low for mental contamination may find they do not connect the stimuli used in ABMT to their symptoms, as contact with a physical contaminate is required to evoke fear. Therefore, the training may be ineffective as attention would be directed away from seemingly ‘neutral’ stimuli. Individuals who score low in mental contamination, may find ERP more efficacious than ABMT due to it direct interaction with feared stimuli, provoking anxiety and distress.

As well as mental contamination, a second factor which could influence the efficacy of either ABMT or ERP is the ability of the client to tolerate distress. A potential key distinguishing feature of ABMT from ERP, is that in comparison to ERP, ABMT is in theory considerably less distressing. The term ‘distress tolerance’ refers to a limited capacity to experience unpleasant emotions (Timpano, Buckner, Richey, Murphy & Schmidt, 2009). Compulsive behaviours are carried out as a result of obsessions becoming too distressing and the need to reduce anxiety (Haines, Josephs, Williams & Wells, 1998). Low tolerance for distress has been found to predict OCS severity (Cougle, Timpano & Goetz, 2012; Laposa, Collimore, Hawley & Rector, 2015). ERP involves exposing a client to feared objects to deliberately provoke
discomfort and distress. The distress and difficulty of ERP can cause participants to refuse treatment and drop out (Gillihan et al., 2013). Although low tolerance for distress is linked to OCS, an extremely low tolerance may impede ERP. For these individuals, a low intensity intervention, such as ABMT, may be more suitable. Identifying traits that may impede or facilitate intervention success may help reduce treatment resistance.

As ABMT is embedded in and delivered via a computer, this may influence its efficacy for clients who are unfamiliar with technology. It may be that younger adults will benefit more from computer-based interventions such as ABMT, due to older adults being more unlikely to access computers (Office of National Statistics, 2015). While previous research has indicated that older adults are open to using technology, anxiety related to using a computer and being uncomfortable with computers have also been highlighted as barriers (Alvseike & Bronnick, 2012; Czaja et al., 2006; Czaja & Sharit, 1998). Older adults may be better suited to more traditional psychotherapy paradigms such as ERP which does not require the use of technology. There has been little research carried out on the efficacy of ERP for older adults and ERP has the potential to be physically taxing on older adults. However, the findings of the available research indicated that ERP is an effective and well tolerated treatment for older adults with OCD (Calamari & Cassiday, 1999; Carmin, Pollard & Ownby, 1998) however younger adults have been found to benefit more from this treatment (Eisen, Pinto, Mancebo, Dyck, Orlando & Rasmussen, 2010).

ABMT may serve as a more acceptable intervention in comparison to ERP for those individuals with severe OCD symptoms. Research has repeatedly demonstrated the link between poorer OCD treatment outcomes from ERP and symptom severity (Keeley et al., 2008; Knoop, Knowles, Bee, Lovell & Bower, 2013; Kyrios, Hordern
The research undertaken in Chapter 4 of this thesis found that symptom severity was negatively related to the acceptability of ERP. The distress and anxiety produced from an exposure may be greater in those with severe OCD symptoms in comparison to those with milder symptom severity. This may potentially result in extremely strong urges to neutralising; therefore, individuals with severe OCD symptoms may experience a greater desire to avoid triggers of obsessive thoughts and the prevention of carrying out compulsions (Purdon & Clark, 1999; Salkovskis, 1999; Rachman, 1997). Greater symptom severity may lead participants to avoid ERP treatment and may increase the acceptability of ABMT due to its weaker evocation of distress.

It is important to explore the acceptability of ABMT, particularly as a motivation to continue to develop innovative new interventions for OCD is that the leading treatment, ERP, has been criticised for its low levels of acceptability and high dropout rate (Abramowitz, Taylor & McKay, 2009; Franklin & Foa, 2007; Gillihan et al., 2012). While acceptability does not equate to effectiveness, research has identified that acceptability of an intervention by service users with OCD is crucial for positive outcomes and symptom reduction (Reid et al., 2017). The term acceptability is frequently used to describe measures of client satisfaction, treatment adherence, perceived helpfulness of an intervention, enjoyability and lack of adverse experiences such as causing excessive anxiety (Andrews et al., 2018; Gun, Titov & Andrews, 2011; Kazdin, 2000; O’Connor, Munnelly, Whelan & McHugh, 2017). As ABMT involves no direct contact with the client’s most feared situations, it may be a more acceptable intervention than ERP; however, previous research has found mixed reactions from clients regarding the acceptability of ABMT (Beard, Weisberg & Primack, 2012; Boutelle, Monreal, Strong & Amir, 2016; Lichtenthal et al., 2017). With regards to
individuals with OCD, the previous chapter in this thesis explored how individuals with OCD rated ABMT and ERP for how effective, anxiety-provoking, challenging and engaging they felt they were on a Likert scale after reading a description of each intervention. They were also asked to rate the ability of each intervention to reduce OCD symptoms and how motivated they would be to undergo each treatment. The results found that ERP was rated as more anxiety provoking than ABMT, it was also rated as appearing more effective and having a greater ability to reduce OCD symptoms. This suggests that ABMT may be more acceptable, but that its face validity may be low. A limitation of the previous study was that participants had not actually experienced each intervention. By exploring participant’s acceptability of ABMT and ERP after having experienced both interventions, would allow for a more representative indication of their acceptability by individuals with OCD. It is crucial to explore the acceptability of ABMT by individuals with OCD thoroughly before it can be clinically disseminated as a new treatment.

5.2.1 Rationale

ABMT is a new and accessible treatment that has been found to reduce attentional bias towards anxiogenic stimuli and symptoms to non-clinical levels in anxiety disorders; however, less empirical scrutiny has been paid to its effectiveness in OCD. The limited previous research carried out in this area has shown promise for reducing attentional bias and symptoms in OCD; however, the exact attentional mechanisms that ABMT modifies remain unknown. Concerns have arisen, especially as similar tasks without the training component of ABMT have been demonstrated to produce the same effects as ABMT, that rather than specifically training attention, ABMT may be influencing attentional bias by providing a brief exposure to anxiety-inducting stimuli or by encouraging avoidance, the latter of which could have longer-
term negative repercussions for clients. The causal role of attentional biases has been queried as previous research has found that cognitive-behavioural therapy such as ERP, which is the leading treatment for OCD, reduces attentional biases without specifically targeting them, suggesting that attentional biases are an epiphenomenon of mental health symptoms rather than a cause. The effects of therapeutic intervention on attentional bias have been little explored in OCD. Currently, no study has compared the effects of ABMT on attentional bias and symptom reduction with another OCD based intervention. Due to the low intensity of ABMT, it may be a more acceptable intervention than ERP and better suited to those with lower distress tolerance, greater symptom severity and the ability to experience OCD symptoms without a physical trigger present. As it is a computer-based intervention, age may also influence its effectiveness as an intervention.

Firstly, the present study aimed to compare experimentally the efficacy of ABMT and ERP upon reduction in OCD symptoms, attentional bias for OCD related stimuli, and performance in a BAT task. In order to tailor the BAT task, only participants with contamination concerns were included. As contamination fear is strongly associated with disgust (Cisler, Olutunji, Sawchuk & Lohr; 2008; Goetz, Lee, Cougle & Turkel, 2013) measures of this concept will also be recorded. Secondly, computerised eye-tracking technology was employed to monitor attentional bias in the form of eye movements linked to vigilance, delayed disengagement/maintenance and to observe any changes in attentional mechanisms. Two baseline control groups relevant to both ERP and ABMT were included for each intervention. Mental contamination, distress tolerance, age and symptom severity were examined for their relationship to changes in BAT performance across all groups. As acceptability is an
important component for intervention success, participants were also asked to rate the intervention they experienced for variables relating to acceptableness.

The current study hypothesised that ABMT would lead to a significant reduction in OCD symptoms, attentional bias and significantly improve BAT performance. The current study wished to explore the influence of ERP on attentional biases, it predicted that ERP would result in BAT task improvement and OCD symptom reduction. In the ABMT group it was predicted that older age would be linked to weaker intervention effects, whereas mental contamination was hypothesised to be positively related to outcomes. For the ERP group, it was hypothesised that distress tolerance would be positively linked to intervention effect on outcomes. In line with previous research on ERP, it is proposed that verbal ratings of disgust, anxiety and the urge to neutralize will reduce over the course of the study; whereas the pattern of these verbal ratings for ABMT have not yet been explored in the literature. It is proposed that greater symptom severity will be positively related to ratings of acceptability within the ABMT group and negatively related to rating of acceptability in the ERP group.

5.3 Method

The current study is a mixed between-groups and repeated measures design. Four groups were included in the study: 1. Attention Bias Modification Training (ABMT); 2. Placebo Computer Task (PCT); 3; Exposure-Response Prevention only (ERP); and 4. ERP with attentional bias assessment (ERP-ABA). The ABMT group completed one session of ABMT. The PCT underwent the same task as the ABMT group but without the contingency between the target and neutral image. Both the ERP and the ERP-ABA groups completed an exposure-based task with a contamination related object, however, only the ERP group underwent a pre and post attentional bias
assessments. This study included an ERP condition without an attentional bias assessment to control for the additional effects that exposure to contamination related images in the attention bias assessment may have on other dependent variables. Dependent variables included pre and post measures of OCD symptoms, attentional bias via eye movements, attentional bias via reaction time, trait anxiety, state anxiety, disgust and BAT, as well as a distress tolerance and mental contamination scores. Only the ABMT, PCT and ERP-ABA group will complete pre and post measures of attentional bias (See Table 6).

Table 7

*Overview of group procedures*

<table>
<thead>
<tr>
<th>Groups</th>
<th>Procedure</th>
<th>Questionnaire</th>
<th>BAT</th>
<th>Attentional bias assessment</th>
<th>Group Task</th>
<th>Attentional bias assessment</th>
<th>BAT</th>
<th>Questionnaires</th>
</tr>
</thead>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PCT</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ERP-ABA</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ERP</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: ✓ = completed measure, X = did not complete measure

5.3.2 Participants

A total of 77 participants were recruited for the current study (77.9 % female). The age of the sample ranged from 18-50 years old with an average age of 26.5 ($M_{age} = 26.50; SD = 7.95$). Participants were assigned a number from 1-4 by an online random number generator and completed the task assigned to the number (e.g. 1 = ABMT, 2 = PCT, 3 = ERP, 4 = ERP-ABA). Sample size was calculated using G*POWER for mixed ANOVA analysis. Using the prior assumptions of $p = .05$, $F=.40$ and Power = 80% the original G*POWER calculation yielded a minimum
sample size of 16 participants in each group. The ABMT, PCT and ERP-ABA subgroups had 19 participants and ERP had 20. Participants were recruited via opportunity sample from university, online advertisements with local Facebook Pages (e.g. Belfast Live) and posters placed on university notice boards. Before being invited to take part in the study, participants were sent an online screening questionnaire including the Obsessive-Compulsive Inventory-Revised scale (OCI-R, Foe et al., 2002) to measure OCS symptoms. To take part in the study, participants had to have a minimum OCI-R total score of 21 and a minimum score of four in its washing subscale. A score of 21 or more in the OCI-R is considered to indicate clinical level OCD symptoms; a score of four in the washing subscale is 1.5 standard deviations above average in a college sample (Foe at al., 2002). Participants were given a £5 Amazon voucher for their time.

5.3.3 Materials

Spielberger State-Trait Anxiety Inventory (STAI): The State-Trait Anxiety Inventory (STAI) is a 40 item scale which is made up of two subscales which have 20 items each, one measuring trait anxiety (TA) and the other state anxiety (SA). Items are scored from low (1 = not at all) to high (4 = very much) for SA subscale and rare (1= almost never) to frequent (4 = almost always) for TA. It has good internal reliability (α = .95) test-retest reliability and construct validity (Julian, 2011; Spielberger, 1989).

The Disgust Propensity and Sensitivity Scale-Revised: (DPSS-R): The DPSS-R (Fergus & Valentiner, 2009) is a 12-item scale designed to measure the frequency and emotional impact of experiencing disgust. The DPSS-R has two subscales; one measuring disgust propensity and the other measuring disgust sensitivity. Each subscale is comprised of six items, participants are asked to indicate
from 1 (never) to 5 (always) how much they feel each item applies to them. It has been found to have good reliability ($\alpha = 0.78$; Fergus & Valentiner, 2009) and internal consistency (Overveld, de Jong & Peters, 2010).

**Distress Tolerance (DT):** The Distress Tolerance scale (DT) consists of 15 items designed to assess individuals’ ability to tolerate emotional distress (Simons & Ganer, 2005). Items focus on times participants’ experienced distress and their beliefs about feeling distress. Items are scored on a scale of one (strongly agree) to five (strongly disagree) with lower scores indicating a low tolerance for distress. It has good internal consistency ($\alpha = .89$) and test-retest reliability (Shaw, Llabre & Timpano, 2015; Simons & Garner, 2005).

**Vancouver Obsessive Compulsive Inventory-Mental Contamination Scale (VOCI-MC):** This is a 20-item scale that assesses the individual’s level of mental contamination. The items are rated from zero (not at all) to one (very much) with higher scores indicating higher levels of mental contamination. It has good internal consistency ($\alpha = 90-94$; Rachman, 2006).

**Obsessive Compulsive Inventory-Revised (OCI-R):** The OCI-R (Foa et al., 2002) is used to identify subtypes of OCD symptoms in participants. These subgroups include contamination, checking, obsessions, mental neutralizing, ordering and hoarding. It consists of 18 self-report items asking participants to rate from zero (not at all) to five (extremely) how much OCD symptoms have caused distress in the previous month. Hajcak, Huppert, Simmons and Foa (2004) found that the OCI-R had good internal consistency ($\alpha = .88$) and test-retest reliability ($\alpha = .70$) in a sample of college students.

**Study Evaluation Scale:** Participants were asked to rate their group task on six different variables on a Likert scale of zero (not at all) to four (very) (See Appendix
C for full scale). They were asked to indicate how anxiety-provoking, challenging, effective and engaging they found the task. They were also asked how motivated they were to take part and how effective they felt the task was at reducing OCD symptoms.

**Stimuli:** Fifty contamination images were used from the Maudsley Obsessive Compulsive Stimuli Set (MOCCS; Mataix-Cols, Lawerence, Wooderson, Speckens & Phillips, 2009). Contamination scenes included used cutlery, public telephones, bins, rubbish etc. Fifty neutral scenes were drawn from the international affective picture system (Lang, Bradley & Cuthbert, 1997). Fifty contamination-neutral images pairs were created and divided up so that 25 images were used for training/control trials and the remaining 25 used for attentional bias assessment. Images used in training/control and attentional bias assessment were counterbalanced within each group therefore half of the sample saw 25 images as assessment trials while the other half saw the same image pairs as training trials and vice versa.

**Equipment**

**Eye tracker:** The eye tracker is a SMI iView X Remote Eye-tracking Device (RED250) from SensoMotoric Instruments. The sample rate is 250Hz and the gaze position have an accuracy of within 0.4° of the visual angle. Calibration consists of 13 points with a nine-point validation and minimum accuracy threshold of one degree.

**ABMT task:** As previously described, the ABMT is a modified dot-probe task which aims to train attention away from threatening stimuli by reinforcing the deployment of attention to neutral stimuli. The training consists of two laterally positioned images displayed simultaneously for 500ms one contamination related and the other neutral, before a subsequent target appears in the previous location of the neutral image. That target was either the letter ‘E’ or ‘F’. Participants were asked to
hit the corresponding mouse key to indicate which target appeared. The target always appeared in the previous location of the neutral image in order to direct attention away from the contamination image. Participants completed a total of 200 training trials. There were random combinations of target type (E or F), target position (left or right) and neutral image position (left or right).

**PCT task:** Participants in the PCT group completed the same task as the ABMT group, with the exception that there was no link between the target and neutral images. Instead the target could appear in the previous spatial location of either the neutral or contamination image with equal probability. PCT controls for the exposure to contamination images, same as in ABMT, but without the training component.

**ERP task:** The ERP task was the same used in Cougle, Wolitzky, Lee and Telch’s (2007) study. The ERP task asked participants to select the most anxiety provoking object from the three objects used in the pre-BAT using their anxiety ratings as guidance. This object was then used as the exposure stimuli. Participants were asked to complete five exposures lasting a total of four minutes each, making as much physical contact with the object as they could during this time. After the four-minute exposure participants were asked to wait for two minutes before washing their hands. After two minutes had passed, they were asked to rate their anxiety, disgust and urge to wash hands on a scale of 0 (not at all) to 100 (extremely).

**ERP-ABA task:** The participant’s in the ERP-ABA condition completed the same ERP task as the ERP group, with the addition of an attentional bias assessment. The ERP-ABA task allows the impact of participants seeing contamination images during the attentional bias assessment on ERP performance to be observed.

**Attentional bias assessment:** A dot-probe task was used to assess attentional bias. Two images were displayed for 500ms before a target (either the letter E or F)
replaced either the neutral or contamination image with equal probability. Participants were asked to click the corresponding mouse key when the target appeared. Eye-tracking movements and reaction time were recorded simultaneously. Twenty-five contamination and neutral images were used. Pre and post assessment were originally designed to have 50 trials in each, however, due to researcher error it was divided into 48 and 52 trials respectively.

**BAT Task**: The BAT is a procedure designed to measure avoidance as individuals are asked to complete a hierarchy of steps involving contact with a contaminate object, each step increases the amount of physical contact (Najmi, Tobin & Amir, 2012; see Appendix D). The number of steps completed is used as a measure of avoidance. The BAT has good convergent validity with the OCD symptom measures (Steketee, 1996; Woody et al., 1995). The BATs used by Najmi and Amir (2010) were used for this study. Three different BATs were carried out using three objects: 1. laundry basket with underwear, socks and ragged items of clothing; 2. a box of dog hair, dirt and dead crickets; and 3. public toilet (Cougle et al., 2007). Participants were asked to complete a BAT with each object twice; once before their main group task and once after the task is completed. Each BAT has six steps in a graded hierarchy task which asks the participants to make increasingly more contact with a contaminated object. The participant is asked to carry out as many steps as they feel comfortable doing so. If a participant refuses to complete a step the task is ended. The number of steps completed and their anxiety from 0-100 is recorded. Pre and Post BAT performance were used to measure changes in avoidance and anxiety in response to contamination related objects.
**Attentional bias reaction time:** Attention bias scores were calculated by subtracting reaction times measured in milliseconds (ms) from congruent trials (when the target is in the previous location of the threatening image) from reaction time from incongruent trials (when the target is in the previous location of the neutral image; Macleod et al., 2002). Positive scores indicate an attentional bias towards OCD related stimuli while negative scores indicate attentional bias away from OCD stimuli.

**Attentional bias Eye-tracking:** To measure attentional bias via eye-tracking, fixations were used to indicate where attention was directed. A fixation refers to the eye pausing on a select area of a visual scene; it is thought that during this pause visual information from the select area is cognitively processed (Irwin, 2004). Research has repeatedly demonstrated a close link between fixations and covert attention (Hayhoe & Ballard, 2005; Liversedge & Findlay, 2000; Rayner; 2009). Fixations can be used to indicate different attentional mechanisms and measure vigilance, delayed-disengagement and maintenance biases by the below measures.

**Vigilance**

Fixations can indicate hypervigilance to threatening stimuli if participants initially orientate their gaze more frequently and faster to threatening stimuli than to a natural image. Comparing the below measurements for contamination and neutral images can indicate hypervigilance for threatening stimuli:

a) Average frequency of initial fixation on images.

b) Average speed (latency) of initial fixation on images

**Delayed-disengagement**

Delayed disengagement bias can be observed if the first fixation a participant makes upon threatening stimuli is significantly longer than an initial fixation to neutral stimuli. This would suggest that it costs more effort to disengage attention from
threatening stimuli and this is the cause of the delay. By comparing the below measurements between contamination and neutral images delayed-disengagement for threatening stimuli can be detected.

a) Average duration of initial fixation on images

**Maintenance**

The overall time spent fixating and the number of fixations towards a threatening image comparison to a neutral image can determine if attention if a maintenance bias is present. If participants are looking more often and for greater lengths towards threatening image, this suggest attention is monitoring the threat; therefore, by comparing the below measurements between contamination and neutral images we can determine if attention is maintained on threatening stimuli.

a) Average duration of fixations on images

b) Average frequency of fixations on images

**5.3.4 Procedure**

The research was granted ethical approval by Queen’s University School of Psychology ethical committee. An online random number generator was used to assign participants to a group before the study began. Participants were given the information sheet to read and encouraged to ask any questions they may have. The random group assignment was explained and further information on the task they would be asked to complete was given. If participants were happy to engage in the study, they signed the consent form. All participants then completed the questionnaire measures OCI-R, SA, TA and DPSS-R. They then completed the three BATs. After the BATs were completed, the ABMT, PCT and ERP-ABA participants had their eye movements calibrated to the eye tracker and were asked to complete the attentional assessment. On completion of the attentional bias assessment, participants completed their
assigned task e.g. ABMT, PCT, or ERP. The ERP group did not complete an attentional bias assessment, instead following the BATs they moved straight into their ERP task. Following their group task (with the exception of the ERP group) the ABMT, PCT and ERP-ABA group completed another attentional bias assessment. They then completed the BATs for a second time, as did the ERP group. After the post task BATs were complete, they filled in the questionnaire measures again with the addition of the VOCI-VOCI-MC and DT scale. Participants were then given a verbal and written debrief, before being thanked for their participation and given a £5 Amazon gift card.

**ABMT procedure**: Before the ABMT task began participants were asked to verbally rate how much anxiety, disgust and urge to wash their hands they were experiencing from 0 (not at all) to 100 (extremely). The ABMT task began straight after the attentional bias assessment as participants were already calibrated to the eye tracker and the assessment required the same task performance as the training trials. Half way through the training trials participants were given a break and asked to again rate how much anxiety, disgust and urge to wash their hands they were experiencing. When participants indicated they were ready to continue the break ended, and they completed the remaining training trials. Follow the end of training trials the participant’s completed another attentional bias assessment. The attentional bias assessments and training trials flowed together so from the participant’s perspective it seemed like one big task. After the post attentional bias assessment was complete the participant was again asked to rate their anxiety, disgust and urge to wash their hands they were experiencing.

**PCT procedure**: The PCT procedure was identical to the ABMT with the exception that instead of the training trials, they completed the PCT task.
**ERP-ABA procedure:** Following attentional bias assessment and the BATs, participants were asked to select the object they found the most anxiety provoking from the BATs to use as their exposure object, their anxiety ratings in the BATs were used as guidance. Before the ERP task began participants were asked to verbally rate how much anxiety, disgust and urge to wash their hands they were experience from 0 (not at all) to 100 (extremely). In the ERP task, participants were then asked to make as much physical contact as they could with the object and maintain this for four minutes. When the four minutes had passed, they could break contact with the object but were asked to wait for two minutes before washing their hands. After two minutes had passed, they were asked to again rate their anxiety, disgust and urge to wash their hands from 0-100 before washing their hands. This pattern of exposure, rating and hand washing was repeated four more times. After the fifth and final exposure, participants were calibrated to the eye tracker and asked to carry out a post attentional bias assessment.

**ERP procedure:** The ERP procedure was identical to the ERP-ABA procedure with the exception that the ERP group did not complete any attentional bias assessments.

**5.4 Results**

**Demographics:** As participants were randomly allocated to groups, a one-way between group ANOVA was used to assess differences for questionnaire scores and age (See Table 7). The data met the assumptions for ANOVA analysis (See Appendix B for data screening). There were no significant differences between groups for pre-scores of trait anxiety, state anxiety or disgust. Nor were there differences for distress tolerance or mental contamination scores. But, there were significant differences found for pre OCI-R scores: $F (3, 76) = 2.96, p = .038$. Post hoc Tukey HSD tests found
that the ERP-ABA group was significantly higher for pre-OCI-R scores than the ABMT group \((p = .020)\). There was also a significant difference found for age \((F (3, 76) = 3.75, p = .015)\), Tukey HSD tests found that the ABMT group was significantly older than the ERP group \((p = .013)\).

**Questionnaire:** Mixed ANOVA’s were used to analyse questionnaire measures before and after each group task following a four (group: ABMT, PCT, ERP-ABA ERP,) by two (pre group task, post group task) design.

No significant findings were detected for OCI-R, disgust and trait anxiety. There was a significant main effect of time for state anxiety \((F (1, 73) = 12.52, p = .001, \eta^2 = .15)\). Tukey HSD tests found no significant differences between groups at pre and post level. There were no significant effects of time within the ABMT and the ERP-ABA group. The PCT group had significantly lower state anxiety, \((F (1, 18) = 7.81, p = .012, \eta^2 = .30)\) at post \((M = 46.47, SD = 4.10)\) than pre measure \((M = 43.31, SD = 5.80)\). The ERP group, also has a significantly lower \((F (1, 18) = 6.29, p = .012, \eta^2 = .25)\) post \((M = 43.45, SD = 6.14)\) than pre state anxiety scores \((M = 46.00, SD = 5.05)\).

Table 8

Demographic and Questionnaire Scores of Groups

<table>
<thead>
<tr>
<th>Demographic/Questionnaires</th>
<th>Groups</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>ABMT Mean (SD)</td>
<td>PCT Mean (SD)</td>
<td>ERP-ABA Mean (SD)</td>
<td>ERP Mean (SD)</td>
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<tr>
<td>Age</td>
<td>30.53 (9.04)</td>
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<td>24.95 (6.35)</td>
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<td>OCI-R</td>
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<td>Trait Anxiety</td>
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<td>50.55 (7.03)</td>
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</tr>
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<td>State Anxiety</td>
<td>44.58 (4.18)</td>
<td>46.47 (4.10)</td>
<td>43.16 (6.12)</td>
<td>46.60 (5.05)</td>
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<td>Distress Tolerance</td>
<td>34.89 (8.12)</td>
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<td>38.84 (7.68)</td>
<td>36.00 (6.87)</td>
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<td>Mental contamination</td>
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<td>49.61 (11.89)</td>
<td>55.00 (12.08)</td>
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</tbody>
</table>
Attentional Bias reaction time: Incorrect trials were excluded. The reaction time was measured in milliseconds. Scores that were less than 200ms or more than 2000ms were excluded. Scores that were two standard deviation from individual average were also removed. A mixed three (groups: 1. ABMT, 2. PCT, 3. ERP-ABA) by two (Attention bias score: pre, post) ANOVA was conducted to assess attentional bias scores (See Appendix B for data screening for ANOVA analysis). No significant simple or main effects were found, or significant group differences between pre and post congruent and incongruent reaction times. Within analysis found that post scores for both congruent ($F (1, 54) = 28.48, p < .001, \eta^2 = .35$) and incongruent ($F (1, 54) = 19.77, p < .001, \eta^2 = .27$) trials were faster than pre trials across all groups. See Table 8 below for average reaction time scores.

<table>
<thead>
<tr>
<th>Reaction Time Measures</th>
<th>Groups</th>
<th>ABMT Mean (SD)</th>
<th>PCT Mean (SD)</th>
<th>ERP-ABA Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attentional Bias Scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>3.13 (50.08)</td>
<td>5.69 (34.18)</td>
<td>10.99 (46.38)</td>
<td></td>
</tr>
<tr>
<td>Post</td>
<td>3.35 (53.68)</td>
<td>9.48 (57.47)</td>
<td>10.25 (45.02)</td>
<td></td>
</tr>
<tr>
<td>Reaction times</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-congruent</td>
<td>683.05 (128.13)</td>
<td>719.16 (239.30)</td>
<td>673.60 (160.07)</td>
<td></td>
</tr>
<tr>
<td>Post-congruent</td>
<td>608.65 (98.80)</td>
<td>620.94 (129.08)</td>
<td>607.27 (112.88)</td>
<td></td>
</tr>
<tr>
<td>Pre-incongruent</td>
<td>686.18 (142.55)</td>
<td>724.86 (250.82)</td>
<td>697.74 (191.71)</td>
<td></td>
</tr>
<tr>
<td>Post-incongruent</td>
<td>612.00 (81.77)</td>
<td>630.42 (124.98)</td>
<td>617.53 (123.26)</td>
<td></td>
</tr>
</tbody>
</table>

Attentional Bias eye movements: Mixed ANOVA’s were used to analyse eye movements on pre and post contamination images following a three (group: ABMT,
PCT, ERP,) by two (Type of eye event e.g. initial fixation count pre and post) design. When the assumption of sphericity was violated Greenhouse-Geisser was reported.

Vigilance

Initial Fixation Count

A mixed ANOVA exploring differences between and within groups for pre and post initial fixation count towards contamination stimuli found no significant simple or main effects.

Latency of Initial Fixation

Mixed ANOVA analysis found a statistically significant interaction between group and latency of initial fixation to contamination images, $F(2, 54) = 5.90, p = .005, \eta^2 = .18$. Post hoc Tukey HSD tests indicate that the ERP ($M = 266.99, SD = 66.42$) group had a significantly faster speed of initial fixation towards pre contamination images than the ABMT group ($M = 306.98, SD = 30.62, p = .043$). The PCT did not significantly differ from ABMT or ERP for speed of initial fixation to pre contamination images. No significant differences between groups for speed of initial fixation to post contamination images were detected. A within measures ANOVA was ran for post hoc analysis and found a statistically significant effect of time for the ABMT group ($F(1, 18) = 6.35, p = .021, \eta^2 = .26$). The speed of initial fixation to post contamination images ($M = 285.42, SD = 41.16$) was faster than the speed of the initial fixation to pre contamination images ($M = 306.98, SD = 30.63$). No significant effects of time for the ERP or the PCT group were detected.

Delayed disengagement

Initial Fixation Duration: The analysis revealed a significant interaction between time and group ($F(1, 54) = 3.45, p = .039, \eta^2 = .11$). A Tukey HSD test found no significant differences between groups at pre and post levels. A within measures
ANOVA was ran for post hoc analysis and found that the ABMT group made significantly, \( F(1, 18) = 9.02, p = .008, \eta^2 = .34 \), longer initial fixation durations to post \( (M = 191.95, SD = 29.55) \) than to pre \( (M = 168.68, SD = 23.95) \) contamination images.

**Maintenance**

Fixation Count No significant interaction or group differences for the total number of fixations on contamination related images were detected. There was, however, a significant main effect of time \( F(1, 54) = 6.73, p = .012, \eta^2 = .11 \). A within measures ANOVA post hoc analysis revealed that there was a significant effect of time in the ABMT group, \( F(1, 18) = 9.58, p < .001, \eta^2 = .35 \), as fixation count was greater for post \( (M = 1.23, SD = 0.17) \) than pre \( (M = 1.11, SD = 0.12) \) contamination images. No significant effect of time was found for the PCT or the ERP-ABA group.

Fixation Time: A significant interaction between time and group, \( F(2, 54) = 4.22, p = .039, \eta^2 = .14 \) was detected for fixation time. Tukey HSD tests found no significant differences between groups at pre and post levels. There were no significant effects of time for the ERP or the PCT group. Within measures ANOVA found the ABMT group made significantly, \( F(1, 18) = 10.38, p = .005, \eta^2 = .37 \), longer fixation durations to post \( (M = 227.41, SD = 51.79) \) than pre \( (M = 187.60, SD = 41.79) \) contamination images.

BAT performance: Due to allergies, three participants were excluded from the BAT involving dirt, dead insects and dog hair. This object was then removed when calculating these participants total percentage of avoidance and average anxiety per step. As several participants were unable to complete any steps in both pre and post measures this resulted in average anxiety scores of ‘0’ however, they did not perform any anxiety provoking steps. Rather than omitting these participants, change scores
for each participant were calculated. Changes scores for average anxiety and percentage of steps avoided were taken by subtracting pre from post scores (change scores = post score minus pre score). A change score with a negative value indicates a decrease in anxiety or avoidance following intervention/control task, whereas a positive value indicates an increase. One way between group ANOVA was ran for change scores of: 1) percentage of steps avoided per contamination object; 2) average anxiety per step for each contamination object; 3) a total score for anxiety across all objects combined; and 4) total score for avoidance all objects combined. See Table 9.

Figure 3. Average Percentage of avoidance pre and post intervention/control task from the BAT.
Figure 4. Average anxiety pre step pre and post intervention/control task form the BAT.

BAT Toilet: There was no significant difference between changes scores in anxiety between groups. There was a significant difference found for change scores of pre and post avoidance, $F(3, 73) = 2.74, p = .049, \eta^2 = .10$. However, Tuckey HSD did not find any significant differences between groups.

BAT Laundry: There were no significant differences between groups for change scores in average anxiety or avoidance of steps in the laundry task.

BAT Dirt: The analysis found no significant difference between changes scores in anxiety between groups. However, there was significant difference found for change scores of avoidance ($F(3, 73) = 3.74, p = .015, \eta^2 = .13$). Tuckey HSD post hoc test found that the ERP-ABA group ($M = -12.28\%; SD = 25.96$) displayed a significantly ($p = .009$) greater reduction in avoidance than the ABMT group ($M = 6.14\%; SD = 20.19$).
Table 10

BAT Change Scores and Effect Size

<table>
<thead>
<tr>
<th>BAT Performance</th>
<th>Toilet</th>
<th>Laundry</th>
<th>Dirt</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidance</td>
<td>CS (SD)</td>
<td>d</td>
<td>CS (SD)</td>
<td>d</td>
</tr>
<tr>
<td>ABMT</td>
<td>12.28 (32.31)</td>
<td>-6.14</td>
<td>0.19</td>
<td>6.14 (20.19)</td>
</tr>
<tr>
<td>PCT</td>
<td>1.75 (25.39)</td>
<td>-0.87</td>
<td>0.03</td>
<td>0.00 (5.55)</td>
</tr>
<tr>
<td>ERP-ABA</td>
<td>-10.52 (31.53)</td>
<td>-0.00</td>
<td>0.00</td>
<td>-12.28 (25.96)</td>
</tr>
<tr>
<td>ERP</td>
<td>-9.16 (22.60)</td>
<td>-7.50</td>
<td>0.22</td>
<td>-4.16 (10.64)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>CS (SD)</th>
<th>d</th>
<th>CS (SD)</th>
<th>d</th>
<th>CS (SD)</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABMT</td>
<td>-5.50 (27.87)</td>
<td>-4.87</td>
<td>0.21</td>
<td>-0.75 (18.96)</td>
<td>0.05</td>
<td>-4.23 (13.84)</td>
</tr>
<tr>
<td>PCT</td>
<td>-7.73 (16.90)</td>
<td>-3.37</td>
<td>0.20</td>
<td>-2.53 (14.07)</td>
<td>0.10</td>
<td>-5.23 (7.50)</td>
</tr>
<tr>
<td>ERP-ABA</td>
<td>-0.08 (24.01)</td>
<td>-6.84</td>
<td>0.36</td>
<td>0.78 (26.60)</td>
<td>0.04</td>
<td>-4.89 (10.10)</td>
</tr>
<tr>
<td>ERP</td>
<td>-10.68 (14.39)</td>
<td>-5.10</td>
<td>0.27</td>
<td>-7.48 (18.46)</td>
<td>0.49</td>
<td>-6.14 (20.10)</td>
</tr>
</tbody>
</table>

Note. CS = Change Score, SD = Standard Deviation, d = Cohen’s d effects size.

Overall BAT: The results indicated no significant differences between overall anxiety change scores between groups. There was a significant difference found for avoidance; $F(3, 73) = 3.61, p = .017, \eta^2 = .13$. Tuckey HSD post hoc test found that ERP-ABA ($M = -7.60, SD = 13.12$) and ERP ($M = -7.87, SD = 13.57$) and greater reduction in avoidance than ABMT ($M = 4.10, SD = 11.84$).

Correlations analysis: Correlations were ran to explore the relationship between change scores for BAT performance (anxiety, avoidance) and questionnaire scores within groups to explore any influence of the measures on BAT performance following either an intervention or control task. Specifically, the current study was interested in exploring how measures of mental contamination, distress tolerance, age,
symptom severity and disgust may have been related to outcomes of the ABMT and ERP. Overall effect sizes of Cohen’s D were used to indicate strength of relationships, and relationships with a medium effect size or greater are discussed. See Table 10.

ABMT Avoidance: A negative relationship with a medium effect size was detected between age and change scores for avoidance in the BAT. In the ABMT group it appears that as age increases there is a greater reduction in avoidance. Increased avoidance was found to be linked to greater symptom severity.

ABMT Anxiety: Higher distress tolerance scores were linked to a greater reduction in anxiety as indicated by a negative association between these two variables with a medium effect size.

PCT Avoidance: As with the ABMT group, in the PCT group as age increases there is a greater reduction in avoidance as described by a negative relationship between these two measures with a medium effect size. Within this group it was found that mental contamination increases so too do change scores for avoidance, indicating greater avoidance being associated with greater mental contamination scores following PCT.

PCT Anxiety: Higher pre scores of disgust were found to be linked to a greater reduction in anxiety following PCT with a large effect size. A negative association was detected between distress tolerance and anxiety change scores, indicating that higher distress tolerance scores are linked to decrease in anxiety following PCT.

ERP-ABA Avoidance: Older age was associated to an increase in avoidance following ERP with ABA assessment with a medium effect size.

ERP-ABA Anxiety: Positive associations with medium effect sizes between anxiety and disgust, mental contamination, distress tolerance and symptom severity
were also detected. Indicating that as each of the increased, so too does anxiety following ERP-ABA.

ERP Avoidance: No associations were detected between any of the questionnaire scores and change scores of avoidance in the BAT.

ERP Anxiety: A positive association with a medium effect size was found between age and anxiety following ERP. This suggests that as age increases, so too does anxiety. A negative relationship with a medium effect size was found between distress tolerance and change scores for anxiety, suggesting that lower distress tolerance scores are linked to an increase in anxiety following ERP. Disgust was negatively linked to anxiety change scores, therefore as disgust increased, anxiety was found to decrease.

Table 11

Correlations between Questionnaires and BAT Performance

<table>
<thead>
<tr>
<th>Change Scores</th>
<th>Age</th>
<th>Pre DSPS</th>
<th>Pre OCI-R</th>
<th>VOCI-MC</th>
<th>DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABMT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>-.35*</td>
<td>.26</td>
<td>.36*</td>
<td>.26</td>
<td>.15</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.09</td>
<td>-.05</td>
<td>-.03</td>
<td>.16</td>
<td>-.36*</td>
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<tr>
<td>PCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>-.30*</td>
<td>.26</td>
<td>-.03</td>
<td>.43*</td>
<td>-.28</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.27</td>
<td>-.70**</td>
<td>.09</td>
<td>-.18</td>
<td>-.44*</td>
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<tr>
<td>ERP-ABA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>.30*</td>
<td>.15</td>
<td>.07</td>
<td>.02</td>
<td>-.11</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.08</td>
<td>.47*</td>
<td>.53*</td>
<td>.40*</td>
<td>.39*</td>
</tr>
<tr>
<td>ERP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>.23</td>
<td>-.07</td>
<td>.05</td>
<td>.13</td>
<td>-.02</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.36*</td>
<td>-.37*</td>
<td>.19</td>
<td>-.22</td>
<td>-.42*</td>
</tr>
</tbody>
</table>

Note: *= medium effect size, ** large effect size
Verbal Reports of Anxiety, Disgust and Urge to Wash Hands: One-way within ANOVAs were ran to analyse measures of anxiety, disgust and urge to wash hands across different intervention tasks. If sphericity was violated Greenhouse-Geisser was reported.

Measures of anxiety, disgust and urge to wash hands were recorded before, during the halfway break and after the computer task in the ABMT and PCT group giving three time points, pre, mid and post. As ERP requires the charting of anxiety across exposures, measures of anxiety, disgust and urge to wash hands were recorded at six time points in the ERP and the ERP-ABA groups, before the task and after all five of the exposures, the last measure serving as a post task measure. See Table 11 for average scores.
Table 12  
*Ratings of Verbal Reports of Anxiety, Disgust and the Urge to Wash Hands Across Time Points*  

<table>
<thead>
<tr>
<th>Time Points</th>
<th>Verbal Ratings</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anxiety Mean (SD)</td>
<td>Disgust Mean (SD)</td>
<td>Urge to wash hands Mean (SD)</td>
</tr>
<tr>
<td>ABMT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>21.32 (31.53)</td>
<td>6.63 (15.26)</td>
<td>13.87 (24.95)</td>
</tr>
<tr>
<td>Mid</td>
<td>23.95 (27.87)</td>
<td>19.47 (27.07)</td>
<td>19.08 (23.44)</td>
</tr>
<tr>
<td>Post</td>
<td>27.57 (31.22)</td>
<td>28.58 (32.76)</td>
<td>27.50 (33.11)</td>
</tr>
<tr>
<td>PCT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>17.63 (17.98)</td>
<td>2.37 (7.14)</td>
<td>8.16 (15.38)</td>
</tr>
<tr>
<td>Mid</td>
<td>23.42 (18.34)</td>
<td>11.05 (20.72)</td>
<td>14.32 (21.03)</td>
</tr>
<tr>
<td>Post</td>
<td>21.84 (22.62)</td>
<td>15.63 (24.93)</td>
<td>16.84 (25.78)</td>
</tr>
<tr>
<td>ERP-ABA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>28.16 (22.62)</td>
<td>27.63 (27.25)</td>
<td>35.79 (36.10)</td>
</tr>
<tr>
<td>Exposure 1</td>
<td>43.95 (26.49)</td>
<td>52.63 (28.11)</td>
<td>77.89 (24.79)</td>
</tr>
<tr>
<td>Exposure 2</td>
<td>43.42 (28.82)</td>
<td>51.32 (29.29)</td>
<td>74.21 (24.62)</td>
</tr>
<tr>
<td>Exposure 3</td>
<td>37.37 (23.36)</td>
<td>46.84 (25.59)</td>
<td>67.37 (25.89)</td>
</tr>
<tr>
<td>Exposure 4</td>
<td>31.97 (23.49)</td>
<td>42.63 (25.52)</td>
<td>63.16 (30.29)</td>
</tr>
<tr>
<td>Exposure 5</td>
<td>28.26 (24.95)</td>
<td>39.21 (28.64)</td>
<td>56.58 (34.88)</td>
</tr>
<tr>
<td>ERP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>21.43 (19.23)</td>
<td>30.50 (26.99)</td>
<td>29.50 (35.80)</td>
</tr>
<tr>
<td>Exposure 1</td>
<td>38.75 (22.12)</td>
<td>45.65 (28.53)</td>
<td>64.25 (33.45)</td>
</tr>
<tr>
<td>Exposure 2</td>
<td>36.65 (19.50)</td>
<td>41.25 (27.95)</td>
<td>63.35 (32.16)</td>
</tr>
<tr>
<td>Exposure 3</td>
<td>31.95 (19.77)</td>
<td>36.35 (25.14)</td>
<td>56.40 (31.54)</td>
</tr>
<tr>
<td>Exposure 4</td>
<td>30.05 (23.94)</td>
<td>35.30 (29.96)</td>
<td>53.50 (32.84)</td>
</tr>
<tr>
<td>Exposure 5</td>
<td>26.65 (23.50)</td>
<td>31.65 (27.32)</td>
<td>50.50 (34.75)</td>
</tr>
</tbody>
</table>
ABMT: The analysis found that ratings of anxiety across the ABMT task did not significantly differ from one another. There was a significant difference between time points for ratings of disgust, \((F(2, 36) = 7.62, p = .005, \eta^2 = .30)\). Post hoc Bonferroni analysis found that post measures of disgust (see Table 4) were significantly higher than pre measures \((p = .018)\). No significant differences were found for measures of urge to wash hands across the task.

![ABMT](image)

*Figure 5.* Average ratings of anxiety, disgust and the urge to wash hands across ABMT task.

**PCT:** No significant differences between time points for anxiety and urge to wash hands across the PCT task were detected. There was a significant difference between time points for ratings of disgust, \((F(2, 36) = 6.28, p = .005, \eta^2 = .30)\). Post hoc Bonferroni analysis found that post measures of disgust were significantly higher than pre measures \((p = .029)\).
Figure 6. Average ratings of anxiety, disgust and the urge to wash hands across PCT task.

ERP-ABA: Ratings of anxiety significantly differed across the ERP-ABA task ($F (2.35, 42.21) = 7.62, p = .001, \eta^2 = .30$). Post hoc Bonferroni analysis found that pre-ratings of anxiety were significantly lower ($p = .035$) than anxiety ratings after the first exposure. Anxiety then significantly reduced after the fourth ($p = .010$) and fifth ($p = .011$) exposure.
Figure 7. Average ratings of anxiety, disgust and the urge to wash hands across ERP-ABA task.

There was a significant difference between time points for ratings of disgust, $(F(2.10, 37.85) = 9.65, p < .001, \eta^2 = .40)$. Post hoc Bonferroni analysis found that pre measures of disgust were significantly lower ($p < .05$) than all subsequent time points with the exception of the post measure, no significant differences were detected between pre and post measures of disgust.

The urge to wash hands significantly differed between time points, $(F(2.00, 35.91) = 15.60, p < .001, \eta^2 = .46)$. Post hoc Bonferroni analysis found that pre measures of urge to wash hands were significantly lower than after the first four exposures ($p < .05$) but no significant differences were found between pre and post exposure measures.

ERP: Within the ERP group ratings of anxiety significantly differed between time points, $(F(2.01, 38.26) = 6.09, p = .005, \eta^2 = .24)$. Post hoc Bonferroni analysis found that pre measures of anxiety were significantly lower than after the first ($p < .001$) and second exposure ($p = .003$) (see Table 2 for means). The fourth ($p = .010$) and post ($p = .011$) exposure rating of anxiety were significantly lower than the first exposure. No significant differences between pre and post measures were detected.
Ratings of disgust were also found to significantly differ across the study, \( (F(1.93, 36.65) = 3.362, p = .047, \eta^2 = .15) \). Post hoc Bonferroni analysis found that pre measures of disgust were significantly \( (p = .001) \) lower than after the first exposure. Post measures of disgust were significantly lower than after exposures one-three \( (p = .015-.039) \).

There was a significant difference between time points for ratings of the urge to wash hands, \( (F(2.39, 45.49) = 8.71, p < .001, \eta^2 = .31) \). Post hoc Bonferroni analysis found that pre measures were significantly lower than after exposures one-three \( (p = .002) \). No significant differences between pre measures and post measures were detected.

![Figure 8. Average ratings of anxiety, disgust and the urge to wash hands across ERP task](image)

**Study Evaluation scale**

A one-way between groups ANOVA was carried out to assess group differences between items in the study evaluation scale and overall scores of acceptability. Overall scores of acceptability were calculated by adding all of the rating
variables together with ratings of anxiety and challenge being reversed scored. There were no differences found between groups for rating of anxiety, motivation, engagement and challenging. Significant differences were found between groups for effectiveness \((F (3, 70) = 3.275, p = .026, \eta^2 = .12)\). Tukey HSD post hoc analysis found that the ERP-ABA \((M = 3.00, SD = 1.14)\) was significantly higher \((p = .030)\) than the PCT \((M = 2.17, SD = .86)\) group for effectiveness. No other significant differences were found between the remaining groups for effectiveness. Significant difference was found between groups for the perceived ability to reduce OCD symptoms \((F (3, 70) = 3.23, p = .027, \eta^2 = .12)\). Tukey HSD post hoc analysis found that the ERP-ABA \((M = 3.15, SD = .81)\) was rated significantly higher \((p = .027)\) than the PCT \((M = 2.11, SD = 1.37)\) group for perceived ability to reduce symptoms. No other significant differences were found between groups for perceived ability to reduce symptoms or total scores of acceptability.

Correlation analysis was used to explore relationships within groups between symptom severity, as measured by pre scores of the OCI-R and the average total score and individual items for the study evaluation scale (See Table 12). Overall effect sizes were used to indicate strength of relationships, relationships with a medium effect size or greater are discussed.
Table 13

*Correlations between OCI-R and Study Evaluation Scale*

<table>
<thead>
<tr>
<th>Total Study Evaluation Scale and Items</th>
<th>Total Acceptability</th>
<th>Anxiety</th>
<th>Engage</th>
<th>Challenge</th>
<th>Effect</th>
<th>Motivated</th>
<th>Reduce Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABMT</td>
<td>-.16</td>
<td>.34*</td>
<td>.31*</td>
<td>.43*</td>
<td>.42*</td>
<td>.13</td>
<td>-.34*</td>
</tr>
<tr>
<td>PCT</td>
<td>-.10</td>
<td>.36*</td>
<td>.26</td>
<td>.40*</td>
<td>.03</td>
<td>-.25</td>
<td>.44*</td>
</tr>
<tr>
<td>ERP</td>
<td>.07</td>
<td>.39*</td>
<td>.17</td>
<td>.26</td>
<td>.15</td>
<td>.37*</td>
<td>.21</td>
</tr>
<tr>
<td>ERP-ABA</td>
<td>.68**</td>
<td>.73**</td>
<td>.69**</td>
<td>.37*</td>
<td>.78**</td>
<td>.58**</td>
<td>.78**</td>
</tr>
</tbody>
</table>

*Note: *= medium effect size, ** large effect size*

**ABMT:** Symptom severity was found to be linked to how anxiety-provoking, engaging, challenging and effective participants rated the ABMT task to be. For ABMT’s ability to reduce symptoms a negative relationship was detected, as OCD symptoms increased its perceived ability to reduce OCD symptoms decreased.

**PCT:** The analysis found that OCD symptoms were positively related to how anxiety-provoking, challenging and the PCT tasks ability to reduce symptoms was.

**ERP:** Within the ERP group, severity of OCD symptoms was positively linked to how anxiety-provoking and how motivated participants would be to undergo ERP.

**ERP-ABA:** Large effect sizes were detected between positive relationships between OCD symptom severity and for how anxiety-provoking, engaging, challenging, effective participants felt ERP was. Positive relationships were also detected between how motivated participants were to partake in ERP and for its perceived ability to reduce OCD symptoms.
5.5 Discussion
The current study aimed to explore the effects of ABMT on attentional bias, performance in a contamination themed BAT and OCD symptoms in individuals with contamination concerns, and this was then compared to the effects of ERP. Counter to the hypotheses and previous research, ABMT appeared to have a negative effect on attentional bias. While ERP did not alter the attentional processing of contamination images, both ERP groups displayed significantly greater reduction of avoidance in the BAT task in comparison to the ABMT group. Whereas individuals in the ABMT group displayed an increase in avoidance in the majority of BAT task conditions. No changes in OCD symptoms were found across the sample. A secondary aim of the study was to explore any links between mental contamination, distress tolerance, age and symptom severity on BAT performance across the groups. No relationship was detected for mental contamination in the ABMT group, however, in the PCT group higher mental contamination was linked to greater avoidance in the BAT. Distress tolerance was related to a greater reduction in anxiety following BAT in the ERP group as was predicted, however, contradictory findings were discovered in the ERP-ABA group in which increased distress tolerance was linked to increased anxiety. Oppositional to what was predicted, older age was linked to a greater reduction in avoidance in the ABMT group, whereas in both ERP groups older age was linked to increased avoidance and anxiety.

When exploring attentional bias across the study, the only group to alter attention deployment post intervention was the ABMT group. Analysis of the eye movement data found that following ABMT, participants orientated attention towards contamination images more often and for greater lengths of time in comparison to before the intervention. Indicative of a bias which supports the vigilance hypothesis, participants in the ABMT group directed their gaze faster towards the post intervention
contamination images in comparison to pre intervention images. There was an increase in how often and how much time was spent with gaze directed towards contamination images. There was also a greater amount of time spent disengaging gaze from contamination images following the first fixation. These findings suggest an increase in attentional bias in the form of both vigilance and delayed disengagement/maintenance with the ABMT group. These results are conflicting with the current studies’ hypothesis and with the findings of the previous literature, in which ABMT has been found to reduce attentional bias. Both Habedank et al., (2017), and Najmi and Amir (2010), found a reduction in attentional bias following ABMT; however, both of these studies have used reaction time to calculate and compare attentional bias scores. The reaction time attentional bias scores of the current study revealed no significant differences across any group. The current studies contrasting findings of reaction time and eye tracking measures of attention further supports the argument that sensitive methodologies that are able to continually capture attention are preferable to those, such as reaction time, that allow only a snapshot to be measures (Armstrong & OlatunjI, 2010). An increase in attentional bias was only present in the ABMT group, suggesting that it may be the result of the contingency between the neutral stimuli and target. Previously, researchers have suggested that for a change in attentional bias to occur, the link between the neutral stimuli and the target should be made apparent to participants, providing them with a rationale to engage with the paradigm (Notebaert et al., 2015). This may counter potential boredom effects and reduce the interpretation of the ABMT as strange (Beard et al., 2012). However, to explain the rationale of the ABMT to participants could cause any reduction of attentional bias to be the result of effortful avoidance of the contamination images to please the researcher, rather than as a result of attentional training. Attempts to explain
null findings following ABMT in other areas of research, such as anxiety, have highlighted the possibility that participants may completely ignore the neutral stimuli and only commence search for a target when it appears (Bradley et al., 2010; Notebaert et al., 2015) resulting in, no attention training tasks place. It is possible that in the current study, participants may have worked out the paradigm - and so where the target would appear - which may have resulted in a decrease in effort and attentional resources required for task performance, freeing up attentional resources which were then directed towards contamination images. This may explain why an increase in attentional bias in PCT did not occur as there was no link between image content and target which may have resulted in more effortful engagement with the task and less attentional processing of images. The findings of the current study support concerns that have been raised regarding the use of ABMT and the uncertainty of its ability to train attention (Koster et al., 2010). Further research is required to understand the specific influence of ABMT on attentional processes in order to reduce the risk of its application exacerbating attentional bias processing and subsequently aggravating symptoms.

No changes in attentional biases were detected in the ERP group. The minimal previous research in this area that has found a reduction of attentional bias following ERP have been longitudinal, spanning over weeks of multiple ERP sessions (Direnfeld et al., 2003; Foa & McNally, 1986). It may be that without being specifically targeted, changes in attentional bias occur over time following ERP, perhaps as the result of corrective information gained during the initial ERP sessions. Further research which explores the influence of multiple ERP sessions on attentional bias using sensitive methodologies to capture attention is required to further understand if an indirect therapeutic approach can influence attentional biases.
With regards to BAT task performance, in all groups, anxiety appeared to reduce post intervention/control task, however, the effect sizes were small for this change. The results found that both ERP groups displayed significant reduction in avoidance in comparison to ABMT. Exploring the change scores for each group revealed that the ABMT increased in avoidance in the majority of BAT tasks, whereas both ERP groups reduce in avoidance across the majority of BAT tasks, however, it is important to note that similar to changes in anxiety, the effect sizes were small for all avoidance. Avoidance of feared materials related to obsessive symptoms is a well-documented maladaptive coping mechanism that maintains OCD symptoms (Gillan et al., 2014; Veale, 2007), the ability of a single session of ERP to reduce behavioural avoidance provides further support for its efficacy in treating OCD symptoms (Abramowitz & Jacoby, 2015; Koran & Simpson, 2013; NICE, 2013). ABMT’s lack of ability to influence BAT performance in the current study is contradictory to the findings from Najmi and Amir’s research (2010); however, Najmi and Amir’s research did not include a baseline measure of BAT performance and they did report a decrease in attentional bias, albeit by reaction time. It may be that reducing attentional bias will result in a reduction of behavioural avoidance but as the current study found ABMT to have no influence on attentional bias, no therapeutic effects were observed on BAT performance. The current findings tentatively suggest that as it currently stands ABMT is not a reliable method of reducing attentional bias, therefore, it cannot be relied upon to reduce behavioural avoidance as a result. Although a single session of ERP may not reduce an attentional bias, the results support its efficacy of its ability to reduce maladaptive coping mechanisms related to OCD such as avoidance.

A secondary aim of the study was to observe any links between mental contamination, distress tolerance, age and symptom severity with BAT performance
in ABMT and ERP. No apparent relationship between mental contamination and ABMT was observed. This may be due to the lack of therapeutic benefit from ABMT; however, in the PCT group, greater mental contamination was linked to greater avoidance following the PCT task. This finding suggests that those individuals with greater mental contamination in the PCT, may have had anxiety triggered by viewing contamination images, impairing their ability to interact with physical contaminates following the task. It also suggests that those with less mental contamination may not have been as influenced by the contamination images, suggesting that avoidance of physical contaminates was not exacerbated by viewing contaminant images beforehand. This supports the concern that those who experience less mental contamination may not be suitable for interventions which involve the passive viewing of anxiety-provoking stimuli, such as ABMT. With regards to distress tolerance, higher distress tolerance was linked to a greater reduction in anxiety post intervention/control task in the ABMT, PCT and ERP task. The finding that distress tolerance is linked to reduced avoidance following ERP is in line with the current studies predictions for this relationship between these two variables. As ERP is an emotionally demanding therapeutic intervention which requires the elicitation of distress, the ability to tolerate discomfort may reduce the risk of dropout and facilitate engagement with ERP performance and subsequently enhance therapeutic gains. But, contradictory to this finding was the link between higher distress tolerance and increased anxiety in the ERP-ABA group. This may be the result of the combination of decreased avoidance and the progression of interaction with contaminate objects, resulting in greater anxiety. However, this was not found for the ERP group who also had reduced BAT avoidance. Potentially, due to the ERP-ABA group undergoing both an exposure task and an attentional bias assessment, higher distress tolerance lead
participants to higher engagement with contamination images in the attentional bias assessment; building upon the anxiety from the recent exposure task.

Surprisingly, when exploring older age in the ABMT group and performance on the BAT task, older age was found to be related to a greater reduction in avoidance. However, as this relationship was found in the PCT group and as none of these groups displayed any therapeutic effects this link between older age and reduction in avoidance may not be related to the ABMT paradigm. It is possible that the ABMT and PCT task served as a form of exposure, as individuals viewed multiple contamination images. This form of exposure may have resulted in older adults increasing their activity with contamination objects post intervention/control task, which suggests that despite older adults being more unlikely to access computers, it may not impede their engagement with materials displayed via the computer (Lee & Coughlin, 2015). It is possible that younger adults were more habituated to computer-based activities and this may have led to a reduction in interest and less engagement with materials, therefore, contamination images may not have served as a form of exposure. This would subsequently not lead to a reduction in avoidance as was found in older adults who may have found the computer task more novel and captivating of attention, however, this is a highly speculative claim which requires further research for support. Contrasting finding between age and BAT performance were found in the ERP-ABA and ERP groups, in these groups older age was linked to increased avoidance and anxiety. This agrees with the previous literature which has found ERP to be more effective in younger participants, perhaps due to its demanding nature (Eisen et al., 2010). The analysis of the relationship between symptom severity and BAT performance across groups found that greater symptoms were linked to enhanced avoidance in the ABMT group and increased anxiety in the ERP-ABA group. This
finding is in line with previous research that has found severe symptoms to be a significant predictor of poorer intervention for OCD (Eisen et al., 2012; Keeley et al., 2008; Knoop et al., 2013; Kyrios et al., 2015).

With regards to acceptability of each intervention, the results found that there were no significant differences between ABMT, ERP and PCT for individual items on the study evaluation scale or the total score for acceptability. The ERP-ABA group was rated significantly higher for effectiveness and its perceived ability to reduce symptoms than the PCT group, however, no differences were detected between acceptability of the ERP groups and ABMT. Due to ABMT involving no direct contact with a feared object, this result is unexpected, especially as ERP is frequently criticized for its low acceptability to service-users due to its confrontation of feared objects (Franklin & Foa, 2007). This finding disagrees with the results of the previous Chapter in this thesis (Chapter 4) which found that found EPR was rated as more anxiety-provoking, effective and having a greater ability to reduce symptoms than ABMT. However, it is important to note that the while the ERP task included contact with a contamination related object designed to provoke discomfort in individuals with contamination concerns, OCD is a highly idiosyncratic disorder (Bloch et al., 2015) even within subgroups of symptoms. Despite the ERP task using the most anxiety provoking contamination related object from the BAT, it is possible that participants experienced less anxiety then they would have if the object been personalised to their own intrusive thoughts relating to contamination concerns as traditional ERP therapy would do.

The study also wished to explore the influence of symptom severity on acceptability of ABMT and ERP. Across all groups, as symptom severity increased so too did ratings for how anxiety provoking participants found the intervention/control
tasks to be. This suggests that the confrontation of materials related to OCD symptoms is associated with anxiety for those with greater symptom severity across multiple modalities. Within the ABMT group, greater symptom severity was positively related to how engaging, challenging and effective participants rated ABMT to be. This finding is promising as despite being challenging, participants with greater OCD symptoms felt ABMT was engaging and effective, supporting its possible role as a treatment for severe OCD. However, a negative relationship was detected between symptom severity and participant ratings for how much they felt ABMT’s could reduce OCD symptoms. In the current study, participants’ verbal reports in the ABMT group revealed that levels of disgust significantly increased and remained significantly higher than pre measures across the study. This suggests a danger of the participants perceiving an unfavourable cost-benefit analysis of ABMT as the negative experiences of ABMT such as disgust, are not abated by a clear rationale for symptom reduction. This is concurrent with concerns that participants will struggle to understand how ABMT works and reduce their level of engagement (Beard et al., 2012; Brosan, Hoppitt, Shelfer, Sillence & Mackintosh, 2011).

Concerning ERP’s acceptability, in the ERP-ABA group OCD symptoms were positively linked to ratings of total acceptability and for how anxiety-provoking, engaging, challenging and effective participants rated ERP to be. Participants in this group also displayed a positive relationship between OCD symptoms and for how motivated they were to undergo ERP and for its perceived ability to reduced symptoms. These findings challenge the original hypothesis that greater symptom severity would be related to decreased acceptability for ERP. It suggests that even though individuals with greater symptom severity experienced negative aspects of ERP such as its level of anxiety-provocation, they also found it to be effective and
believed its ability to reduce symptoms. Analysis of verbal reports of anxiety, disgust and the urge to wash hands in the ERP groups suggest that despite increasing after the initial exposures, these feelings significantly decreased across the experiment. Perhaps experiencing the therapeutic gains of a decrease in these unpleasant experiences increased the attractiveness of ERP as it provides a rationale for engage in anxiety-provoking and challenging exposures. However, it is noteworthy that the same influences of symptom severity were not detected in the ERP group. Within the ERP group OCD symptoms were only positively related to how anxiety-provoking the intervention was and how motivated participants felt to undergo ERP. The added attentional bias assessment the participants in the ERP-ABA group experienced may have given a sense of a more through intervention than the ERP group. Regardless however, despite increased anxiety being linked to greater symptom severity across the ERP groups, it was also related to stronger levels of motivation to undergo ERP. This is perhaps due to ERP’s clear way of treating OCD symptoms and the experience of a reduction in anxiety, disgust and the urge to wash hands across the experiment providing a rationale for undergoing ERP.

The current research had the following limitations. The study was limited to a single session of each intervention, it is possible that more sessions of ABMT over a longer period of time are required before a positive effect can be observed; ABMT may be similar to other therapies in that it initially worsens symptoms before elevating them. However, other research has reported positive effects of a single session of ABMT in other clinical samples although this finding is not consistent (Hakamata et al., 2010). Due to the limited validated image sets available for research in OCD, participants in the ABMT and PCT viewed the same contamination image a total of eight times in the
training/control task, increasing the risk of participants habituating to images and inhibiting attentional biases. However, due to the increase in attentional bias in the ABMT group it does not appear that habituation occurred. The current study’s sample was recruited from the general population which limits its generalisability to individuals with a clinical diagnosis of OCD.

The random allocation of participants to groups resulted in significant differences between the ERP and ABMT groups for age and symptom severity. Despite the ERP-ABA group having significantly greater symptom severity than the ABMT group, the ERP-ABA group showed a decrease in avoidance when compared with ABMT. Based on the previous literature, greater symptom severity could have potentially disadvantaged the ERP-ABA group by predicting greater avoidance. It is important to note that the ABMT group was significantly older than the ERP group, which also displayed a significant reduction in avoidance when compared to ABMT. Younger adults have been shown to benefit more from ERP than older adults (Eisen et al., 2010), although the difference in mean age of the two groups resulted in the ABMT group being older than the ERP group by only 7.51 years. Randomised control trails, in which the risk of confounding variables such as symptom level and age are controlled for, are the gold standard experiment design for informing psychological interventions (Mohr et al., 2009). However, this design has also been heavily criticised for not producing samples that are representative of real service-users therefore reducing the ecological validity of the results (Mulder et al 2018). The current study chose not to control for symptom severity and age in order to try and create a representative sample.

The sample size was also limited to 19-20 participants which limited the range of statistical analysis. Typically, ERP is carried out in personalised situations which
trigger client intrusions and provoke fear, as the current study was unable to use personalised situations, this may have reduced participant discomfort and potentially facilitated ERP performance. While efforts were made to use exposure objects which provoked anxiety, as the objects were not personalised this lowers the study’s representation of true ERP. The study also used a small, invalidated measure to investigate study acceptability, a more robust scale should ideally be used in future research. As the analysis included running multiple statistical tests, the rate of encountering a type 1 error is increased, however Bonferroni corrections were applied when necessary to try and minimise this risk.

In conclusion, a main clinical implication of the current research is the need to better understand what takes place in ABMT with regards to its influence on specific attentional processes in OCD. While there is very little research on ABMT and OCD, the current study disagrees with the previous positive results and raises concerns over the use and effectiveness of ABMT as a treatment for OCD. Further research is required using sensitive methodologies instead of reaction time to observe the effects of ABMT in a clinical population OCD to discover if it is a viable intervention or to confirm the current study’s findings of its ineffectiveness. Qualitative research exploring the experience of ABMT for individuals with OCD could help to understand how participant’s interpretation of ABMTs effectiveness could influence its use as an intervention. The current study suggests that the face validity of ABMT may be weak as belief in its ability to reduce OCD symptoms declined as symptom severity increased. It may be that the rationale for ABMT is required before therapeutic gains can be made. The results of the current study argue against the use of methodologies such as reaction time to measure attention in this field of research and illustrate the benefits of sensitive measures such as eye tracking.
Chapter 6 Developing Visual Stimuli Set related to Obsessive-Compulsive Symptoms

6.1. Abstract
The few number of visual resources available for OCD research is problematic when investigating attentional biases and designing appropriate interventions. The resources that are available have limitations when used to study an attentional bias in OCD. The use of verbal stimuli has been theorised to be inappropriate stimuli for this area and the cause of the inconsistent results of past literature. The current study aimed at developing an appropriate image set related to three common subgroups of OCD symptoms; checking, contamination and symmetry/ordering. It also developed a collection of neutral images to provide control stimuli. Three groups: individuals with OCD (N=25); a control group (N=40); and clinical psychologists (N=5) rated images to create the final stimuli set, resulting in 30 images in each OCD category and 90 neutral images. A high test-retest reliability and Cronbach’s alpha was found for the stimuli set. The current study also compared the ratings of anxiety for OCD related words and images. The results found no difference between the ratings of OCD related words and images, which suggests that other methodological factors should be explored to explain the previous literatures inconsistency.

6.2. Introduction
Research using symptomatic images to explore attentional bias in OCD has grown over the last several years (Armstrong, Olatunji & Sarawgi 2012; Armstrong, Sarawgi & Olatunji, 2010; Bradley, Hanna, Wilson, Quinn & Dyer, 2016; Rogers, Hanna & Dyer, 2016). In order for this research to understand the processes behind attentional biases related specifically to OCD, it is crucial to use appropriate stimuli related to OCD symptoms (Armstrong & Olatunji, 2012). Employing anxiogenic stimuli in research that evokes attentional processing specific to OCD allowed the
attentional mechanisms that should be targeted by an intervention to be highlighted; however, there are few visual resources related to OCD available. Previous research has drawn images for stimuli in OCD research from generally affective stimuli sets (Armstrong & Olatunji, 2012) such as the International Affective Picture System (IAPS; Lang, Bradley & Cuthbert, 2005). A drawback of using generally affective images is that they have not been designed to target fears related to OCD symptoms, increasing the risk that they are not anxiety-provoking for individuals with OCD and will therefore not allow differential information processing to be observed. As valid stimuli is the crux of attentional bias research, it is important for the future of OCD research to have an appropriate stimulus set related to symptoms in order for attentional bias specific to OCD to be targeted and appropriate interventions to be applied (De Putter, Yper & Koster, 2017).

A frequently used visual stimuli set related to OCD is the Maudsley Obsessive–Compulsive Stimuli Set (MOCSS; Mataix-Cols et al., 2009). The MOCSS include 50 images per common OCD symptom subgroups; contamination, symmetry/ordering, checking and hoarding. They also include 50 generally aversive and neutral images drawn from the IAPS. To create the MOCSS, images related to OCD were collected following a list generated by three clinical psychologist that complied common items that would cause an individual with OCD to experience anxiety and the urge to ritualize. Neutral images were “carefully chosen to avoid resembling common triggers of OCD symptoms” (Mataix-Cols et al., 2003, p. 484). OCD related scenes were selected by an independent group of nine participants whose OCD symptom severity was unreported. OCD scenes were rated for how visually complex, disgusting and anxiety provoking they were on a scale from 0-3 but no details of inclusion criteria from these 3 scales were reported.
The nature of the paradigm under which the MOCSS was created causes concern when the images are employed in different contexts. The MOCSS were first introduced in a study by Mataix-Cols et al. (2003) which investigated neural correlates of anxiety associated with OCD in a control sample alongside a symptom provocation paradigm. The symptom provocation paradigm involves participants viewing all images in blocks organised by category following instructions specific to the image category. For example, for washing images the instruction is to imagine that they must come into contact with what is shown in the following pictures without washing afterwards. Except for the neutral image category that instructs the participant to imagine that they are completely relaxed while looking at the following scenes. Following viewing each block, participants rated how anxious they felt from 0-8. The MOCSS alongside this symptom provocation program have been repeatedly found to provoke anxiety in both individuals with OCD and control groups (Mataix-Cols et al., 2004; Mataix-Cols et al., 2009). Although, the general population has been found to experience intrusive thoughts (Parkinson & Rachman, 1981), the cognitive-behavioural model of OCD (Salkovskis, 1999) suggests that an attentional bias for OCD related stimuli is a causing and maintaining factor in OCD symptomology. Thus, this information processing bias would be considered one of the factors that transforms a generally intrusive thought into an obsession. That is why one of the aims of attentional bias research in OCD is to highlight the differences in attention deployment to OCD related stimuli in the hopes of discovering its precise mechanisms that could be targeted by intervention. Ideally, stimuli related to OCD should only be anxiety provoking for individuals with OCD and not a control group in order to highlight the differences in attention deployment. A limitation of the MOCSS is that they appear to be anxiety provoking for control participants as well as individuals with OCD (Mataix-
Cols et al., 2003; Matiax-Cols et al., 2004; Matiax-Cols et al., 2009). The MOCSS were reportedly rated for anxiety, disgust and complexity, while anxiety is a crucial element of the stimuli set it would also be beneficial for more rating factors to be included. Other useful factors which the images could have been rated for are other emotional experiences about how unpleasant, upsetting and attention-grabbing participants find them.

The procedure for image selection for the MOCSS does not report details of the inclusion criteria for the final stimuli set, leaving it difficult to ascertain the required level each image must have of anxiety provocation in individuals with OCD. Matiax-Cols et al., (2009) describe the images as being selected by individuals with OCD and a control group after being rated level of visual complexity, anxiety and disgust on a 0–3 scale (0 = nil; 3 = high). They also removed images that were reportedly too simple or too complex, however, no specific details are given of this inclusion criteria for pictures based on these two factors. There are no reports of inclusion criteria that the average rating of an image must have to be included in the final MOCSS. This lack of detail allows the validity of the MOCSS to be questioned as it is unclear how individuals with OCD and the control group rated these images, or how this rating contributed to the final stimuli set.

The second, less used, stimuli set of images related to OCD is known as the Berlin Obsessive Compulsive Disorder-Picture Set (Simon, Kischkel, Spielberg & Kathmann, 2012; BOCD-PS). The BOCD-PS include three OCD symptom subgroups; aggressive obsessions, contamination and checking with each category containing 25 images. To create the BOCD-PS, three clinicians selected 25 images related to the OCD themes from a large pool of pictures collected by the researchers. These 25 images were then rating by 13 individuals with OCD and 13 control
participants for unpleasantness, arousal and anxiety on a scale of 0-9. The study found that the OCD group rated the OCD related images significantly more anxiety provoking than the control group. A limitation of this selection procedure is that it does not note if each image was assessed by its average rating per group, for example, if to be included in the final 25 image set a picture have an average rating of 5 or more for anxiety by the OCD group and also be rated as 4 or less by the control group. While overall, the results suggest that the control group did not find the OCD images as anxiety provoking as the OCD group, it is unclear how much anxiety they did experience. Similar to the MOCSS, with the possibility that the control group did find the OCD images anxiety provoking this may influence attentional bias and prevent differences in information processing being observed in individuals with OCD.

As the MOCSS and BOCD-PS have done, a way to reduce the inclusion of unsuitable images would be to have each individual image rated by both individuals with OCD and a control sample. However, unlike the MOCSS and BOCD-PS, by having the images rated by both individuals with and without OCD, a selection criterion could be devised in which only OCD related images which are anxiety provoking for individuals with OCD could be selected. As clinicians have theoretical and applied knowledge of OCD their opinion of stimuli related to OCD would be a valuable asset to a stimulus selection procedure. As much of the literature on OCD is filled with inconsistency, it seems important to strive for reliable stimulus in this area. To date, no stimuli sets related to OCD have been assessed for their reliability.

Neutral stimulus can provide a baseline measure of attentional processes, this is a crucial requirement when investigating mechanisms behind an attentional bias related to OCD as it allows differences in attentional deployment between OCD and
non-OCD related stimuli to be observed. Due to the wide variety of OCD symptoms, neutral stimuli must be carefully reviewed for its ability to provoke OCD symptoms. While neutral images in the MOCSS were reportedly carefully chosen to avoid resembling common triggers of OCD symptoms, it would be beneficial to have them rated by individuals with OCD to ensure they do not provoke anxiety.

Reviews of the literature argue that visual images are more appropriate for provocation of symptoms in OCD than verbal stimuli as they are more emotionally arousing (Armstrong & Olatinji, 2012) and are processed more elaborately (Hinojosa, Carretie, Valcarcel, Mendez-Bertolo & Pozo, 2009). Research has indicated that visual stimuli are more suitable than verbal stimuli for eliciting an attentional bias in other mental health disorders such as social anxiety disorder (Pishyar, Harris & Menzies, 2004). Research that has employed verbal stimuli has found conflicting evidence for and against (Kampman, Keijers, Verbraak, Naring & Hoogduin, 2002; Kyrios & Iob, 1998; Lavy, Van Oppen & Van Den Hout, 1994; Moritz et al., 2004; Tata, Leibowitz, Prunty, Cameron & Pickering, 1996; Unoki, Kasuga, Matshima & Ohta, 1999) an attentional bias in OCD. Whereas, in comparison, research that has used visual images has consistently found evidence of an attentional bias in OCD (Armstrong et al., 2012; Armstrong et al., 2010, Bradley et al., 2016; Rogers et al., 2016). To date, there has not been a direct comparison made between ratings of anxiety for verbal and visual stimuli related to OCD symptoms by individuals with OCD. The results of comparing words and images related to OCD could provide guidance to future research on the appropriate stimuli form and shed light upon the causes of the previous literatures inconstancy.

Frequently, task performance using generally aversive words have been compared to OCD related and neutral words when researching attentional bias in
individuals with OCD. When comparing these performances, research has found both an attentional bias specific to OCD related words (Foa, Ilai & Shoyer, 1993; Tata et al., 1996) and aversive words (Unoki, Kasuga, Matsushima & Ohta, 1999). As OCD is associated with the tendency to overestimate the likelihood and consequences of threats (Steketee et al., 1998) it is unsurprising that attentional bias has been found for both OCD and generally aversive stimuli (Unoki et al., 1999). However, research has not yet compared the interpretation of both generally aversive and OCD related stimuli by individuals with OCD to see if they are equally anxiety provoking. It is important to understand if the attentional bias in OCD is specific to OCD related stimuli, or if factors associated with OCD such as the overestimation of threats, extend the attentional bias for all aversive stimuli. As the majority of previous literature in this area has used verbal stimuli, this study aims to compare OCD related, aversive and neutral words in both individuals with OCD and controls to observe if there are any differences in ratings of anxiety.

Due to the diverse nature of OCD, studies will often select a specific subgroup of symptoms in order to tailor their stimuli and guide recruitment of participants. For the current thesis, contamination symptoms were selected as this subgroup has been reported as the most common presentation of OCD symptoms (Rasmussen & Eisen, 1992) and the majority of previous research has recruited individuals with contamination concerns in an undergraduate sample to observe attentional bias (Armstrong, Sarawgu & Olutunji, 2012; Armstrong, Olutunji & Sarawgi, Simmons, 2010). This study will include a larger proportion of contamination related stimuli which will be used in subsequent studies. Contamination related words will be used as the verbal stimuli related to OCD and will be compared to contamination related images.
6.2.1. Rationale

In order to carry out research exploring an attentional bias in OCD an appropriate stimuli set related to symptoms is required (de Putter et al., 2017). The aim of the current study is to create an appropriate visual stimulus set related to OCD, specifically for the symptoms of checking, contamination and symmetry/ordering. Unlike the MOCSS and BOCD-PS, this stimuli set will have each individual image rated by individuals with OCD, an control group and clinical psychologist. Only those images which are validated as anxiety provoking by the OCD and clinical psychologist group, but not anxiety provoking by the control group, will be included. To date, this will be the only existing stimulus set related to OCD that has been rated by individuals with expertise and lived experience of OCD as well as a control sample. This aims to produce a stimulus set that will allow for attentional processing differences to be observed between individuals with OCD and a control sample. Observing these differences will allow for the specific mechanisms of attentional bias to symptomatic stimuli to be highlighted and targeted when treating OCD. To ensure reliability of the stimuli set the test-retest and Cronbach alpha values will be assessed. The current study will also include other ratings of the stimuli including how unpleasant, upsetting and attention-grabbing participants find them.

The second aim of the study is to compare the ratings of words and images related to OCD by individuals with OCD. This hopes to explain the previous inconsistent evidence found for attentional bias when verbal stimuli were employed and to guide future researchers on the suitability of verbal stimuli when researching attentional bias and OCD.

The third aim of the study is to compare anxiety ratings for OCD related, aversive and neutral words in both individuals with OCD and control participants. This
hopes to better understand the mixed findings of attentional bias for OCD specific and/or generally aversive words (Foa., et al., 1996; Unoki et al., 1999).

6.3. Method

The current experimental study is a mixed design: individuals with OCD; control; and clinical psychologists. Participants will rate images (checking, contamination, symmetry/ordering, neutral) and words (aversive, contamination and neutral) via an online survey.

6.3.2 Participants.

OCD group: Individuals with OCD were recruited from three online websites related to OCD; International OCD foundation, OCD action and OCD U.K. A total of 27 individuals were recruited, two of these individuals were removed as one participant had not been clinically diagnosed with OCD and the other had a score of less than 21 on the Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002). This score suggests subclinical level of OCD symptoms (Foa et al., 2002). This led to a total of 25 participants in the OCD group (56% female). A total of 11.1% were aged 18-25 years, 38.9% were aged 26-35 years, 33.3% were aged 36-45 years and 16.7% were aged 46-55 years.

Control group: For the control group, undergraduate students were recruited from a first-year psychology class and took part for class credit, 40 participants were recruited (92.5% female). To create an control group, individuals with a score of 21 or more on the Obsessive-Compulsive Inventory-Revised scale (OCI-R, Foa et al., 2002) were removed from the student group as a score higher than 21 indicates the presence of obsessive-compulsive symptoms (Foa et al., 2002), resulting in 27 participants (96.3% female) being included in the control group. 92.6% were aged 18-25 years and 7.4% were aged 26-35 years.
Clinical Group: Clinical psychologists were recruited from Queen’s School of Psychology Clinical Doctorate staff. A total of five clinical psychologists rated the images (20% female). 40% were aged 26-35 years, 40% were aged 36-45 years and 20% were aged 46-55 years. Sixty percent had been qualified for one to four years, 20% 5-10 years and 20% 10-20 years.

Sample size was calculated using G*POWER for correlation analysis for the test-retest analysis. Using the prior assumptions of $p = .05$, $r = .30$ and Power = 80% the original G*POWER calculation yielded a minimum sample size of 29 participants. Sample size was also calculated for between group analysis to allow for comparisons between the three groups ratings using $p = .05$, $F = .40$ and Power = 80% the original G*POWER resulting in a minimum sample size of 22 participants in each group. This resulted in the comparisons of the three-group analysis being under-powered due to small sample size of clinical psychologist group. Sample size calculations for ANOVA analysis using the same assumptions, but for two groups, recommended 25 participants in each group.

6.3.3 Materials

OCI-R; (Foa et al., 2002): The OCI-R (Foa et al., 2002) will be used to assess the level of obsessive-compulsive symptoms and subtypes of symptoms in participants. These subgroups include washing, checking, obsessions, mental neutralizing, ordering and hoarding. It consists of 18 self-report items asking participants to rate from zero (not at all) to four (extremely) how much OCD symptoms have caused distress in the previous month. Hajcak, Huppert, Simmons and Foa (2004) found that the OCI-R had good internal consistency ($\alpha = .88$) and test-retest reliability ($\alpha = .70$).
Yale- Brown Obsessive Compulsive Scale Self Report Severity Scale (YBOCS-SR, Goodman et al., 1989): The YBOCS-SR (Goodman et al., 1989) severity scale will be used to assess the level of OCD symptoms. The scale assesses compulsions and obsessions in terms of interference, distress, resistance and control. Items are rated from zero (none) to four (sever). Scores range from 0-40. The scale has been found to have good construct validity (Deacon & Abramowitz, 2005). The internal reliability of the scale has been found to be good in non-clinical samples ($\alpha = .88$ for total score, $\alpha = .78$ for obsessions subscale and compulsions $\alpha = .84$ subscales; Frost, Steketee, Krause & Trepanier, 1995). High test-retest reliability has been found for the YBOCS-SR ($\alpha = .88$; Steketee, Frost & Bogart, 1996).

Demographics All participants were asked about their age and gender. Individuals with OCD were also asked to confirm if they had received an official diagnosis of OCD by a health professional.

Rating scale: The OCD and control group rated the images and words on how anxiety-provoking, attention-grabbing, upsetting and unpleasant they were on a Likert scale of one (not at all) to seven (very). The clinician group were asked to rate the stimuli from one to seven on how anxiety provoking and how likely they were to cause an individual with OCD to experience an obsession and to carry out a compulsion.

Stimuli: A list of scenes related to OCD were compiled based on factor-analysis studies on OCD symptoms and the guidance of a clinical psychologist with specialism in OCD. Images were collected by the researcher using a digital camera and a Sekonic Flashmate L-308S Digital Light/Flash Meter to ensure the photos had an optimum exposure. As a large number of contamination related scenes were required for a later experimental study, 140 contamination images were included. As the research expected to lose stimuli from the rating process 60 images were generated.
for symmetry/ordering and checking images with the aim of having at least 20 in the final data set related to these categories. There was a total of 300 neutral images collected with the aim of providing a neutral counter image for every OCD related image. Contamination scenes included dirty toilets, used plasters, bins, dirty shoes, dirty hands touching food, used tissues, condoms and used injections. Checking scenes involved open doors, electrical outputs switched on, cooker hobs, ovens, irons, hair straighteners, open windows. Symmetry/ordering scenes included askew pictures on the wall, messy shop shelves, unorganised CDs, cluttered desk, chess pieces mixed up and untidy cupboards. Neutral scenes included flower displays, fields, trees, beeches, sky, inanimate objects unrelated to OCD symptoms such as watering can, vase, shells and boats.

The collection of verbal stimuli was guided and reviewed clinical psychologist with expertise in OCD. A total of 47 appropriate contamination words were identified, following on from this a total of 47 aversive words and 94 neutral words were included (See Appendix E). A larger number of neutral words were included to provide contamination and aversive words with a neutral word counterpart for a later experimental chapter in this thesis.

Online Surveys: Qualtrics online survey software was used to create the online surveys in which the stimuli would be rated (See Appendix F). Due to the large number of items to be rated, the stimuli were spread across three online surveys. The order of stimuli presentation was randomised with each stimulus being displayed individually.

6.3.4. Procedure

O: Participants contacted the researcher if they were interested in the study after viewing the online advertisement. They were then sent a full information sheet and given the opportunity to ask any questions via email. If they wished to take part
in the study, they were sent links for each of the three surveys. They were asked to finish all three surveys within two weeks and they would be given a £10 amazon voucher as a thank you for their time and efforts. Within the first two months of launching the study 188 participants signed up for the study however there was a was a high dropout rate of 96.27% resulting in only seven participants full data being collected after four months of testing. This may have been due to the large amount of stimuli required to be rated. The data from the first seven participants were used to cut down the neutral and contamination stimuli as these were the largest in the image categories. A total of 200 neutral images with an average rating for anxiety of less than four were kept. A total of 60 contamination related images that had an average rating of four or more for anxiety were kept. All of the word stimuli were removed. Following this, a total of 18 individuals with a clinical diagnosis of OCD rated the remaining 200 neutral images, 60 contamination images, 60 symmetry/ordering images and 60 checking images.

Control group: The control group rated all stimuli twice to allow for test-retest reliability to be assessed. Participants were sent all three links for the three surveys and were asked to complete them within two weeks. They were then asked to wait a minimum duration of 1 week before repeating the surveys to allow the test-retest reliability to be assessed. Participants were sent links for the three surveys via email and were asked to complete them within two weeks.

6.4. Results

Participant ratings from all groups were entered into SPSS. Average ratings for each individual image were generated for each group, these were used to decide which images would be included in the final data set. Similar to previous research that has
created and validated new stimuli sets (Bartolini, 2011; McEwan et al., 2014), an average rating of over the half way point in the scale was taken as an indication that the participants endorsed the images association with the rating factor (e.g. anxiety). OCD related images with an average anxiety rating score of four or more by the OCD group and the clinician group but that also had an average rating of less than four by the control group were included in the final data set. Neutral images that had a rating less than four by all groups were included in the final data set.

Reliability of the final stimuli set was assessed by correlating ratings from time one and time two by the control group and Cronbach’s alpha analysis.

**Descriptive statistics:** The OCD group was significantly higher in OCI-R, \((t(50) = 4.10, p < .001, t(50) = 10.56, p < .001)\) scores than the control group (see Table 13 for averages). A MANOVA analysis was ran to explore group differences on subscale measures of OCD symptoms. The analysis found a significant between group difference in OCI-R subscale scores; \(F(6, 38) = 43.06, p < .005;\) Pillai’s Trace = 0.87, \(\eta^2 = .87\). Tukey’s HSD post-hoc analysis found that the OCD group scored significantly higher than the control group in the OCI-R washing (\(p < .005\)), checking (\(p < .005\)), ordering (\(p = .002\)), obsessive (\(p < .005\)), and neutralising (\(p < .005\)) subscales (See Table 13). There were no significant differences for the OCI-R hoarding subscale. The YBOC-SR subscales statistically significant; \(F(42, 42) = 42.00, p < .005;\) Pillai’s Trace = 0.28, \(\eta^2 = .72\). Tukey’s HSD post-hoc analysis found that the OCD group had significantly higher both YBOC-SR subscales measuring obsessions (\(p < .005\)) and compulsions (\(p < .005\)).
Table 14

Demographic and Clinical Characteristics of OCD and Control Groups

<table>
<thead>
<tr>
<th></th>
<th>OCD group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender %</strong></td>
<td>56% Female</td>
<td>96% Female</td>
</tr>
<tr>
<td></td>
<td>44% Male</td>
<td>4% Male</td>
</tr>
<tr>
<td><strong>OCI-R, M (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>31.64 (8.20)</td>
<td>11.93 (4.75)</td>
</tr>
<tr>
<td><strong>Washing</strong></td>
<td>5.64 (2.45)</td>
<td>0.81 (0.92)</td>
</tr>
<tr>
<td><strong>Checking</strong></td>
<td>5.08 (1.38)</td>
<td>2.07 (1.77)</td>
</tr>
<tr>
<td><strong>Ordering</strong></td>
<td>5.52 (2.89)</td>
<td>2.63 (2.17)</td>
</tr>
<tr>
<td><strong>Obsessing</strong></td>
<td>6.00 (2.08)</td>
<td>2.44 (1.80)</td>
</tr>
<tr>
<td><strong>Hoarding</strong></td>
<td>4.32 (2.29)</td>
<td>3.00 (1.88)</td>
</tr>
<tr>
<td><strong>Neutralizing</strong></td>
<td>5.08 (2.23)</td>
<td>0.96 (1.16)</td>
</tr>
<tr>
<td><strong>YBOC-SR, M (SD)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21.16 (3.97)</td>
<td>7.69 (5.32)</td>
</tr>
<tr>
<td><strong>Obsessions</strong></td>
<td>9.60 (2.40)</td>
<td>4.44 (3.30)</td>
</tr>
<tr>
<td><strong>Compulsion</strong></td>
<td>11.56 (2.24)</td>
<td>3.19 (3.11)</td>
</tr>
</tbody>
</table>

**Image Ratings**: Images related to OCD symptoms were included in the final data set if they had a rating of four or more on anxiety by individuals with OCD and clinicians. Neutral images were included in the final data set if they had an average rating of less than 4 by both individuals with OCD and the control group. This inclusion criteria resulted in 30 checking, 30 contamination, 30 symmetry/ordering and 90 neutral images being included in the final stimuli set (see Table 14 for stimuli category average ratings, Appendix G for images). The data did not meet the assumptions for a mixed ANOVA analysis which would have been preferable. The
analysis wished to explore any group differences on ratings of the visual images. When a between group ANOVA analysis could not be performed as the assumption of homogeneity of variance or normal distribution of residuals was violated, a non-parametric Kruskal-Wallis analysis was used. Following a significant Kruskal-Wallis analysis, pairwise comparisons were performed using Dunn’s (1964) procedure with a Bonferroni correction for multiple comparisons were significant was detected at \( p = .001 \) instead of \( p = .050 \). Adjusted \( p \)-values and median ratings \((m=)\) are presented. Within differences were assessed using a repeated measures ANOVA. When the assumption of sphericity was violated, Greenhouse-Geisser was reported. For ratings of anxiety, all three groups are included in the analysis, however, only the OCD and control group rated images for how unpleasant, upsetting and attention grabbing they found them.

**Ratings of Anxiety:** Groups significantly differed for ratings of anxiety for the checking images \( F(2, 47) = 36.82, p < .001, \eta^2 = .61 \). Tukey HSD post hoc analysis found that the control group rated checking images significantly lower in anxiety than the OCD \((p < .001)\) and clinician group \((p < .001)\). No significant differences between the OCD and Clinician group were found. Significant group differences were also found for ratings of anxiety for contamination images in Kruskal-Wallis analysis \( H(2) = 23.29, p < .001 \). Similar to results for checking images; group differences were again found as the control group) rated the images lower in anxiety than the OCD and clinical group. For ratings of anxiety for symmetry images, significant group differences were also detected \( F(2, 47) = 47.17, p < .001, \eta^2 = .67 \). As with checking and contamination images, Tukey HSD post hoc analysis that the control group rated the symmetry images lower than the OCD \((p < .001)\) and the Clinician \((p < .001)\) group for anxiety. Between group differences were detected for anxiety ratings of neutral
images $H(2) = 33.68, p < .001$. Pairwise comparison analysis found the OCD group rated the images significantly higher than the control group.

For the OCD group, within group ANOVA found a significant difference between image categories for ratings of anxiety; $F(1.52, 25.93) = 7.46, p = .005, \eta^2 = .31$. Pairwise comparisons found that the neutral images were rated significantly lower than checking ($p = .028$), contamination ($p = .044$) and symmetry ($p = .014$). The control group also displayed within group differences for ratings of anxiety; $F(1.90, 49.50) = 27.95, p < .001, \eta^2 = .52$. Pairwise comparisons found that like the OCD group, neutral images were rated significantly lower than checking ($p < .001$), contamination ($p < .001$), and symmetry ($p < .001$). A significant difference was found among the ratings of anxiety by the clinician group; $F(3, 12) = 74.60, p < .001, \eta^2 = .95$. As with the OCD and the control group, neutral images were rated significantly lower than checking ($p = .004$), contamination ($p < .001$), and symmetry ($p = .018$) for anxiety.

**Ratings of Unpleasantness:** Kruskal-Wallis analysis detected group differences in ratings of unpleasantness for checking $H(1) = 28.17, p < .001$, symmetry $H(1) = 28.30, p < .001$ and neutral $H(1) = 29.15, p < .001$ images. For these three image categories the OCD group rated the images higher for unpleasantness in comparison to the control group. No significant group differences were found for ratings of unpleasantness for contamination images.

Within group analysis found significant differences among image categories for ratings of unpleasantness in the OCD group; $F(1.42, 24.26) = 6.31, p = .011, \eta^2 = .271$. Pairwise comparisons found that the neutral images were rated significantly lower for unpleasantness than checking ($p = .039$) and symmetry ($p = .027$) images, however, no significant differences were detected among contamination and neutral
images. Significant within differences were detected for the control group $F (1.97, 51.37) = 72.15, p < .001, \eta^2 = .735$. Neutral images were rated lower for unpleasantness than checking ($p = .001$), contamination ($p < .001$) and symmetry ($p < .001$) images.

Table 15

*Average Group Ratings for Image Categories by OCD and Control Group*

<table>
<thead>
<tr>
<th>Image Category</th>
<th>Anxiety Mean (SD)</th>
<th>Upsetting Mean (SD)</th>
<th>Unpleasant Mean (SD)</th>
<th>Attention Grabbing Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCD Control</td>
<td>OCD Control</td>
<td>OCD Control</td>
<td>OCD Control</td>
<td>OCD Control</td>
</tr>
<tr>
<td>Contamination</td>
<td>4.62 (0.43)</td>
<td>2.89 (1.55)</td>
<td>4.63 (0.46)</td>
<td>2.80 (1.44)</td>
</tr>
<tr>
<td>Checking</td>
<td>4.31 (0.85)</td>
<td>2.18 (1.03)</td>
<td>4.34 (0.93)</td>
<td>1.74 (0.86)</td>
</tr>
<tr>
<td>Symmetry</td>
<td>4.25 (0.81)</td>
<td>1.80 (0.92)</td>
<td>4.22 (0.92)</td>
<td>1.64 (0.83)</td>
</tr>
<tr>
<td>Neutral</td>
<td>3.77 (1.24)</td>
<td>1.06 (0.10)</td>
<td>3.72 (1.19)</td>
<td>1.06 (0.09)</td>
</tr>
</tbody>
</table>

**Ratings of Upsetting:** Group differences for ratings for how upsetting the OCD and the control group followed the same pattern as ratings of anxiety and unpleasantness. Kruskal-Wallis again found significant group differences between the OCD and control group for ratings of how upsetting checking $H (1) = 27.59, p < .001$, contamination $H (1) = 19.19, p < .001$, symmetry $H (1) = 28.30, p < .001$ and neutral $H (1) = 27.97, p < .001$ images. Across all image categories, the OCD group rated the image as more upsetting than the control group.
Within group analysis found that the OCD group significantly varied in how image categories were rated for how upsetting they were $F(1.51, 25.67) = 7.89, p = .004, \eta^2 = .32$. Pairwise comparisons found neutral images were rated significantly lower than checking ($p = .026$), contamination ($p = .035$) and symmetry ($p = .007$) images. The control group also displayed significant differences for ratings of image categories; $F(1.75, 45.50) = 30.41, p < .001, \eta^2 = .54$. As with the OCD group; the control group rated the neutral images were rated significantly lower than checking ($p = .001$), contamination ($p < .001$) and symmetry ($p = .003$) images.

Table 16

*Average Rating of Images by Clinician Group*

<table>
<thead>
<tr>
<th>Rating Variables</th>
<th>Image Categories</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contamination</td>
<td>Checking</td>
<td>Symmetry</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>5.82 (0.60)</td>
<td>4.97 (0.79)</td>
<td>4.49 (1.18)</td>
<td>1.40 (0.50)</td>
</tr>
<tr>
<td>Obsession</td>
<td>6.03 (0.60)</td>
<td>5.03 (0.90)</td>
<td>4.69 (1.35)</td>
<td>1.44 (0.50)</td>
</tr>
<tr>
<td>Compulsion</td>
<td>6.12 (0.44)</td>
<td>5.14 (0.75)</td>
<td>4.79 (1.19)</td>
<td>1.41 (0.51)</td>
</tr>
</tbody>
</table>

**Ratings of Attention Grabbing:** As with ratings for anxiety, unpleasantness and upsetting, Kruskal-Wallis analysis again found the OCD group rated checking $H(1) = 27.87, p < .001$, contamination $H(1) = 07.28, p = .007$, symmetry $H(1) = 27.67, p < .001$ and neutral $H(1) = 28.73, p < .001$ images as more attention-grabbing than the control group.

Within group ANOVA detected significant variance in how image categories were rated for how attention-grabbing they were among the OCD group $F(1.80, 30.68) = 6.74, p = .005, \eta^2 = .28$. Pairwise comparisons found neutral images were rated significantly lower than contamination ($p = .034$) and symmetry ($p = .038$) images.
but no significant difference was detected between neutral and checking images. The control group also displayed significant differences for ratings of image categories; \( F(1.98, 51.52) = 37.37, p < .001, \eta^2 = .59 \). As with the OCD group; the control group rated the neutral images significantly lower than the checking \((p < .001)\), contamination \((p < .001)\) and symmetry \((p = .001)\) images.

**Additional Clinician Ratings:** As only the clinician group rated the final stimuli set for how obsession and compulsion provoking it would be, a within ANOVA analysis was ran to explore differences for ratings of these two factors for the final stimuli set categories. See Table 15 for average ratings for ratings of obsession provoking, a significant within difference between stimuli categories was detected; \( F(3, 12) = 61.31, p < .001, \eta^2 = .94 \). Pairwise comparisons found neutral images were rated significantly lower than checking \((p = .007)\), contamination \((p < .001)\) and symmetry \((p = .024)\) images. Contamination images were rated significantly more obsession provoking than checking images \((p = .028)\). Analysis of ratings of how likely the images would be to cause a compulsion also revealed a significant within difference; \( F(3, 12) = 75.98, p < .001, \eta^2 = .95 \). Pairwise comparisons found neutral images were rated significantly lower than checking \((p = .004)\), contamination \((p < .001)\) and symmetry \((p = .013)\) images. Contamination images were rated significantly more compulsion provoking than checking images \((p = .042)\). See Table 16 for median ratings.
### Table 17

*Median Rating of Images by Clinician Group*

<table>
<thead>
<tr>
<th>Rating Variables</th>
<th>Image Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contamination</td>
</tr>
<tr>
<td>Anxiety</td>
<td>6.00</td>
</tr>
<tr>
<td>Obsession</td>
<td>6.40</td>
</tr>
<tr>
<td>Compulsion</td>
<td>6.37</td>
</tr>
</tbody>
</table>

**Reliability of stimuli set:** The test-re-test reliability was assessed by the data from the student group (N = 40). Ratings from time one and time two were assessed using Pearson’s correlation to determine test-retest reliability for each subgroup of stimuli. A Correlation score of .40-.59 as fair, .60-.75 as good and .75 or greater as excellent indicator of reliability (Cicchetti, 1994; Kottner et al., 2011). An acceptable Cronbach’s alpha figure was indicated as $\alpha = .70$ or more (Taber, 2018). See Table 17.
Table 18

_Correlations between time 1 and 2 and Cronbach alpha of final image set by student group_

<table>
<thead>
<tr>
<th>Image Categories</th>
<th>Rating Variables</th>
<th>Anxiety</th>
<th>Upsetting</th>
<th>Unpleasant</th>
<th>Attention-grabbing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>a</td>
<td>r</td>
<td>a</td>
<td>r</td>
</tr>
<tr>
<td>Checking</td>
<td>.96</td>
<td>.87</td>
<td>.96</td>
<td>.91</td>
<td>.97</td>
</tr>
<tr>
<td>Contamination</td>
<td>.98</td>
<td>.96</td>
<td>.98</td>
<td>.89</td>
<td>.98</td>
</tr>
<tr>
<td>Symmetry</td>
<td>.97</td>
<td>.79</td>
<td>.96</td>
<td>.80</td>
<td>.96</td>
</tr>
<tr>
<td>Neutral</td>
<td>.94</td>
<td>.88</td>
<td>.92</td>
<td>.90</td>
<td>.94</td>
</tr>
</tbody>
</table>

_Note. a = Cronbach alpha, r = Pearson’s Correlation_

Comparing _words and images_: Between group ANOVAs were used to assess group differences for anxiety, as with the previous analysis of the final image set, Kruskal-Wallis test was used when assumptions were not met. A one-way within group ANOVA was used to compare ratings of anxiety for contamination related words and images, aversive words and neutral words for the OCD and control group. Within differences were assessed using a repeated measures ANOVA. When the assumption of sphericity was violated, Greenhouse-Geisser was reported. Ratings of Anxiety words and images: There was a statistically significant difference between the four types of stimuli for ratings of anxiety within the OCD group; _F_(3, 18) = 21.88, _p_ < .001, _η²_ = .79. Post hoc Bonferroni tests indicate that the neutral words were significantly lower in anxiety than aversive words (_p_ = .026), contamination words (_p_ = .007), and contamination images (_p_ < .001). No significant difference between
aversive words, contamination words and contamination images for anxiety in the OCD group were detected (see Figure 1).

There was a statistically significant difference between the four types of stimuli for ratings of anxiety within the control group; $F(3, 78) = 39.72, p < .001, \eta^2 = .60$. Post hoc Bonferroni tests indicate that the neutral words were significantly lower in anxiety than aversive words ($p = .001$), contamination words ($p = .001$) and contamination images ($p = .014$). Aversive words were significantly higher in anxiety than contamination words ($p = .001$). No significant difference between aversive words and contamination images were found in the control group.

Between group analysis found that the OCD group rated the contamination words $F(1, 34) = 6.30, p = .017, \eta^2 = .17$ and contamination images $F(1, 34) = 7.05, p = .012, \eta^2 = .18$ significantly higher than the control group. No significant differences were detected between groups for ratings of anxiety for neutral or aversive words.

![Figure 9. OCD and control group’s ratings of anxiety for verbal stimuli and contamination images.](image-url)
6.5. Discussion

The study aimed at creating an appropriate visual stimulus set for use in OCD research by including symptom related images that were only anxiety provoking for individuals with OCD, and not a control group, as this would allow attentional processing specific to OCD to be observed. The inclusion criteria for the final stimuli set was designed to only allow OCD related images that were anxiety provoking for individuals with OCD, but not so for control participants, to be included. Every image in the current stimuli set has been assessed individually for its suitability for the final stimuli set, rather than as a group category, reducing the risk of unsuitable images being selected. The groups were found to significantly differ as individuals with OCD and the clinician group rated the OCD related images as more anxiety provoking than the controls. A limitation was that the individual's with OCD also rated the neutral stimuli as more anxiety provoking than controls despite the inclusion criteria of neutral images aimed at avoiding group differences for this category. However, within group analysis found that the OCD group rated the OCD related images as more anxiety provoking than the neutral images. The same finding was detected for ratings by the OCD group for the final image set for how unpleasant, upsetting and attention grabbing they were. This suggests that overall, the individuals with OCD found the OCD related images more anxiety-provoking, unpleasant, upsetting and attention grabbing than the neutral images. While individuals with OCD rated the neutral images more strongly for these factors than the control group, the results suggest that they can still serve as a control stimulus as the OCD related images elicited stronger reactions.

The final stimuli set was further supported from analysis of clinician ratings. The results found the OCD related stimuli were rated higher by clinicians for their anxiety provocation, likelihood of triggering an obsession and compulsion than the
neutral images. No group differences were detected for the clinician and OCD group. This finding is supportive of the use of clinician expertise to guide image selection for stimuli related to OCD as much of the previous research in this area has done (Harkness, Harris, Jones & Vaccaro, 2009; Moritz et al., 2008; Moritz et al., 2009; Moritz & Von Muhlenen, 2008; et al., 1996).

As inconsistent findings are frequent throughout the previous research in this area the current study wished to explore the reliability of the stimuli set. For all ratings of the stimuli set, strong reliability was indicated as by Cronbach’s alpha. The majority of stimuli also had strong test-retest scores, the only exception being ratings of unpleasantness for neutral images whose score indicated fair reliability. It is hoped that by having good reliability, future research that employs this stimulus will have a reduced risk of further conflicting results.

Previously, it has been theorised that visual stimuli would be more provocative of anxiety and relatable to OCD symptoms than verbal stimuli. Verbal stimuli have been frequently employed in past research. But queries surrounding its ability to provoke anxiety in individuals with OCD have lead has the suspicion that use of verbal stimuli may be responsible for the previous conflicting findings (Armstrong & Olatunji, 2012). There were no significant differences between ratings of anxiety for the contamination related images and words by the OCD group. This finding does not support the argument that inconsistent evidence for attentional bias in relation to OCD is caused by using words related to symptoms as anxiogenic stimuli related to OCD symptoms (Armstrong & Olatunji, 2012). Another potential cause of the inconsistency of the previous literature may be due to other methodological considerations such as the measurement of attention. The previous research that has failed to find evidence of an attentional bias in OCD has used reaction time to measure attention
(Summerfeldt & Endler, 1998). It may be that the measurement of attention by reaction time is not sensitive enough to consistently detect a bias. As mentioned in the literature review (Chapter 2), reaction time can be confounded by numerous variables. It would be beneficial for future research if this could be explored further to allow recommendations on the appropriate stimuli and measure of attention when researching attentional bias and OCD to be made.

As previous research has found attentional bias for both OCD related and generally aversive words, the current study aimed to explore ratings of anxiety for both these stimuli. Ratings of anxiety for aversive and OCD related words were compared in order to ascertain if attentional bias is specific to OCD related stimuli or if it extends to all threatening stimuli. The results revealed that individuals with OCD rated both OCD related and generally aversive words as more anxiety provoking than neutral words, no significant differences were found between OCD and aversive words. This supports previous research that has detected a bias in individuals with OCD for both symptoms related and generally aversive stimuli (Unoki et al., 1999). While there may be an attentional bias for symptoms related stimuli in OCD, due to the association of OCD and the tendency to overestimate threat, attentional bias may be present for generally aversive stimuli unrelated to symptoms also. Using generally aversive stimuli to explore attentional bias may allow attention deployment to threatening stimuli to be observed across different subgroups of OCD symptoms, permitting any similarities or differences to be investigated. However, symptom related OCD would still be acquired to observe attentional bias specific to OCD.

It is interesting to note that the OCD group rated the neutral stimuli as more anxiety-provoking than controls. Similar findings have been detected in the past with previous research showing individuals with high OCD symptoms rating neutral
images as more unpleasant than control participants (Casado et al., 2011). The negative appraisal of neutral stimuli by individuals with OCD is theorised to be the result of two dysfunctional beliefs associated with OCD, 1) overestimation of threat and 2) intolerance of uncertainty (Steketee et al., 1998; Sookman & Pinard, 2002). The overestimation of threat relates to an exaggeration of the probability of harm and the intolerance of uncertainty describes the need for knowledge that one can cope in situations that are ambiguous (Obsessive Compulsive Cognitions Working Group, 2001). These beliefs may result in seemingly neutral stimuli being appraised as dangerous and anxiety provoking. This finding sparks concern for measuring attentional bias using neutral stimuli as a baseline, as it may be that neutral stimuli is not actually neutral to those with OCD. However, further research will be required to clarify the interactions between OCD beliefs and the appraisal of neutral stimuli.

A limitation of the current study is the potential for participant fatigue due to the large number of stimuli that had to be rated, resulting in the verbal stimuli being rated by only 7 individuals with OCD. To counter fatigue and drop-out, stimuli were rated across three online surveys, during each survey participants could close the webpage and save their place automatically. Participants were made aware of this and encouraged to take as many breaks as they needed. Another potential shortcoming is the statistical analysis was restricted to either within or between ANOVAs or their non-parametric alternatives due to the data failing to meet the statistical assumptions for a mixed ANOVA. However, statistical corrections including Tukey and Bonferroni (Fields, 2009) were made to counteract the running of multiple statistical analysis. The current stimuli set requires further validation and its final value will be based on its employment in research that will compare attentional processes in individuals with OCD and control participants.
This study has produced the first stimuli set related to OCD symptoms which has had each image individually rated by three relevant groups and had reliability assessed. Importantly, it is the first image set that has been created with the aim of eliciting anxiety in individuals with OCD only. This will hopefully result in attentional processing differences for stimuli related to OCD to be observed and an appropriate intervention created. Future research can use this stimulus set to learn more about the mechanisms behind the attention bias in individuals with OCD and inform intervention design.
Chapter 7 Comparison of Stimuli and Measure of Attention in OCD Attentional Bias.

7.1 Abstract
The previous research exploring attentional bias in OCD has been filled with inconsistent and conflicting findings. The present study aimed to investigate the conditions in which an attentional bias in OCD can be observed by comparing different types of stimuli and methods of measuring attention. Participants were 21 individuals with moderate obsessive-compulsive symptoms with contamination concerns and 21 control participants. The study employed a dot-probe task which used contamination, aversive and neutral stimuli. Each stimuli category included colour images, black and white images and words. Reaction time and eye movements were simultaneously recorded to measure attention. The results found no evidence of attentional bias from the reaction time data. However, the eye tracking data found that all participants displayed attentional biases for aversive words, aversive images and contamination images. No attentional bias was detected for neutral stimuli or contamination related words. The results suggest that reaction time is not sensitive enough to detect an attentional bias. They also support the argument that verbal stimuli may not be enough to provoke anxiety in individuals with contamination concerns as neither reaction time nor eye tracking data found evidence of an attentional bias.

7.1 Introduction
Attentional bias for symptom specific stimuli has been highlighted as a causing and maitaining factor in OCD (Salkovskis, 1999). However, the exact mechanism involved in the attentional bias in OCD are unknown. There are two leading theories that attempt to depict the attentional processes which are frequently referred to throughout the litareture as the Vigilance and Delayed Disengagement/Maintenance hypotheses. The vigilance hypothesis suggests that a bias in processing threatening
information is present in the early and pre-attentive stages of attention, resulting in rapid orientation and engagement of attention to threats in the environment (Beck & Clark, 1997; Eysenck, Derakshan, Santos & Calvo, 2007; Matthews & Mackintosh, 1998; Mogg & Bradley, 1998; Wells & Matthews, 1994). The delayed disengagement and maintenance hypothesis suggest that the bias occurs in the later stages of attention. The delayed disengagement bias proposes that attentional bias towards threatening information is the result of the individual being unable to disengage and shift attention away from threatening stimuli (Eysenck et al., 2007; Derryberry & Reed, 2002; Fox et al., 2001). There is a significant overlap between delayed disengagement and maintenance bias. However, the maintenance bias describes the re-orientation, monitoring and maintenance of attention to threatening stimuli (Weirich, Treat & Hollingworth, 2008). Further research is needed to understand the mechanisms involved in attentional bias in OCD. Despite not being certain of the mechanism involved in attentional bias, there is frequent support throughout the literature of the maladaptive effect that attentional bias has upon symptoms of various psychopathologies including OCD (Browning, Holmes & Harmer, 2010; Cisler & Koster, 2010; Tata, Leibowitz, Prunty, Cameron & Pickering, 1996). Previous research on attentional bias in OCD has produced inconsistent and contradictory findings in relation to its existence and its processes when detected (Cisler & Koster, 2010; Summerfield & Endler, 1998).

Methodological factors such as stimuli and measurement of attention may be responsible for the previous inconsistent findings in the literature. It would be beneficial for future researchers to learn of the optimum methodological techniques for the provocation and measurement that can be used to observe an attentional bias in OCD in order to reduce this inconsistency. The inconsistency of evidence for an
attentional bias in OCD may be due to the limitations of reaction time as a measure of
attention. Reaction time allows only a snapshot of attention to be captured and can be
confounded by age and gender (Der & Deary, 2006). Research has also suggested that
a delay in reaction times in response to threatening stimuli may be the result of
‘freezing’ rather than representing an attentional process (Algom, Lev & Chajut,
2004). Yang, Jackson, Gao and Chen (2012) found that individuals with a high fear of
pain did not differ from control participants on reaction time to pain related words in
a dot probe task. However, eye movement data that was simultaneously recorded
revealed a bias to orientate more often and quicker to pain related words. In Chapter
5, the reaction time data revealed no attentional bias towards OCD related stimuli by
participants with high contamination symptoms, however, eye movements were able
to reveal attentional bias. A possible explanation for this finding is that the attentional
bias in OCD is subtler than in other mental health disorders, such as anxiety, and
requires sensitive methodologies such as eye tracking to detect it (Armstrong &
Olatunji, 2012). With the exception of the research detailed in Chapter 5 of this thesis,
no research has simultaneously recorded reaction time and eye movement data to
observe an attentional bias related to OCD. Further research is needed to support the
superiority of eye tracking over reaction time in application to attentional bias research
in OCD.

A limitation of using reaction time to measure attention is the way in which
attentional bias is calculated. When using reaction time, researchers must use a task
that allows the mechanisms of attentional bias to be deciphered. A task that is
evidenced to achieve this is the dot-probe task. The typical procedure of the dot probe
is: 1) two stimuli (one threatening and the other neutral) are presented together for any
time between a few milliseconds to minutes; 2) these stimuli disappear and a target,
typically a dot or a letter, appears in the previous location of one of the stimuli; and 3) participants are asked to detect, and in some paradigms, identify the target. When a target appears in the previous location of the threatening stimuli it is referred to as a congruent trial. Whereas if the target appears in the previous location of the neutral stimuli it is referred to as an incongruent trial. A bias in the early stages of attention (vigilance) is indicated if the response to the target is quicker on congruent trials as attention is already directed to the area the threat was in. If response time is delayed on incongruent trials it is thought to be an indicator of a bias occurring in the later stages of attention and involving difficulty disengaging/maintaining attention to threat as visual attention must be disengaged and relocated to the target. The reliability of the dot-probe task has been called into question (Schmukle, 2005); however, research has found the reliability of the dot-probe task is improved by using eye movements as a measure of attention (Waechter, Nelson, Wright, Hyatt & Oakman, 2014). To measure attentional bias via eye tracking, fixations are used to indicate where attention is directed. A fixation refers to the eye pausing on a select area of a visual scene; it is thought that during this pause visual information from the select area is cognitively processed (Irwin, 2004). Research has repeatedly demonstrated a close link between fixations and covert attention (Hayhoe & Ballard, 2005; Liversedge & Findlay, 2000; Rayner; 1998). Fixations can be used to indicate different attentional mechanisms and measure vigilance, delayed-disengagement and maintenance biases. Fixations can indicate hypervigilance to threatening stimuli if participants initially orientate their gaze more frequently and faster to threatening stimuli than to a natural image. Delayed disengagement bias can be observed if the first fixation a participant makes upon threatening stimuli is significantly longer than an initial fixation to neutral stimuli. This would suggest that it costs more effort to disengage attention from threatening
stimuli and this is the cause of the delay. The overall time spent fixating and the number of fixations towards a threatening image comparison to a neutral image can determine if attention if a maintenance bias is present. If participants are looking more often and for greater lengths towards threatening image, this suggest attention is monitoring the threat. By contrasting these two methods of measuring attentional bias, it appears that eye movements allow a continuous measure of attention and a straightforward indication of the biases that are present.

The detection of an attentional bias in OCD may require visual stimuli as verbal stimuli has been criticised for its inability to provoke anxiety (Armstrong & Olatinji, 2012). Research has found that emotionally charged words are not processed as elaborately as emotive visual images (Houwer & Hermans, 1994; Kensinger & Schacter, 2006). In other disorders when conflicting evidence has been found for symptom related attentional bias, research has compared words and images using a dot probe task in an attempt to understand the inconsistency. Pishyar, Harries and Menzies (2004) compared individuals with high social anxiety on their performance in a dot probe task using negative words and negative facial stimuli. They found that only for negative facial stimuli was evidence for an attentional bias found. Similar findings have been found for pain related biases (Dear, Sharpe, Nicholas & Refshauge; 2011). To date, there has been no research carried out comparing OCD related words and images for their ability to provoke attentional bias. The majority of previous research studying attentional bias in OCD has used verbal stimuli (Summerfeldt & Endeler, 1998). Moritz and Muhlenen (2008) found no evidence of an attentional bias in individuals with OCD with checking symptoms while using symptom related words in an emotional cueing task. However, Moritz, Muhlenen, Randjbar, Fricke and Jelinek (2009) repeated the study with the modification of using images instead of
words and found evidence of an attentional bias for images related to OCD symptoms. It would be beneficial to compare OCD related verbal and visual stimuli’s ability to evoke attentional bias in order to guide future research when choosing between these two options.

Research has found that the colour of an image has a strong influence over attention deployment (Parkhurst, Law & Niebur, 2002), therefore, colour has the potential to confound research as if an emotional stimuli set is more colourful than a control stimulus set it is possible to misconstrue the presence of an attentional bias. This suggests a benefit in using black and white (BW) images as emotional stimuli in attentional bias research. However, research has found that removing the colour from an image has the potential to reduce its valence (Cano, Class & Polich, 2009). As the attentional bias in OCD may require strong provocation, removing the colour of an OCD related image may reduce its ability to evoke an attentional bias. To date no study has compared colour and BW OCD related images in attentional bias research.

Another factor that may influence attentional bias is the way in which OCD-related stimuli is compiled. Stimuli that has been validated for use in research by expert clinical opinion has found both evidence for an attentional bias (Moritz et al., 2009; Tata et al., 1996) and no evidence (Harkness, Harris, Jones & Vaccaro, 2009; Moritz et al., 2008; Moritz & Von Muhlenen, 2008). This same is true for stimuli compiled from ratings of individuals with OCD. Lavy, Van Oppen and Van Den Hout (1994) used the ratings of six individuals with OCD (three checking concerns, three contamination concerns) to compile words related to OCD. Lavy et al., (1994) and Unoki, Kasuga, Matshima and Ohta (1999) both found attentional bias from reaction time data for these words in individuals with OCD; however, when Kampman, Keijsers, Verbraak, Naring and Hoogduin (2002) complied stimuli using ratings from
15 individuals with OCD they did not find any evidence of attentional bias. Nor did Morein-Zamir et al. (2013) who found no significant differences between individuals with OCD and controls on visual search performance using personalised and general OCD relevant stimuli. Previously, research using eye tracking has found that ratings of stimuli predict attentional bias. Mogg, Bradley, Field and De Houwer (2003) found that longer initial fixations were associated with a bias to rate smoking related images more positively by individuals who smoked. It would be beneficial for individuals using sensitive methodologies if the relationship between stimuli compilation and implicit measures of attention (e.g. eye tracking) could be further explored. In Chapter 6 of this thesis, 140 contamination images were collected and screened to be relevant to contamination symptoms by expert opinion. After being rated by individuals with OCD a subset of these images was created resulting in 30 images that were rated to be anxiety provoking by individuals with OCD but not anxiety provoking for control participants. By comparing the attentional processes deployed to the original 140 contamination images compiled by expert opinion and the subset validated by individuals with OCD the current study may shed some light upon the best method for compiling stimuli.

Previous research has found evidence of an attentional bias for generally aversive stimuli in individuals with OCD (Unoki et al., 1999). However, as with attentional bias for symptom related stimuli, the evidence for an attentional bias to aversive stimuli in individuals with OCD is conflicting. Foa, Ilai, McCarthy, Shoyer and Murdock (1993) found individuals with OCD showed delayed reaction times to aversive words. As OCD is associated with the tendency to overestimate threats (Moritz & Jelinek, 2009; Sookman & Pinard, 2002; Steketee, Frost & Cohen 1998), it may be that attentional bias extends to not only OCD related stimuli but to all
threatening and aversive stimuli. Cisler and Olatunji (2010) found that individuals with contamination fear had greater difficulty disengaging from contamination and threatening images than a control group. Similar results were found by Mullen, Hanna and Dyer (2016) who found that individuals with a clinical diagnosis of OCD made significantly more and longer fixations on both OCD relevant (checking, contamination, hoarding, order) and generally threatening images than neutral counterparts in comparison to a matched control group; however, Armstrong, Sarawgi and Olatunji (2012) found no differences with attention deployment to generally threatening images measured with eye tracking between individuals with obsessive-compulsive symptoms and a control group. This inconsistent evidence makes it difficult to discern if attentional biases are specific to OCD related symptoms or to all aversive stimuli. In order to include the appropriate stimuli in an intervention, it is important to understand what elicits attentional bias in OCD in order to know what stimuli would be the most appropriate to use.

7.2.1 Rationale

The current study aims to explore different measurements of attention and stimuli type in an attempt to understand the inconsistency of the previous research and to find the optimum methodological conditions for researching attentional bias and OCD. The study will simultaneously record reaction time and eye tracking data to discern the best measurement of attention while participants complete a dot-probe task. The three stimuli types included in the study; contamination, aversive and neutral, will have a verbal, colour and BW version so that stimuli format can be compared across stimuli categories. Participants will be individuals with high contamination symptoms (HCS) and a control group with low contamination symptom (LCS). Contamination symptoms were selected as this subgroup has been reported as
the most common presentation of OCD symptoms (Rasmussen & Eisen, 1992) and the majority of previous research has recruited individuals with contamination concerns in an undergraduate sample to observe attentional bias (Armstrong, Sarawgu & Olatunji, 2012; Armstrong, Olatunji & Sarawgi, Simmons, 2010).

7.3 Method

7.3.1 Participants

Undergraduate classes were screened using the Obsessive-Compulsive Inventory-Revised (OCI-R, Foa et al., 2002). Individuals with an overall score of 21 or greater and with a score on the washing subscale of four or more were included in the HSC (N = 21). A score of 21 or more in the OCI-R is considered to indicate moderate OCD symptoms; a score of four in the washing subscale is 1.5 standard deviations above average in a college sample (Foa et al., 2002). Individuals with a score below 21 and with a score of zero on the washing subscale were included in the LCS (N = 21). The HCS had an average age of 24 (SD = 7.74) with 62% of the sample being female. The LCS had an average age of 24 (SD = 6.10) with 62% of the group being female. The HCS group was significantly higher on total OCI-R (HSG: $M = 37.48$, $SD = 11.63$; LSG: $M = 10.24$, $SD = 4.44$; ($t(21) = 13.69$, $p < .001$) and OCI-R washing subscale (HSG: $M = 6.81$, $SD = 2.23$; LSG: $M = 0.01$, $SD = 0.30$; ($t(25) = 10.03$, $p < .001$). Sample size was calculated using G*POWER for ANOVA analysis. Using the prior assumptions of $p = .05$, $F=.40$ and Power = 80% the original G*POWER calculation yielded a minimum sample size of 42 participants. This effect size was taken from Armstrong et al. (2012) who found significant differences between individuals with low and high contamination concerns using a free viewing eye tracking paradigm.
7.3.2 Materials

**Obsessive Compulsive Inventory-Revised (OCI-R):** The OCI-R (Foa et al., 2002) was used to identify subtypes of OCD symptoms in participants. These subgroups included contamination, checking, obsessions, mental neutralizing, ordering and hoarding. It consists of 18 self-report items asking participants to rate from zero (not at all) to five (extremely) how much OCD symptoms have caused distress in the previous month. Hajcak, Huppert, Simmons and Foa (2004) found that the OCI-R had good internal consistency (\( \alpha = .88 \)) and test-retest reliability (\( \alpha = .70 \)) in a sample of college students.

**Yale-Brown Obsessive Compulsive Scale Self-Report Severity Scale (YBOCS-SR):** The YBOCS-SR (Goodman et al., 1989) severity scale was used to assess the level of OCD symptoms. The scale assesses’ compulsions and obsessions in terms of interference, distress, resistance and control. Items are rated from zero (none) to four (severe). Scores range from 0-40. The internal reliability of the scale has been found to be good in non-clinical samples (\( \alpha = .88 \) for total score, \( \alpha = .78 \) for obsessions subscale and compulsions \( \alpha = .84 \) subscales; Frost, Steketee, Krause & Trepanier, 1995). High test-retest reliability over one week has been found for the YBOCS-SR (\( \alpha = .88 \); Steketee, Frost & Bogart, 1996).

**Stimuli:** 140 contamination images and 233 neutral images were drawn from Chapter 6, these images were originally collected under the guidance of clinical psychologist with specialism in OCD. Images were collected by the researcher using a digital camera and a Sekonic Flashmate L-308S Digital Light/Flash Meter to ensure the photos had an optimum exposure. A subset of contamination images created in Chapter 6, which had been rated as anxiety-provoking by individuals with OCD, were highlighted as stimuli selected by individuals with lived experience of OCD. From the
original 140 contamination images, 24 images were randomly drawn and transformed into BW images. Generally threatening images were drawn from the International Affective Picture System (IAPS, Lang, Bradley & Cuthbert, 1997), from the data set 47 images were identified as being generally aversive but not appearing to be related to contamination OCD, this was agreed upon by expert opinion. Of these 47 images, 24 were randomly drawn and transformed into BW images. Using the Subtlex-UK word frequencies for British English (Van Heuven, Mandera, Keuleers & Brysbaert, 2014) a total of 23 contamination words which could be matched for length, type and frequency to a neutral counterpart word were selected by expert opinion. Subsequently 23 aversive words and neutral counterparts also matched for length, type and frequency were selected (See Appendix H).

Eye Tracking equipment and set up: Eye movements were tracked using an Iview X Hi-Speed 250Hz eye tracker which uses infrared light to track reflections from the cornea and pupil. A 250Hz eye tracker is considered to have a high sampling rate (Holmqvist et al., 2011). It has a high tracking accuracy ranging from 0.25 °-0.5°. A nine-point calibration and validation procedure were used; the calibration procedure was repeated until participant’s gaze was tracked to a one degree or less of accuracy. A total of five participants were unsuccessully calibrated and removed from the study resulting in 42 participants, 21 in each group.

Vigilance

Fixations can indicate hypervigilance to threatening stimuli if participants initially orientate their gaze more frequently and faster to threatening stimuli than to a natural image. Comparing the below measurements for contamination/aversive and neutral stimuli can indicate hypervigilance for threatening stimuli.
a) Average frequency of the first fixation made upon the image (initial fixation) on images.

b) Average speed (latency) of initial fixation on images

**Delayed-disengagement**

Delayed disengagement bias can be observed if the first fixation a participant makes upon threatening stimuli is significantly longer than an initial fixation to neutral stimuli. This would suggest that it costs more effort to disengage attention from threatening stimuli and this is the cause of the delay. By comparing the below measurements between contamination/aversive and neutral stimuli delayed-disengagement for threatening stimuli can be detected.

a) Average duration of initial fixation on images

**Maintenance**

The overall time spent fixating and the number of fixations towards a threatening image comparison to a neutral image can determine if attention if a maintenance bias is present. If participants are looking more often and for greater lengths towards threatening image, this suggest attention is monitoring the threat. Therefore, by comparing the below measurements between contamination/aversive and neutral stimuli we can determine if attention is maintained on threatening stimuli.

a) Average duration of fixations on images

b) Average frequency of fixations on images

Dot-probe task: The dot-probe task was created using E-prime software and followed the design of previous research that has simultaneously recorded eye tracking and reaction time during a dot-probe task (Fashler & Katz, 2014; Yang et al., 2012). Participants were given verbal instructions of the task before commencement. At the
beginning of the task there were 8 practice trials with feedback to ensure participants understood the procedure. Each trial began with a fixation cross which appeared for 500ms. Following the fixation cross, stimuli pairs were then shown for 2500ms. The stimuli were then followed by the target, a dot, in the previous location of either the emotional or neutral stimuli. Participants were asked to press ‘Z’ if the dot appeared on the left and ‘M’ if it appeared on the right on the computer’s keyboard. The spatial location of the emotional stimuli and target was counterbalanced across each stimuli category trial. The target appeared in the same location as the emotional and neutral stimuli with equal probability. Following practice trials participants viewed each stimuli and its counterpart once, resulting in 281 experimental trials. The order of stimuli presentation was randomised.

**7.3.3 Procedure**

Participants were screened in an online survey of the OCI-R and YBOC-SR. Those identified as having an OCI-R score of 21 or more and a score of four or more in the OCI-R washing subscale were invited to take part. A description of what the study would entail was given to participants before being invited to ask any questions they had. They were asked to read the information sheet before giving written consent. After consent had been obtained, participants were calibrated to the eye tracker and carried out the dot-probe task. After the study had been complete, participants were then given a verbal and written debrief and awarded course-credit for taking part.

**Statistical analysis:** As each stimuli category had different numbers of items, average scores of reaction time and fixations were used for statistical analysis. Mixed ANOVAs were carried out to compare different measurements and stimuli categories and format. The data was checked to ensure it met each assumption required for ANOVA analysis.
Attentional bias reaction time: Attention bias scores were calculated by subtracting average reaction times as measured in milliseconds to the detection of the target from congruent trials (when the target is in the previous location of the threatening image) from average reaction time from incongruent trials (when the target is in the previous location of the neutral image; Macleod et al., 2002). Positive scores indicate an attentional bias towards OCD related stimuli while negative scores indicate attentional bias away from OCD stimuli.

Attentional bias Eye Tracking: To measure attentional bias via eye tracking, fixations were used to indicate where attention was directed. A fixation refers to the eye pausing on a select area of a visual scene; it is thought that during this pause visual information from the select area is cognitively processed (Irwin, 2004). Fixations were defined as eye position in a one degree radius for a minimum of 100ms. To detail the mechanisms of attention five eye patterns were defined (Bradley et al., 2016; Mullen et al., 2017). Areas of interest were defined by drawing a border of 1cm around each image. Initial fixations that were made less than 50ms after the trial had begun were excluded as outliers.

7.4 Results

Attentional Bias Reaction time: Mixed ANOVA analysis were used to observe any significant effects following between (Group (HCS, LCS) by three within (stimuli type; colour image, BW image, word) design on attentional bias reaction time scores. To reduce the risk of multiplicity a Bonferroni correction for multiple comparisons was applied and was detected at $p = .001$ instead of $p = .050$. See Table 18 for reaction time attentional bias scores.
**Contamination stimuli:** The results showed no significant interaction simple effects or between groups differences for attentional bias reaction time scores contamination stimuli across different forms.

Table 19

*Reaction Time Attentional Bias Scores*

<table>
<thead>
<tr>
<th>Attentional Bias RT Scores</th>
<th>HCS</th>
<th>LCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contamination</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>-3.6</td>
<td>-2.39</td>
</tr>
<tr>
<td>Desaturated</td>
<td>0.75</td>
<td>12.45</td>
</tr>
<tr>
<td>Words</td>
<td>-7.78</td>
<td>5.46</td>
</tr>
<tr>
<td><strong>Aversive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>-13.12</td>
<td>-1.66</td>
</tr>
<tr>
<td>Desaturated</td>
<td>-9.55</td>
<td>4.27</td>
</tr>
<tr>
<td>Words</td>
<td>0.8</td>
<td>-1.66</td>
</tr>
</tbody>
</table>

*Note.* RT = Millisecond Reaction Time

**Aversive stimuli:** As with contamination stimuli; no significant interaction simple effects, or between group differences were found for attentional bias reaction time score.

**Attentional Bias; Eye movements:** As with the reaction time analysis, mixed ANOVA analysis were used to observe any significant effects following between (Group (HCS, LCS) by three within (stimuli type; colour image, BW image, word) design for vigilance, delayed disengagement and maintenance. To reduce the risk of multiplicity a Bonferroni correction for multiple comparisons was applied and was detected at $p = .001$ instead of $p = .050$. 
**Contamination Stimuli:** Eye Movements: For each contamination-neutral stimulus type (colour image, BW, word) a two between (Group (HCS, LCS) x 2 within (contamination, neutral) was ran for each of the five eye movements linked to attentional biases. See Table 19 for average eye movements.

**Vigilance-Contamination**

There were no significant interactions or between group differences detected for the number of initial fixations made between any of the contamination-neutral stimuli pairs. However, a significant main effect was found for contamination-neutral colour images $F(1, 40) = 15.37, p < .001, \eta^2 = .28$. Subset of images $F(1, 40) = 14.38, p < .001, \eta^2 = .26$ and BW images $F(1, 40), 54.34, p < .001, \eta^2 = .58$. In both of these stimuli type, greater average initial fixation count for contamination images in comparison to neutral images was found. (see Table 2 for means and standard deviations). No significant interaction, main effect, or between group differences was detected for entry time to contamination-neutral stimuli pairs.

**Delayed-Disengagement/Maintenance**

The analysis detected no significant interaction, main effect, or between group differences for any of the contamination stimuli for initial fixation duration, fixation count or fixation time between contamination and neutral images.
### Average Eye Movements for Contamination Stimuli

<table>
<thead>
<tr>
<th>Eye Movements-Contamination Stimuli</th>
<th>HCS</th>
<th>Neutral</th>
<th>LCS</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td><strong>Initial Fixation Count</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>0.50 (0.05)</td>
<td>0.44 (0.06)</td>
<td>0.49 (0.06)</td>
<td>0.45 (0.07)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>0.53 (0.08)</td>
<td>0.43 (0.10)</td>
<td>0.52 (0.10)</td>
<td>0.44 (0.09)</td>
</tr>
<tr>
<td>Words</td>
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<td>0.49 (0.10)</td>
<td>0.47 (0.10)</td>
<td>0.48 (0.11)</td>
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<tr>
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<td>0.35 (0.08)</td>
<td>0.52 (0.11)</td>
<td>0.39 (0.09)</td>
</tr>
<tr>
<td><strong>Entry Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>419.96 (984.11)</td>
<td>416.91 (105.11)</td>
<td>400.18 (75.70)</td>
<td>407.46 (103.00)</td>
</tr>
<tr>
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<td>421.64 (122.28)</td>
<td>409.15 (66.78)</td>
<td>400.88 (115.01)</td>
<td>397.58 (107.05)</td>
</tr>
<tr>
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<td>383.62 (88.46)</td>
<td>437.36 (173.37)</td>
<td>421.75 (148.04)</td>
</tr>
<tr>
<td>Subset</td>
<td>409.91 (89.37)</td>
<td>443.06 (147.85)</td>
<td>382.70 (60.77)</td>
<td>407.72 (111.50)</td>
</tr>
<tr>
<td><strong>Fixation Count</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>3.32 (1.10)</td>
<td>3.21 (1.07)</td>
<td>3.83 (0.64)</td>
<td>3.23 (0.62)</td>
</tr>
<tr>
<td>Desaturated</td>
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<td>3.26 (1.09)</td>
<td>3.65 (0.74)</td>
<td>3.28 (0.75)</td>
</tr>
<tr>
<td>Words</td>
<td>3.10 (0.75)</td>
<td>2.37 (0.84)</td>
<td>3.17 (0.88)</td>
<td>3.07 (0.95)</td>
</tr>
<tr>
<td>Subset</td>
<td>3.41 (1.26)</td>
<td>3.09 (1.13)</td>
<td>3.84 (0.81)</td>
<td>3.13 (0.69)</td>
</tr>
<tr>
<td><strong>Fixation Time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>814.71 (291.10)</td>
<td>816.48 (327.190)</td>
<td>939.66 (180.50)</td>
<td>756.18 (168.75)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>767.01 (265.26)</td>
<td>821.03 (327.49)</td>
<td>879.89 (195.75)</td>
<td>774.61 (197.11)</td>
</tr>
<tr>
<td>Words</td>
<td>682.82 (227.09)</td>
<td>779.34 (263.79)</td>
<td>696.02 (205.96)</td>
<td>675.25 (218.97)</td>
</tr>
<tr>
<td>Subset</td>
<td>832.89 (328.36)</td>
<td>805.97 (370.48)</td>
<td>938.03 (217.68)</td>
<td>740.23 (185.93)</td>
</tr>
<tr>
<td><strong>Initial Fixation Duration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>226.61 (32.50)</td>
<td>225.93 (33.99)</td>
<td>224.77 (32.06)</td>
<td>219.13 (27.43)</td>
</tr>
<tr>
<td>Desaturated</td>
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<td>220.99 (43.26)</td>
<td>215.58 (29.53)</td>
<td>219.32 (35.82)</td>
</tr>
<tr>
<td>Words</td>
<td>202.52 (30.90)</td>
<td>209.24 (34.59)</td>
<td>200.78 (34.70)</td>
<td>204.68 (50.42)</td>
</tr>
<tr>
<td>Subset</td>
<td>225.56 (34.32)</td>
<td>224.85 (30.68)</td>
<td>229.42 (43.08)</td>
<td>224.12 (42.96)</td>
</tr>
</tbody>
</table>
**Aversive Stimuli Eye Movements:** For each aversive-neutral stimuli type (colour image, BW image, word) a two between (Group (HCS, LCS) by two within (contamination, neutral) was ran. See Table 3 for averages.

**Vigilance-Aversive Stimuli**

When exploring initial fixation count for aversive-neutral stimuli pairs the results found no significant interactions or between group differences. However for each of these stimuli types a main significant effect of stimuli category was found; words $F(1, 40), 13.97, p < .001, \eta^2 = .26$, colour images $F(1, 40) = 71.89, p < .001, \eta^2 = .64$, and BW images $F(1, 40) = 50.34, p < .001, \eta^2 = .56$. For all stimuli types, greater initial fixation count was detected for aversive stimuli. The analysis found no significant differences within or between groups for entry time to aversive-neutral stimuli pairs.

**Delayed-Disengagement/Maintenance**

For aversive-neutral stimuli pairs, there were no significant findings when analysing initial fixation duration. However, for fixation count between aversive-neutral stimuli pairs significant main effects were found for aversive-neutral colour, $F(1, 40) = 129.181, p < .001, \eta^2 = .764$ and BW images $F(1, 40) = 78.783, p < .001, \eta^2 = .66$. For both stimuli types there was a greater fixation count for aversive images in comparison to neutral images. The results for fixation time revealed a similar finding; significant main effects were found for aversive-neutral colour, $F(1, 40) = 94.04, p < .001, \eta^2 = .70$ and BW images $F(1, 40) = 68.61, p < .001, \eta^2 = .63$. Both groups had greater fixation time for aversive images in comparison to neutral images.
Table 21

Average Eye Movements for Aversive Stimuli

<table>
<thead>
<tr>
<th>Eye Movements - Aversive Stimuli</th>
<th>HCS</th>
<th>LCS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Initial Fixation Count Colour</td>
<td>0.59 (0.85)</td>
<td>0.38 (0.10)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>0.59 (0.84)</td>
<td>0.40 (0.11)</td>
</tr>
<tr>
<td>Words</td>
<td>0.57 (0.10)</td>
<td>0.45 (0.89)</td>
</tr>
<tr>
<td>Entry Time Colour</td>
<td>416.34 (96.04)</td>
<td>435.58 (126.18)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>438.18 (116.99)</td>
<td>420.99 (114.38)</td>
</tr>
<tr>
<td>Words</td>
<td>385.64 (92.20)</td>
<td>408.66 (134.05)</td>
</tr>
<tr>
<td>Fixation Count Colour Colour</td>
<td>4.30 (1.03)</td>
<td>2.60 (0.86)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>3.96 (0.92)</td>
<td>2.77 (0.91)</td>
</tr>
<tr>
<td>Words</td>
<td>3.13 (0.83)</td>
<td>3.22 (0.86)</td>
</tr>
<tr>
<td>Fixation Time Colour Colour</td>
<td>1041.15 (257.00)</td>
<td>652.06 (260.94)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>996.98 (229.58)</td>
<td>664.30 (254.90)</td>
</tr>
<tr>
<td>Words</td>
<td>708.52 (226.89)</td>
<td>750.42 (254.33)</td>
</tr>
<tr>
<td>Initial Fixation Duration Colour Colour</td>
<td>220.85 (30.47)</td>
<td>228.99 (32.20)</td>
</tr>
<tr>
<td>Desaturated</td>
<td>219.61 (33.41)</td>
<td>213.51 (39.59)</td>
</tr>
<tr>
<td>Words</td>
<td>205.97 (33.920)</td>
<td>207.06 (32.73)</td>
</tr>
</tbody>
</table>
Table 22

**Summary of Significant Findings for Reaction Time and Eye Movement Measures of Attentional Bias across Sample**

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Reaction Time</th>
<th>Vigilance</th>
<th>Delayed Disengagement</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ABS</td>
<td>IFC</td>
<td>ET</td>
<td>IFD</td>
</tr>
<tr>
<td><strong>Contamination-Neutral Stimuli</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Images</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for contamination images. Effect size=.28</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td>Subset colour images</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for contamination images. Effect size=.26</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td>Desaturated Images</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for contamination images. Effect size=.57</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td>Words</td>
<td>No Sig.</td>
<td>No Sig.</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td><strong>Aversive-Neutral Stimuli</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Images</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for aversive images. Effect size=.26</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td>Desaturated Images</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for aversive images. Effect size=.56</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
<tr>
<td>Words</td>
<td>No Sig.</td>
<td>Sig. Greater initial fixations for aversive words. Effect size=.28</td>
<td>No Sig.</td>
<td>No Sig.</td>
</tr>
</tbody>
</table>

*Note* = No Sig. = no significant within differences between stimuli type. Sig. = significant within differences between stimuli types. ABS = Attentional bias score, IFC = Initial Fixation Count, ET = Entry time, FC = Fixation count. FT = Fixation Time
7.5 Discussion

The aims of the current study involved investigating the different measurements of attention and stimuli formats in an attempt to understand the inconsistency of the previous research and to explore different conditions and their influence on detecting an attentional bias in OCD. In order to understand the impact of different methodologies for measuring attention, the study simultaneously recorded reaction time and eye tracking data. Similar to the findings of Yang et al., (2012) and the previous chapter in this thesis, the current study did not find any evidence of attentional bias via reaction time for any stimuli type. This finding supports the argument that reaction time is too insensitive a measure of attention in this field of research, risking the detection of an attentional bias in OCD being lost. This finding also supports the theory that reaction time may be responsible for the inconsistent evidence of an attentional bias in OCD (Armstrong & Olatunji, 2011). Perhaps when past research has failed to find evidence of an attentional bias in OCD using a reaction time measure of attention, it was not that the bias was not present, but that reaction time was too insensitive a measure to detect. In comparison, the eye tracking data was able to detect and provide an insight into the mechanisms of attentional biases. There were no between group differences detected throughout the study for attention deployment across stimuli categories and types, however, the eye movements were able to discern the biases in attentional processes towards some formats of the contamination and aversive stimuli across the groups. This finding further supports the argument that eye tracking is the more sensitive than reaction time and better suited for researching attentional processes (Armstrong & Olatunji, 2011). Eye-tracking was not only able to detect biases, but to highlight their specific attentional processes as discussed below.
The current study wished to compare attention deployment towards verbal and visual stimuli related to OCD as verbal stimuli has been argued as too weak to elicit anxiety, rendering it improper for use in attentional bias research in OCD (Armstrong & Olatunji, 2011; Moritz et al., 2008). There were no differences between or within groups for attention deployment to contamination or neutral words detected. However, there was evidence of a vigilance bias across the sample towards contamination images as participants initially fixated on contamination images faster and more often than their neutral counterparts. As evidence was only detected for an attentional bias towards contamination images and not for words, this finding is in agreement with the concerns noted by prior studies that verbal stimuli related to OCD symptoms is not provocative enough to detect an attentional bias (Moritz et al., 2008). As with reaction time, the majority of previous research has employed verbal stimuli as anxiety-provoking stimuli when attempting to observe an attentional bias (Moritz & Muhlenen, 2008; Summerfeldt & Endler, 1998; Weierich, Treat & Hollingworth, 2008). The current finding supports the theory that verbal stimuli, as well as reaction time measures, may be too weak to elicit attentional bias across participants. As words are not processed as elaborately as images (Houwer & Hermans, 1994; Kensinger & Schacter, 2006) perhaps this reduced processing inhibited the link between symptom related words and obsessive thoughts being formed. Whereas the more detailed processing that images received may provide a greater opportunity for triggering symptoms. An interesting finding was that unlike contamination words, participants did display a vigilance bias by initially orientating to aversive words more often than their neutral counterpart. A possible explanation for this is that the aversive words were more powerful elicitors of anxiety than the contamination words as they detailed threats to life e.g. ‘strangle’ or ‘kill’. This may be explained by the evolutionary-threat
hypothesis that suggests that humans have an adaptive lowered threshold for processing stimuli which is related to a threat to survival (Pratto & John, 1991), therefore, even verbal stimuli can provoke an attentional bias if it is level of threat is strong.

To date, no study had yet compared the impact of stimuli colour upon attentional bias in OCD. As colour can draw attention towards an image (Parkhurst et al., 2002) it may be beneficial for future researchers to use BW images. The current study found that both the BW and colour contamination images evoked a vigilance bias as they had a higher frequency of initial fixations than their neutral counterparts. This finding suggests that it is the semantic context of the image, rather than physical features such as colour that guide processing (Bradley, Codispoti, Cuthbert & Lang, 2001). This implies promise for using BW images in future research which would remove the potential confounding influence of colour. Unlike contamination images, BW aversive images not only had greater number of initial fixations than their neutral counterparts, but also provoked a maintenance bias by having longer and more frequent fixations made upon them. As with aversive words, it may be that the aversive images had a higher level of threat due to their depiction of physical harm (Pratto & John, 1991) resulting in maintained attention.

In the previous literature there have been different methods used to compile OCD related stimuli, including using the ratings of clinical experts (Moritz et al., 2009) and individuals with OCD (Lavy et al., 1994). An aim of the current study was to compare attentional biases towards images created from these two methods to observe any differences potentially influenced by either clinical or lived experience. For both stimuli sets, there was a vigilance bias in the form of higher frequency of initial fixation made upon contamination images in comparison to their neutral
counterparts. This implies consensus among clinician’s expertise and lived experience of OCD when selecting appropriate stimuli for research. This suggests that clinicians using their expertise to select stimuli in previous research may not be responsible for the conflicting evidence of attentional bias in OCD research (Harkness et al., 2009; Moritz et al., 2009; Tata et al., 1996).

Another aim of the current study was to explore attention towards aversive stimuli as similar for evidence for biases towards symptom specific stimuli, research has not always consistently found evidence of attentional bias to generally aversive material in OCD (Armstrong et al., 2012; Unoki et al., 1999). Although no group differences were detected, the findings revealed attentional biases via the eye movement data towards all types of aversive stimuli in the entire sample. For colour and BW aversive images, attention was found to be biased in the form of vigilance and maintained attention. However, attention towards aversive words was only biased in the early stages in the form of more frequent initial fixations. This is potentially due to aversive images being more emotionally provocative than words, similar to contamination stimuli.

The current study did not find significant differences between HCS and the LCS using eye-tracking data. As the participants did not have an official diagnosis of OCD, it reduces the transferability of the findings to a clinical sample and may explain why no group differences were detected for attention deployment to contamination related stimuli. It is also possible that other confounding variables present in the control group such as high trait anxiety, which was not measured in the current study, are responsible for the lack of group differences.

The current study had the following imitations. Another limitation of the current study is found in the procedure. As the trials were delivered randomly, it is
possible that some participants may have viewed the majority of some stimuli types before others and this may have influenced how attention was deployed in the remaining trials. In future research comparing different stimuli types, it may be beneficial to deliver it different stimuli types in blocks (e.g. block 1: contamination, block 2: aversive) and randomise the order in which blocks are delivered. The current study focused on contamination symptoms as it is the most common presentation of OCD (Rasmussen & Eisen, 1992). However, future research could explore different stimuli types on other subgroups of OCD symptoms e.g. checking, ordering. The analysis included multiple comparisons within conditions and between groups; increasing the risk of type 1 error, however to counter-act this Bonferroni corrections were applied (Field, 2009).

In conclusion, the results of the current study could potentially lead to several inferences about the nature of measurement and stimuli in attentional bias research in OCD, which can be applied to future research designs and to explain the inconstancy of the past literature. When compared with the eye tracking measure of attention, reaction time failed to detect or describe any attentional biases, despite eye tracking revealing bias across the sample. This further supports the criticisms of employing reaction time in attentional bias research in OCD and may explain the inconstancy of evidence for attentional bias in OCD that has been concurrent throughout previous research employing reaction time as a measure. As with reaction time, the use of verbal stimuli has been argued as a cause of the failure to consistently detect an attentional bias in OCD. Despite not detecting differences between the HCS and the LCS, the eye movement data in the current study suggests that OCD related images are more powerful elicitors of attentional bias than OCD related words. This further supports the recommendations using visual images as anxiogenic stimuli. The current study
also supports clinician-based stimuli selection as no differences were detected as attentional bias were detected for both those stimuli select by individuals with lived experience of OCD and clinicians.
Chapter 8 General Discussion

8.1 Overview

The current thesis had three core aims; the first was to explore attentional biases in obsessive-compulsive disorder (OCD) to discern if attentional bias modification training (ABMT) is an acceptable and efficacious potential intervention for OCD. The second was to improve the stimuli and measurement of attentional bias in OCD and thirdly, to further explore the mechanisms of attentional bias using this improved understanding of measurement. These aims were achieved by a comprehensive literature review and four experimental studies. The current chapter aims to summarise the key findings of this thesis and to illustrate their clinical implications. The limitations of the thesis will be discussed and proposals for future research will be made. In order to achieve the core aims of the thesis, research questions were devised to guide study design, the current chapter will discuss how each of these research questions have been answered and how this information achieves the core aims of thesis. Please see the table 22 for the list of core aims and research questions to be discussed in the current chapter.
### Table 23

**Aims of Thesis and Main Research Questions**

<table>
<thead>
<tr>
<th>Thesis Chapters</th>
<th>Aims of Thesis and Research Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aim 1: Discern If ABMT Is an Acceptable and Efficacious Intervention for OCD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Will ABMT appear to be a more acceptable intervention to individuals with OCD than ERP?</td>
<td>- Descriptions of ABMT were rated as less anxiety-provoking and challenging than ERP. However, ERP was rated as more effective.</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Will AMBT be more effective as an intervention for OCD than ERP in reducing attentional biases, OCD symptoms and improving interaction with feared objects?</td>
<td>- ABMT had negative influence on attentional biases. No changes in OCD symptoms across groups. ERP groups reduced avoidance compared to ABMT. - No significant differences between ratings of acceptability for ERP and ABMT. - Greater symptom severity linked to increased ratings of how anxiety-provoking, challenging, engaging and effective participants found ABMT. However a negative relationship was found between symptom severity and ABMT’s perceived ability to reduce OCD symptoms.</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Create an appropriate image set related to OCD</td>
<td>- Only OCD related images that were anxiety-provoking for individuals with OCD, but not controls were entered into final stimuli set. - No significant differences between ratings of anxiety for contamination words and images by the OCD group.</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Is eye-tracking superior to reaction time as a measure of attentional bias?</td>
<td>- Reaction time revealed no attentional bias towards stimuli. Eye tracking revealed attentional bias towards contamination and aversive stimuli. - Attentional bias were detected for both colour and black and white versions of aversive and contamination stimuli. - Only contamination images evoked attentional bias. No differences in attention deployment top stimuli selected by individuals with OCD and subset of images selected by researcher.</td>
</tr>
<tr>
<td>Thesis Chapters</td>
<td>Aims of Thesis and Research Questions</td>
<td>Answers</td>
</tr>
</tbody>
</table>
Aim 3: Explore the Mechanisms of Attentional Bias Using this Improved Understanding of Measurement

<table>
<thead>
<tr>
<th>Chapter 7</th>
<th>Will individuals with contamination concerns display an attentional bias towards contamination related images via eye-tracking measures?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is the attentional bias in OCD specific to symptom related stimuli or does it extend to generally aversive stimuli?</td>
</tr>
<tr>
<td></td>
<td>Attentional bias towards contamination related images were detected in both individuals with contamination concerns and the control group.</td>
</tr>
<tr>
<td></td>
<td>Attentional bias towards contamination related images and aversive related images were detected in both individuals with contamination concerns and the control group.</td>
</tr>
</tbody>
</table>

8.2 Literature review summary

Reviewing the literature revealed that a significant number of individuals with OCD find the leading psychological treatments currently available to them quite challenging. The recommended psychological intervention to treat OCD, exposure-response prevention (ERP), is associated with a high volume of dropout and treatment resistance due to it requiring individuals to expose themselves to feared situations. Salkovskis (1999) cognitive model of OCD was recognised as the leading theoretical framework used among clinicians to guide psychological intervention due to its strong evidence base and clinical utility. Particular emphasis was devoted to the attentional bias component of Salkovskis model’s and the potential for a novel and innovative intervention applied in this area. An intervention which would treat an attentional bias in OCD was highlighted as a potential alternative treatment for those who are resistant or reluctant to engage in ERP.

The two main theoretical perspectives into the potential nature of the attentional biases, the Vigilance and Delayed Disengagement/Maintenance theories, were introduced and their implications for treatment were discussed. The literature review revealed that the previous research on attentional bias in OCD was fraught with inconsistent evidence for its existence, a lack of clarity on the nature of attentional
processes involved, methodological concerns and limited resources of validated materials. It was detected that the majority of previous literature on OCD and attentional bias had employed reaction time as a measure of attention which potentially limited the detection and delineation of attentional bias. Eye-tracking was highlighted as an emerging and promising measurement in this field which unlike reaction time, had provided consistent evidence for an attentional bias in OCD.

The literature review found that ABMT, a new intervention which focuses on reducing attentional biases, had significant gains in treating clinical symptoms of anxiety disorders, however there was little application of ABMT to OCD. Arguments were made for ABMT’s potential as an alternative treatment to ERP for those with severe OCD symptoms due to its delivery via computer and lack of direct contact with feared situations. The lack of understanding as to how ABMT influences specific attentional mechanisms was noted as a limitation.

Overall, the literature review found support for the potential therapeutic benefits of reducing an attentional bias in individuals with severe OCD symptoms who may find ERP too abrasive. However, the previous literature on attentional bias in OCD is plagued with inconsistent findings, potentially due to methodological limitations, complicating the application of an intervention directed at attentional bias in this clinical population. Notwithstanding these shortcomings, ABMT could potentially serve as an alternative intervention for OCD.
8.3. Aim 1: Discern If ABMT Is an Acceptable and Efficacious Intervention for OCD

8.3.1 Chapter 4 overview

Acceptability of Attention Bias Modification Training and Exposure-Response Prevention by Individuals with Obsessive-Compulsive Disorder

The research conducted in Chapter 4 aimed to explore the acceptability of ABMT by individuals with a reported diagnosis of OCD and compare this with acceptability of ERP in order to ascertain if ABMT would be a preferable treatment option. Acceptability was measured by asking participants to rate each intervention for how effective, anxiety-provoking, challenging and engaging they felt they were. They were also asked to rate the ability of each intervention to reduce OCD symptoms and how motivated they would be to undergo each treatment.

Will ABMT appear to be a more acceptable intervention to individuals with OCD than ERP?

The results of Chapter 4 indicated that ERP was rated significantly more anxiety-provoking and challenging as a treatment modality in comparison to ABMT however, ERP was also rated higher by participants for its effectiveness and ability to reduce OCD symptoms. Regression analysis detected that acceptability for ERP were predicted by previous experience of CBT, lower age, less severe OCD symptoms. A regression analysis could not be ran for what may predict acceptability in ABMT as the correlation analysis only revealed one significant negative relationship between age and acceptability for ABMT.

8.3.3 Chapter 5 overview

The Comparison of Attentional Bias Modification Training with Exposure Response Prevention on Attentional Bias, OCD symptoms and Behavioural Approach Task Performance
Chapter 5 aimed to compare the effects of ABMT with those of ERP on attentional bias, OCD symptoms and performance in a behavioural approach task (BAT) towards contamination related objects. Participants without a diagnosis of OCD but with clinical levels of OCD symptoms and contamination concerns were randomly assigned to one of four conditions: ABMT, Placebo control task (PCT), ERP and ERP with an attentional bias assessment (ERP-ABA). An ERP condition without an attentional bias assessment was included as the assessment involved viewing contamination related images which may have served as an exposure in itself and facilitated the effects of ERP.

**Will AMBT be more effective as an intervention for OCD than ERP in reducing attentional biases, OCD symptoms and improving interaction with feared objects?**

In contrast to what was hypothesised, the results of Chapter 5 found that ABMT had a negative influence on attentional bias as participants within this group displayed an increase in eye movements’ indicative of vigilance and delayed disengagement/maintenance biases. No alterations in attentional biases were detected in the other groups. With regards to OCD symptoms, no changes were detected within or between the groups across the course of the study. Inspection of BAT performance revealed that both ERP groups displayed significantly greater reduction of avoidance in the BAT task in comparison to the ABMT group.

**Will ABMT to be a more acceptable intervention to individuals with OCD than ERP?**

The results found that there were no significant differences between ABMT, ERP and PCT for individual items on the study evaluation scale or the total score for acceptability. The ERP-ABA group was rated significantly higher for effectiveness.
and its perceived ability to reduce symptoms than the PCT group, however no differences were detected between acceptability of the ERP groups and ABMT.

**Will symptom severity influence acceptability of ABMT?**

Across all groups, as symptom severity increased so too did ratings for how anxiety provoking participants found the intervention/control tasks to be. Within the ABMT group, greater symptom severity was positively related to how engaging, challenging and effective participants rated ABMT to be. However, a negative relationship was detected between symptom severity and participant ratings for how much they felt ABMT’s could reduce OCD symptoms.

**8.4 Clinical Implications Aim 1: Discern If ABMT Is an Acceptable and Efficacious Intervention for OCD**

The findings from Chapter 4 indicate potential for ABMT as less anxiety-provoking and challenging treatment than ERP, providing promise for ABMT’s place as a future alternative treatment option. As acceptability for ERP was found to decrease with OCD symptom severity, this finding further added to the argument that alternative interventions are required for those with severe OCD symptoms who are reluctant to engage in ERP. ABMT, as it appears to be a less anxiety-provoking and challenging treatment, may be a suitable low intensity alternative to ERP. However, opinions on ERP’s ability to reduce symptoms and to be the most effective treatment was significantly higher than ABMT. Indicating that while ABMT may be a more subtle approach to ameliorating symptoms, ERP appears to have a clearer rational for symptom reduction. This finding suggests that a potential limitation of ABMT compared to more traditional therapies such as ERP, may be the level of ambiguity and obscurity in its mechanisms of treated symptoms (Beard, Weisberg & Primack, 2011). This ambiguity surrounding ABMT’s mechanisms of change may become a
barrier to its successful implementation as a treatment. To counter this potential barrier, psychoeducation materials explaining the paradigm and rationale for ABMT may be beneficial. However, this increases the risk that any alterations in attention process may be the result of the participant avoiding the symptom related stimuli to please the researcher. As the research carried out in ABMT and OCD is in its infancy it may be more appropriate to see if its paradigm can have therapeutic benefits before progressing onto implementing a psychoeducation component into its administration in order to ensure that the results are due to its training.

Age was found to be negatively related to ABMT’s acceptability, suggesting that older adults may not find ABMT as attractive a treatment option as younger adults do. As modern technology grows, so too does its implementation into the public sector, such as computer delivered therapy (Newby, Twomey, Shi Yuam & Andrews, 2016). It is important however that new technology based interventions meet the needs of all clients seeking help from mental health services, including those who may be unexperienced with computers. The link between older age and lower acceptability of ABMT may be due to older adults being less likely to have experience with computers (Office of National Statistics, 2010). Therefore, this result raises an important consideration when exploring a technology-based intervention, will those unfamiliar with technology, such as an older population, be less likely to find computer based interventions acceptable? If so, this may influence the way in which ABMT is delivered to ensure it is inclusive to all clients, regardless of familiarity with technology.

The results of Chapter 4 indicated potential for the acceptability of ABMT, however they also hinted at issues with ABMTs perceived effectiveness, giving rise to new research questions that felt important to answer. Will ABMT be a more
acceptable treatment option than ERP after participants have experienced it, as opposed to reading a description? Will age and symptom severity influence the acceptability of ABMT? Lastly, as acceptability does not equate effectiveness, how will ABMT fair when compared with ERP for its ability to reduce attentional biases, OCD symptoms and improve interaction with feared objects?

The study conducted in Chapter 5 sought to answer the questions raised in Chapter 4. Analysis of Chapter 5 indicated that ABMT did not differ from the other groups for acceptability. As ABMT is potentially less anxiety provoking than ERP as it involves no direct contact with contaminate objects, this result was unanticipated. This finding disagrees with the results of Chapter 4 in which ERP was rated as more anxiety-provoking, effective and having a greater ability to reduce symptoms than ABMT. A driving factor in the application of ABMT for this project was its potential as a more acceptable and effective intervention for OCD symptoms as an alternative to ERP, however the results of Chapter 5 provide no support for the superiority of acceptability of ABMT over ERP. It was hypothesised that symptom severity may influence acceptability of each intervention.

Across all groups, symptom severity was found to increase how anxiety-provoking participants found ABMT and ERP. This suggests that the confrontation of materials related to OCD symptoms is associated with anxiety for those with greater symptom severity across multiple modalities. However, a dividing finding between ABMT and ERP was a decrease in the belief of ABMT’s ability to reduce symptoms as symptom severity increased whereas, in the ERP group, as symptom severity increased, so too did the belief in ERP’s ability to reduce symptoms. This challenges the original hypothesis that greater symptom severity would be related to increased acceptability in ABMT and decreased acceptability in ERP. Despite increased anxiety
being linked to greater symptom severity across the ERP groups, it was also related to stronger levels of motivation to undergo ERP. Perhaps, this contrast between the belief in ABMT and ERP’s ability to reduce OCD symptom is because ERP may have a clearer rationale for symptom reduction to clients, whereas ABMT may not. However, it is important to consider that in a real ERP therapy the exposure would be with a personalised fearful situation as OCD is a highly idiosyncratic disorder (Bloch et al., 2015) even within subgroups of symptoms. Will efforts were made to use the most anxiety-provoking contamination related object as the exposure in the ERP task, it is possible that participants experienced less anxiety then they would have if the object been personalised to their own intrusive thoughts relating to contamination concerns as traditional ERP therapy would.

To summarise the findings in relation to acceptability of ABMT, the results of the current thesis suggest that ABMT may not be as acceptable to participants with severe OCD symptoms as originally hypothesised. Initially, it appeared that ABMT may not be as anxiety provoking or challenging as ERP, however after experiencing ABMT there were no differences between these two interventions for ratings of acceptability. Furthermore, it appears that symptom severity reduces acceptability of both ABMT and ERP, however it increases the belief in ERP’s ability to treat OCD, whereas it reduces the belief that ABMT is an effective treatment. This may potentially be due to the rationale behind ERP being a clear concept than that of ABMT. Previously, research exploring the acceptability of intervention for an obsessive-compulsive related disorder found that by providing a more detailed rationale for treatment significantly increased its acceptability (Elliott, 2001). ABMT may still be an acceptable intervention to those with severe symptoms but the lack of reasoning behind its strange paradigm may reduce participant’s faith in its ability to
reduce symptoms, subsequently reducing its acceptability. As it is a non-traditional therapy and delivered via computer, to ensure acceptability ABMT may require particular emphasis on the reasoning behind its paradigm. Despite the support for ABMT being a more preferable treatment than ERP not being as clear cut as originally hypothesized, the current thesis examined and compared the efficacy of these two interventions.

In contrast to what was predicted and the previous literature, Chapter 5 found that ABMT did not reduce attentional bias towards contamination related images, it appeared that ABMT had the opposite influence in that attentional biases towards contamination images increased. Interestingly, only the eye movement data revealed any changes in attentional bias, the reaction time data revealed no significant findings. It is important to note that all previous studies exploring ABMT and OCD have used reaction time as a measure of attentional bias and as an indicator of change. Using reaction time however limits the delineation of specific attentional process that are influenced by the ABMT paradigm such as vigilance or delayed disengagement/maintenance process. The contrasting findings of the eye-tracking and reaction time data suggest that sensitive methodologies such as eye tracking, that monitor attention continuously, may be a preferable option when researching attentional bias in OCD. An increase in attentional bias was only present in the ABMT group, suggesting that it may be the result of the contingency between the neutral stimuli and target. It is concerning that ABMT appeared to exasperate attentional bias towards contamination images. It has been suggested that for a change in attentional bias to occur, the link between the neutral stimuli and the target should be made apparent to participants, providing them with a rationale to engage with the paradigm (Notebaert et al., 2015). However, as noted when discussing the findings of Chapter
4, does psychoeducation at this early stage of exploration of ABMT in OCD increase
the risk of confounding the findings. Explaining ABMT’s intention to reduce attention
deployment to OCD related stimuli to participants could potentially result in effortful
avoidance of these materials to please the researcher. The results of Chapter 4
combined with the findings of Chapter 5 weaken the argument for ABMT as an
alternative to ERP. The results of the current thesis argue that while ERP may be
emotionally demanding intervention it is still the superior treatment in comparison to
ABMT. While ABMT has had success in the treatment of anxiety disorders, it is
possible that it will not be as successful in its application to OCD. While anxiety
disorders and OCD have many overlapping features, they are fundamentally different
psychopathologies (APA, 2013). The differences between these two categories of
psychopathology may reduce the generalisability of ABMT’s success in treatment of
anxiety disorders to OCD. As eye tracking studies have begun to provide consistent
evidence of attentional bias towards OCD related stimuli in individuals with OCD
symptoms; is it perhaps more beneficial to adopt a bottom-up rather than top-down
approach to reducing attentional bias in OCD. Salkovskis model (1999) suggest that
reducing attentional bias has the potential to be an effective treatment in OCD; it has
been repeatedly demonstrated that a reduction in attentional bias is related to a
reduction in clinical symptoms across number anxiety disorders (Bar-Haim et al.,
2010; Hakamata et al., 2010). Perhaps, ABMT is being applied to OCD too
prematurely. Instead, efforts could be focused on gaining a more detailed
understanding of the nature of attentional bias related to OCD by continuing to use
sensitive methodologies such as eye tracking, allowing the small literature that has
used eye-tracking in OCD to be validated and expanded upon. This information could
then be used to glean if ABMT is an appropriate intervention for OCD, or if perhaps other paradigms are required.

8.5: Aim 2: Improve the Stimuli and Measurement of Attentional Bias in OCD

Chapter 6: Developing A Visual Stimuli Set related to Obsessive-Compulsive Symptoms

The results of Chapter 5 suggested that ABMT may not be a suitable approach to reduce an attentional bias in OCD. An alternative to applying a pre-existing intervention design to treat attentional bias in OCD that was originally created to treat anxiety disorders; would be to adopt a bottom-up approach and to learn more about attentional bias specific to OCD in order to use the most appropriate treatment. The majority of the previous literature investigating the specifics of attentional bias in OCD is marred with inconsistent findings; leading to confusion and a lack of clarity as to the nature of attentional bias in OCD. This is potentially due to previous methodological limitations in this area, for example the majority of previous research has used verbal rather than visual stimuli as anxiety-provoking which may be too weak to consistently provoke anxiety and subsequently, an attentional bias. As research begins to employ eye-tracking technology, this provide the opportunity to use visual images related to obsessive-compulsive symptoms; emotional visual scenes have been shown to be more provocative of emotion and processed more elaborately than emotional words (Hinojosa, Carretie, Valcarcel, Mendez-Bertolo & Pozo, 2009). A blockade to researching attentional bias in OCD is that there are few visual resources available specific to OCD symptoms. The resources that are available have limitations when used to study an attentional bias in OCD. In order to further understand attentional biases in OCD, appropriate symptom specific visual stimuli are required.
Create an appropriate image set related to OCD

Chapter 6 sought to create an appropriate visual stimulus set for OCD research in attentional bias and to compare the ratings of anxiety for contamination related words and images. Images were collected relating to three common subgroups of OCD symptoms; checking, contamination and symmetry/ordering. A collection of neutral images to provide control stimuli were also captured. Three groups; individuals with self-reported OCD, a control group and clinical psychologists rated images the images. To be entered into the final stimuli set, each individual OCD related image must have had an average rating indicative of its ability to provoke anxiety in only individuals with OCD. Therefore, OCD related images that were rated as anxiety-provoking by the OCD group and the clinical psychologists, but not by the control group, were entered into the final stimuli set. Individuals with OCD rated all images, including neutral images, as more anxiety-provoking than the control group. A high test-retest reliability and Cronbach’s alpha was found for the final stimuli set indicating good reliability.

**Will ratings of anxiety differ between contamination words and images?**

There were no significant differences between ratings of anxiety for the contamination related images and words by the OCD group. Between group analyses found that the OCD group rated the contamination words and contamination images significantly higher than the analogue group.

**Chapter 7: A Comparison of Stimuli and Measure of Attention in OCD**

**Attentional Bias.**

Chapter 7 sought to explore the conditions in which an attentional bias in OCD can be observed by comparing different types of stimuli and methods of measuring attention. Participants were 21 individuals with moderate obsessive-compulsive
symptoms with contamination concerns and 21 control participants. The study employed a dot-probe task which used contamination, aversive and neutral stimuli. Each stimuli category included colour images, black and white images and words. Reaction time and eye movements were simultaneously recorded to measure attention. In Chapter 6 of this thesis, 140 contamination images were collected and screened to be relevant to contamination symptoms by expert opinion. After being rated by individuals with OCD, 30 images were selected that were rated to be anxiety provoking by individuals with OCD but not anxiety provoking for control participants. As well as comparing different stimuli formats and measures of attention, Chapter 7 compared the attentional processes deployed to the original 140 contamination images compiled by expert opinion and the subset validated by individuals with OCD.

**Is eye-tracking superior to reaction time as a measure of attentional bias?**

There were no group differences between attentional bias measures across the study for any stimuli type, nor was there evidence of attentional bias from the reaction time data. However, the eye tracking data found that all participants displayed attentional biases for aversive words, aversive images and contamination images. No attentional bias was detected for neutral stimuli or contamination related words.

**Will the colour of an image influence attentional bias in OCD?**

The current study found that both the black and white and colour contamination images evoked a vigilance bias as they had a higher frequency of initial fixations than their neutral counterparts. No significant differences for attention deployment between black and white and colour contamination images were detected.

**Are visual stimuli superior to verbal stimuli when measuring attentional bias in OCD?**

There were no differences between or within groups for attention deployment to contamination or neutral words detected. However, there was evidence of a
vigilance bias across the sample towards contamination images as participants initially fixated on contamination images faster and more often than their neutral counterparts.

**Will stimuli selection procedure influence attentional biases to OCD related stimuli?**

There were no significant differences between attention deployment to the subset of images selected by individuals with OCD or the images selected by the researcher. There was a vigilance bias in the form of higher frequency of initial fixation made upon both sets of contamination images in comparison to their neutral counterparts.

**8.6 Clinical Implications: Aim 2: Improve the Stimuli and Measurement of Attentional Bias in OCD**

Both Chapter 6 and 7 sought to compare and contrast stimuli and measurements of attention when researching attentional bias in OCD to try and explain the previous inconsistency’s within the literature and to inform future research in experiment design. The results of Chapter 6 indicated that the images included in the final stimuli set were only anxiety provoking for individuals with OCD, and not a control group. This selection procedure aims to address a limitation of the pre-existing stimuli sets in this area by screening for OCD images that are only anxiety provoking for individuals with OCD, and not control participants. If the control group do find the OCD images anxiety provoking this may influence attentional biases across a sample and prevent attentional processes specific to OCD being observed. It is the aim that the stimuli set created in Chapter 6 can be used to explore differences in attention processes between individuals with OCD and control participants. Using these images will reduce the risk of differences in attention deployment between individuals with OCD and control participants being missed. Therefore, reducing the knowledge of attentional processes involved in the exacerbation and maintenance of OCD symptoms
and subsequently missing an opportunity to create an intervention. An unexpected finding was that individuals with OCD rated the neutral stimuli as more anxiety-provoking than controls. The elevated anxiety ratings of neutral stimuli by individuals with OCD may potentially be the result of two dysfunctional beliefs associated with OCD, 1) overestimation of threat and 2) intolerance of uncertainty (Steketee et al., 1998; Sookman & Pinard, 2002). These beliefs may cause proposedly neutral images to provoke a negative emotional reaction in individuals with OCD. This could potentially pose a challenge to researcher’s using neutral stimuli as a baseline when measuring attentional bias. Further research is required to explore the appraisal of neutral stimuli by individuals with OCD and how this may influence stimuli selection. It may be advisable for future researchers to ask participants to rate all stimuli, including neutral stimuli, following testing to ensure that neutral stimuli is not evoking strong emotional reactions.

Unlike any other stimuli set available for OCD, Chapter 6 explored the reliability of the final image set. The results found good reliability via test-retest analysis and Cronbach’s alpha scores. Previously, researchers have failed to find consistent results with the same verbal stimuli set related to OCD (Lavy et al., 1994; Kyrios & Iob, 1998; Unoki, Kasuga, Matshima & Ohta, 1999), potentially due to the unreliability of the stimuli. None of the previous image sets related to OCD have been assessed for reliability. Attempting to create a reliable set of images for research in OCD, Chapter 6 sought to reduce the risk of future studies producing inconsistent results due to unreliable stimuli. By having a reliable stimuli set, it is the hope that this will reduce the risk of future inconsistency, allowing details of attentional bias in OCD to be observed and validated.
Previously, verbal stimuli has been accused of being the source of inconsistent evidence of attentional bias in the literature as it is thought to be too weak to be relied upon to consistently produced anxiety. An aim of Chapter 6 was also to try and explain the previous past inconstancy of evidence for attentional bias in OCD by comparing ratings of anxiety between contamination related words and images. No differences in ratings of anxiety by individuals with OCD for contamination related images or words were detected. These findings of Chapter 6 do not support the argument that inconsistent evidence for attentional bias in relation to OCD is caused by using words related to symptoms as anxiogenic stimuli related to OCD symptoms (Armstrong & Olatunji, 2012). This suggests that other variables such as the measurement of attention may be responsible for the inconsistency of past research. Chapter 7 aimed to expand upon the results of Chapter 6 by comparing attentional bias between verbal and visual contamination related stimuli. In this study, only an attentional bias was detected for contamination images, and not contamination words. Across the sample all participants initially fixated on contamination images faster and more often than their neutral counterparts. As evidence was only detected for an attentional bias towards contamination images and not for words, this finding is in agreement with the concerns noted by prior studies that verbal stimuli related to OCD symptoms is not provocative enough to detect an attentional bias (Moritz et al., 2008). The results of Chapter 7 disagree with the findings of Chapter 6, it appears that while individuals with OCD may rate contamination related words and images the same, only contamination images provoked an attentional bias when verbal stimuli failed to do so. Perhaps this difference in ratings of anxiety and attentional bias for verbal stimuli explains why, even when verbal stimuli had been screened for a study by individuals
with OCD, it did not consistently provoke an attentional bias in past research (Lavy et al., 1994; Kyrios & Iob, 1998).

The majority of previous research has employed verbal stimuli as anxiety-provoking stimuli when attempting to observe an attentional bias in OCD (Moritz & Muhlenen, 2008; Summerfeldt & Endler, 1998; Weierich, Treat & Hollingworth, 2008). The results of Chapter 7 support the criticisms of verbal stimuli being too weak to be used in attentional bias research in OCD and being the cause of the inconsistent findings. Research has shown that images receive more detailed information processing than words (Houwer & Hermans, 1994; Kensinger & Schacter, 2006); perhaps this more elaborate processing of images enables the link between symptom-related words and obsessive thoughts to be formed, resulting in greater anxiety. As verbal stimuli are not processed to the same extent as visual images, this may reduce their ability to trigger obsessive thoughts; resulting in less arousal. Moving forward with research in this area, the results of Chapter 7 promote the use of images related to OCD symptoms and not words to reduce the risk of further inconsistency within the literature.

However, a drawback of using images over verbal stimuli is that it is more challenging to match an OCD related and a neutral picture for physical features. Colour in a picture can influence saliency and draw attention because of physical features of a scene rather than its semantic content. Therefore, in order to discern differences in attention deployment to OCD related and neutral images, it is important to attempt to match their physical characteristics such as colour (Parkhurst, Law & Niebur, 2002). A way to counteract the influence of colour is to use black and white images. This may reduce the risk of attentional bias being the source of colour, rather than content, of an image. Chapter 7 compared attention deployment to contamination
related images that were either in colour or black and white to explore the influence that colour has on attention deployment. The results revealed that towards both black and white and colour contamination images, participants made a higher frequency of initial fixations than their neutral counterparts. This finding suggests that it is the semantic context of the image, rather than physical features such as colour that guide processing (Bradley, Cdispoti, Cuthbert & Lang, 2001; Bradley, Elbert & Lang, 2001). Using black and white images to explore attentional bias in OCD would reduce the risk of saliency caused by the colour of an image guiding participant attention, which could potentially result in an attentional bias towards the most colourful image, rather than symptom specific images, being detected.

No significant differences were detected for stimuli selection procedures for contamination images in Chapter 7. Both the 140 images compiled by expert opinion and the subset of 30 contamination images rated as appropriate by individuals with OCD had vigilance bias in the form of higher frequency of initial fixation made upon contamination images in comparison to their neutral counterparts. This finding disputes the theory that the different methods used to compile stimuli of research in attentional bias in OCD contributed to the inconsistency of findings as there appears to be consensus among clinical and lived expertise as to what stimuli is appropriate. Interestingly, the findings of Chapter 6 and 7 revealed that while individuals with OCD did not display a difference in how anxiety-provoking they found verbal and visual contamination images, they only displayed attentional bias to the images. Potentially, the tendency of individuals with OCD to overestimate threat may increase opinions of how anxiety provoking stimuli is, but not necessarily result in this stimulus evoking an attentional bias. It would therefore have been interesting to compare individuals with OCD and clinician ratings of the verbal contamination and visual stimuli, without
the overestimation of threat influencing ratings, clinicians may have recognised that verbal stimuli would not be as provocation of attentional biases than images. This finding implies that both clinical and lived experience allow appropriate stimuli selection of OCD related images. To ensure strong chances of stimuli evoking an attentional bias it may be best to combine both of these expertise when designing future research, as the stimuli set created in Chapter 6 has done.

8.7. Aim 3: Explore the Mechanisms of Attentional Bias Using this Improved Understanding of Measurement

Chapter 7 investigated group differences in attention deployment to contamination images via eye tracking between individuals with elevated levels of obsessive-compulsive symptoms with contamination concerns and control participants. It also aimed to investigate attentional deployment towards aversive stimuli in order to understand if attentional bias in OCD are specific to stimuli related to OCD symptoms or extends to generally aversive material.

Will individuals with contamination concerns display an attentional bias towards contamination related images via eye-tracking measures?

The results found that individuals with high obsessive-compulsive symptoms and contamination concerns displayed at attentional bias for contamination related image in comparison to their neutral counterpart. However, attentional bias towards contamination images was also detected in the control group. All participants had increased vigilance towards both colour and black and white contamination images as a higher frequency of initial fixations were recorded for the contamination images in comparison to their neutral counterpart.

Is the attentional bias in OCD specific to symptom related stimuli or does it extend to generally aversive stimuli?

Although no group differences were detected in attention deployment towards aversive stimuli, the findings revealed attentional biases towards all types of aversive
stimuli in the entire sample. For colour and black and white aversive images, attention was found to be biased in the form of vigilance and maintained attention. However, attention towards aversive words was only biased in the early stages in the form of more frequent initial fixations.

Clinical Implications Aim 3: Explore the Mechanisms of Attentional Bias Using this Improved Understanding of Measurement

Chapter 7 attempted to explore differences in attentional processing of contamination related images between the individuals with elevated obsessive-compulsive symptoms and control participants, however no group differences were detected. It is important to consider that the sample in this study was not drawn from a clinical population of those officially diagnosed with OCD, also levels of anxiety and disgust are unknown for the control group and this too may have influenced the lack of group differences detected. Previous research has also found that control group’s eye tracking data is biased towards OCD related images when compared to neutral images (Cludiud, Wenzlaff, Briken & Wittekind, 2017). A difficulty that could impede group differences being revealed is the novelty of scenes related to contamination OCD in comparison to neutral scenes. Neutral scenes tend to depict landscapes or everyday objects which are non-emotional, whereas contamination images may display more unusual scenes such as shoes on kitchen counter tops or used bandages. As novel stimuli are more likely to have attention resources deployed to them (Johnston, Hawley, Plew, Elliott, & DeWitt, 1990) there is the potential that as contamination stimuli may be more novel to control participants, it may result in attentional bias out of interest rather than fear and impede group differences being revealed. This further complicates drawing out differences in attention deployment between those with OCD and those without. It would be beneficial to have participants
rate the images after the study to reveal their experiences of them as either novel or anxiety-provoking, it may be influenced by having already viewed them.

Despite the lack of group differences, Chapter 7 was able to discern a heightened vigilance towards contamination images via the eye-tracking data. Previously, research has also detected vigilance towards contamination related images in individuals with high obsessive-compulsive symptoms and contamination concerns (Armstrong, Olatunji, Sarawgi & Simmons, 2010; Armstrong, Sarawgui & Olatunji, 2012). Armstrong et al., (2012) found that a vigilance bias predicted behavioural avoidance in individuals with high obsessive-contamination symptoms. Emerging from the previous literature is a link between hypervigilance and contamination symptoms as even research that has employed reaction time and used contamination related words has also found evidence of vigilance bias in individuals with a clinical diagnosis of OCD (Tata, Leibowitz, Prunty, Cameron & Pickering, 1999). Hypervigilance ensures that threatening stimuli are detected quickly in the environment and prioritised (Richards, Benson, Donnelly & Hadwin, 2013). As contamination OCD is preoccupied with the threats surrounding illness, hypervigilance may serve to scan the environment for potential contaminants that can be quickly detected and then avoided (Summerfeldt & Endler, 1998; Armstrong et al., Olatunji, 2012). Unlike delayed disengagement/maintenance bias, hypervigilance can take place without the presence of a threat. As ABMT is not designed to treat attentional processes that occur without the presence of a threat, it may not be the most appropriate intervention for the reduction of hypervigilance (Richards et al., 2013). Richards et al., (2013) after reviewing the role of hypervigilance in anxiety, recommends that training used to treat hypervigilance should be focused on domain-general attentional control training to reduce monitoring the environment for
threatening stimuli, rather than simply reinforcing attention away from threats as ABMT does. Further research is required to confirm the role of hypervigilance in a clinical sample of OCD and to inform appropriate intervention design.

Chapter 7 aimed to explore the relationship between obsessive-compulsive symptoms and attention deployment to aversive stimuli, as similar to OCD related stimuli, conflicting findings have been found for attentional bias to generally threatening images in OCD. For all aversive stimuli, including words, attention was found to be biased in the form of increased vigilance and maintained attention. However, attention towards aversive words was only biased in the early stages in the form of more frequent initial fixations. This is potentially due to aversive images being more emotionally provocative than words, similar to contamination stimuli. Despite the lack of group differences, these results support the previous research that has found attentional bias towards generally threatening stimuli via eye tracking in individuals with obsessive-compulsive symptoms (Cisler & Olatunji, 2010; Mullen et al., 2016). It may be that attentional bias in OCD are elicited by aversive stimuli due to the tendency to overestimate threats (Moritz & Jelinek, 2009; Sookman & Pinard, 2002; Steketee et al., 1998). Based on these findings, potential interventions may benefit from including both aversive and OCD specific stimuli.

### 8.8 Future Research

The acceptability of ABMT may influence it effectiveness, as the current thesis only used quantitative measures of acceptability, future qualitative research exploring how participants experience ABMT and how this may influence effectiveness is required to better understand any potential barriers located in ABMT’s facial validity. Due to the idiosyncrasy of OCD, it is possible that attentional bias will be very difficult
to capture in a lab environment regardless of optimum research conditions. Therefore, qualitative research could be used to ask participants their insight into what captures their attention and how this experience related to the vigilance and delayed/disengagement biases e.g. constantly looking for contaminates or once seen can’t look away. This information could then be used to create better research paradigms and stimuli selection procedures to better observe attentional bias in OCD.

While ABMT was not found to be effective in the current thesis, there is the potential that it may takes multiple session before therapeutic benefits can be seen for OCD. Future research exploring the effects of ABMT could include multiple sessions to observe the effects of time on attentional bias and OCD symptoms. While ABMT has been effective for anxiety disorders, it is possible that the same effects may not be replicated in OCD. Rather than abandoning attentional bias reduction as a form of intervention, especially considering the repeated demonstration of the benefits a reduction of attentional bias has led to across multiple psychopathologies, research could explore other interventions aside from ABMT. As hypervigilance occurs without the presence of a threat, research could explore methods of reducing attentional bias that does not involve threatening stimuli such as general attention control training.

Further work is required to better understand the role of attentional bias in OCD in order to apply this knowledge to designing innovative and effective treatments. The current thesis has attempted to produce an image set that will enable researchers to explore attention deployment by individuals with OCD to symptom specific stimuli. However, further research is required to confirm the effectiveness in the image set to evoke an attentional bias in individuals with an official diagnosis of
OCD. It is crucial that further work is carried out using eye-tracking technology to record and measure attentional bias in individuals with a clinical diagnosis of OCD.

The idiosyncratic nature of OCD symptoms may be a barrier for capturing attentional bias in a laboratory with impersonalised OCD related images. By personalising OCD stimuli in eye tracking studies, the researchers run the risk of participants habituating to images before they have begun the attentional bias assessment, reducing the chance of attentional bias being observed. However, the development of eye-tracking technology has created mobile eye tracking glasses with built-in cameras, allowing participants to move around freely in real world environments while their eye movements are tracked (Duchowski, 2002; Mele & Federici, 2012). Future research could focus on monitoring the attention of individuals with OCD in a real-world setting. This would also provide the opportunity for the participants to watch the video of what they looked at and to reflect back on their experience, do they feel they looked at certain aspect of the environment more or less than others and if so, do they feel this influenced their thoughts and emotions?

Aside from eye tracking, there are other sensitive methods of measuring attention that could provide an in depth observation of attentional processes in OCD. Electroencephalograph (EEG) is the measurement of brain waves referred to as event related potentials (ERPs), these ERPs can be linked to specific stages of attention. Previous research that has used EEG to explore attentional bias in OCD have observed an attentional bias in OCD (Rogers, Hanna & Dyer, 2016; Thomas, Gonsalvez & Johnstone, 2013). A limitation of EEG data is that it is time locked to the presentation of stimuli, however this does not mean that a participant’s attention was engaged to the stimuli. A way to ensure that attention is engaged is to use eye fixations as temporal markers for EEG data by recording eye movements simultaneously. This technique is
referred to as fixation related potential’s (FRP) A potential future study could use FRPs to investigate an attentional bias in OCD, allowing an in-depth look at the mechanisms involved in the attentional bias via both covert and overt measure of attention.

The implementation of virtual reality technology into psychological research (Diemer, Alpers, Peperkorn, Shiban & Muhlberger, 2015) provides an opportunity to apply this novel research methodology to the exploration of attentional bias in OCD. Virtual reality would provide participants with an immersive, but controlled, interaction with OCD related objects, increasing the ecological validity of the laboratory setting. The application of virtual reality in OCD research is preliminary, but continuing to grow (Kim, Kim, Kim, Roh & Kim, 2009). Past research has used virtual reality technology to measure OCD performance on checking related tasks (Kim et al., 2009) but no research has applied this technology to measure attentional bias in OCD. Due to the immersive nature of virtual reality, it may be better suited to capturing attentional bias in than traditional paradigms such as the dot-probe. Virtual reality may increase participant engagement with OCD related stimuli and subsequently evoke attentional biases.

8.9 Strengths and Limitations

While the specific strengths and limitations of each study have been discussed in the previous chapters, there were overarching limitations across the thesis with regards to sampling and structure.

8.9.1 Sampling

While the current thesis sought to include individuals with an official diagnosis of OCD in Chapter 4, no confirmation of diagnosis other than by the participant was available. While efforts were made to advertise the study exclusively to individuals
who had received the diagnosis of OCD by a healthcare professional, it is possible that participants without this official diagnosis took part in the study. However, due to time restrictions of the project, the large number of stimuli that needed to be validated and the study being hosted online, requesting individuals with a diagnosis to take part seemed like the only viable option. As a small portion of participants were removed as they indicated they did not have diagnosis, this inspires hope that participants answered the diagnosis question honestly.

A second limitation of the current thesis was the use of a non-clinical sample with the majority of participants being from university undergraduate classes. As the thesis was under time pressure time and required a minimum of just under 100 participants OCD symptoms to take part in research, it was decided to recruit from a non-clinical sample. However, efforts were made to include participants with high obsessive-compulsive symptoms according to an extensively used and valid measure (Obsessive Compulsive Inventory-Revised, Foa et al., 2002). The majority of the participants were also female, reducing the generalizability of the results to males.

Due to the heterogeneity of OCD and the need to tailor stimuli and tasks, the thesis was limited to focusing on contamination symptoms, reducing the expansion of the work to other OCD subgroups. However, a failing of past research has not been to recognise subgroups of OCD when planning experimental design and risk using inappropriate symptom specific stimuli to the concerns of participants. It is the hopes that while some of the research in the current thesis can only be applied to contamination, other work regarding appropriate attentional bias measurement and the image set can be used to further research in other OCD subgroups.
8.9.3 Methodological

The thesis employed an unvalidated measure of acceptability to assess factors that felt relevant to explore for the specific interventions included in the thesis, therefore judgments cannot be made about the validity and the reliability of the scale. As the current thesis only used quantitative measures to explore acceptability, this reduces the level of detail and inferences that can be gained from the studies regarding the experience of undergoing ABMT and how this may influence effectiveness. A second methodological limitation was that time restriction allowed only one data collection point in Chapter 5. It would be beneficial to compare the effects of ABMT and ERP over time as this would increase the likelihood of witnessing their influence on trait measures such as OCD symptoms to be observed. The study was limited to a single session of each intervention. Research has revealed that due to high levels of shame and stigma around OCD, individuals typically wait 6 years between first experiencing OCD symptoms and seeking treatment (Stobie, Taylor, Quigley, Ewing, & Salkovskis, 2007). Therefore, it is likely that service-users with OCD have had their obsessive thoughts and compulsive behaviours engrained for years when they first access psychological help (Robinson, Rose & Salkovskis, 2017). Based on this research, a single-session of an intervention may fail to produce any significant benefit to the client who has been experiencing symptoms for years. It is possible that more sessions of ABMT over a longer period of time are required before a positive effect can be observed; ABMT may be similar to other therapies in that it initially worsens symptoms before elevating them. However, the current thesis is still the only recorded piece of work that has compared the influence of two interventions on attentional bias, recruiting just under 80 individuals with a high obsessive-compulsive symptoms and contamination. As multiple data collection points are associated with the loss of
participants due to drop-out and as the current study was time limited; one data collection point was decided upon. The current thesis explored multiple hypothesis simultaneously across its experimental work, increasing the risk of occurring type 1 errors. To reduce this risk of multiplicity, appropriate statistical adjustment were applied when appropriate (Lee & Lee, 2005). As Tukey HSD is a statistical adjustments which allows the comparison of all groups; it was applied when between-group differences were explored. For within group comparison the conservative Bonferroni method was applied to adjust for multiplicity.

8.9.3 Structure

As with any piece of research, circumstances outside of the studies have shaped the structure of the thesis. Originally, a core aim of the PhD was to unite eye-tracking methodology with electroencephalogram (EEG) to measure attentional bias in individuals with OCD. Unfortunately, due to unforeseen circumstances in the beginning of the third year of the PhD access to the EEG technology was irreplaceably lost, resulting in the reconfiguration of order of Chapters. It may seem strange that the final contamination images from the stimulus set reported in Chapter 6 were not used in the study in Chapter 7 which compared different stimuli types and measurement. Originally, Chapter 7 was planned to be reported before the creation of the image set in Chapter 6. Both pieces of research were going on simultaneously, originally the 140 contamination images that were employed in Chapter 7, which had been validated by a clinical psychologist and psychologist with extensive experience in OCD, were destined to be used in the EEG study in order to avoid repetition of stimuli which could influence the brainwave data and skew results. Chapter 6 was supposed to be the final study reported as it finished after the study completed in Chapter 7. However, once
the final images were collected it allowed an extra, but important, research question to be asked about the influence of stimuli selection procedures on attentional bias.

8.10 Conclusions

In conclusion, this thesis has found that the acceptability of ABMT by individuals with OCD may not be as favourable as once anticipated. Nor was ABMT found to be as effective as predicted. The large amounts of research that have demonstrated therapeutic benefits from reducing attentional bias in other mental health disorders still inspire hope for targeting attentional bias as a treatment option for OCD. Instead of encouraging the abandonment of attempting to treat an attentional bias in OCD, the current thesis hopes to spark research which will explore alternative methods, asides from ABMT, for treating attentional bias. The repeatedly inconsistent evidence for attentional bias in OCD has put strain upon this area and prevented further knowledge of attentional bias being used to create appropriate interventions. The current thesis has made strides explaining this past inconsistency in order to explain the past conflicting evidence and to argue against the lack of an attentional bias in OCD, but rather a lack of knowledge on the appropriate stimuli and measures to capture this phenomenon. It has provided information which hopes to help create appropriate research design in future studies by comparing different methods of measuring attention and different stimuli formats for evoking attentional bias. The thesis has produced a stimulus set specific to OCD which went through a rigorous selection procedure and has been demonstrated to have good reliability in order to further facilitate learning in this area.


 Alvseike, H., & Bronnick, K. (2012). Feasibility of the iPad as a hub for smart house technology in the elderly; effects of cognition, self-efficacy, and technology


presented at the *Poster Presented at the 2001 Meeting of the Association for the Advancement of Behavior Therapy. Philadelphia, PA,*


scale: I. development, use, and reliability. *Archives of General Psychiatry, 46*(11), 1006-1011.


the establishment of novel treatment for anxiety. *Biological Psychiatry, 68*(11),
982-990.

Hansen, D. W., & Ji, Q. (2010). In the eye of the beholder: A survey of models for
eyes and gaze. *Pattern Analysis and Machine Intelligence, IEEE Transactions on,
32*(3), 478-500.

Harkness, E. L., Harris, L. M., Jones, M. K., & Vaccaro, L. (2009). No evidence of
attentional bias in obsessive compulsive checking on the dot probe paradigm.
*Behaviour Research and Therapy, 47*(5), 437-443.

therapy* American Psychological Association.

Experiential avoidance and behavioral disorders: A functional dimensional
approach to diagnosis and treatment. *Journal of Consulting and Clinical
Psychology, 64*(6), 1152.


Research and Therapy, 45*(11), 2804-2812.

predictor of treatment outcome in behavioral group treatment for obsessive–

(2009). Electrophysiological differences in the processing of affective


MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their
association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*(1), 107.


Mullen, M. (2016). *Attentional Bias in Individuals with Obsessive-Compulsive Disorder: An Eye-Tracking Methodology,*


completing a computer-based anxiety intervention targeting attentional bias.

*Clinical Psychology Review, 50*, 37-49.


Appendix A
Acceptability survey from Chapter 4

These next questions will describe two treatments for Obsessive Compulsive symptoms and ask you six questions for each of them. This research is interested in your opinion and there are no right or wrong answers.

Exposure Response Prevention Therapy
Exposure Response Prevention therapy ERP is a treatment for Obsessive-Compulsive symptoms. ERP requires individuals to repeatedly expose themselves to what makes them anxious and to wait before carrying out a compulsion to reduce anxiety. The time between exposure and compulsion is gradually increased, with the aim of anxiety from the obsessive thought decreasing over time and removing the need for the compulsion. For an example of how ERP works, imagine a person who has Obsessive-Compulsive Disorder who has obsessive thoughts about contamination and compulsively washes their hands to reduce the anxiety of these thoughts. This person is asked to touch a contaminated object e.g. public door handle without immediately washing their hands afterwards. This process is repeated with the time between exposure to the door handle and hand washing gradually getting longer. This therapy is based on the theory that repeated exposure to an anxiety-provoking object gradually reduces distress and fear.

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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<td>How much anxiety do you think you would experience if you did ERP?</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much do you feel you would engage with ERP?</td>
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<td></td>
</tr>
<tr>
<td>How challenging do you think ERP would be?</td>
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<td></td>
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<tr>
<td>How effective do you think ERP would be?</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>How good do you think ERP would be for reducing Obsessive-Compulsive symptoms?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How motivated would you be to take part in ERP?</td>
<td></td>
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</tr>
</tbody>
</table>
**Attentional Bias Modification Training**

The leading theory on Obsessive-Compulsive Disorder suggests that attention is preferentially given to objects or scenes related to Obsessive-Compulsive symptoms and that this maintains and exacerbates symptoms. Attentional Bias Modification Training (ABMT) is a computerized task that aims at reducing this attentional bias. It consists of a series of trials made up of two images side by side; one is neutral and the other anxiety provoking. When these two images disappear a target appears where the neutral image was. Participants are asked to respond as soon as they detect the target. The theory is that as the target is always preceded by the neutral image attention is directed away from the anxiety provoking image and trained towards the neutral image, therefore breaking down the attentional bias.

<table>
<thead>
<tr>
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<td>How much anxiety do you think you would experience if you did ABMT?</td>
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</tr>
<tr>
<td>How much do you feel you would engage with ABMT?</td>
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<td>How challenging do you think ABMT would be?</td>
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</tr>
<tr>
<td>How effective do you think ABMT would be?</td>
<td></td>
</tr>
<tr>
<td>How good do you think ABMT would be for reducing Obsessive Compulsive symptoms?</td>
<td></td>
</tr>
<tr>
<td>How motivated would you be to take part in ABMT?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B  
Data screening for statistical analysis

The section below includes the assumptions for each statistical analysis and an example of how the data met the assumptions for the statistical analysis carried out from chapter 4-7.

Regression Analysis

1) Linearity Between Predictor and Dependant Variables
To ensure that relationships between each of the predictors and the dependant variables followed a linear pattern, scatterplots of the data were created and visually expected for linearity. All scatterplots depicted linear relationships between predictor and dependant variables. For example please see Figure 1 below.

Figure 1. Scatterplot depicting relationship between ERP acceptability and Age.
2) Outliers
The data was screened for outliers by distance and by influence by assessing the figures for Cook’s distance and leverage values. One case was removed due to leverage value that was three times larger than the mean. Following this removal, no other cases held outliers scores.

3) Multicollinearity
The ‘tolerance’ collinearity diagnostic in SPSS was used to ensure the absence of multicollinearity between variables. Variables with a tolerance value < 0.01 were deemed to exhibit multicollinearity (Brace et al., 2006). All variables in the analyses meet the assumption of no multicollinearity. For example, the OCI-R washing subscale had a tolerance value of 0.901.

4) Homoscedasticity
Scatterplots were created to inspect the distribution of residuals along the regression line to assess equality of distribution. From visual inspection of scatterplots, the residuals were equally distributed and the assumption of homoscedasticity was met. Please see figure 2 below.
5) **Type of data**
The independent variable was a continuous score and therefore were at the interval/ratio level of measurement. The majority of dependant variables were also at the interval/ratio level of measurement. Dichotomous variables were included and coded as either “0” or “1”.

6) **Normality of residuals**
This assumption was assessed by examining a histogram of the standardised residuals, inspection of the histogram depicted a normal distribution of residuals.
ANOVA analysis

Multiple ANOVA analysis were used throughout Chapters 4-7, the assumptions that were met for each within-group, between-group and mixed ANOVA analysis are discussed below before

ANOVA Assumptions

1) Type of data
For within-group, between-group and mixed ANOVA analysis dependant variables were measured at the interval/ratio level. The independent variables were categorical and involved the same participants in both groups.

2) Normality of residuals
This assumption was assessed by examining a histogram of the standardised residuals for each ANOVA, inspection of the histograms depicted a normal distribution of residuals.
3) **Sphericity**
To assess the variances of differences were met for the within-group and mixed ANOVA’s, Mauchly’s test of sphericity was carried out. When the assumption was Sphericity was violated, Greenhouse-Geisser was reported meeting the assumption of Sphericity.

4) **Homogeneity of variance**
To assess equal variances between groups, Levene’s test in SPSS was carried out and interpreted for each between-group and mixed ANOVA analysis. If the significance value for Levene’s test was greater than .05 the assumption of homogeneity was met.

5) **Homogeneity of variance-covariance matrices**
For each mixed ANOVA homogeneity of variance-covariance matrices was tested by Box’s M Test of Equality of Covariance Matrices. All Box M values for mixed-ANOVA analysis were greater than .001.

Appendix C

Study evaluation scale from Chapter 5

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<th>3</th>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much did you feel you engaged with the study? ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How challenging did you find the study? ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How effective did you find the study? ()</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How good do you think the study would be for reducing Obsessive Compulsive symptoms? ()</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>How motivated were you to take part in the study? ()</td>
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Appendix D  
Behavioural Approach Task From Chapter 5

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<th>Dirty laundry</th>
<th>Step taken</th>
<th>Peak Anxiety 0-100</th>
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<tbody>
<tr>
<td>Step 1</td>
<td>Touch laundry with sheet of tissue</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Touch laundry with finger</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Touch laundry with one hand</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>Touch laundry with both hands</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>Touch laundry then touch arms and chest</td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td>Touch laundry then touch face</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dirt Mixture</th>
<th>Step taken</th>
<th>Peak Anxiety 0-100</th>
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</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Touch dirt with sheet of tissue</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>Touch dirt with finger</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Touch dirt with one hand</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>Touch dirt with both hands</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>Touch dirt then touch arms and chest</td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td>Touch dirt then touch face</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Toilet</th>
<th>Step taken</th>
<th>Peak Anxiety 0-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Touch toilet with sheet of tissue</td>
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</tr>
<tr>
<td>Step 2</td>
<td>Touch toilet with finger</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Touch toilet with one hand</td>
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<tr>
<td>Step 4</td>
<td>Touch toilet with both hands</td>
<td></td>
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<tr>
<td>Step 5</td>
<td>Touch toilet then touch arms and chest</td>
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<tr>
<td>Step 6</td>
<td>Touch toilet then touch face</td>
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Participant ID___________________________ Pre or Post_____________________
### Appendix E

**Verbal Stimuli rated in Chapter 6**

#### Contamination words

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<thead>
<tr>
<th>Toilet</th>
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<th>Muck</th>
<th>Disease</th>
<th>Grime</th>
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<td>Cough</td>
<td>Stained</td>
<td>Stain</td>
<td>Dirty</td>
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<tr>
<td>Virus</td>
<td>Muddy</td>
<td>Snot</td>
<td>Flu</td>
<td>Yuck</td>
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<td>Contaminated</td>
<td>Filth</td>
<td>Sickness</td>
<td>Mud</td>
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<td>Illness</td>
<td>Dirt</td>
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<td>Gross</td>
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<td>Germs</td>
<td>Urine</td>
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<td>Spit</td>
<td>Slime</td>
<td>Bin</td>
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<tr>
<td>Sneeze</td>
<td>Slimy</td>
<td>Contagious</td>
<td>Unclean</td>
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<tr>
<td>Dust</td>
<td>Dusty</td>
<td>Mucky</td>
<td>Rubbish</td>
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</tr>
<tr>
<td>Bacteria</td>
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#### Aversive words

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<th>Agony</th>
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<td>Strangle</td>
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<td>Trauma</td>
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<td>Insult</td>
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<td>Injury</td>
<td>Slaughter</td>
<td>Suffer</td>
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<td>Gash</td>
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<td>Pain</td>
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<td>Massacre</td>
<td>Destroy</td>
<td>Sore</td>
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<td>Drown</td>
<td>Manslaughter</td>
<td>Execution</td>
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### Neutral words

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<td>Lobby</td>
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<td>Arch</td>
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Appendix F
Online survey example from Chapter 6

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<td>How unpleasant do you consider this image?</td>
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<tr>
<td>How anxiety-provoking do you consider this image?</td>
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<tr>
<td>How upsetting would you consider this image?</td>
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<tr>
<td>How likely is it that this image would grab your attention?</td>
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Appendix G
Final Image Set Related to OCD

Images related to checking symptoms
Images relating to contamination symptoms
Images relating to symmetry symptoms
Neutral images
## Appendix H

### Word stimuli pairs from Chapter 7

#### Contamination-neutral word pairs

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>1.</td>
<td>Toilet</td>
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<tr>
<td>2.</td>
<td>Virus</td>
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<tr>
<td>3.</td>
<td>Contaminated</td>
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<tr>
<td>4.</td>
<td>Illness</td>
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<tr>
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<td>Germs</td>
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<tr>
<td>6.</td>
<td>Bacteria</td>
</tr>
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<td>7.</td>
<td>Dirt</td>
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<tr>
<td>8.</td>
<td>Urine</td>
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<tr>
<td>9.</td>
<td>Slime</td>
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<td>10.</td>
<td>Sickness</td>
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<td>11.</td>
<td>Contagious</td>
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<tr>
<td>12.</td>
<td>Infected</td>
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<tr>
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<td>Disease</td>
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<td>Flu</td>
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<td>Unhygienic</td>
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<td>Unsanitary</td>
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<td>Bin</td>
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<td>23.</td>
<td>Grime</td>
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### Aversive-Neutral Word Pairs

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<td>Danger</td>
<td>Design</td>
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<tr>
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<td>Drown</td>
<td>Raced</td>
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<td>Wound</td>
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<td>6</td>
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<td>Memory</td>
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<td>Violent</td>
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<td>Torture</td>
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<td>Rake</td>
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<td>Suffer</td>
<td>Repeat</td>
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<tr>
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<td>Bomb</td>
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<td>Slaughter</td>
<td>Courtyard</td>
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<td>Rape</td>
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